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DEVELOPMENT OF THE LONG-RANGE ESCORT FIGHTER

USAF HISTORICAL DIVISION
RESEARCH STUDIES INSTITUTE
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F O R E W O R D

This monograph relates the history of the long-range escort fighter from 1918 through World War II. The story is concerned primarily with the development of the fighter and the problems incident thereto and with the employment of the fighter in Europe and the Pacific.

The study was written originally as a doctoral dissertation by Mr. Bernard Boylan of the University of Missouri. Mr. Boylan wrote his dissertation while holding the USAF Historical Division's Fellowship for 1953-54.

Like other Historical Division studies, this history is subject to revision, and additional information or suggested corrections will be welcomed.

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PREFACE

The United States Army Air Forces entered the second World War without a long-range fighter airplane. This type of aircraft, which escorted heavy bombers to and from their targets, did not achieve satisfactory performance until late 1943. Its belated development constituted one of the most serious errors in America's pre-war planning, for by the end of the second year of American air operations in Europe it was clear that heavy bombers, lacking fighter support, could not penetrate deeply into enemy territory and adequately defend themselves against hostile interceptors. One of the most important programs undertaken by the AAF in the midst of the war was that of developing and supplying sufficient long-range fighters for escort purposes.

The writer has considered it expedient to develop the problem of escort as a two-fold story. This study analyzes the concept of the escort fighter as a tactically sound weapon, and also discusses the parallel technical development of range extension. Separate treatment of these two aspects of the problem should clarify the story.

Estimates of enemy aircraft destroyed have been cited frequently throughout this study. These constitute Eighth Air Force claims and not actual German fighter losses. Un-

fortunately, such estimates often were exaggerated, a fault, however, that stems from the very nature of aerial combat. Eighth Air Force leaders, recognizing by the autumn of 1942 that claims of German fighters destroyed or damaged by heavy bomber crews were too optimistic, made many efforts to scale down statistics and to correct procedures for reporting. Figures on German Air Force losses were important for the strategic planner, and it was in the realization of the need for accurate data that Eighth Air Force commanders strove to correct mistakes. A similar problem existed in ascertaining Japanese aircraft losses in the Pacific area of operations.

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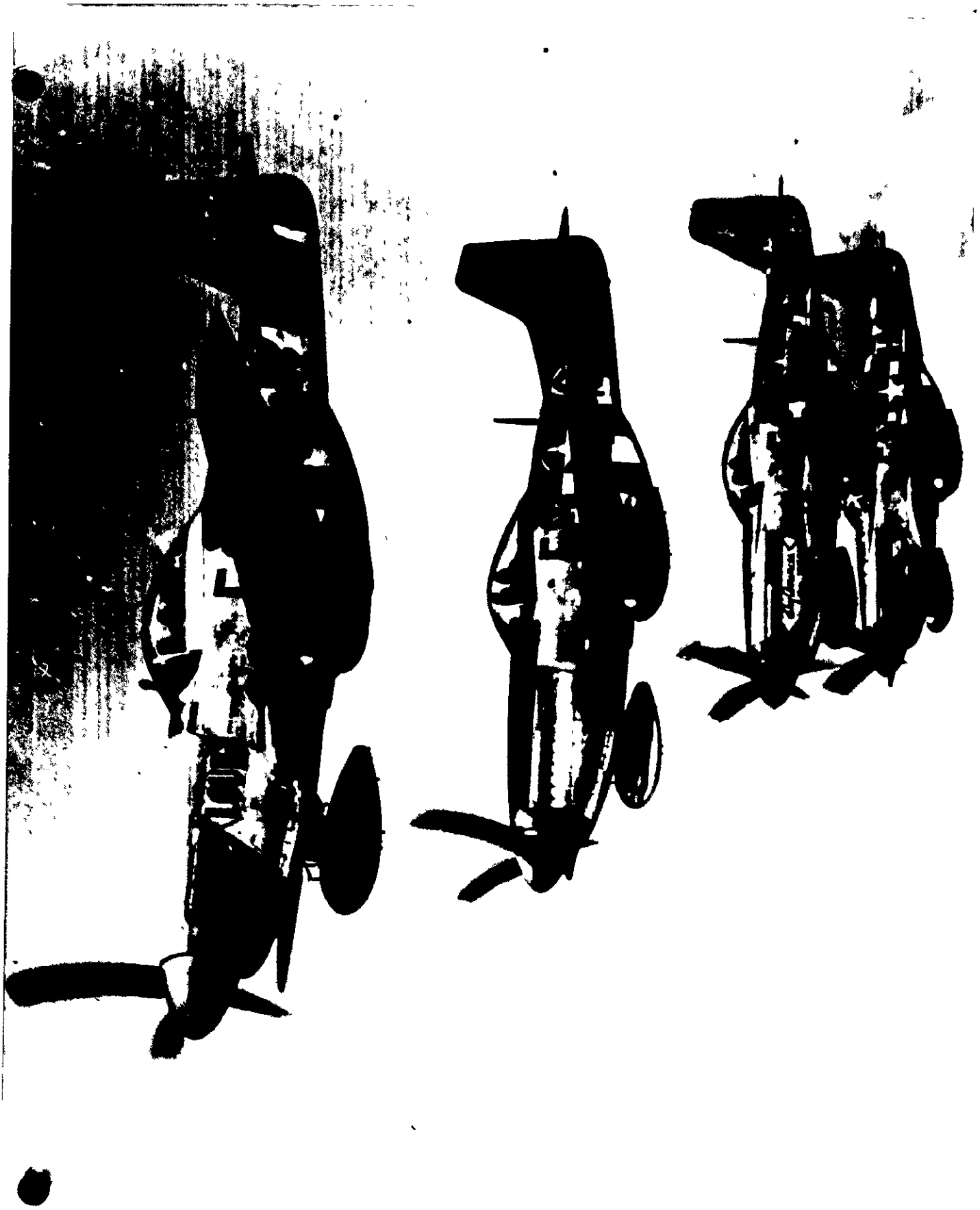

CHAPTER I

THE EARLY PERIOD, 1914-1941

Early Tactics in World War I

Only a few individuals closely associated with aeronautical development visualized the unlimited field that existed for aviation in warfare prior to World War I. Although they constantly advocated extensive use of the airplane for future military operations, their efforts met with little success among the majority of professional militarists. The first use of airplanes as military weapons came in 1911 when the Italians used them against the Turks in Tripoli to reconnoiter enemy lines. But widely held military opinion of the time probably was expressed by General Ferdinand Foch of France who stated that the airplane was good sport but worthless for use by the army.[1]

When the war began in August, 1914, both the Allies and Germany were experimenting with power-driven aircraft, but they started the conflict with the idea that the airplane was only a secondary unit of the reconnaissance service.[2] Some military authorities, however, admitted that the airplane might be used for reconnaissance, messenger service, regulation of artillery fire, and transportation of staff officers, but they still contended that aerial combat was a dream of

theorists.[3] All air units involved in the early part of the war were used to obtain information and received instructions to avoid combat. During the initial stages of the campaign, in spite of the few airplanes available[4] and the limitations of speed (a seventy-horsepower engine giving an aircraft speed of sixty to seventy miles an hour), air reconnaissance, for example, provided the English with valuable information on the German attempt to outflank the British army at Mons, and another sighted General Kluck's swerve toward the Marne.[5] Nevertheless, airmen, principally on their own initiative, introduced combat into the sky. Rifles and pistols were the only weapons available to pilots at the outset of the war and when combat occurred it sometimes bore the appearance of an exhilarating shooting match.[6] On 14 August 1914 an indecisive duel occurred between a French and a German pilot. Another conflict on 28 August, however, between an English airplane and a German proved more conclusive:[7]

> An English pilot emerging from a cloud found immediately beneath him a German airplane. Swooping down to within revolver shot he emptied all his chambers with an effect he could not observe because the cloud once more enveloped him. Later on, when he emerged from the clouds, he saw underneath a small crowd gathered around a smashed airplane, and he came to the conclusion that his revolver shots had not been without effect.

The belligerents also attempted aerial bombing early in the war. German planes bombed Compiegne in mid-August, 1914, and three months later three English planes flew 250 miles over enemy territory to bomb the Zeppelin works at Friedrichshaven.[8] Early combat, such as described above, and irregu-

lar bombing missions were incidental to the principal work of reconnaissance. The German staff, reporting on aeronautics in October, 1914, asserted that "as experience has shown, a real combat in the air, such as journalists and romancers have described, should be considered a myth. The duty of the aviator is to see and not to fight."[9]

Whenever one side introduced a new plane or even an innovation, the other strove to equal or surpass it. For example, early in 1915 the French mounted machine-guns on the upper wings of their planes, although the propeller often hindered firing in a forward direction. In May, 1915, the Germans produced a new Fokker fighting machine equipped with an interrupter gear which enabled the machine-gun to fire through the orbit of the revolving propeller without the risk of hitting the blades. These planes inflicted heavy losses on English and French aircraft.[10] With a need to protect observation came a purely fighting plane.[11] France, England, Germany, and Italy started development of very fast and highly maneuverable combat airplanes to prevent the enemy from enjoying unrestricted freedom of the skies. The task of destroying hostile aircraft in flight was assigned to combat aircraft,[12] and it was then, after improvements were made in the design of single-seater airplanes, that the necessity for organizing pursuit aviation as a separate class of air forces was realized.[13]

The development of bombardment, observation, and pursuit planes was simultaneous. The bomber was a two-place plane,

larger and slower than the pursuit; therefore, it was more vulnerable to attack. Its mission was to drop explosives on enemy ground installations, communications, and civilian production centers. It accommodated two men, a bombardier and a pilot.[14] By late 1915 the British had established bombardment as a separate wing of the Royal Flying Corps and were deploying mass bombing by many planes over a single target satisfactorily. Pursuits now accompanied bombers and reconnaissance planes on many missions. Reconnaissance planes also became more specialized and were organized into highly trained observation groups. Some observation planes, like the bombers, were two-seaters in order to accommodate a pilot and an observer. They too were less maneuverable and slower than pursuits, and, therefore, easy prey to the faster combat planes.[15]

During the first year and a half of the war, pilots flew alone and relied on their own individual skill to trap an opponent. The success of these "aces" led to formation flying. As the methods and results of their work became generally known, both reconnaissance and bombardment pilots learned to exercise greater vigilance and it became more difficult for the attacker to approach from an advantageous position to deliver a surprise assault. Casualties were numerous among the single-seater pilots because the lone occupant of the plane could not keep his attention focused on all directions at once.[16] The advantage, in many cases, gained by teamwork

in flying thus resulted in a decline in the effectiveness of the "ace."[17]

The British, to combat the Fokker plane, concentrated their fighters in special squadrons.[18] These pursuit groups patrolled assigned sectors of the front to harry the enemy by attacking whenever possible and, thereby, afforded protection to their aircraft engaged in reconnaissance. One of the first missions, therefore, assigned to pursuit was that of providing protection to observation aircraft.[19] By the end of 1916 the belligerents recognized the use of three specialized types of aircraft: observation, bombardment, and pursuit. Realizing the offensive capabilities of the latter, they sought means to protect the other branches with the smaller plane.

At this stage of aeronautical progress in Europe, the United States entered the war in April, 1917. America's contribution to the conflict until that time had been in the form of vast quantities of war materials for the Allies. Once in the war, America sought frantically to build up a large air force in a minimum of time.[20] This resulted in disappointing, though sincere, attempts to contribute in a major way to the production of aircraft and training of pilots. In April, 1917, when General John J. Pershing became Commander-in-Chief of the American Expeditionary Forces, he declared that of the sixty-five officers and approximately one thousand men in the aviation section of the Army's Signal Corps, only five or six could meet battle conditions and none had experience with

guns, bombs, or bombing devices.[21] The United States, lacking in preparation, relied on her allies to supply most of the combat aircraft and for aid in instructing American pilots.[22]

The problems which beset the Allies in their conduct of the war rapidly became those of the United States. Among them was the relationship of pursuit to the other aviation branches. In the fall of 1917 the Allies decided that the single-seater was becoming obsolete and should be reserved for special purposes.[23] In December, General Pershing recommended that production of this type of plane be left to America's allies.[24] The trend away from the single-seater grew out of the pilots' inability to protect themselves from fire at their rear. Since two-seater planes could deliver fire from both front and rear, they seemed to have the advantage,[25] but new tactics in formation flying brought the single-seater in favor again, and it remained the most aggressive plane throughout the war by placing bombardment and observation at its mercy.

Bombardment proponents naturally sought to provide for the bomber's defense. Two principal courses of action were open: one, to increase its defensive armament, and two, to provide an escort of pursuit planes to protect it against enemy attack on daylight raids. In time, both measures were employed, but in 1917 some question remained as to the feasibility of continuing daylight bombing operations in view of heavy losses inflicted on Allied bombing forces by enemy pursuit.[26] Rather than lose this valuable weapon the

Americans perfected formation flying and emphasized more accurate gunnery.[27] But the solution lay in the pursuit escort, and bomber losses became appreciably lower (though German attacks did not diminish), when friendly pursuit supported bombers to a target and back.

Although bombardment units desired pursuit protection, the best method to provide this was by no means settled, an argument that continued until well into the second World War. There were two theories concerning protection: bombardment pilots favored "close" escort, which required pursuit planes to fly in proximity to the bombers; pursuit pilots argued for "convoy" escort, which permitted them to fly at a greater distance away from the bombers, thus allowing more flexible offensive action against the enemy. The Air Service decided that close protection should be given in only rare instances since it violated the principle of economy of force and deprived pursuit of an offensive role.[28] In the fall of 1918, the 2d and 3d U.S. Pursuit Groups, using the convoy system, escorted the American 1st Bombardment Group.[29] Employed in this manner the pursuits destroyed more enemy planes than by using close support.[30]

By the end of the war the Americans had learned that bombers could not defend themselves satisfactorily in the face of hostile pursuit plane attacks without the aid of escort. They also had discovered the value of extra gasoline tanks for additional escort range.[31] Whether escort should

be regarded as one of pursuit's chief functions was unsettled in November, 1918, but the use of this plane for support and observation had been widely accepted among Allied and German pilots.[32]

The Search for an Escort

In the first post-war decade attempts to produce a satisfactory pursuit plane for escort failed because of technical difficulties. Pursuit design was neglected and all that was accomplished was to install more powerful motors.[33] One reason was the lack of agreement among airmen on the type of pursuit plane needed by the Air Service. This was unfortunate in view of the fact that pursuit aviation emerged in 1918 as the branch which seemed to hold most promise for the future. In 1920, Brig. Gen. William Mitchell, Assistant Chief of Air Service, pointed out, "The most important branch of aviation is pursuit which fights for and gains control of the air. The pursuit can outmanuever any existing aircraft of other branches of the Air Service: consequently, pursuit aviation can bring an enveloping and surrounding attack in three dimensions against other aircraft, which is decisive."[34] However, the extent to which pursuit should be utilized for escort was unsettled. General Mitchell said it was a necessary if secondary role. He believed that close support for bombardment was a waste of pursuit and that its employment as escort was justified only in rare instances. Pursuit,

he said, should operate at some distance from bombers and should deal with attacking planes as early as possible. Once the bombers dropped their bombs, however, he thought they could defend themselves and that escorting pursuit should range away in search of enemy planes.[35]

During the twenties only a few innovations were added to the general escort tactics used in the first World War. Pursuits were to assist any bomber forced to drop behind the formation and to prevent concentration of superior enemy forces against any part of the friendly formation.[36] The basic tenets of pursuit tactics placed escort under the classification of "special missions," and though pursuit and bombardment manuals discussed escort,[37] no new theories on its use were developed for many years. Airmen regarded escort as a legitimate function for pursuit, but found no plane that could provide it.

Most fliers considered the multiplace or two-place type as ideal for escort since they believed its greater defensive firepower was advantageous in missions that were lacking in support.[38] As early as 1922, Maj. Carl Spaatz, who commanded the 1st Pursuit Group, said that defensive escort-type pursuit required radius equal to the aircraft it was protecting, speed superior to the protected planes, flexible machine-guns for the observer, strength and maneuverability.[39] Later, it was proposed that this plane not only have radius equal to the bomber's, but that climb and maneuverability should be

sacrificed to high speed. Its armament should consist of a 37-mm. gun and two .50-caliber machine-guns.[40] One Air Corps Tactical School instructor said that the single-seater pursuit, even with droppable tanks to increase its range from 50 to 100 miles, could not be expected to penetrate far into enemy territory because the weight of ammunition and gasoline necessary for a long mission would reduce the plane's combat efficiency.[41] This assumption faced airmen whenever they discussed a long-range fighter. Though this problem was raised at a conference for Air Corps leaders at Langley Field, Virginia, in April, 1929, results of the meeting were inconclusive.[42]

In spite of disagreement concerning the type of pursuit plane required, the technical aspect of range extension showed advancement. The Air Corps Tactical School text at the end of the twenties, for the first time, discussed the development of droppable tanks to increase the range of pursuit planes.[43] In addition, a memorandum to Materiel Division stated that auxiliary tankage would give a minimum cruising range of 600 miles to pursuit and that the auxiliary tanks could be dropped in flight.[44] On the other hand, the Tactical School's 1929 manual stated that the efficient cruising speed of pursuit and bombardment differed so much that a single pursuit group could not support the latter on deep penetrations through an entire mission. It recommended that two pursuit groups be used: one to support the bombardment group to its objective;

the other for support during retirement. It suggested further that both should support bombardment when it was releasing projectiles over a target.[45]

In his informative book, Air Warfare, Maj. William Sherman, Chief of Air Corps Instruction at the General Service School, Fort Leavenworth, Kansas, argued that bombardment had considerable powers of defense, though it would be subjected to unnecessarily high losses if completely dependent on its own powers. Sherman reasoned that since bombers were usually called upon to penetrate deeply into hostile territory and since their speed was so low that an effective enemy ground observation defense system would have adequate time to send up planes to intercept them, it was important for bombers to be supported by friendly pursuit aviation. The pursuit plane, having a cruising speed which exceeded that of the bomber by 40 to 80 miles an hour, but a radius of action about one-half that of the bomber, obviously could not cruise with it on distant sorties. The best that could be accomplished with limited fuel capacity was an escort on some portions of the bomber's trip when hostile pursuit was likely to attack.[46] Sherman maintained stoutly that pursuit aviation "is in fact, the very backbone of the air force."[47] He said that unless other branches of aviation were tied to pursuit their value would be reduced greatly. Without a pursuit force, the whole scheme of air operations would fail against an enemy strong in pursuit aircraft. He felt that as pursuit aviation grew, it would increase the effectiveness of the other branches.[48]

Sherman's advice was forgotten in the following years as bombardment moved ahead of pursuit, which was pushed farther into the background. The stage was thus set for an era in which the bomber became the supreme implement of American air power.

The Ascendancy of the Bomber and the Escort Problem

The production of new bombers in the early thirties all but eclipsed the escort idea and challenged the existence of pursuit aviation itself. The advent of the B-10[49] and the Norden Mark XV bombsight in 1932 enabled the Air Corps to develop high-altitude precision daylight bombing.[50] As a result, the bomber contributed to a doctrinal revolution which profoundly affected both pursuit and bombardment aviation.[51] Beginning with the B-9 in 1930, there followed a series of new bombers, each boasting improved speed, range, and general performance. These planes, the B-9, B-10, B-12, and B-17, represented such advanced technological improvements that pursuit aviation, lacking parallel developments, soon became a less important branch of the Air Corps.[52] Indeed, although the Air Corps Tactical School textbook of 1930 indicated that bombers would need escort,[53] enthusiasts for the large plane insisted that pursuit could not stop it.

An umpire of maneuvers in 1931 concluded that "due to increased speeds and limitless space, it is impossible for fighters to intercept bombers and therefore it is inconsistent

with the employment of air force to develop fighters."[54] From these same exercises, Lt. Col. Henry H. Arnold, commander of March Field, California, who ordered B-10 squadrons from San Diego to attack March Field, concluded that fighters would be ineffective in wartime.[55] Again, in 1934, when Arnold conducted maneuvers on the Pacific coast, using P-26's and B-12's, the latter a modified version of the B-10, he concluded that it was doubtful if single-seater pursuit, even flying 50 miles faster per hour than the bombers, could prevent them from reaching their objective.[56] He stated:[57]

> The present type pursuit plane does not have sufficient flying range to accompany bombardment to the objective and return. In addition it would be a partial waste of the pursuit force to tie it down to individual bombardment missions. . . . . Pursuit or fighter airplanes operating from front line airdromes will rarely intercept modern bombers except accidentally. Such being the case, they can normally operate solely against other Pursuits or Observation and it is doubtful whether such operations justify their existence.

Another officer, Brig. Gen. Oscar Westover, Assistant Chief of the Air Corps, in a discussion of the disparity in performance between bombardment and pursuit, stated that "bombardment aviation has defensive fire power of such quantity and effectiveness as to warrant the belief with its modern speeds it may be capable of effectively accomplishing its assigned mission without support."[58] He declared that nothing could frustrate accomplishment of a bombardment mission.

Another advocate of the large plane, Brig. Gen. Frank M. Andrews, advised his superiors that though bombers formed a large target for hostile pursuit and antiaircraft fire, this

was compensated for by their strength and defensive firepower.[59] A glowing account written by Arnold and Eaker is an example of this outlook:[60]

> The /bombing/ formations will continue persistently onward as relentless as the waves of the sea. The fighting and pursuit planes will soon exhaust their fuel supply, cease their attacks, and land for servicing, but the bombers will complete their missions and return to their bases to take on more bombs for other operations. Once more the pursuit planes will rise to the attack and endeavor to halt the seemingly endless stream of hostile bombers until the defending airmen are exhausted and the losses of planes become so great that the few effectives remaining can be brushed aside with little or no effort. The bombers keep coming.

Such statements as the foregoing reflected Air Corps skepticism concerning the pursuit arm. Bombardment instructors at the Tactical School taught that the backbone of airpower was the large plane. They, too, championed the theory that heavy bombers would attack from high altitudes in large formations and would depend on their defensive firepower for protection. Since few airmen then visualized single-seater pursuit with enough range for escort, they assumed that bombers would go to their targets and return without needing accompanying fighters.[61] If in this assumption bomber proponents seemed overly enthusiastic, they found justification in the relatively poor performance of pursuit in the early thirties,[62] especially when contrasted with the big bombers whose design and characteristics were truly remarkable for that day. During the depression years the Air Corps devoted much of its resources to perfecting a long-range bomber; obviously pursuit aviation suffered.[63]

Instructors at the Tactical School did not face the question dispassionately. Brig. Gen. Haywood S. Hansell, Jr., recalled many years later that a strong rift developed between the bombardment and pursuit sections, which he said created an impasse and resulted in a stubborn blindness that denied the need for mutual assistance. The whole doctrine suffered, since there was no way to prove the validity of the question. General Hansell has suggested that fanatical belief in the bomber's defensive power was not so much a choice as an election to operate unescorted, since the bombardment groups concluded that fighters could not be built with sufficient range to accompany them.[64]

In the face of this opposition pursuit enthusiasts continued to advocate the need for escort. They doubted the bomber's invincibility, although many accepted its dominance because they lacked anything resembling a fixed policy on fighter escorts. Pursuit enthusiasts were more adamant, however, when the fighters demonstrated successful interception in exercises held at Ft. Knox, Kentucky, in 1933, against a bomber force that had no protecting fighters. From this exercise, Capt. Claire L. Chennault of the Tactical School drew two conclusions: (1) that pursuit could intercept bombardment if furnished timely information and if the defense area had sufficient depth to allow for necessary time factors, and, (2) that bombers flying deep into enemy territory required friendly escort to prevent losses, if not complete failure.[65]

But the performance of the B-10 and B-12, even before the appearance of the B-17 in 1935, led Arnold to say in his memoirs that "notions that unescorted bombers might be able to outrun defending fighters, temporarily existed."[66]

Those who favored pursuit development realized that there was a physical limit to the fighter, even with droppable gas tanks for additional range. A Tactical School manual, "The Air Force," stated that pursuit carried its fuel in two tanks of approximately equal size, one droppable and one fixed. As soon as combat appeared imminent, the escort pursuit dropped its "belly tank."[67] The manual acknowledged that on short penetrations escort might be unnecessary since the bombardment plane could fly at a speed fast enough to avoid hostile pursuit directed against it in enemy territory. However, the manual advocated escort for deeper penetrations.[68] A pertinent section stated:[69]

> . . . in case special support has been decided upon for a bombardment or attack mission, send such number of pursuit as will be superior to the number of hostile pursuit that will be encountered, less those that can be neutralized by the support formations. If practicable, to insure control of the air to an even more certain degree during the operation, do not consider the defensive power of the supported formation.

The manual acknowledged that the existing single-seater pursuit with a droppable tank could not support friendly air units to the depth of penetration possible to bombers. It declared, "if it is necessary to support friendly air operations to their full depth of penetration, other means must be provided. Lacking such other means, operations by night must be undertaken."[70]

The commanding general of GHQ Air Force, Maj. Gen. Frank Andrews advocated the use of additional fuel tanks to increase the range of interceptors. In 1935 he wrote to the Chief of the Air Corps that an interceptor should have an external, droppable fuel tank with capacity for one-hour of full-throttle operation at a crucial altitude. He thought this tank would be useful in ferrying flights. He did not consider it part of the equipment for military missions nor the designed useful load.[71] At the time Andrews was writing, the Air Corps regarded interceptors as short-range planes with limited functions. The staff held that an enemy plane could intercept a small fighter halfway to the target and force it to drop its extra fuel, thus nullifying its further use as an escort. Clearly, the answer was in another type of plane. This initiated a searching inquiry to find the right aircraft.[72]

Reconsideration of a long-range escort fighter came at a time when air-defense problems were limited largely to a program of continental defense. In late 1934 the Air Corps developed an interest in a bomber-destroyer type aircraft which would have long range and carry both small - and large-caliber guns. It commenced a series of studies to determine the type of plane needed for long-range missions, and naturally, the Air Corps boards took the pursuit problem into consideration. Their findings and recommendations covered many aspects of pursuit aviation, including multiengine and single-engine types, multiplace and single-place planes.

Though the question of range, purpose, and armament received attention, in the final analysis no fixed policy developed concerning the role for pursuit escort.

At the end of the twenties the Air Corps considered the multiplace plane as the most satisfactory for pursuit.[73] Colonel Arnold, in late 1934, pressed the Chief of the Air Corps for a new design of a multiseater escort fighter, though he admitted the difficulty in developing such a plane. Arnold believed that the B-12 was unsuitable as a multiseater escort, partially because of the demand that it should outperform other bombers. He thought a multiseater should carry eight to ten guns, some of large caliber, and enough fuel to equal the bomber's range. He thought a compromise might be made to give the multiseater the necessary performance, with armament added in the amounts necessary for an escort plane.[74]

In January, 1935, the Air Corps Board, convening at Maxwell Field, Alabama, considered the multiseater/single-engine fighter, but instead recommended adoption of a two-engine plane. According to the Board's specifications, the plane would include four fixed .50-caliber machine-guns and one flexible .30-caliber gun, carry not more than five bombs, and have sufficient range to support the longest bombardment mission. The Board anticipated that with reduced gas load the airplane could give bombardment close support.[75] In February, 1935, the Chief of the Air Corps requested the Chief of Materiel Division and the President of the Air Corps Board to submit their opinions on adopting such a plane, and

to give the weight and performance estimates it might require.[76]

The board concluded that an escort plane should have the following characteristics: a speed 25 per cent greater than the bomber, range at least equal to it, ceiling as high or higher, and an extremely rapid rate of climb. The board believed that a plane meeting these qualifications would be larger than the bomber and that its qualities as a fighter would be impaired. The report said that "the performance requirements for interceptor type pursuit differ so greatly from the requirements for a fighter to accompany and give close support to bombardment that any attempt to cover both fields with one airplane would . . . result in extremely unsatisfactory performance for both functions."[77] The board noted that there was a need for an interceptor-type pursuit plane, but that additional support for bombardment had not been proved. It did recommend, however, that steps be taken to determine the need for escort, and asked bombardment to exhaust every means for its own defense. Only after all other means failed should additional airplanes be sought for close support. The board advocated development of an experimental fighter from an "existing type" for this purpose, but requested that the project be conducted only if it did not interfere with the progress of other branches of aviation until the need for an escort plane was demonstrated thoroughly.[78]

In February, Wright Field engineers completed their studies of the two-engine pursuit plane. One design, designated No. 301, was basically a B-10 type, a multiplace fighter

to be used as an escort. The second, No. 313, was a two-place pursuit plane. Because of Air Corps Board recommendations that pursuits have a margin of at least 50 miles an hour over bombardment, the engineers pointed out that its fuel load would have to be reduced, thus lessening its radius of action and usefulness as an escort fighter. Additional weight on the B-10 from increased armament and from strengthening the structural design made it heavier than the bomber. The engineers concluded that the multiplace fighter would have less performance than the bomber.[79] They rejected the second design also because of performance limitations, and informed the Chief of the Air Corps that both planes were inadequate as weapons.[80]

In 1935 the Air Corps rejected all two-place designs submitted to it since none was sufficiently advanced.[81] To be sure, the Tactical School text of that year acknowledged that pursuit, if attacking in superior numbers, could possess an "overwhelming superiority in . . . air combat,"[82] and that experience might prove escorting fighters essential. However, the text continued, escorts would neither be provided nor requested unless experience showed that bombardment could not penetrate enemy resistance.[83] This was in accordance with the Air Board's January recommendations.

Notwithstanding the verdict of Wright Field engineers, the question of using a multiengine/multiseater fighter arose again when a Tactical School instructor said that the escort

answer still lay in employment of a plane similar to the bomber. He advocated long-range, multiengined fighters as an organic part of each bombardment group.[84] GHQ initiated specifications for this type of plane in July, 1936.[85] This plane was a fighter with bomb-carrying capacity. In response to criticism of this large plane, GHQ complained that some of the pursuit advocates "still want to cling to the idea that a multitude of guns and bombs can be flown by a single engine airplane, which is already handicapped to a greater extent in its performance than a multi-engine airplane, even with a reduction in weight."[86] The GHQ further stated that the short-range pursuit should remain an interceptor, with the bomb-carrying and useful-load provisions eliminated to afford it more climb.[87] The Tactical School textbook of 1937 concurred with GHQ and stated that the two-seater "has no value in either short or long-range operations and that development should be along the lines of (1) a high performance, short-range airplane for offensive work only, and (2) a heavily armed long-range multi-seater capable of offensive and defensive tactics."[88]

The experience of the Spanish Civil War (1936-1939), demonstrated to some observers the vulnerability of the bomber, though a majority of American airmen still regarded it as invincible against pursuit attack. The Army Air Corps saw nothing in aerial warfare in Spain to suggest a change in its own doctrine.[89] Most of the aircraft employed was obsolete; the tactics ill-defined. Furthermore, it was

impossible to judge accurately the potentialities of mass formations operating under capable direction because of the comparatively small numbers of fighters and bombers employed. Nevertheless, American observers reported that one of the lessons learned in Spain was the need for protection of bombers--a lesson which became painfully acute to Air Corps planners in World War II. The observers said single-place escorts were the only effective protection against attacking fighters.[90] For example, the German Junker 52, lacking adequate firepower in its nose, was so much at the mercy of an attacking plane in that quarter, that many of its unescorted missions failed completely.[91] American intelligence reports pointed out that defensive armament created no problem for the attacker, which to observers illustrated further the need for escorted bombing formations.[92]

The Spanish Civil War also convinced some German pilots of the value of escort, but if Germany saw this need she failed to provide her own air force with a plane suitable for long-range escort operations.[93] General Arnold reflecting on the Spanish war in his memoirs, wrote:[94]

> The escort of bomber formations proceeding to and from their objectives, by double, or more than double, their number of fighters has been found on both sides to be a necessity, notwithstanding the ability of the bomber to shoot down fighters. Yet we in the United States were still debating the need for fighter escorts for bombers.

The ominous events in Europe during this period, which culminated in the Munich crisis in September, 1938, prompted the administration to undertake a vast expansion of military forces in the United States with particular emphasis on air power. General Arnold viewed this program as the "Air Force Magna Charta."[95] Not only was the pursuit branch to see expansion, but there occurred renewed interest in the fighter's capabilities. The favorable performance of pursuit aviation in Spain, particularly by German Messerschmitt fighters, and the positive advance in interceptor development--these, and other factors, presageda re-evaluation of the fighter. Indicative of this change in attitude was the opinion of officers in the 8th Pursuit Group who stated that the multiseater/multiengine fighter would be valuable for close protection of bombardment. They believed that this plane should have slightly greater range than bombardment and carry from 12 to 15 .50-caliber machine-guns.[96]

Tactical School instructors now taught that pursuit, light bombardment, and observation, if available, could perform important supporting operations to insure successful conduct of a bombardment attack, but that unsupported bombardment units could handle their own reconnaissance and defense.[97] One instructor, Capt. Harlan T. McCormick, stated that the speed of the multiengine fighter would be reduced by the additional weight of the fuel load, , but that this disadvantage would be offset considerably by its increased firepower.

To McCormick, escort planes seemed as logical as the protection of capital ships by destroyers. He said that any means to save the bombers from attrition at the hands of hostile pursuit should be tried.[98]

At a Wright Field conference in 1938 to discuss an escort plane, airmen agreed that the Air Corps had a legitimate place for this type if it was used for support of the other branches. They recommended that an escort plane have a maximum firepower to the front and rear, and some ability to deliver fire above and below. They rejected the two-seater plane, however, as having no place in modern aviation since they believed it filled requirements neither for an interceptor nor for a long-range pursuit.[99]

The confusion which continued in the quest for an escort is illustrated in Air Corps Study Number 35 of May, 1939, which concerned itself with determining the most effective method of employing aircraft in defense of continental United States.[100] In a section entitled "The Army Air Component, Tactical Requirements," the study stated that security-force aviation had the task of protecting friendly bombardment over enemy territory and in the vicinity of its objective. The study said:[101]

> The higher operating speed of modern bombers increases the difficulty of interception by hostile pursuit and thereby lessens the need of support by friendly pursuit. The increased operating radius of bombardment aviation facilitates the attack of objectives which may be mostly far beyond the range of the pursuit or fighter airplane. There appears to be little, if any, possibility of ever building an accompanying fighter with an operating range comparable to that of bombardment and also fighting characteristics, which would enable it to cope with the enemy pursuit in the vicinity of the bombardment objectives.

In a discussion of counter air force operations, this study observed that American pursuit should be designed primarily for successful interception and destruction of hostile bombardment over or near friendly territory. Such missions effectively performed would contribute to the attrition of an enemy striking force. It considered desirable, but impractical, the employment of fighter aircraft in defense of bombardment units operating far within enemy territory. The study also stated that bombardment units needed to place their principal security on their own high operating speed and defensive armament. There seems to have been some doubt about the armament, however, for the study stated, "there appears to be room for considerable improvement in the defensive armament of bombardment airplanes and this matter should receive careful attention."[102]

In preparing for this study, the board distributed questionnaires to several Air Corps organizations, including the 2d Bombardment Wing, the 1st Pursuit Group, and the 9th Bombardment Group. To the question of to what extent and in what manner the improved performance of aircraft in recent years had affected the technique of air attack and air combat, one reply asserted that increased speeds of bombardment planes, coupled with increased ceilings at which they could effectively operate, had decreased their vulnerability to pursuit attack. Further, this answer said, with a speed equal to and often superior to pursuit, bombardment

no longer had to use formation tactics to provide effective concentration of machine-gun fire. If bombardment did not rely on formation flying, it could operate independently and thus avoid interception. Pursuit interception, therefore became a matter of split-second timing in which the probability of catching the bomber after its initial drive was slight.[103] The 9th Bombardment Group answered the question by stating: "The principal effect of the increased performance of modern aircraft on the technique of air attack and air combat has been to virtually eliminate pursuit support of bombardment and to materially increase the possibility of the element of surprise."[104]

To the question of what maximum radius of action certain types of defending aircraft should have, the 2d Bombardment Wing replied that pursuit aircraft could never provide close support for bombardment on long-range operations; therefore, the radius of action required should be determined by the distance away from a defended locality pursuit must intercept hostile high-speed bombers. A minimum of three hours' fuel would be required to permit converging interceptions from a wide front on high-speed, long-range bombers.[105] This wing appealed for development of a long-range escort fighter on the assumption that the progress in design might make such a plane possible.[106]

Another of the board's questions was whether bombardment aircraft should be afforded air protection over enemy territory or in the vicinity of defended objectives. The 2nd

Bombardment Wing stated that on long-range missions where maximum advantage could be taken of altitude, time, speed, cloud cover, and scheme of maneuver adaptable to the situation, the presence of supporting aviation, if within its range, too often served to alert hostile defenses and deny bombardment an element of surprise, which would sacrifice security. The wing believed that on so-called combined missions with escort pursuit, coordinated attacks required bombardment to attack at a specific time or within a limited time bracket. It therefore concluded that at high altitudes where high winds prevailed, time schedules could not be met without excessive adjustment of throttles--which would increase the risk of detection from the ground due to excessive noise--or without killing time while over hostile territory, which would also increase the chance of interception by hostile air units.[107] To this same question the 1st Pursuit Group replied:[108]

> It is believed that bombardment aviation will rerequire pursuit or fighter support only when the situation demands operations over prolonged periods against a single objective or a number of objectives in a specific limited area. The need for pursuit protection is not apparent under conditions when bombardment can select the time and place of attack against a large number of widely scattered objectives.

To another question of whether there was a need for pursuit or fighter aircraft to accompany bombardment over enemy territory, the answer given was "No." One reply stated that bombardment over enemy territory should be able

to take care of itself up to the target, but suggested that once the objective was reached and bombers were homeward bound, pursuit defense might be desirable. The answer concluded that the normal pursuit fighter with a 500-mile radius could be used.[109]

The Air Board concluded from its studies that the ideal pursuit plane should have a minimum tactical operating radius of 500 miles, minimum speed of 425 miles an hour, and be so designed as to support bombardment on missions exposed to enemy attacks.[110] The board considered hostile pursuit, not antiaircraft fire, the greater menace to bombers and stated that "air missions should be afforded friendly pursuit protection whenever practicable."[111]

Besides the ambiguity of the opinions expressed by officers on the need for long-range escorts, there was still no clearly defined statement on the kind of pursuit planes needed by the Air Corps. The 1939 Air Corps text regarded only the single-engine, single-seater type capable of escort. "It has an endurance of about two hours at full-throttle and can be used as a convoy on fighter missions."[112] This was the first statement that the single-seater pursuit could serve as escort, though the text's discussion of when escort would be used reflected the tentative view of the subject. The text continued, "the pursuit to be employed in support of bombardment depends upon the importance of the mission, the probable strength of the enemy, and the amount of pursuit available."[113]

It concluded that unless improvement was made in range, pursuit would be employed only on defensive missions, although its action would always be offensive and its object the destruction of enemy aircraft.[114]

In June, 1939, Lt. Col. Donald Wilson, Director of the Department of Air Tactics and Strategy at the Air Corps Tactical School, submitted to Col. Millard F. Harmon, also of the Tactical School, a memorandum setting forth his ideas concerning an accompanying plane. Wilson saw the need for an escort, but cautioned against building one that would compromise range, performance, and firepower for protection against hostile pursuit. Moreover, he believed that to divert production to fighters, when the total number of aircraft to be built was limited, would represent a corresponding loss of bombers. Wilson considered the escort necessary only when the estimated war situation indicated that bombardment operations could not be conducted without support. He then maintained that if this situation arose some bombers might be provided with additional firepower to serve as escorts.[115]

Capt. Walter G. Bryte, Jr., a student at the Tactical School, in an opposite view, stated, "It is time that we begin intensive experimental development, the development of accompanying fighter aviation in order to enable bombardment aviation to perform successfully those missions which do the greatest damage to the enemy. . ."[116] Bryte wanted pursuit units to

cooperate with bombardment immediately to develop tactics and acquire training together. The Air Corps, he wrote, should also procure droppable auxiliary fuel tanks for fighters to increase their escort range. He believed that this should be done before an emergency arose from heavy combat losses.[117]

Pilots of the 8th Pursuit Group in the fall of 1939 unanimously agreed that existing bombers were extremely vulnerable to pursuit attack. They estimated that day bombers, if intercepted by hostile fighters, would suffer 50 per cent losses, and concluded that the only safety for bombers was in night operations or under heavy cloud cover.[118]

The opening of hostilities in Europe in September, 1939, caused the Air Corps to renew its efforts to find an adequate escort fighter. General Arnold, now appealing for a new attitude toward pursuit, disclosed his own doubts about the bombers:[119]

> Reference to reports from air activity in recent wars clearly indicates the necessity for pursuit aviation and the very great role it plays in air combat and anti-aircraft defense. A doctrine which has been widely propounded in certain Air Corps circles for many years to the effect that fighter craft cannot shoot down large bombardment planes in formations, has now been proven wholly untenable. It has been demonstrated recently beyond a doubt that the best anti-aircraft defense is pursuit aviation.

Arnold held a conference on 27 December 1939 in Washington with representatives of GHQ Air Force, Materiel Division, Plans Division and Ordnance to determine the adequacy of the defensive firepower of bombardment aircraft. The participants

examined reports on air combats in Europe to discover whether they indicated a necessity for armament changes in the American bombers.[120] Questions raised at the meeting were pursued more fully in a study by the Air Corps Board, the Tactical School, armament representatives from OCAC, and the Materiel Division. They concluded that bombardment formations should have close pursuit support on daylight operations where heavy opposition might be encountered, although they said its absence would not justify abandoning important missions.[121] The group also concluded that "pursuit protection for long-range bombers during daylight operations against objectives known to be defended by pursuit, is of great tactical importance and the pertinent technical problems incident to the provision of such protection merit thorough investigation."[122]

The board suggested consideration of : (1) fighter aircraft having the longest range practicable for bombardment support; (2) a means of refueling pursuit aircraft from bombers in flight; and, (3) the carrying, by long-range bombers, of high-performance pursuit aircraft to be released to engage enemy pursuit and to be recovered later.[123]

In a section outlining steps to improve the defensive firepower of bombardment aircraft to minimize losses from hostile pursuit attack, the board stated:[124]

> Bombers now in existence or production in general cannot be given fire equality with even interceptor pursuit due to structural limitations. They are thus vulnerable to both interceptors and heavy fighters. Whenever air

> opposition is likely, they will require pursuit support if losses are to be kept within reasonable limits. The exchange of one bomber for one, two, or even three hostile interceptors can hardly be considered a reasonable trade in the long run by bombardment.
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> **********
>
> Even though individual bombers do possess fire power equivalent to that of individual interceptors, there is no guarantee at any time that the air opposition they encounter on a specific mission will be limited to interceptor pursuit except possibly in the case of naval targets defended entirely by carrier-based aviation; if unsupported bombers encounter a reasonable force of heavy fighters they will, in all probability, suffer severe losses.

Though these statements were the strongest made up to 1940 challenging the bombers' capabilities, the board recommended that only the older models receive support.[125] It then qualified its opinion by stating:[126]

> Pursuit or fighter escorts may become necessary for the protection of older models of bombers in order to obviate excessive losses in some situations and preparation should be made against such an eventuality. The development of an accompanying fighter that can fly great distances and yet meet the enemy interceptor on equal terms near his own airdrome is an engineering problem of no mean proportions. The engineering development of mechanism whereby each long range bomber can, when enemy interception is anticipated, take along, either pick-a-back or by suspension, an interceptor pursuit airplane of superior speed and maneuverability to engage the enemy on equal terms without the handicap of a fuel load sufficient for a long return flight to friendly territory, might not be any more difficult than the development of a long range fighter and there appears to be a possibility that such an arrangement might have tactical advantages. Provision for refueling the accompanying pursuit aircraft by the bombers without the necessity of attachment for prolonged periods might offer equally satisfactory results.

In the final analysis, the report stated that the defense of bombers would depend on the horsepower-firepower ratio of the two types of airplanes and the percentage of the pursuits that bombardment could recover.[127]

Like its predecessor, Study Number 35, this one reflected the belief that the most recent bombers, particularly the B-17's, could defend themselves without escort. Apparent, however, in both studies, was a more favorable reappraisal of pursuit. This represented a fundamental change in the Air Corps attitude toward the smaller plane.

Criticism of the bomber now began to come not only from pursuit proponents, but from bombardment enthusiasts as well. Maj. Harold L. George, on 26 December 1939, advised Maj. Gen. Delos C. Emmons, Commander of GHQ Air Force, that there was no question in his mind that American bombardment units were defenseless against American pursuit groups. In turn, Emmons told General Arnold in January, 1940, that aerial operations in Europe confirmed results of the first World War that the "bombardment plane cannot defend itself adequately against pursuit attack."[128] Acting on these statements, General Arnold directed the head of the Air Corps Board and the commanding officers of the 23d Composite Group to recommend types of pursuit and fighter aircraft needed for bombardment protection. All air-fighting tasks now contemplated for pursuits were given priority. A study by this group pointed out that any special type developed for escort missions should accompany bombers to their full radius of

action at a speed at least equal to that of the bomber. If the escort could not fly as fast and as high as the plane it was to accompany, then it was not to be used. The study observed that an escort fighter with heavy firepower "will augment the defensive firepower of the bombardment formation, especially at the rear . . . where it is most vulnerable to attack by hostile interceptors."[129] Such a plane might be as large as the bomber, but the study admitted that this type would diminish the strength of bombardment units by as much as 25 per cent because the fighter would be built from a bomber fuselage, thereby reducing the number of aircraft carrying bombs.[130] Those who prepared the study were undecided whether such an escort plane was worth developing without a thoroughgoing design study of its capabilities compared to an interceptor fighter. Instead, they proposed a study to compare the effectiveness of increased bombardment firepower to that given by escorting fighters.[131]

While these recommendations were under consideration, the Air Corps explored the subject in another study on pursuit which had been started in November, 1939, and completed in August, 1940. This report stated that pursuit development lagged too far behind bomber development.

As a result of this type of thinking, the Air War Plans Division, in 1941, was describing a desired escort plane as one that would have the radius of a bomber, but with slightly higher speeds. It would carry the largest possible number

of guns and be employed to fulfill one mission: the defense of the bomber against hostile pursuit.[132] The escort initially would take positions on the flanks and rear of bombardment formations, and, when combat began, would be maneuvered into positions where maximum hostile attack was developing. The escorts would be so deployed that enemy pursuits could not attack bombardment without first passing through the fire of the supporting planes, or without first disposing of them. The Air War Plans Division offered two recommendations: one, that an escort fighter designed solely for defense be recognized; and two, that the Army Air Forces immediately define military characteristics for this type of plane.[133] Since no prototype existed, they cautioned, "it would be wrong to count on this new type, but the tactical requirement for such an airplane exists and a program for development of the type should not be neglected."[134]

Reports from England at this time gave the Air Corps a fertile source of firsthand information. In August, 1941, Col. Ira C. Eaker, of the Air Corps staff, toured England to inspect various aspects of the British air effort. Among other subjects, he received instructions to ascertain the British viewpoint on escort fighter protection.[135] According to Eaker, the English, almost to a man, keenly desired such a plane, but doubted if one could be built satisfactorily. Air Cdre. Reginald Baynes Mansell explained the problem:[136]

> How will you get such a big fighter through the little, single-seater day fighter screen? The big fighters accompanying the bombers into Germany will have to pass through a screen of Messerschmitts and they will sting it to death. It will have to be a big heavy plane in order to carry the fuel and armor and the light fighter can get inside and knock it down.

The British experience with planes in the heavy fighter class, such as the Typhoon and Tornado, had shown that they were unable to withstand the smaller Spitfires and Messerschmitts.

On the other hand, Air Chief Marshal Sir Charles Portal, Chief of the British Air Staff, believed that an escort plane could be built exactly like the bomber. He told Eaker that such planes would surround bombardment formations and carry guns as heavy as any which enemy fighters could bring against them. Portal and Sir William Dickson, Chief of the War Plans Section, Air Staff, cautioned Eaker against building a compromise fighter-bomber plane, which they believed would be unsatisfactory in either capacity. The British thought that if an escort such as Portal suggested could be built, the bombers would only need tailguns, resulting in a lighter load and increasing the bomb-carrying capacity.[137] Thus, the principal thought Eaker brought home was that the obstacles to building a small escort fighter centered in provision of sufficient fuel for it to accompany the bomber.[138]

A pursuit board meeting in October, 1941, proposed a recommendation similar to Portal's. It considered the convoy

fighter or convoy defender as a multiplace pursuit designed to fly in formation with bombardment aircraft during daylight raids. In size and appearance it would look more like a bomber than a conventional pursuit.[139] The board went a step farther, however, by stating that only with the assistance of such a plane could bombardment successfully deliver daylight attacks deep in enemy territory and beyond the range of interceptor pursuit. The convoy defender, it said, should equal bombardment in speed, climb, range, and endurance. "It is visualized as being so much like the bomber in appearance that the hostile pursuit, having once encountered it to their dismay will be hesitant thereafter to close on any bomber formation."[140] The board doubted if bombardment aviation could successfully wage offensive war by night attacks. It believed that added defensive armor and armament to aid bombers to fly through a hostile interceptor screen in daylight without support of convoy defenders might prove only a temporary solution. "The board believes that the development of this type should be initiated at once, and that the experimental model to be procured should be designed for convoying a particular bombardment type aircraft which will be in operation when the convoy defender can also be put in operation."[141]

Having presented its case for the plane, the report then stated:[142]

> Assuming that it can be built, there still remains a doubt as to its ability to successfully perform its mission. That would depend on the enemy, and his ability to counter the new weapon. The Board is unable to say whether or not the project is worthwhile, and can only point out the need for furnishing day bombardment with the very maximum attainable defensive power if that form of attack is to gain a decision in war against any other modern power.

The board doubted the practicability of the convoy defender and recommended that future pursuit development be grouped in six classes of planes. The convoy defender received the lowest priority.[143] The board even questioned beginning such a project at that time and said that heavy demands on industry for production and development of other planes might make it impossible to start a new project of the size and costliness of the convoy defender.[144] Thus, a scant six weeks before Pearl Harbor, 7 December 1941, the board with strong doubts that heavy bombers could successfully penetrate far into hostile territory, nonetheless, placed the escort plane in the lowest bracket for development. This conclusion is surprising when it is recalled that the Air Corps had the Battle of Britain and other combat experiences on which to draw for formulation of sound air doctrine. A week after Pearl Harbor, a Bombing Board recommended development of an escort for bombardment formations.[145]

During 1941 the Air War Plans Division staff was divided about equally on this question, with the difference of opinion depending on the degree of confidence the staff members had in the bomber. One element held that the AAF should

build a bomber with power to penetrate enemy territory alone. The other element believed that a bomber could not defeat a fighter and that pursuit would cripple a bomber anywhere at any time. If bombers were to operate successfully over enemy countries, they should have support from escorting units to augment their defenses. Nevertheless, even the British employment of the B-17 in the spring of 1941 failed to convince some of the Air Staff that the plane was incapable of unescorted missions against hostile fighters.[146] Thus, from the level of various operational groups to the highest echelon of air planners in Washington, the question of the bomber and that of an escort fighter caught the attention of the AAF[147] before Pearl Harbor, but seemed to admit of no positive solution.[148]

Range Extension: The Development of an Idea

It is in the period of the first World War that the origins of range extension are to be found, but from the time of the first Wright plane the effort to extend range was continuous. The principal means by which the fighter's range was extended in the twenty-five years after the war was by increasing the internal tankage of pursuits and utilizing droppable and/or fixed external fuel tanks. Without this development, which paralleled the growth of pursuit aviation doctrine, the long-range fighter would not have

been possible.

The American concern for aircraft production, with the accompanying problem of range, was increased when the United States government in April, 1917, undertook to produce large quantities of the British-designed De Haviland-4,[149] a biplane, two-seater, to be used primarily for reconnaissance and secondarily as day bomber and defensive fighter.[150] In the first DH-4's sent from the United States to Europe, the fuel tank was placed between the pilot and the observer; if the plane crashed, the pilot was crushed by the tank.[151] Furthermore, the tank often burst into flames when hit by enemy gunfire because it lacked a leakproof covering.[152] Some pilots called the plane a "flying coffin."[153] In a later model of this plane, the DH-9, engineers placed the tank behind the observer and increased the fuel capacity from 66 to 88 gallons.[154] While the movement of the tank from one part of the plane to another was not a complete solution, it was an improvement of some value. A detachable tank was also placed on the DH-4.[155]

Construction of a leakproof gas tank was still another attempt to minimize the fire hazard,[156] but at the time the United States began to produce the DH-4 none was in use. It was not until the late spring of 1918 that the first such tanks were placed on the French Breguet bomber.[157] The United States Air Service had refused self-sealing tanks as early as August, 1917, but requested them in September of the

following year. It was not until 12 November 1918 that the first leakproof tanks were satisfactorily installed on the DH-4's.[158] These tanks were French models. The Air Service ordered American manufactured-and-designed leakproof tanks as standard equipment for all United States planes but none was used until after the Armistice.[159]

Another method of solving fire hazards was to drop the fuel tank from the plane when danger of fire became apparent. This idea also was adopted by the French on their Breguet bomber, which had a five-hour fuel supply. In this improvement, the fuel system was divided into two tanks, the lower of which could be dropped easily in case of fire, and the upper so protected that it was very rarely liable to burn. These tanks were in front of the pilot and did not hurt him if the plane crashed.[160] Thus, the idea of a droppable tank as then conceived was originally a safety innovation, but it was not far removed from that of carrying fuel for long-range flights. Since the essential technical method of the problem was now known, it served in the post-war period as a further consideration for extending the range of airplanes.

After the war, experiments with fuel tanks still revolved around the same problem: that of lessening the danger from fire. These tests, in turn, led to a series of technical developments which were later applicable to range-extension. Although these experiments were not part of an overall plan, they were valuable in furthering the knowledge of Air Service

engineers. In one experiment on the DH-4, McCook Field engineers installed an 80-gallon tank covered with heavy rubber underneath the fuselage. In the event of a crash they expected the tank to slide forward underneath the fuselage instead of breaking directly against it and spilling gasoline over the hot engine. They also tested aluminum and tin-plated tanks and found that the metal tanks reduced the plane's speed by only four miles an hour.[161] Though the engineers were not directly concerned with range extension, they were testing a method of fuel-carrying in removable tanks.

In a quest for more knowledge of aircraft development, Brig. Gen. William Mitchell, Lt. Clayton Bissell, and engineer Alfred Verville visited France, Italy, Germany, Holland, and England in 1921-22. On their return they reported to the Air Service that gravity gasoline tanks should be removable, and separated from the internal or integral part of the pursuit's fuselage structure, save for feeding connections. In addition, they recommended that pursuit planes with two and one-fourth hours' capacity carry an extra tank for three-fourth hours' flight. Their recommendation that extra fuel be segregated from the internal part of the fuselage was not a new idea, but was emphasized to remove the temptation to place it directly within the plane.[162]

Following the Mitchell report, the Fokker Company of Amsterdam, Holland, delivered four Fokker CO-4 two-seater observation planes to McCook Field for experimentation.

These planes had two types of fuel supply. In one model the main tank was directly behind the engine; in the other it rested on the axle of the landing gear underneath the fuselage. This necessitated the use of two kinds of landing gear, one to accomodate the axle tank, the other to use with the tank in the fuselage. The Fokker planes permitted installation of extra tanks in the wings, fuselage, or landing gear, and allowed Air Service engineers to experiment by utilizing the unique fuel-carrying capacities of these planes.[163]

Experiments in air-to-air refueling also contributed to the quest for more range. One test occurred on 18 November 1923 at Kelly Field, Texas, but ended in tragedy. During the flight one pilot was killed when the hose pipe of the tanker plane became entangled with his aircraft, causing a collision. Another experiment of a more important nature occurred in January, 1929, when Maj. Carl Spaatz and four others remained in the air more than 150 hours by using this method of refeuling.[164] After this endurance test Spaatz stated that air-to-air refueling could be applied successfully to military aviation.[165]

Another early test for more range was undertaken in a coast-to-coast flight on 23 June 1924 when Air Service engineers increased the fuel capacity in a Curtiss PW-8 biplane from its normal supply of 77 gallons to 167 gallons by installing two auxiliary tanks with 45- and 47-gallon capacities. The flying time of the trip was 18 hours, 38

minutes, at an average speed of 148 miles per hour.[166]

The first plane to incorporate droppable tanks as standard equipment was the Douglas XO-2. The main fuel supply was in two droppable tanks, each holding 60 gallons, in the lower wings. In addition, the plane carried a 10-gallon gravity tank in the upper wing and a 40-gallon auxiliary tank in the fuselage, to give it a total of 170 gallons. A similar model, the Curtiss XO-1, carried its entire fuel load in one 118-gallon tank in the fuselage which was supported at four corners. The front supports could be released by pulling a tripping device, which severed connections and allowed the tanks to fall clear of the plane.[167] In 1925 the Air Service inaugurated the "P" series by redesignating the PW-8 as P-1.[168] With these new pursuits came the use of the belly tank, which fitted closely to the under surface of the lower wing.[169]

In the autumn of 1925 the engineers at McCook Field undertook tests to determine the effect on the rate of climb and flight-level speed of a Curtiss D-12 single-place biplane with and without a 52-gallon droppable auxiliary tank. These tests showed that the speed and climb of the plane was slightly reduced by the tank, but that the general handling characteristics were not affected seriously.[170] In April, 1926, the engineers conducted a similar test with a Curtiss P-2, also a single-place biplane, with a 50-gallon droppable

tank, and again found that the extra weight did not detract appreciably from the airplane's general performance.[171] In the fall of 1931, the Air Corps undertook performance flights of a Curtiss XA-8 with a 52-gallon droppable tank. This was the first tank shaped like a tear-drop, and it showed a marked aerodynamical advance in design. This tank configuration became standard design and was used thereafter by the Air Corps.[172]

In the following year, engineers at a supply conference at Wright Field discussed the general progress in range extension and tank design, and agreed that dumping gasoline by opening a valve in a droppable tank presented an unacceptable fire hazard. They further decided that, whenever possible, the auxiliary fuel carried externally should be droppable from all types of planes where the design would permit it. They then concluded that auxiliary gas tanks were necessary for both pursuit and observation planes.[173] Initially the Air Corps preferred not to use external tanks, for its policy was to make aircraft designs as trim as possible. In 1933, however, the Air Corps engineers experimented with auxiliary fuel in internal tanks of a Boeing P-26 monoplane and also tested the P-36 with an internal tank.

In the mid-thirties the Air Corps specified, for the first time, that the Army's planes be capable of a 50 per cent overload, a provision that would enable planes to carry bombs or extra gas if necessary.[174] The overload factor permitted

the Air Corps to expand the internal gas-carrying capacity without resorting to the use of external tanks and the encumbering shackles necessary for such an installation.

In February, 1939, Curtiss-Wright suggested to the Air Corps that it might be interested in testing a 52-gallon tank which could be mounted on the bomb rack of a P-36C. The company offered to build such a tank for experimental purposes and to provide the connection with the main tank. The Materiel Command accepted the offer in March, but in April OCAC questioned use of an external tank because of the fire hazard. The plea of Materiel Command that the tank was only experimental was not overruled at first, but in May the Chief of the Air Corps directed that no tactical plane be equipped with a droppable fuel tank.[175]

In pleading their case for permission to install an auxiliary external tank on only one airplane, the engineers of Materiel Command stated in a lengthy report that it would increase endurance by approximately one hour. The installation, they said, plus the fuel, would weigh about 350 pounds. They recognized that its effect upon performance was uncertain, but anticipated that since this fuel supply would be used primarily for extending the range, and not in actual combat, the magnitude of reduction in performance was relatively unimportant. The engineers believed there would be no appreciable change in performance or weight when the tank was removed and the plane converted to a standard type.

Turning to the disadvantages of internal installation of fuel tanks, they said they were carried as empty weight most of the time. There was a tendency to service built-in tanks to the limit of their capacity, regardless of whether this was overload fuel and without heed to the mission to be performed. The engineers said that if sizeable overloads of fuel were to be carried in pursuit planes for specialized missions, their fundamental design should not be penalized by the installation of large built-in tanks. They knew that there were no military characteristics for an external tank, but suggested that it might offer advantages as an overload factor. Since the installation involved no serious change in the airplane and offered the possibility of increased tactical utility, Wright Field suggested that this was worthy of investigation.[176] That there were no military demands for such a tank serves to illustrate how foreign droppable tanks were to the Air Corps as a means to meet the need for an escort plane, especially when great effort had been expended already in wrestling with this problem.

In 1936 the Air Corps, still thinking largely in terms of continental defense, asked for designs of a twin-engine interceptor-fighter. On 23 June 1937 the Air Corps accepted a design for the XP-38 submitted by Lockheed Aircraft Corporation.[177] The proposed military characteristics for this plane embodied an advance in the requirements for range, which at

cruising speed with overload was listed at 1,386 miles. It had additional tankage for one hour's flight at 75 per cent power. The practical ferrying range was to be about 700 miles.[178] The performance characteristics of the twin-engine interceptor type adopted in the XP-38 were reflected in the pursuit specifications tentatively set forth by the Air Corps in October, 1938. Lockheed delivered the XP-38 to the Air Corps in January, 1939.

A second type of interceptor was a single-seater/single-engine type, similar to the XP-38. Its ferrying range was 700 miles and it had additional tankage for at least one hour's operation at 75 per cent power. The fuel and oil were to be an alternate load.[179] Republic Aircraft submitted a design for the original XP-47 in response to a Circular Proposal 39-770, issued in March, 1939, although the basic specifications for this plane had been established in 1936. Its essential characteristics included speed of 325 miles per hour or more at 20,000 feet and an endurance for one hour at high speed at 20,000 feet. Additional fuel for one hour's operation at 85 per cent high speed at sea level was to be provided by using an auxiliary tank not included in the normal load design.[180] The first model built around the Allison V-1710 engine did not satisfy the Air Corps, but it accepted a later model single-engine plane designed around the Pratt-Whitney R-2800 engine. This plane made its first flight in

May, 1941.[181] The range specifications for this aircraft called for additional fuel and oil tankage sufficient for one hour's endurance at operating speed as an overload factor if it would not result in the reduction of performance. An Air Corps committee tentatively agreed on this specification for both the single and twin-engine interceptor pursuits.[182]

At a conference to discuss particulars of a single-seater interceptor fighter, the commanding officers of the 1st, 8th, and 20th Pursuit Groups called for increased endurance in the plane. In their report, the officers stated:[183]

> It should have an endurance of one hour at full-throttle with additional tankage for two hours at operating speed. This will give the airplane approximately four hours at operating speed should the necessity arise. It should be able to fly 300mph at sea level.

A lengthy memorandum by Material Division in April, 1939, established fuel and range requirements for the interceptor type plane. It called for one hour's supply at full power and additional tankage for one hour at 75 per cent power. The report stated that long-range endurance or long-range at high speeds could be obtained by running at reduced power and that the requirements for two hours at 75 per cent of the normal power and one hour at 75 per cent overload represented within very few gallons the quality desired by all the suggested specifications to that time. Since the plane was to be an interceptor, the memorandum pointed out: "It is believed that a careful study will reveal sufficient duration for local patrol, sufficient range for ferrying and cross

country if the operating speed is kept to low figures except when ultra high performance is absolutely necessary."[184]

In June OCAC objected to the fuel provisions for the interceptor, declaring that the overload fuel for two hours at operating speed was far too great. OCAC believed that the fuel provided in the specifications for one hour at full throttle, plus one hour at operating speed, was ample since it permitted a range at 60 per cent power of 1,300 miles. To gain performance, the load, including overload, was to be kept at an absolute minimum.[185] The GHQ Air Force rejected reduction of fuel because it believed gasoline provided in the current specifications was adequate.[186] It believed, however, that the interceptor represented progress in pursuit design. The overload factor in these models permitted the Air Corps ultimately to use this specification to increase internal fuel capacity greatly in fighter planes.

In 1940 the Air Corps began a concerted move to obtain fighters with vastly increased range. Lt. Benjamin S. Kelsey, of Materiel Command, who had completed an inspection of English and French fighter planes, returned from Europe realizing that the capabilities for ferrying or combat would have to be greater than the Air Corps then contemplated. Shortly thereafter, the Air Force asked the Republic and Lockheed coporations to undertake a project to increase the ferrying range of the P-47 and the P-38 from 2,500 to 3,000

miles.[187] In May, 1941, Lockheed sent the Chief of Materiel Division blueprints of four proposals for droppable tanks that met Wright Field specifications. The designs called for 120-gallon tanks to be suspended from Air Force standard bomb shackles with a release provided in the cockpit.[188]

The following September Lockheed requested some clarification on the intended use of the droppable tanks, since its engineers understood that they were not to be used in high altitudes, but only in ferry flights at normal heights. Lockheed was told that the tanks were to be used at high altitudes for escort aircraft. Lockheed replied that if this were true, the tanks should be provided with some type of pump which could complicate installation.[189] On 15 October 1941 Materiel Command authorized Lockheed to attempt to provide the fuel tank installation with the pressure pump. This the company did, in addition to starting a plan for building a larger tank than the one it had originally constructed.[190] On 28 April 1942 Lockheed wrote Materiel Division that tests on a F-4 airplane[191] indicated that a droppable tank holding more than 75 gallons of fuel could be built which would substantially increase range and not cause a prohibitve drag on the plane. Specifically, Lockheed proposed to equip the F-4 with two 150-gallon tanks supported by electrically operated bomb shackles.[192] The experimental engineering section tested Lockheed's 150-gallon tank on 9-10 June and approved it for the AAF.[193] Lockheed then provided

tanks for the P-38's, which guaranteed a cruising range of about 2,000 miles, while Republic, using similar tanks, promised about 1,600 for the P-47. Range-extension tanks and the design of the aircraft to accommodate them, thus, were available by the end of 1941. When, in 1942, the Air Force decided to ferry P-38's to England, the planes were fitted with installations for tanks that had been tested and developed in the previous year, using one of the designs perfected by Materiel Division at Wright Field. The decision to ferry the P-38's meant sending them through Lockheed's plant to be fitted, which took about 60 days. The airplanes were ready for flight in May and left for England in June.[194]

While the modification of the P-38 was the first large wartime project to fit fighter airplanes for long-distance flight, the range-extension program had been applied to other planes as well. Engineers in the Philippines had added external tanks to P-40's, and in Washington a plan was made to fill floats and attach them to P-38's for flights to Bataan in the spring of 1942.[195]

The program for range extension, which saw such a renewed effort in 1940, had been developing slowly for 20 years. From the end of the first World War until the beginning of the thirties, American aviation policy was essentially oriented to the idea of continental defense. In addition, the general performance of military aircraft at that time precluded an attack on the United States from another continent.[196]

The need for aircraft with a long reach was, therefore, not urgent. In the 1930's, largely because of the technical advancement in bombardment aviation, American thinking turned toward a doctrine of strategic airpower. The aircraft during this time, first bombers, then pursuits, became advanced in design and performance. The experiences of the Spanish Civil War and the early phase of World War II occasioned a series of attempts to define the relationship between the bomber and the fighter, but these efforts led only to indefinite theories and proposals. The technical program to increase fighter range was accelerated at the end of the thirties, but while the Air Corps generally accepted the need for an escort fighter, the method to implement this need was not defined clearly. By 1942, the Air Corps had begun to expand its range-extension program, though this lacked the urgency it was to have by the fall of 1943. Preliminary experimentation and satisfactory tests had given the Air Corps a sound beginning on this technical program.

CHAPTER II

THE QUEST FOR A SOLUTION, 1941-1943

The Eighth Air Force - The Early Experience

The Eighth Air Force, the major instrument of American airpower in Europe, was activated on 28 January 1942 at Savannah Army Air Base, Georgia. Its two supporting units were organized on 1 February 1942, the Eighth Bomber Command at Langley Field, Virginia, and the VIII Interceptor Command at Selfridge Field, Michigan.[1] The policies that went into the training procedures and directives of the Eighth Air Force reflected both the strengths and weaknesses of American thinking about air operations. When the Eighth Air Force and supporting units were sent to England, it became necessary to modify the basic doctrine to the circumstances in which it could operate.

The primary tactical purpose for the establishment of the Bomber Command, United States Army Forces, British Isles,[2] was the destruction of vital enemy targets. The policy governing the employment of this force depended on the number and types of aircraft available and their effective ranges; effect of enemy opposition and American wastage rates; types of targets to be destroyed and their location; weather; range and effectiveness of escort fighters, and the training rate of initial combat teams and their replacements.[3]

On the basis of a study of operations conducted by the

RAF Bomber Command, Brig. Gen. Ira C. Eaker, Commanding General of VIII Bomber Command, submitted recommendations on training, tactical doctrine, and methods of employment of units required to conduct an effective air offensive in cooperation with the RAF against Germany.[4] The idea of range and effectiveness of fighter escort was considered seriously during the initial build-up of the Eighth Air Force, but no final policy was reached. One of the earliest statements on the role of the Eighth's fighter units was contained in a cable General Arnold sent to Maj. Gen. James E. Chaney, commander of USAFBI, in which he said five groups of pursuit planes would be sent to England. Two were to be employed in defense of Northern Ireland and three with striking forces in operations against the German Air Force.[5] To forestall any temptation to pattern American air operations after the British, Arnold insisted that "not English but only American doctrines and principles must guide us,"[6] since American air plans were based on a daylight bombing program, while the British were committed to night operations. This necessitated the use of American pursuit for operations and, therefore, they were not to be under the RAF Fighter Command.

Attention was given to both bombardment and pursuit employment in a lengthy document entitled "Plan for Bomber Command and Constituent Units to Arrive in the United Kingdom." The bomber program was divided into two phases. In

the first, designated "freshman attacks," targets were to be confined to a 100-mile radius of the southeast coast of England. The second phase, "full-out operations," was to strike at strategic facilities and establishments supporting the operations of enemy forces and his capacity to wage war.[7] Bombardment aviation was to operate at approximately 25,000 feet, with support as far inland as pursuit range would permit. The route both in and out was to be over terrain where enemy pursuit activity was the least prevalent. Bombers were to fly in defensive formations until they achieved the bombing accuracy needed to destroy enemy targets.[8] In keeping with the principle that the primary role of the United States fighter forces was to escort American bombers,[9] pursuit pilots were to be prepared for cooperation and coordination with bombardment. Development of technique, tactics, and technical equipment was to be accomplished by American fighter pilots stationed in England.

In formulating its plans the Air Force in 1941 implied that bombers could successfully penetrate deep into enemy territory in daylight operations. The Air War Plans Division plan for that year (AWPD/1) urged development of special escort planes and suggested employment of a modified bomber type for this role. However, it stated, for the moment, that bombers could rely on current interceptor-type models for support, especially the P-47. Two of the fighter groups based in southeast England would allow for a maximum range

in support of the bombers.[10] General Baker's staff members apparently believed a special escort plane would soon be sent to England for they made provisions in their study of operational training to cover the needs of escort-fighter units.[11] This plane had been called for in AWPD/1, but was more akin to a bomber than to an existing fighter type.

In the absence of a specific escort plane, Arnold wrote to Air Marshal Portal in April, "It is possible that with the greater defensive firepower of our bombers, and a carefully developed technique of formation flying with mutually supporting fire, that our bombers may be able to penetrate in daylight beyond the radius of the fighters."[12] However, Maj. Gen. Carl Spaatz, commanding the Eighth Air Force, advocated early in May that bombers be used in night operations if escort fighters could not be provided, though he realized that the accuracy of bombing at night was not as high as in daylight.[13] Less than two weeks later Spaatz observed that the problem might be met by counter flight of pursuit to attract enemy fighters away from the bombers, giving them indirect support at the same time. He apparently thought that the need for escort would occur only under a few special circumstances.[14] An RAF group captain bluntly voiced a less optimistic note by saying that "until experiences proves otherwise, American bombers must be protected by fighters."[15]

If some uncertainty existed in the spring of 1942 on the use of fighters, there was also some indecision as to

types of planes best suited for use in England. Early in May when Chaney learned that American fighter groups were to be equipped with P-38's and -39's, he wrote Air Marshal Portal that he gravely doubted if they were suitable for escort missions. He suggested that the American units, instead, be assigned Spitfires, and that a like number of Kittyhawks (P-40) be sent to the British in the Middle East.[16] Chaney reasoned that the P-38 was an interceptor-type plane designed to shoot down bombers rather than to cope with opposing fighter forces. He considered the Spitfire the "best all-round fighter developed in this War, which readily adapts itself to the mission of providing top cover for bombardment missions within its range."[17] Since the War Department had considered equipping a third fighter group with Spitfires, Chaney believed that all American fighter units should be so geared. This issue was not settled immediately.[18]

There was also a question as to where American fighter units should be sent. The British favored integrating American units into the RAF Fighter Command. They also suggested that once American units completed their "freshman careers," they could be reassembled and a sector in the RAF Fighter Command turned over to them.[19] This problem was resolved by General Arnold and Air Marshal Portal in a meeting from 26 May to 1 June. They agreed that the United States Bomber Command would operate independently, but in collaboration with the Royal Air Force. The primary role of the United

States fighter forces would be to escort American bombers, and, in addition, theywould be responsible for the air defense of their own sectors which remained under the operational control of the Air Officer Commanding-in-Chief of the RAF Fighter Command.[20] They also decided that the American fighter units arriving in England would be attached initially to an RAF fighter sector for a brief period of operational training.[21] The Arnold-Portal conversations established a working basis on which the Americans could build their air strength in the British Isles.

The role of the American fighter was re-emphasized on 2 June at a meeting in the Air Ministry, at which time the function and disposition of American fighter units slated for arrival in England during the following 12 months was discussed.[22] Eaker's early plans had called for at least the temporary location of VIII Fighter Command headquarters with the VIII Bomber Command at High Wycombe, England. It was eventually decided that VIII Fighter Command units would be stationed on RAF fighter airdromes and would be under RAF control only for initial operations. In order to have headquarters near its British counterpart, the VIII Fighter Command moved into Bushy Park in July, some three miles from the RAF Fighter Command headquarters.[23]

Much of the activity of the VIII Fighter Command during 1942 was concerned with building organizations into fighting units. The first unit to join this Command was the air echelon of the 31st Group, which arrived by transport in

England in June and commenced combat training on 26 June. Elements of the 1st Fighter Group crossed the Atlantic Ocean in two B-17's and eight P-38's, the longest flight of fighter planes up to that time. Brig. Gen. Frank O'D. Hunter, Commanding General of VIII Fighter Command, and his staff landed at Prestwick, Scotland on 27 July after having made the trip via Goose Bay, Labrador, Greenland, Iceland, and Stornoway, Scotland.[24] Plans to ferry fighter aircraft across the Atlantic had begun at a meeting in Arnold's office in February, 1942. The ferrying of aircraft saved valuable shipping space in cargo ships and also eliminated problems connected with packing and reassembly in England.[25] With General Hunter's arrival in England, the VIII Fighter Command began to plan in earnest for a rapid build-up to sizeable proportions around the nucleus of the 31st and 1st Fighter Groups. The 1st kept its P-38's and the 31st received Spitfires.[26] Though the VIII Fighter Command was promised three groups of P-47's, many months passed before the promise was fulfilled.[27]

The third group to join VIII Fighter Command was the 52d, which arrived in England by ship in late August and took delivery of Spitfires. Shortly thereafter the 14th joined the Command. It arrived in P-38's via the ferry route. Two of the 14th's squadrons, the 50th, which was in Ireland, and the 48th, began training soon after their arrival early in August for it had been found that American fighter pilots

were deficient in gunnery, formation flying, navigation, and combat tactics. RAF instructors trained the Americans in the use of British planes and operating procedures to indoctrinate those groups that were to fly the Spitfire.[28] Thus, by mid-August, 1942, the VIII Fighter Command boasted of four fighter groups, but they varied widely in preparedness for battle.

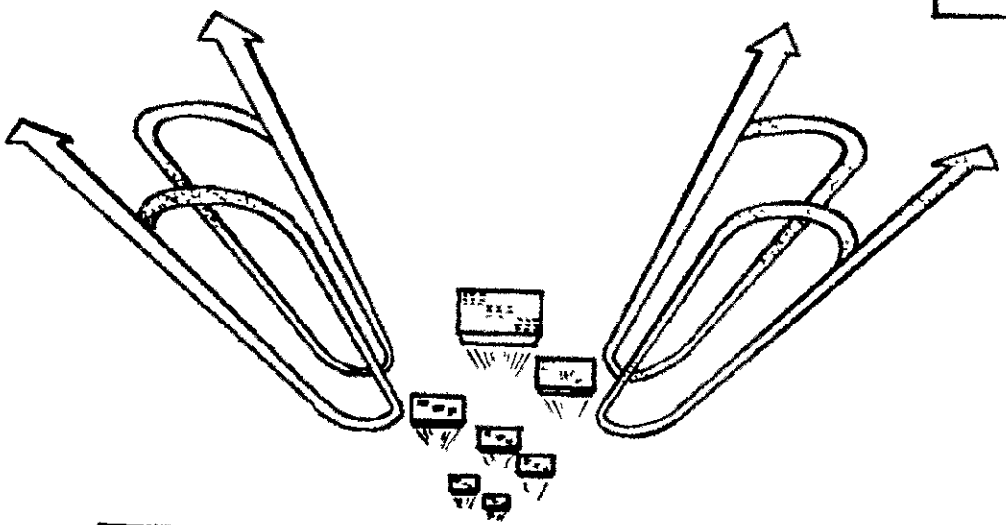
Initial combat came in July, when elements of the 31st Fighter Group joined an RAF squadron on a sweep. The first mission under the control of VIII Fighter Command itself came on 19 August when its units participated in the Dieppe raid.[29] On 29 September the Eagle Squadron, composed of volunteer American pilots in the RAF, became the 4th Fighter Squadron, and part of VIII Fighter Command. In the same month demands for TORCH[30] necessitated transfer of the 1st, 14th, and 52d Fighter Groups to the Mediterranean area for operations with the Twelfth Air Force.[31] For the remainder of the year, the 4th Group flew Spitfires. In December the 78th Group, equipped with P-38's, arrived in the United Kingdom, but early in 1943 all of its planes and 60 of its pilots were transferred to North Africa, and it was not until 8 April that the 78th became operational in England.[32]

The first mission of American heavy bombers against the Continent came a month after initial fighter action. Anticipating the battle, Spaatz presumed that the B-17's could

FIGHTER ESCORT

BASIC TYPE OF ESCORT EMPLOYING
2 FIGHTER SQUADRONS

HIGH SECTION
1000' TO 1500'
ABOVE BOMBERS



LOW SECTION
500' TO 1000'
ABOVE BOMBERS

SECTIONS FLY ON EACH SIDE OF BOMBERS
OUT OF RANGE OF MACHINE GUN FIRE.
(OVER 3600)

SOURCE: EIGHTH AIR FORCE TACTICAL DEVELOPMENT

defend themselves against German fighters, but added:[33]

> If we are right, the daylight penetration will be limited only by the sustained fire power of the bomber formation. Although the combat crews are being carefully trained, this matter is too vital to the success of the war to draw hasty conclusions from a few operations and with insufficient numbers to saturate the defenses.

Twelve B-17's, with strong support by RAF fighters, struck the marshalling yards at Rouen and Sotteville on 17 August 1942. Fighter opposition was negligible and antiaircraft fire was observed only at two places. Two bombers sustained slight damage. Three Me-109's attacked the formation and several others were seen watching it, but did not participate in the action. All 12 planes returned to England.[34]

The success of this first American mission resulted in a series of optimistic estimated that daylight bombing was a feasible means of air warfare. This mission had been escorted heavily both to and from its targets and plans called for continued assistance by escorts within the limits of their radius. The larger question, whether B-17's could penetrate deep into enemy territory unescorted and suffer a minimum of losses, continued unanswered on the basis of this early raid, but subsequent flights by American Fortresses confirmed the belief in their ruggedness.[35] Spaatz optimistically cabled Arnold that results of the Rouen raid justified daylight bombing, but he believed that enemy attacks were not pressed because of the concentration of crossfire between bombers in the formation and the added threat

occasioned by heavy fighter protection. Meanwhile, no definite conclusions could be reached regarding the feasibility of bomber attacks unsupported by fighters.[36]

Baker in a letter to Spaatz reviewing the mission wrote:[37]

> I am favorably impressed with the B-17 as a daylight bomber at high level. I am convinced it has excellent defensive fire power. . . . It is too early in our experiments in actual operations to say that it can definitely make deep penetrations without fighter escort and without excessive losses. I can say definitely now, however, that it is my view that the German fighters are going to attack very gingerly.

On 21 August, on the basis of four missions flown by American bombardment, Spaatz wrote Maj. Gen. George E. Stratemeyer that though the missions had been within the range of fighter protection, "I am confident that we can do deeper penetrations without fighter support and get by with it."[38]

In view of the weak fighter defenses on the coasts of France and Belgium, Spaatz urged Arnold to increase American air strength to 20 groups of heavy bombers, 10 groups of medium bombers, and 10 groups of fighters. Such a force would enable the Americans to take advantage of the heavy German fighter commitments on the Eastern Front and permit "maximum destruction of the German Air resources, particularly aircraft factories, while the German air forces are so committed. . ."[39] Spaatz pictured current German fighter defenses as being spread "on this front in a thin line, with no depth."[40] At the same time he skirted the escort question, but wrote Arnold that daylight operations could be extended with a larger bomber force. He wrote, "We have no intention

at this time of extending our bombing operations beyond the radius of fighter support until our forces are more highly seasoned and of sufficient numbers to overcome mass fighter resistance; but as soon as sufficient numbers have been built up, our daylight radis will be extended into the heart of Germany."[41] Another officer, Col. Newton Longfellow, commanding the 1st Bombardment Wing, concluded from an analysis of the first four combat missions that bombers needed close support by fighters when operating in a small formation. If the formation was large enough to provide good mutual defensive support, it then might be possible to limit escort in some cases.[42]

Eaker, too, became convinced that the early missions had proved the Eighth's bombers capable of high-level, accurate daylight bombing in good weather without excessive losses and only with the fighter cover then available.[43] Though he avoided committing himself to Arnold, Eaker was less reserved in a letter of 27 August to Spaatz in which he stated, ". . . I am now thoroughly convinced . . . that in the future successful bomber operations can be conducted beyond the range of fighter protection." He admitted, however, that escort would be valuable in accompanying the bombers through the enemy fighter belts and helpful in aiding crippled planes reach their home base.[44] He expressed similar sentiments in an interview where he said that there were few worthwhile targets within the radius of action of

accompanying Spitfires. He declared, "We think as a result of the first eight raids, that we can make penetration without them."[45] Baker admitted the wisdom of employing escorting fighters at the beginning because they served to protect crippled bombers from enemy planes. Though he realized the limitation of the current fighters, he was unwilling to dispense with their services at that time. Baker said he wanted P-38's because he thought Spitfires could accompany bombers only 50 to 60 miles, whereas the P-38's could make a 500-mile round trip. "We would like to have P-38's with us to help us get in so that the fighters won't work on us while we are bombing." The bomber commanders, he added, "are anxious to have the Spitfires go with us as far as the fighter belt and then have the P-38's go with us another 100 miles or so. Any of the planes that follow will have to return and then go in and meet us coming out."[46]

Stratemeyer, on the other hand, cautioned that to send B-17's beyond the range of escorting fighters would result in excessive losses unless they could saturate the defense. He was anxious to see bombing accuracy improved to insure complete destruction of the target when bombers were beyond the range of pursuit. He observed that losses would be higher without support, but that the task of bombing would be completed on each mission.[47]

An even more positive view concerning the capabilities

of the American bomber was expressed by the authors of AWPD/2, who declared that it was far superior to German bombers in firepower and capacity to absorb punishment. "The ratio of attrition between bombers and fighters has also been radically altered. Our daylight penetrations of German defenses have up to this time indicated a relatively low attrition rate to our bombers and a relatively high attrition rate to German fighters."[48] The report continued, "The Commanding General of the American Army Air Forces in Great Britain has expressed the opinion that our current type of bombers can penetrate existing German defenses to the limit of their radius of operation without excessive losses."[49]

By August, 1942, it was obvious that American fighters could not furnish adequate escort protection, small as the bomber force was at that time. As a result, the R.A.F Fighter Command offered additional escort for American bombardment. The problems attendant in such support were settled in an agreement on 8 September entitled, "Joint American/British Directif on Day Bomber Operations Involving Fighter Co-operation." This directive was to be prosecuted in three phases: one, the bulk of the escort would be conducted by the British; two, the escorting would be done by American fighter forces while the British fighters were employed in diversionary sweeps and withdrawal cover; and, three, the American bombers would develop their full day-bomber offensive, receiving such support and cooperation as would be required from

the British short-range fighter force.[50] Using this document as a basis for planning Eaker interpreted phase one as "shallow penetrations with fighter support," and phase two as "deeper penetrations with general fighter cover through the fighter belt en route and on return, with the bombers proceeding to the targets beyond fighter range, without fighter cover." The third phase Eaker defined as "deep penetrations using large numbers of bombers without fighter support."[51] In phase two, Eaker advocated the use of bombers beyond the range of fighters, and in the last phase he urged a full-scale offensive employing mass bombing tactics without the assistance of escorting fighters. This belief that bombers could go beyond the range of fighter support if they were in sufficient numbers and if successive attacks by the enemy fighters did not exhaust their ammunition was fostered after an analysis of a mission on 2 October, in which 30 Fortresses had attacked an aircraft factory at Meaulte without sustaining any losses.[52] Commenting on missions up to 8 October, Eaker said that there was then no evidence to suggest that bomber losses would be so high as to make daylight bombing uneconomical. "I think it is safe now to say that a large force of day bombers can operate without fighter cover against material objectives anywhere in Germany without excessive losses."[53]

Following the Lille mission on 9 October, Eaker again observed that large formations of B-17's, capably flown and

ably led, could bomb targets beyond the fighter range. He felt that the bomber force in England could now enter the second phase of its program --the plan for bombing submarine pens -- which called for deeper penetrations with general fighter cover within the enemy fighter belt to and from the target, and with bombers proceeding to the targets beyond fighter range. Eaker was anxious to initiate this program, notwithstanding the loss of three P-38 units to North Africa and the Eighth's dependence on the short-range Spitfires.[54]

Later in October Eaker reiterated his earlier convinction that daylight bombing was feasible without fighter escort. "You have probably been asked," he wrote to Arnold, "whether it is feasible to bomb objectives in Germany by daylight without fighter cover. I am absolutely convinced that the following measures are sound . . . . Three hundred heavy bombers can attack any target in Germany by daylight with less than four per cent losses. A smaller number of bombers will naturally suffer heavier losses."[55] Eaker concluded that daylight bombing of Germany with B-17's and -24's was not only practical but economical.[56]

There was some recognition, however, of a need for escort through the German defenses on the coast of France and Belgium where they had placed their fighter screen. This "fighter belt," as airmen called it, was considered a major obstacle by some Eighth Air Force commanders.[57] Col. Frank

A. Armstrong of the 1st Bombardment Wing, one of a group of officers who returned to the United States to brief other airmen on early combat experiences, expressed the need for some fighter protection to "get us through the fighter belt," and to escort the bombers through this belt on the return trip.[58] Once the Germans began to offer defense in depth to American bombing forces, the term was all but dropped.

In the fall of 1942 VIII Bomber Command reviewed its activities and optimistically reported that the B-17 could defend itself against the German fighters, Me-109 and FW-190.[59] Indeed, the summary stated that the two German planes "are no match for close formations of the B-17 and B-24's in units of 12 or more."[60] Even though no losses had been incurred when fighters were employed above the bombers and on the flanks of the formation, the report held that uncertain atmospheric conditions and difficulties involved in making a closely-timed rendezvous en route to a target made such support impractical. Another escort method, loose support in relays -- from the enemy coast to the target by an initial group, from the target and withdrawal by a second force, relived by a third force at the coast line -- it considered dangerous since bomber groups arriving late at rendezvous points had to proceed unprotected. The fighters could not wait for latecomers without the risk of leaving other bombers unprotected near the target or jeopardizing a group which had proceeded from the rendezvous on time. Fighters could escort the bombers as far as possible when missions

were beyond their range, while other fighters could meet the bombers on withdrawal. The use of fighter sweeps and other diversions enabled the method to work well. The report concluded that a bomber formation of 18 planes would receive adequate protection from 36 fighters. The number of fighters had been considerably reduced after early missions presumably had shown little need for them. Strong enemy attack against B-17's and -24's had resulted in heavy losses to the enemy fighters but in low average losses to the bombers. Notwithstanding the defensive power of the bomber, the summary continued, "This should not be construed as an adverse reflection on the importance of fighter cover in reducing bomber wastage, but it suggests that the use of sufficient numbers, say 500 or more, to saturate the enemy defenses, would make possible the dispatch of unescorted bombers without excessive average loss." The report concluded: "One salient fact emerges from any study of German fighter tactics against missions flown to date: no tactics have been evolved capable of inflicting uneconomical losses on units of 12 or more B-17's or B-24's when flown in close formation."[61] This observation was tempered by a statement that the Germans would undoubtedly try to increase the size of weapons and improve armor protection on their fighters. This would mean placing larger guns and heavier armor protection on American bombers. Notwithstanding these possibilities, the summary stated that losses could be kept within economical limits even against prospective German countermeasures.[62]

If the early campaign had convinced some airmen that the bombers could operate without escort and maintain a low loss rate, it confirmed the beliefs of others that the problem of escorting bombers was still unsolved. Among the latter was Maj. G. Chesley Peterson of the 4th Fighter Group, who said that without fighter diversion or escort a bomber formation flying deep into enemy territory would suffer severe losses. The farther the bombers penetrated, the more they would use up their ammunition before returning to home base.[63] The British, on the other hand, in the fall of 1942 continued to believe that to build a long-range escort was out of the question.[64]

While the Eighth Air Force was assuring itself that future air battles would be won by tactics that so far had proved successful, a meeting of AAF generals took place in the United States in November to discuss military characteristics for a new fighter-type airplane. They considered the question of escort, but reached no basic decisions at this two-day conference. General Gordon Saville, one of the conferees, stated that, "the present defensive philosophy is that we will go in with our belly tanks; we will drop them at the coast because some guy might shoot at us any time after we reach the coast. To my mind, that defeats the purpose." On the possibility of building a long-range fighter and the need for one, he continued:[65]

> I don't believe that we can design a fighter that has inherent self-sealing gas enough to go over there, do these things and come home. I don't think it can be done. . . . We need a fighter that can occupy a position with relation to the operational space that the enemy must occupy in order to launch the attack with any degree of success on those bombers.

Thus, some nine months prior to the first use of droppable tanks by fighters in the United Kingdom, airmen visualized escort fighters employing them. They recognized the need for an escort, and considered droppable tanks as feasible at that time, though General Saville believed they were of limited value.

As 1942 drew to a close, VIII Bomber Command could take stock of its small but promising operations. Though only 27 missions had been flown, and none exceeding 79 planes, the B-17 had shown itself the best day bomber to fly in the theater and the P-38 had appeared to be the best fighter plane for escorting bombers. Though some airmen were skeptical of the bombers' performance capabilities, they were satisfied that these missions had proved two things: one, that bombers supplied with adequate escort survived the missions, and two, that properly-escorted bombers could make a bomb run without any fear of being bothered seriously by enemy interceptors.[66] Too late to affect operations in 1942 was the arrival in England on 24 December of the first group of P-47 Thunderbolts, the plane that was to carry such a large part of the escort burden in 1943, and to play an important role in experiments to increase the range of fighters.[67]

The Escort Fighter in North Africa

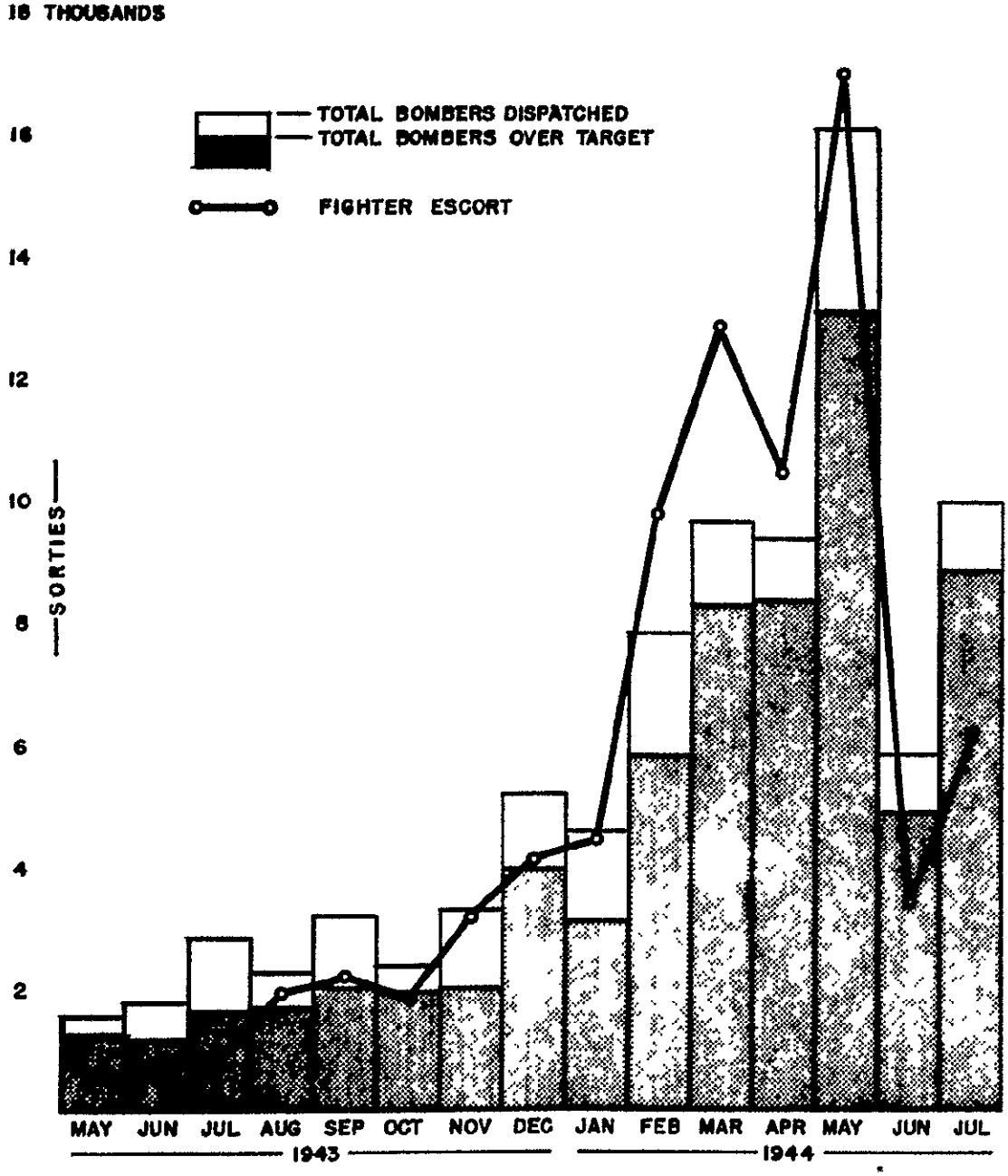
In view of the operation contemplated against North Africa, the AAF activated the Twelfth Air Force on 20 August 1942 at Bolling Field, Washington, charging it with the command of air operations for TORCH. The unit left New York on 5 September, arriving in Scotland six days later. Brig. Gen. James H. Doolittle assumed command of the Twelfth on the 23d. The XII Fighter Command was activated on 24 August at Drew Field, Florida, and was assigned to the Twelfth Air Force when it arrived in England on 17 September. Its first echelon arrived at Tafaraoui airdrome in North Africa on 8 November. The XII Fighter Command's first commander was Col. Thomas W. Blackburn.[68]

Taking precedence over the airpower build-up in the British Isles, TORCH necessitated stripping forces in the United Kingdom in order to meet logistical requirements for the projected operation. The needs of the Twelfth Air Force were so demanding on the resources of the Eighth that Eaker wrote in late October, 1942, "This command is now completely unoperational with the exception of fourteen aircraft from each of the two squadrons of the 14th Group. . ."[69] The VIII Fighter Command lost four fully-trained operational groups, with their service units, to the North African venture, and was left only one group of Spitfires (the 4th Fighter Group) which was under the operational control of the British. In addition to supplying the Twelfth Air Force

with its planes, the Eighth Air Force was responsible for the transportation of the units destined for North Africa. This movement encompassed the dispatch of 1,072 aircraft, including 412 P-38's and 239 P-39's, which were ferried to North Africa, and transportation by air of some 2,109 officers and 2,817 enlisted personnel.[70] To accomplish this movement, the largest ferrying project attempted to date, the Eighth Air Force provided the use of long-range ferrying tanks to permit the transfer from southern England to Gibralter and Oran.[71]

Of the two types of planes, the P-38, once in Africa, became the outstanding fighter in the theater. Its performance in ground strafing, fighter sweeps and reconnaissance proved it to be the most versatile plane in the campaign. But it was in the role of an escort plane that the P-38 was regarded as unique.[72] The P-38 quickly became the plane almost exclusively used to escort both heavy and medium bombers because of its superior range. By the end of November, 1942, Doolittle was writing Arnold that out of the 16 missions flown only one was conducted without escort, with the Twelfth losing two planes on that occasion and none previously. On that one particular mission the bombers flew unescorted because the P-38's were "mudded down" and could not get off the ground.[73] The employment of escort as standard operating procedure stimulated the growth of tactical doctrine covering this variant of fighter-bomber operations. A principle of this doctrine held that escort's primary object

EIGHTH AIR FORCE
ESCORTED MISSIONS



SOURCE : ACHTUNG INDIANER HISTORY OF THE VIII U.S.A.A.F. FIGHTER COMMAND

was to insure the bombers safety from fighter interference. "Consequently, no enemy fighters which are not in a position to attack the bombers should be allowed to draw /away/ a section of the escort proper."[74] The airmen regarded fighter escort as adequate only when the fighters in formation at least equalled in number the bombers which they were protecting. Although desirable, this was not always possible, especially when heavy bombers were operating on a large-scale assault. Escort tactics were divided into two classifications: one, where the ratio of fighters to bombers was high, the escort flew defensively in close support of them; and, two, where the ratio of fighters to bombers was low, the fighters made an offensive sweep of the target ahead of the bombers and retired following the last group. This afforded maximum protection to themselves as well as to the bomber formation.[75]

Anticipating that the Germans would soon mount 37-mm. guns on the FW-190, the VIII Bomber Command offered the following as countermeasures: one, bomber units were to fly in a compact formation to permit maximum concentration of firepower to the rear; two, gunners were to be trained to increase their accuracy of fire at long range; and, three, escort fighters were to be prepared to give close attention to the rear of the bomber formation to prevent overtaking hostile fighters from bombing the formation or from securing a position directly behind it.[76] While the majority

of missions flown in the North African campaign were within the radius of operations of the P-38 without tanks, droppable tanks were used when attacking distant targets.[77]

By the early spring of 1943 additional P-38's were needed to give support, now an accepted practice in the North African theater. Increasing attacks on bombers over their targets prompted Brig. Gen. John K. Cannon, commanding general of XII Bomber Command, to set up an inquiry. To this the 5th Bombardment Wing replied that the attacks came not as a result of faulty fighter tactics but from the lack of escort fighters. Doolittle wrote Arnold that "our only problem in connection with the use of the P-38 is that there are not enough of them and it does not appear that there ever will be."[78]

Although the North African campaign was only a prelude to larger operations, it afforded the American Air Force an excellent testing ground for its theories, doctrines, and equipment. In addition, the performance of escort fighters in that theater had strengthened the daylight bombing program. A memorandum to General Cannon from the 5th Bombardment Wing pointed out:[79]

> Bomber losses from fighters do not warrant the belief held in some quarters that our bombers can withstand sustained attacks by enemy fighters. Although the presence of even a small number of escort fighters gives a certain degree of moral support to the bombers' crews it is believed to be uneconomical to operate without sufficient fighters to simultaneously protect stragglers and break up attacks on each end of the bomber formation. Bomber losses would seem to justify a fighter escort whose minimum strength is one fighter for each bomber.

It would seem reasonable to presume that the air operations to be conducted from the United Kingdom would have profited from the experiences in North Africa. If this was true in some respects, the lesson of the need for escort went all but unheeded. There remained a small core of airmen who blindly held to the bombers' defensive capabilities. To others the lessons of North Africa were clear, and they agreed with Doolittle who said that the most serious problem facing the Northwest African Strategic Air Force was the shortage of long-range, high-performance escort fighters.[80]

Perhaps the absence of a crucial need for droppable tanks caused the AAF to ignore their full potentialities. Perhaps the need was seen, but the air war moved too quickly before the storm of late summer and early autumn. But it was not to be the African or the Mediterranean theaters where the crisis of the daylight bombing offensive was to occur, but in operations from the British Isles against enemy targets in occupied Europe.

The Origin of CBO and After

The rapidity with which events moved in 1943 was due to two principal factors. One was a growing realization of the need for escort to accompany the bombers which was seem by some as a pressing need early in the year. The second factor was the frantic effort of the German Air Force to stem the tide of deep penetrations by American bombers. Although

prospects for 1943 had seemed to indicate a successful culmination of the build-up and prosecution of the strategic bombing program, the Eighth Air Force was confronted with several pressing problems: one, acquisition of the P-47 as a long-range escort fighter; two, the growing losses of American bombers in late December 1942 and throughout January, when most of the American effort was focused on bombing submarine pens at the Bay of Biscay; and, three, the British pressure to use American bombers in conjunction with their own night bombing raids on the Continent, a problem settled at the Casablanca Conference in late January.

In England, paralleling the steady growth of VIII Bomber Command, came the build up, from the low point brought about by the logistical demands of the TORCH operation, of VIII Fighter Command units early in 1943. In view of the role that fighters would be called upon to play in supporting the bombers, Eaker urged Arnold to equip the VIII Fighter Command units with P-47's since all P-38's assigned to the European theater would go for sometime to the Mediterranean.[81]

A plane destined to carry the major burden of the VIII Fighter Command's assignments during 1943, the P-47, arrived in England 24 December 1942. It was a newcomer among the fighters then in combat. On 29 December Brig. Gen. Newton Longfellow, Commanding General of VIII Bomber Command, conferred with representatives of Pratt and Whitney Aircraft Corporation in regard to the P-47. Longfellow was told that

the P-47 with a belly tank would give protection to bombers 200 miles beyond the enemy coast,[82] but unfortunately the plane arrived in England without external fuel tanks.[83] The internal fuel capacity of this plane was 305 gallons, 205 in the main tank and 100 in an internal auxiliary tank, giving it maximum radius flying escort of about 175 miles.[84] Early estimates of the capabilities of the P-47 had raised some doubts about the soundness of using it for close support because of the low speeds it would have to maintain and because it lacked a fast acceleration rate. Flying under these conditions would place the plane at a distinct disadvantage if combat was suddenly demanded of it. The acceleration problem was remedied later with the installation of a paddle-blade propeller and a water-boost injection system.[85]

The 4th Fighter Group was the first unit to obtain the P-47's, receiving a few of them in January, 1943. The entire group was assigned P-47's in March.[86] Baker, confident that the P-47C would be satisfactory, wrote Arnold that he had hoped the planes would be in combat by March 1. Looking forward to the time when the P-47 would serve as long-range escort, he reminded Arnold that the full tactical use of the plane would depend to a considerable degree on how fast he could be furnished with droppable tanks.[87]

General Hunter, commander of VIII Fighter Command, believed that the plane could be employed most effectively in general support or as high cover for the bombers.[88] He esti-

mated that he would need 20 fighter groups to escort the bombers. In addition, he observed that the size of the fighter force should be determined not by the number of bombers to be protected, but by the strength of the opposition to be expected, the range at which the fighters could operate, and the relative performance of American and enemy fighters. Hunter felt that it would be uneconomical to use fighters at their extreme range until they could concentrate in sufficient numbers to neutralize the enemy fighter force by sheer weight of numerical superiority.[89] Although the goal set was 20 fighter groups, by August, 1943, the VIII Fighter Command could count only three, the 4th, 56th, and 78th, all of which were equipped with the P-47's.[90]

Another problem facing the Eighth Air Force was the growing rate of bomber losses in late December and throughout January. In a raid on 20 December at Romilly-sur-Seine, out of 72 attacking planes, 6 were lost. In a letter to General Stratemeyer on 2 January, Eaker insisted that bomber losses would decrease if the Eighth Air Force could be given a larger operating force. He pointed out that the losses would diminish if the Eighth's bombers would go after German targets other than just the submarine pens at the Bay of Biscay. The continual bombing of one area had enabled the Germans to concentrate their fighters around it. However, he added, "We are still able and shall continue to knock down better than six to one enemy fighters for our bomber losses."[91] He suggested that American losses might decrease

if the bombers were equipped with a front or chin turret since their firepower was deficient in the nose. It was at this quarter that the German attacks had been directed.[92] After the Lille mission of 13 January, Brig. Gen. H.S. Hansell had suggested placing fighters in front of bomber formations to implement the firepower.[93] Even in March, Maj. Gen. F.L. Anderson, commanding general of the 4th Bombardment Wing, was stressing the need for additional firepower in front of the bombers.[94] This weakly-defended area finally was strengthened in mid-1943 by adding nose turrets.[95]

German fighter reaction to bombing attacks on the submarine pens led Eaker to conclude that ". . . we are going to have to go back to our old tactics of using more deception in target selection, slipping around between German, mid-French, and submarine targets in order to scatter the fighter defenses."[96] This hardly was the tactics of a bold offense, but apparently he believed that the enemy would not anticipate the bomber attacks under less obvious circumstances.

On 30 December three bombers were lost in an attacking force of 40 that struck at the submarine pens at Lorient. This was followed by a similar strike on the 3d of January when 7 bombers out of 68 were lost. The latter attack was the most costly to date. Eaker, summing up his feelings, told Arnold that he was not gloomy about the two missions, and felt that the Germans had paid heavily in fighters

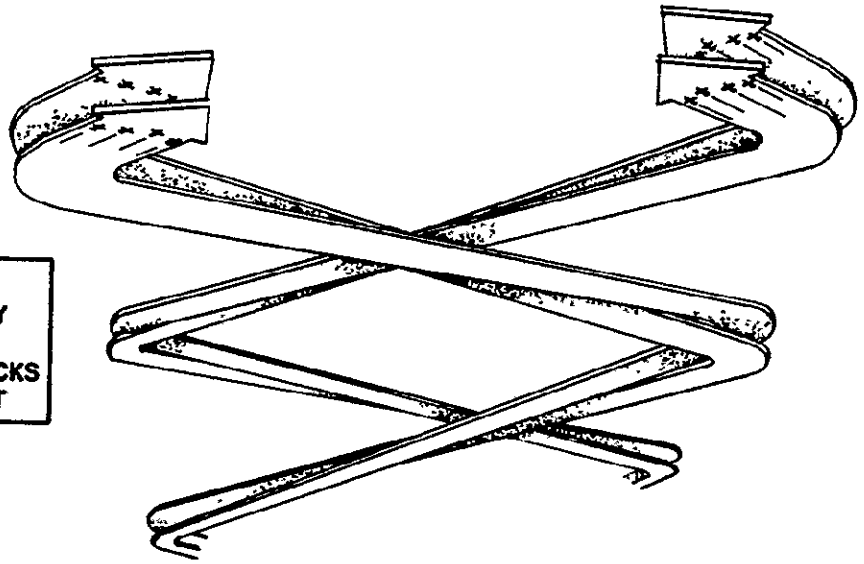
destroyed and damaged. He believed that there were two courses of action open which would lessen bomber losses: one, that bomber attacks be dispersed in order to divert the enemy and, two, that fighters support bombers all the way to the target and back. This escort could be provided by the 78th Fighter Group, which by 15 January would have its P-38's at full strength. Eaker wrote:[97]

> On many of these vital targets which we propose to attack, this force can easily overpower the fighter defenses of the enemy which can be assembled. I propose to take these P-38's with us and I am today working out a plan with our Fighter Command to accomplish this. The P-38 is a much better plane than has been generally assumed, and I feel quite certain that 50 or 60 of these fighters riding above our bombers will do much to prevent the combined and concentrated attacks which heretofore have been made on our bombers over the submarine bases when no friendly fighters were present. I believe that the very presence of these American fighters will reduce our bomber losses by more than 50 per cent. As soon as we get the additional fighter groups, we shall rush the business of getting them into the fight.

This strong plea for fighters came at a time when Eighth Air Force strength by no means had reached the number which would permit it to "smother the defenses;" hence, to ask for the fighters was in keeping with Eaker's blueprint which he had set forth in October, 1942.

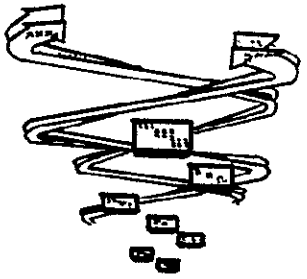
Eaker's optimism was short-lived, however, when the 78th Group, on which he had counted for escort, had 60 of its pilots and all of its aircraft transfered to North Africa. This was a blow to the Eighth's commander. Writing to Spaatz, he confessed, "I think this was the most serious blunder we have made in a long time."[98] And to

FIGHTER ESCORT



SQUADRON 5 MILES AHEAD AND SLIGHTLY ABOVE BOMBERS TO STOP HEAD ON ATTACKS BY ENEMY AIRCRAFT

SQUADRON
1500 FT. TO 2000 FT.
ABOVE BOMBERS



SQUADRON
1000 FT. TO 1500 FT.
ABOVE BOMBERS

BASIC TYPE OF ESCORT EMPLOYING 3 FIGHTER SQUADRONS. FLIGHTS CROSS OVER ON TURNS TO COVER EACH OTHER AGAINST TAIL ATTACK. SECTIONS AND SQUADRONS CRISS CROSS FOR MUTUAL PROTECTION.

SOURCE: EIGHTH AIR FORCE TACTICAL DEVELOPMENT

Arnold he wrote, "It was a terrible blow to lose the P-38's. That decision is going to mean the loss of many bombers and their fine crews."[99] But Eaker, hopeful that one P-47 group would soon be ready to offer escort, was not downhearted, perhaps due to a recent mission over Wilhelmshaven on 27 January which resulted in only 3 losses out of 53 attacking bombers. Writing to Stratemeyer on 30 January, he said he was convinced that the bombers " . . . knocked the ears off the German day fighters."[100] This optimism lasted only a few weeks, and while there were no missions to cause him grave concern, Eaker wrote Brig. Gen. Eugene Eubank that if the bomber strength was between three to five hundred planes, the need for escorting fighters would not be so vital, but with so few bombers on hand he believed it was necessary to have some support. British fighters offered excellent aid within their limited range, but the Spitfire could not accompany bombers into Germany.[101] Once again Eaker was supporting the proposition that increase size of a bomber formation was an alternative to adequate fighter protection. Nor was this to be the last time he offered this argument when his bombers faced heavy enemy-fighter opposition.

The third problem facing the Eighth Air Force early in 1943 was that of continuing its daylight bombing program. On 14-24 January, Roosevelt, Churchill, their military staffs, and other Allied war leaders met at Casablanca, North Africa,

to plan further moves against the Axis. Among the problems reviewed was that of the forthcoming bomber offensive from the United Kingdom against Germany. They settled the question of daylight bombing temporarily. Doubt had continued to exist among the British regarding capabilities and tactics of the American bombing force. The British and some Americans applied considerable pressure to the Eighth Air Force to combine the American effort with that of the British night-bombing program.[102] As a result, General Arnold, who was attending the conference, summoned Eaker, whose experiences gave him special qualifications to defend American air doctrine. In his presentation to the conference, Eaker maintained that the destruction of German fighters could not be accomplished if the American bombing program became a night operation. He pointed out that the Eighth Air Force rate of loss in day raids was lower than that of the RAF on its night operations and cited the loss ratio of two to three enemy fighters for every American bomber lost.[103] After Eaker's defense of the American doctrine, the daylight bombing program was allowed to proceed. The Combined Chiefs of Staff on 21 January 1943, issued "CCS/166D", the Casablanca Directive, which defined the American bombing effort as "the progressive destruction and dislocation of the German military, industrial, and economic system, and the undermining of morale of the people to a point where their capacity for armed resistance is fatally weakened."[104] A more detailed blueprint,

"The Combined Bomber Offensive Plan," was approved and inaugurated some six months later on 10 June. In the interim the Eighth Air Force had tested the German air defenses and had adjusted its tactics and techniques to the broader scale of operations projected by the Combined Chiefs of Staff.[105]

Eaker, aware that Eighth Air Force strength was still growing slowly, urged the War Department to accelerate the build-up in the United Kingdom in any way possible. He made this appeal in conjunction with Lt. Gen. Frank M. Andrews, who had succeeded General Dwight Eisenhower on 5 February as commanding general of ETOUSA. Together they argued that it was essential to increase the Eighth Air Force to permit the simultaneous dispatch of a minimum of 300 heavy bombers, an objective which would require an estimated 600 on hand in the theater.[106] In January heavy-bomber strength in tactical units considered operational numbered 84; in March it totaled 112; and in May 200. The July figure showed 378 American bombers in England.[107]

In early February Stratemeyer estimated that successful operations against German targets would require a minimum force of two formations of 72 planes each, but he preferred four formations of that size. He would not believe that the bombers were helpless against the German fighter force and wrote Eaker, "You and I know they can be self-supporting and that the losses in formations of that size will be small. We can take such losses, but we can't take the losses that

that will occur when you go deep into Germany with small formations."[108] To counter any charges that bombing operations were neglecting vital targets in Germany at this time, Eaker wrote that while he preferred to hit German targets in Germany, rather than those in France, he believed it was best to strike where the weather was favorable and where the bombers would have maximum fighter cover until such time as new groups could be built and added to the bomber force.[109]

Following a mission to Vegesack on 18 March, in which only 2 out of 97 attacking bombers were lost, Eaker said it showed conclusively "that if we had the force to keep the fighters /German/ and other defenses dispersed, we should go in with little loss."[110] During March no mission sustained large losses, which encouraged the feeling that bombers could penetrate without fighter escort. Spaatz optimistically told Eaker, "I am just as convinced as ever that the operations of the day bombers if applied in sufficient force from the U.K. cannot be stopped by any means the enemy now has and your more recent raids should have gone a long way toward demonstrating that fact to the more persistent unbelievers."[111]

If escort was not deemed urgent at this time, it was not forgotten. One may speculate that a mission on 7 May, when 7 out of a force of 25 to 31 attacking bombers failed to return from St. Nazaire, prompted Eaker to write Maj. Gen. Barney M. Giles, AC/AS, OC&R, that the most pressing problem facing the Eighth's P-47's was the absence of auxiliary fuel

tanks. On the same day, 13 May, Eaker repeated this request for tanks to Maj. Gen. Oliver P. Echols.[112] Nevertheless, the general attitude of commanders in the United States was still hopeful. While not insisting that fighter escort was unnecessary, Spaatz wrote Arnold, "The impact of the well-flown B-17 formation into the European air picture has been tremendous and, in my opinion, will be the decisive factor, unless the Germans find some means of opposing it better than they now have."

Towards the end of May the Germans began to mount 33-mm. cannon on FW-190 fighters which permitted them to attack bombers beyond the reach of return fire. Eaker considered this the "most damaging device they have used." However, he added, "There is still not the slightest question but that we can continue effective daylight bombing with large well-flown formations at a loss ratio of five per cent or less."[114] In a press conference in June Eaker reiterated his and others faith in the bomber in combat. He told newsmen: "We have found that a formation of this size can defend itself and that it will sustain, normally, five per cent losses or less."[115] Over a 10-month period, he insisted, the loss ratio had been four per cent, with no noticeable rise in this figure.[116]

However, by May the earlier estimates of the bombers' defensive powers were to give way as the record of operations began to create doubts of the bombers' capabilities. Since the greatest challenge to the bomber was not antiaircraft fire

but the German fighter, Spaatz stated in April that the prime need was for a reduction in the enemy fighter force. He wrote Arnold that "in my mind, the effect of reducing the single-seater fighter effort is equivalent to stepping up our bomber production by the amount equal to our bombing attrition rate chargeable to enemy fighter activity."[117] In mid-July Eaker was still confident of the bomber offensive, but he was aware that the time element was growing more important. Writing to Arnold, he said:[118]

> . . . during this immediate present before the enemy has discovered a way of making our bombing uneconomical, we must press it home, and we must destroy the principal means he has for stopping our bombers, namely his fighter force. If we keep all the bomber strength we can possibly scrape together working on his industry and particularly his fighter factories, and if we can keep knocking them down in the air at the rate we are now doing, but at an increasing scale, we have nothing to fear. The point I hope to make with you is that time is exceedingly precious.

Eaker's guarded optimism was not shared by General Fred Anderson, who wrote Stratemeyer on 21 July that he doubted if an invasion of the Continent would be necessary due to the destruction of targets being carried out by VIII Bomber Command. He told Stratemeyer that though there were some missions which had not been achieved, their failure was not attributable to enemy opposition, but to the weather.[119]

Schweinfurt I, The Crisis

The struggle for air supremacy took on the guise of a decisive contest, and the continuing air battles profoundly affected development of the escort fighter. Conversely, the tactical use of this type of plane in combat influenced the outcome of the air war. Fighter operations during the first half of 1943 generally were confined to fighter sweeps and routine patrols. P-47's escorted bombers for the first time on 4 May 1943 on a mission to Antwerp against Ford and General Motors factories. Though enemy activity was strong, the escorting fighters contributed to a mission that saw no bomber losses.[120] The succeeding missions during May, June, and July permitted the fighters to perfect escort tactics. While early escorting efforts aided in a decrease of bomber losses, their limited range was not enough to give protection on deep penetrations. Lacking planes with a radius longer than that of the P-47 and the Spitfire, the B-17's were forced to operate well beyond their bases without fighter escort.[121]

The missions beyond fighter range grew more hazardous as German opposition to the American daylight bombing effort became increasingly effective. The first mission against Germany was on 27 January when three bombers out of 53 attacking Wilhelmshaven were lost. On the second mission against that city on 26 February, 7 planes were lost from

an attacking force of 63, while two attacks against Kiel resulted in a loss of 8 out of 126 bombers on 14 May and 6 out of 102 on 19 May. On 22 June the target, a rubber refinery at Hüls, resulted in the loss of 16 planes from a force of 183 bombers. Out of 199 planes attacking Hamburg and Hanover in northwest Germany on 26 July, planes lost totaled 24, while on 28 July the force of 95 bombers hitting Kassel and Oschersleben sustained 22 losses. Another mission against Kassel on 30 July showed 12 bombers failing to return from an original attacking force of 134 planes.[122]

In April, General Hunter, commanding general of VIII Fighter Command, had expressed the need for 20 groups and stated that opposition to the bomber offensive would grow heavier unless German fighters were neutralized by an American fighter force.[123] An unfortunate experience on 13 June bore this out when VIII Bomber Command lost 26 out of 182 planes attacking Kiel. Eaker cabled Arnold immediately that the Americans obviously faced a tough battle against the German fighters. He believed that the battle had reached a critical stage and should be pressed to its maximum. The greatest need, Eaker pointed out, was for more replacement crews, depot facilities, and long-range tanks for fighters.[124]

In June the Assistant Secretary of War for Air, Robert A. Lovett, reviewed the American air effort in England and on his return to Washington submitted his findings to General

Arnold. Among other things he believed that the long-range fighter needed immediate attention. In a memorandum touching on P-47 operations in Europe, he wrote, "On the general subject of use of fighters out of Britain, it is increasingly apparent that fighter escort will have to be provided for B-17's on as many missions as possible in order to get them through the first wave of the German fighter defense, which is now up in depth so that the B-17's are forced to run the gauntlet both into the target and out from it."[125] Lovett observed that the P-47 could be used as a top cover provided a satisfactory belly tank was developed for it. He also thought that the P-38 and the P-51[126]* held the greatest promise as escort fighters. In addition, the Secretary pointed out that the Eighth Air Force needed from five to eighth groups of P-38's and P-51's in order to meet the increasing opposition it faced and "will face on the ascending scale during the balance of the year."[127]

This memorandum by Lovett and the increased rate of bomber losses, coupled with his own conviction that the solution to the daylight bombing problem was inextricably tied to the problem of providing bombers with long-range escort, prompted Arnold to send an ultimatum to Giles on 28 June. He said:[128]

> Attached are Mr. Lovett's comments on the P-47 situation in England. This brings to my mind very clearly the absolute necessity for building a fighter

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* See Chapter III for discussion of P-51.

> airplane that can go in and out with the bombers. Moreover, this fighter has got to go into Germany. Perhaps we can modify some existing type to do the job. The P-38 has been doing a fine job from North Africa in escorting our B-17's 400 miles or more. Whether this airplane can furnish the same close escort against the GAF on the Western Front is debatable. Our fighter people in U.K. claim that they can't stay with the bombers because they are too slow and because they /the fighters/ must have top speed by the time they hit the coast. The P-38 is not able for its poor acceleration, so perhaps it too will not be able to furnish close escort and be able to meet the FW's and 109's. About six months remains before deep penetration of Germany begins. Within this next six months, you have got to get a fighter that can protect our bombers. Whether you use an existing type or have to start from scratch is your problem. Get to work on this right away because by January, '44, I want a fighter escort for all of our bombers from U.K. into Germany.
>
> H.H.A.

The option to "start from scratch" would not be possible if the deadline for producing a fighter was merely some five months away. The alternative, and the one which was considered feasible, was to modify the existing fighter types by providing them with the extra range necessary to accompany the bombers. The Arnold ultimatum set in motion the most important Air Force technical development program in 1943.

This order was in effect the opening of a race against time. If the American bombers could fly to the German targets, crippling Germany's ability to build airplanes, they would in time seriously hurt the German effort to wage an aggressive war against the bombers. If, on the other hand,

the German fighters could destroy the bomber and escort formations, then the victory would be with the Germans. The outcome of this struggle was to hinge on the successful use of the long-range fighter. By insisting that the problem of escort be solved, Arnold doubtlessly believed that the need for an auxiliary tank would not be pressing before 1 January 1944, when he said deep penetration of Germany would begin on a large scale. On this point Arnold evidently was forgetting that the operations against vital strategic targets could not be postponed for five months. Within two months of the issuance of Arnold's memorandum, the Eighth's heavies suffered such serious losses that all became aware of the deadly seriousness of the need for escort fighters.

In preparing to meet the 1 January deadline, it was necessary to survey the situation both in the United States and in the ETO. Giles asked the Requirements Division to specify what fighters were most suitable for accompanying the bombers and was told that the P-38 offered the best possibilities. Accordingly, the Lightning was the first fighter modified for long-range flight.[139] Turning to the situation in the ETO, Giles told Arnold that fighter strength in VIII Fighter Command was well below the requirements for conducting adequate escort operations. He recommended that a minimum strength be established immediately with one group of fighters for each two heavy-bombardment groups. To implement the immediate build-up of fighter strength, Giles also suggested

that the 20th Group (P-38) be sent to England rather than to North Africa, a suggestion which was approved.[130] Recent operations in the ETO had indicated that long-range fighters would be most welcome to give impetus to the bombing program.[131]

While the range of the fighters was slowly being increased in the daily operations of the Eighth Air Force, measures were taken also to increase the defensive power of the bomber formations so that they could give better mutual support.[132] In projecting the future course of air battles, Arnold wrote Eaker that he could visualize "sending four to five hundred heavy bombers well into the interior of Germany, escorted by six to eight hundred fighters. When we get this going we would welcome the German pursuit to come up and fight."[133]

A lengthy report, "Eighth Air Force Strategic Program--Its Planning and Execution," summarized Eighth Air Force problems then being met by the bomber force. It stated:[134]

> These task forces /bombers/ cannot adequately protect themselves from the numerous determined attacks from the enemy. Therefore, as our operations become more numerous our need for fighter protection becomes greater . . . . The Germans press their attacks with determination and our missions prove conclusively that only with strong fighter support can we expect maximum operating efficiency.

The report pleaded for fighter support and urged additional strength in the bombers. If this build-up could not take place, it was possible that German fighter strength in the West would increase to a point where the enemy would be

able ". . . to destroy our air superiority there and the fighter force opposed to us in the West may be so large that we cannot accomplish our mission."[135]

In August the decision was made to use the fighters to disrupt the German defensive system by employing them on diversionary attacks designed to permit bomber forces to penetrate the enemy belt with the least possible opposition. Increasing pressure was put on General Hunter to employ his forces exclusively in the defense of the bombers, but he was reluctant to use his small force except for "penetration and withdrawal support."[136] Hunter urged a build-up of 25 groups for long-range escort. In a report submitted to Washington outlining the advantages if 150-gallon droppable tanks were used on fighters, Hunter stated that the Allied fighters would then be able to support bombers 300 miles from base and effectively counter the attacks of enemy single-engine fighters from current bases. This, he believed, might cause the Germans to withdraw single-engine fighters from their current bases along the coast line in order to cover Germany proper. He reasoned that if this development occurred, it would cause the enemy serious loss of coastal shipping, destruction of secondary targets, and make possible attacks on coastal troop concentrations by American light and medium bombers. This, in turn, would cause enemy withdrawal and dispersion of single-engine fighters and lessen the German's ability to make second interceptions.[137] While sections of

this analysis were sound, the obvious question was ignored -- namely, how would Allied fighters protect the bombers once the fighters reached the point where they could no longer offer support. What was to stop the enemy from regrouping his fighters in depth and offering serious opposition, which was precisely what the Germans were doing at that time. As analyzed by the commanding general of VIII Fighter Command, the question of escort was not answered in a manner indicating either that the problem had been faced squarely or that the proper use of the escort fighter had been realized.

The need for more fighter escort units was appreciated, however, by the commanding general of VIII Bomber Command. In a memorandum to VIII Fighter Command, Maj. Gen. Fred L. Anderson urged maximum fighter support for bombardment formations. "If you can give us more P-47's, many of our bombers will reach the target and many more of our missions will result in complete, rather than partial success. The experience of my Command clearly indicates the need for more such Thunderbolts."[138] Many Eighth Air Force and RAF officers felt that the urgent need for escort should be solved as soon as possible. One RAF officer said that although the P-47 groups had performed miracles and had consistently done excellent work, "we still require in the European theater of operations a fighter which can penetrate to even greater distances and which can operate at low altitudes. . . . We want a fighter which can penetrate even deeper, if possible,

to the target and for that purpose it is my opinion that the P-38 is the best aircraft."[139] The conclusion of a report drawn by the Operations Analysis Division of VIII Fighter Command was, ". . . that our fighters have been employed most profitably when they were escorting main bombing attacks." It further stated that while AAF fighter casualties were greater when the bombers were being escorted, "this has been more than compensated for by increased destruction of enemy planes."[140]

Operations began to show the dire need for escort fighters. On 15 August the 65th Group, using 200-gallon belly tanks, supported bombers on strikes against German airfields in France and Holland. The other groups taking part in the escort did not carry tanks.[141] Support was furnished as far as Cleve, Germany, with penetration roughly 275 miles. It was estimated that the fighters were successful in driving off some 50 to 60 enemy aircraft that had been attempting to attack the bombers. In the encounters 8 enemy aircraft were destroyed, 2 probably destroyed, and 5 damaged as against the loss of 1 P-47. Two bombers were lost from an attacking force of 290.[142]

On the eve of 17 August, the fighter strength of VIII Fighter Command consisted of four groups -- the 4th, 56th, 78th, and 353d, all of which were flying P-47's. The American bombing effort reached an unfortunate climax on this date when an attacking force of 183 bombers flying deep over Germany lost 60 bombers and 600 airmen. The bombing mission, itself highly successful, struck a ball-bearing

factory at Schweinfurt and an aircraft assembly plant at Regensburg. A careful analysis of the reasons for this tragic loss clearly pointed to the effectiveness of German fighter tactics. Opposition met during this mission was the most savage encountered to date in the air war. The attacks began when the bomber formation neared Antwerp, and, save for a few lulls, continued almost constantly. The German planes had attacked from all clock positions in groups of 2 and 3 planes and in packs of 25. Using a javelin formation, the Germans attacked the nose position of the bombers in groups of 7 to 15 aircraft. They struck from vertical angles above the bombers and by driving straight down concentrated their fire at the top turrets. The enemy also used a rocket timed to burst in the air and not in contact with the planes. In brief, few tricks, feints, and tactics were omitted by the Germans, and their effort resulted in the most significant defeat the Eighth Air Force suffered in its daylight bombing effort.[143]

The Schweinfurt I mission proved the need for fighters that could travel farther than P-47's with 200-gallon tanks partially filled.[144] This resulted in an increased effort to provide the extra range. On 31 August, on a mission against airfields at Amiens and Glisy, P-47 fighters used the 200-gallon tanks filled with 150 gallons, and the 56th Group used the 75-gallon tanks for the first time. On the mission of 6 September against targets of opportunity in Germany and France, the planes were equipped with 105-gallon tanks in addition to the 75-gallon ones.[145]

In view of the considerable effort to solve the range problem, Arnold on 18 September had written to Eaker that such factors as escort fighters, properly flown formations, and increased bombing accuracy would result in real progress.[146] Another suggestion came from Giles who proposed to Eaker that consideration be given to utilizing specially trained bomber formation leaders, and that the lead airplanes be staffed with crews more highly trained and experienced than those in the rest of the formation.[147] General Fred Anderson, following a mission in France, believed that with fighter support available in sufficient force and range, bomber losses would average only about 75 per cent of casualties under limited fighter support.[148]

Between 17 August and 14 October some missions continued beyond the range of escort, although supporting P-47's escorted bombers into Germany for the first time on 27 September. This mission against Emden was made by 246 bombers accompanied by four fighter groups. The fighters were equipped with 75-gallon tanks. They were highly praised for their work in a report summarizing the mission. It stated that the escort fought off a large number of German fighters sent up to intercept the formation, which minimized the bomber losses.[149] The P-47's escorted the bombers almost 700 miles, destroyed 20 German fighters, damaged 6, and probably destroyed 2.[150] The strike against Bremen/Vegesack on 8 October was made by 357 bombers accompanied by 274 fighters, utilizing the 75-

gallon and 108-gallon tanks. The fighters were able to provide escort only to within a few miles of the targets. Notwithstanding the considerable support offered, the bombers sustained 30 losses, while fighter losses totaled 3. German fighter opposition was unusually strong, but had 12 planes destroyed, 2 damaged, and 10 probables. This mission was a foretaste of the struggle that was ahead for the Eighth Air Force as it sought vital targets in Germany.[151] While losses had usually been kept to a minimum when bombers enjoyed support, once the fighters were forced to return to base, the bombers had to proceed independently to the target. Bombers sustained their most severe losses during this phase of the battle. Of the 13 lost during the Bremen raid, "indications are that all but two were lost in the target area, after penetration support had gone home and before withdrawal support had made RV/Rendezvous/"[152] This quotation is but one sentence of the mission report recounting the battle of the 1st and 2d Air Task Forces on 8 October, yet it holds the key to the losses suffered that day. Clearly, then, it was apparent that escort would have to be complete if losses were to be kept down.

On 14 October a force of 229 bombers returned to Schweinfurt. On this second mission, 196 escort fighters supported the bombers only 240 miles and then withdrew. It was at this point German attacks against the bombers became heavy and persistent, resulting again in 60 American bombers

being lost. Because of bad weather it had been impossible for fighters to provide withdrawal support, and the bombers were forced to return to their base alone. The 60 bombers lost meant for all practical purposes that the effort to achieve air supremacy had failed and that until fighter escort could be provided fully, the attempts to penetrate deeply into German would have to be paid for at a prohibitive cost. General Arnold in his memoirs admitted that he did not know if the Eighth could have continued to operate under such a loss rate.[153] The reports of the mission pointed out only too clearly the deadly effect of German fighters on the bomber formations.[154]

The German tactics were similar to those of the earlier Schweinfurt raid save for an increase in the use of rocket attacks and aerial bombing, and "with attacks from all quarters, from great numbers of enemy single and twin-engine fighters in overpowering strength."[155] The losses sustained in this mission proved to all the apparent helplessness of the American heavy bomber in the face of German fighter tactics. The following day Eaker cabled Arnold that the answer to the German challenge lay in using more fighters at long range. He asked for every available plane and that droppable tanks and replacement crews be sent at once. He added that early arrival of more P-38's and P-51's was imperative.[156] The seriouness of the air war is reflected in the minutes of a Wing and Group commander's meeting held on 18 October. General Anderson,

commander of VIII Bomber Command, told his officers: "We can afford to come up only when we have our fighters with us," but he promised them a rapid build-up of planes to permit the bombing campaign to continue.[157]

The Crisis in Suspension

The two Schweinfurt missions resulted in a reappraisal of the air campaign. At the same time the projected date for OVERLORD,[158] tentatively set for May or June, 1944, was also close enough to merit a reexamination of the air situation. With the CBO now in a crisis period, the Air Staff in Washington felt that ". . . changes in the military situation, evaluation of the bomber offensive to date, new analysis of enemy targets, and the decision that a substantial reduction in GAF fighter forces is essential to the success of OVERLORD, indicate the necessity to modify POINTBLANK."[159] The Air Staff recommended that priority be given to destruction of German fighter factories before the contemplated invasion of western Europe took place. This was not the first time the focus had been directed to German fighter production. The issue had been raised in March, 1943, when Eaker, after reading a paper on the necessity of attacking Germany's aircraft industry and her fighter force, had asked A-5, Eighth Air Force Plans Division, for a statement on the merits of the points he made.[160] The reply Eaker received stated:[161]

> . . . our primary objective should be the German Fighter Force in the air, and on the ground, and the industry which supports it. A sufficient depletion of the German Fighter Force is the one essential preliminary to our imposing our will by the use of air power on any portion of the German war effort which will be selected.

For a satisfactory depletion, A-5 recommended that the maximum loss must be imposed on the German fighter force itself, as well as on the industry which replaced this attrition.

The course of the bombing operations indicated that the advice given Eaker was followed only partially. The bombing of aircraft and ball-bearing factories was pursued, but the campaign to destroy the German fighter force was only incidental. The Schweinfurt missions had showed that the German fighter force would now have to be destroyed if the bombing campaign was to fulfill the plans outlined in the CBO.

The Schweinfurt raids also proved that the 1 January deadline set by Arnold was too late. The crisis that he had predicted for early 1944 came four and one-half months earlier and caught the AAF unprepared to give the bombers their urgently needed support. The impetus to provide this support had begun long before 17 August, but it was to be several more months before ETO could provide amply for long-range coverage. With the Schweinfurt missions went the virtual end of the idea that the heavy bomber could "go it alone." The debate that had continued since the early 1930's was now all but over. The proposal to develop a fighter-destroyer type airplane for escort also was put to rest for the duration of

of the war.[162] To reach targets in Germany would require more than a regrouping of bomber formations and an inculcation of an offensive spirit. These would help, but they were not answers to the German Me-109 and FW-190.

Additional proof of the value of long-range escort was given by the VIII Bomber Command's Operational Research Section which stated: ". . . enemy fighter activity is probably the sole cause of two out of five of our losses, and that is the final cause of seven out of ten of our losses."[163] Lecturing at the Air War College at Maxwell Air Force Base after the war, General Hansell declared:[164]

> There was tremendous pressure on the Bomber Command to give up daylight bombing during this period and to convert to night bombing. That would necessarily have meant giving up the entire concept of precision bombing as it was then known, and abandoning the effort made to cripple industry through the destruction of key industrial targets.

Fortunately, Hansell said, the AAF refused to give up daylight bombing in the face of a temporary reverse and thus retained its doctrine, which was considered essentially sound, but which needed a solution for GAF fighter attacks.[165]

The remedy for this impasse was outlined by Eaker, who asked Arnold to send him every available fighter, especially Mustangs and Lightnings. Eaker told Arnold that while the Thunderbolt was an excellent plane when using the 108-gallon tank, it had a range of only 350 miles. The P-38's and P-51's would extend the range to 450 miles.[166] The battle on the

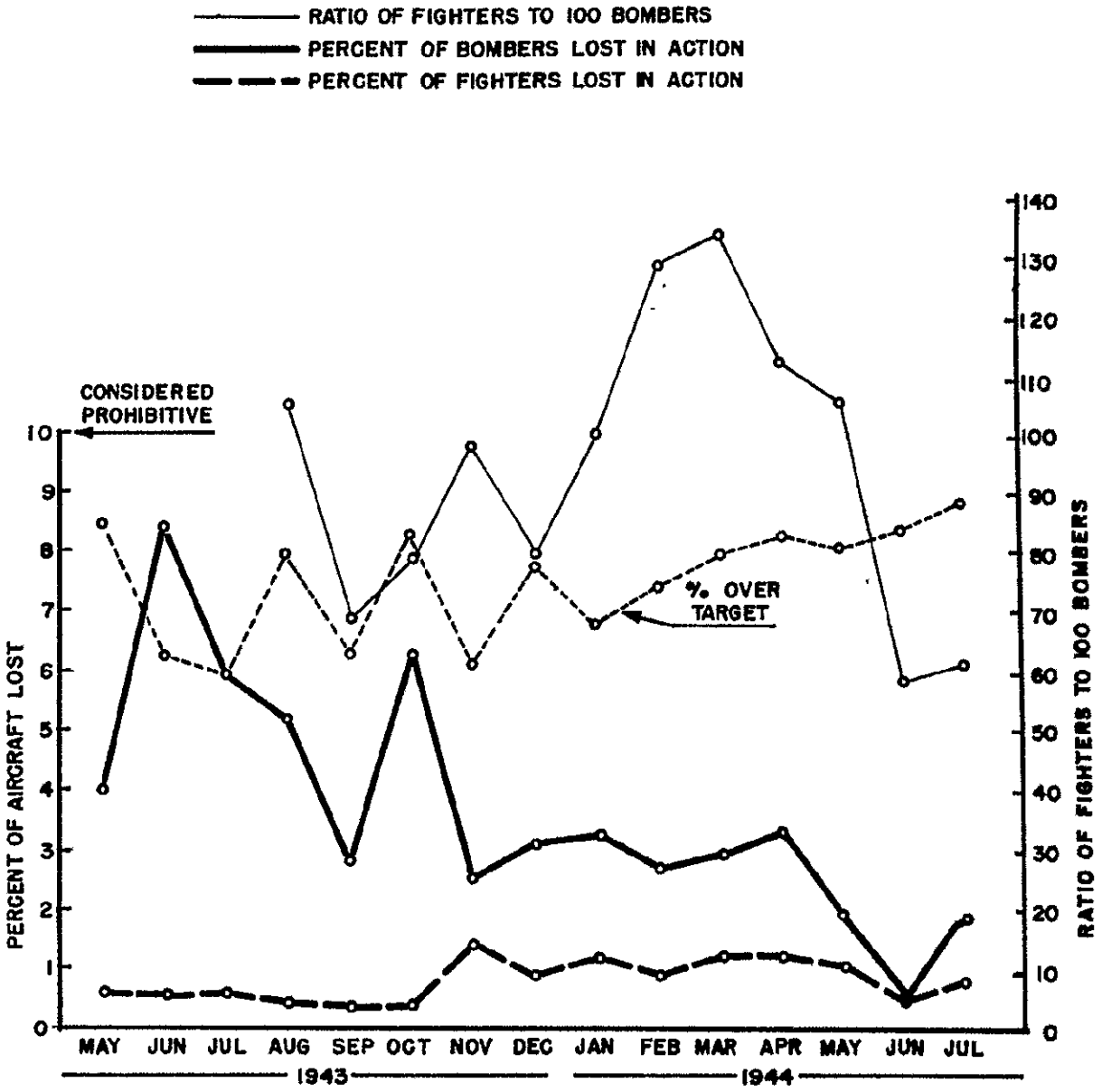
14th of October meant to Arnold that the AAF should scrap immediately outmoded tactical concepts and coordinate more closely all elements of command to make more effective use of its combined resources.[167] To Eaker, Schweinfurt II did not represent a disaster -- only that the air battle had reached its climax.[168]

For the time being the Eighth Air Force was unable to raid Schweinfurt or any other objective deep in Germany.[169] "We are not justified," Eaker wrote Giles, "in striking at them /the Germans/ unless the conditions augur success. These deep penetrations and the impossibility of fighter escort will cost us 80 to 120 bombers. We will suffer this loss any time we penetrate in force to these targets."[170] The second Schweinfurt mission, disastrous enough in itself, had climaxed a week of costly air battles.. Within 6 days the Eighth lost 148 bombers and crews, mostly as a result of air action in 4 attempts to break through the German fighter defenses unescorted.[171] The Eighth made no more deep penetrations, even in clear weather, into Germany for the rest of the year. Prior to December that failure was the result of a command decision based on the lack of escort. After early December it was forced by weather, although the Eighth Air Force still lacked long-range escort sufficient to make deep penetrations anything but costly affairs. Some short-range "pathfinder missions," using a radar bombing method were undertaken in cloudy weather.[172]

On 15 October two additional fighter groups had become operational and were added to the VIII Fighter Command. These were the 55th Group flying P-38's and the 356th Group flying P-47's. General Arnold had promised the Eighth Air Force a large percentage of the Mustangs produced and about one-third of Lightnings to boost fighter strength in the ETO. He also had asked Air Marshal Portal to provide RAF Mustang support for bombing missions.[173] Parenthetically, it should be noted that the build-up of bomber strength was considerably below the standards specified in the Combined Bomber Offensive. The result of using inferior numbers of bombers had been to eliminate any element of surprise which had been evident in earlier operations. This retarded build-up had enabled the Germans to develop the countermeasures employed successfully at Schweinfurt. According to Air Chief Marshal Portal, this meant that unless the Americans would accept a high loss rate, they should increase their number of bombers, surpassing the original number set forth in the CBO directive in order to achieve the same effect.[174]

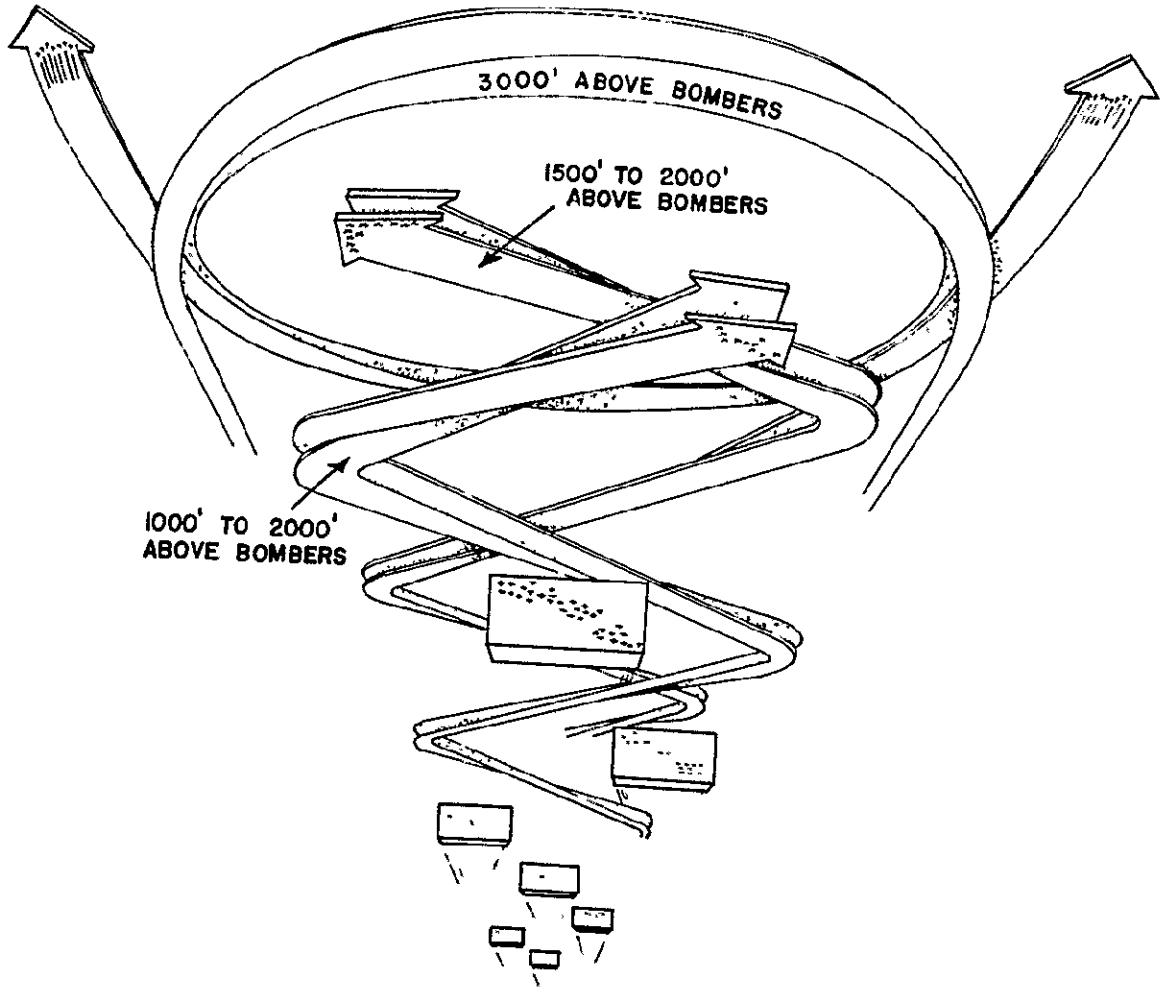
On 29 October Arnold informed Eaker that due to the situation in the ETO, only Lt. George C. Kenney, commanding general of the Fifth Air Force, and Spaatz were to receive any long-range P-38's and -51's.[175] A directive of 31 October on fighter allocation had stated, "The primary role of all U.S. Fighter units in the U.K. until further notice will be the support and protection of the Heavy Bombers en-

ESCORTED MISSIONS
EIGHTH AIR FORCE



SOURCE: ACHTUNG INDIANER
HISTORY OF THE VIII U.S.A.A.F. FIGHTER COMMAND

FIGHTER ESCORT



SOURCE: EIGHTH AIR FORCE TACTICAL DEVELOPMENT

BASIC TYPE OF ESCORT EMPLOYING 3 FIGHTER SQUADRONS. SECTIONS AND SQUADRONS COVER EACH OTHER AGAINST TAIL ATTACK.

gaged in POINTBLANK."[176] The following policy was established to govern future allocations of fighters for England: the first 10 groups of P-47's and all P-38 groups, totaling 15 groups, would be assigned to VIII Fighter Command; the next 6 groups would be turned over to the Ninth Air Force; and all other fighter groups would be assigned to the Ninth Air Force, which was to have 21 groups.[177]

The efforts of the AAF to provide escorts for the Eighth's bombers were evidenced by the return of the twin-boomed Lightnings of the 55th Group which had become operational on 15 October. These fighters gave VIII Fighter Command a plane that could exceed the range of the P-47 by a considerable distance and supply that section of cover from the P-47's withdrawal point to the target. On 13 November VIII Bomber Command sent 143 bombers to strike targets at Bremen. Escort was provided by 345 P-47's and 45 P-38's.[178] The P-38's, using two 150-gallon droppable tanks each, were able to escort the bombers to the target and defend them against persistent enemy fighter attacks. As a result of combat, the P-38's claimed 7 destroyed, 3 damaged, and 5 probables, for a loss of 7 aircraft. While bomber losses totaled 16, only 2 were attributed to enemy fighter action -- a figure which must be accredited to the gallant escort provided by the P-38's. This was the longest escort mission flown to date, and the effective use of the P-38's and P-47's prevented the German fighters from employing their deadly rocket attacks.[179]

On 13 December, 648 heavies escorted by 394 fighters, 41 of which were P-51's belonging to the 357th Fighter Group, were sent against Kiel and Hamburg. This was the first major action of the P-51.[180] The Mustangs, equipped with two 75-gallon tanks each, were given a chance to fly their maximum range. The P-51's and -38's provided target area and withdrawal support from the initial point. In order to complete this sequence of support necessary to give the bombers protection on all phases of the mission, it was imperative to select carefully the contact points where one group of fighters would pick up the bombers and another group leave them. This was necessary since no one group on a long mission could offer continuous support. By a system of prearranged rendezvous points a group or more could pick up the bombers on the withdrawal leg of the mission and cover them on the return to their bases. Losses on the Kiel/Hamburg mission totaled 5 bombers.[181] This flight witnessed excellent cooperation between fighters and bombers, and hopes rose that longer penetrations would be equally successful. The P-51 was introduced into combat and employed to its maximum range, the bombers were given complete cover during the entire mission, and losses from enemy fighters were low. Perhaps Eaker had the Kiel mission in mind when he wrote, "We can now say definitely that the presence of superior fighter aircraft in strength to, over, and from the target will decrease our bomber losses from 50% to 75%."[182] However, he cautioned,

"It probably will never be possible for protecting fighters to insure bombers against any loss if the enemy presses home his fighter attacks in a determined manner with considerable force."[183]

At the end of the year three more groups bolstered VIII Fighter Command strength: the 20th Fighter Group, flying the P-38, which became operational on 28 December; the 359th Group, flying the P-47, which became operational on 13 December; and the 358th Fighter Group, also flying P-47's, which became operational on 20 December.[184]

In retrospect, 1943 was a year of trial and error. It was one in which the Eighth Air Force realized the enemy's ability to offer deadly opposition to daylight bombing assaults. It was a year in which the Eighth Air Force with its supporting fighter and bomber commands was forced virtually to rebuild its forces from a low caused by the exodus of units to support TORCH. The need for adequate escort fighters was ultimately realized, leading to an ambitious technical program devoted to fulfilling that need. By December the solution had been found. The range-extension program had been developed by enlarging the internal fuel capacity of the three fighter planes and through a vigorously executed program of droppable tank production. The P-51 had become the standard long-range fighter. This came about as a result of tests in December and January which "proved rather conclusively that the P-51 aircraft, when equipped with long-

range auxiliary tanks, were the best suited to meet the needs of escort fighters for heavy bomber missions."[185]

With the solution of the escort problem came assurance that the American daylight-bombing program as set forth in the CBO plan, barring some unforeseen development, would be accomplished. While the fighters sent to escort the bombers were to act only as a defensive force and not to seek out enemy fighters aggressively, the result of the bombing program compelled the GAF to offer battle when the bombers sought vital German targets. This led to vicious air battles between American aircraft and the German interceptors. This situation permitted American escort planes to destroy a large percentage of the GAF fighter force and reduce substantially the enemy's ability to offer resistance, an ability further reduced by bombing strategic targets. How important this air struggle was can be appreciated if it is remembered that air supremacy by the Allies was a prerequisite for OVERLORD AND ANVIL.[186] Against this background of achievement the air forces in Europe faced a new year, with escort fighters requiring only a logistical build-up and a refinement of tactical doctrines.

CHAPTER III

THE PROBLEM IS SOLVED

Range Extension: The Fulfillment of an Idea

The events leading to the successful extension of range comprise a story that has its constituent parts in not one but several parallel phases. It is a record exceedingly difficult to trace in its many ramifications, but the major steps form an important part of this story. Indeed, this narrative includes the development of droppable fuel tanks, modifications to increase the internal tankage of American fighter planes, and the development of the P-51 as an escort plane. There was the pressure of time and the difficulties of a hastily augmented tank-production program in the United States, 3,000 miles away from combat theaters. Furthermore, there was the increasing insistence by AAF commanders to provide them with escort fighters with long range, and in this search for an adequate escort came the abortive YB-40 and XP-75 experiments.

With the entrance of the United States into the war, the need for shipping space early in 1942 necessitated a search for means to economize on the use of shipping needed to carry men and supplies to all corners of the earth. This factor, as well as demands from the South Pacific asking for increased range for combat planes, especially for fighters, prompted the

AAF to begin trying to find a means to increase the range of combat planes, and to lessen shipping demands by ferrying them. The expansion of this project laid a foundation for the program of combat-tank production. Few persons in 1940 and 1941 could see the future requirement for thousands of tanks that were to become so indispensable to the long-range fighter program.[1]

Constructing a bulletproof, pressurized, aerodynamically satisfactory droppable fuel tank was the task that faced AAF engineers soon after December, 1941. Allocations of materials, plant facilities, labor, shipping space, and the general urgency which accompanied demand for these tanks, complicated the program. Fortunately, work that had been done prior to America's entrance into the war was valuable in the wartime production of combat fuel tanks. There were, however, many problems to be solved. One was how to construct a shackle aided by sway braces that would hold the tank firmly in place, notwithstanding the pressure exerted against it when the plane was traveling at high speed, and still permit its instantaneous release. Another problem was that of equipping the plane with a booster pump to draw fuel from the tank, and of devising a connection that would permit the fuel feed to disengage from the tank when it was dropped. Still another problem was that of materials when metals that could be used were scarce. Various materials were tried in the manufacture of the tank: aluminum, cold-rolled steel, terneplate, vul-

canized fiber, plastic, canvas, cotton-duck fabric, rubber, and plywood. Satisfactory tanks of jute and paper were built in India and England respectively. Americans eventually constructed tanks of steel.[2]

The quest for fighter range received early attention from the highest level of the AAF. At a conference in General Arnold's office on 20 February 1942 several cablegrams from various theaters of operation asking for increased range of aircraft then in use were presented for discussion.[3] Following the conference, instructions to begin immediate study of means to extend the range of fighters were transmitted by telephone to Materiel Division at Wright Field.[4] Within a week, on 28 February, Materiel Division issued technical instructions initiating action for procurement of 52-gallon tanks for P-40's at the rate of 6 for each airplane. Materiel Division also asked for production of these tanks in sufficient quantities to meet needs of forces in the Far East and England. The tanks were to be increased to a maximum consistent with the structural and flight limitations of the fighter plane for which they were intended.[5]

The question of fighter range was again discussed at a meeting on 12 March at Wright Field, and immediate action was suggested to increase the ferrying range of aircraft then in production, especially that of the P-47. Experiments then under way indicated that a 3,000 mile range could be developed

in this plane.[6] Another conference at Wright Field nine days later permitted a full discussion on how to ferry pursuit planes to combat theaters. Because modification of airplanes already in combat was not considered part of the program, those present believed that extension of combat range would be treated second only to ferry range.[7] In late March, Brig. Gen. Bennett E. Meyers, who was in charge of aircraft procurement, proposed that external tanks for the P-38E carry 175 gallons. The P-47 should carry three external tanks, two of 100-gallons each under the wings and one of 410 under the fuselage, giving it an estimated 3,000-mile range.[8]

Engineers began to explore every means to increase the range of airplanes by augmenting internal fuel capacity and the addition of jettisonable tanks.[9] The Production Engineering Section at Wright Field on 3 April advised Materiel Command that a survey for 75-gallon droppable fuel tanks indicated a need for approximately 25,000, at a cost of about $2,500,000, in order to provide four for each plane.[10] This item was a composition belly tank made by the United States Rubber Company.[11] The engineers recommended that the company be given a contract for 5,000 tanks, with delivery to start in 60 days, and that the remainder be procured from the "cheapest and least strategic source."[12]

By late July it became necessary to establish a unified program to obtain combat range-extension fuel tanks. Previous procurements had been made under various estimates of require-

ments. The Director of Military Requirements outlined the problem in the following manner: one, to determine the average rate of expenditure of combat extension tanks in specific areas by aircraft types; two, to determine the average rate of expenditure of the tanks in various combat theaters; three, to establish delivery rates for various theaters by tank types; and four, to base tank production on the total number of fighter aircraft built.[13] By late 1943 satisfactory progress had been made in providing airplane types and models with various size tanks to give fighter models a range of from 2,000 to 3,000 miles, but combat tank production and development continued haphazardly.[14] The requirements for droppable fuel tanks were subject to constant changes made necessary by numerous problems arising from tactical needs, combat experience, shortages of critical materials, and shipping problems.

Brig. Gen. Benjamin W. Chidlaw, assistant Chief of Air Staff, on 24 February 1943, requested information concerning the design and possibility of a leakproof combat tank for current fighter planes.[15] Materiel Command directed the engineering division to study this problem, taking into consideration such questions as production, restraining priorities, and possible deterioration in the field. The engineers approached industry to secure sample tanks of the "same approved design as the present internal type of self-sealing

tank." The tanks tested were similar in shape to the one proposed. They did not appreciably affect maneuverability of the plane, but increased the stalling speed approximately 20 miles per hour.[16] In May the Requirements Division asked for replacement tanks in the following capacities:

Aircraft	Tank Requirements per Month	Capacity
P-38	3,050	150-gal.
P-39	6,600	75-gal.

However, it stated that only 3,000 tanks would be required before January, 1944.[17]

As work on combat tanks continued, the Engineering Division reported on 23 June that the first series of self-sealing, bullet-proof 75-gallon tanks had passed the gunfire test. This model had been submitted by the Firestone Tire and Rubber Company. It could also be enlarged to 105-gallon capacity without production difficulties.[18] At the request of fuel-tank manufacturers, a meeting was called on 29 June to discus design and requirements of self-sealing tanks. The participants recommended that the 150-gallon self-sealing tanks not be procured until the completion of further tests.[19] The general policy in regard to these tanks suggested that: one, aircraft, when equipped with full combat-extension tanks, should be reasonably stable and capable of being flown on instruments without difficulty; two, the external tankage capacity should be about 75 per cent of the internal self-seal-

ing capacity; and, three, a minimum of 95 per cent of the fuel should be extractable up to the critical altitude of the airplane.[20] By 25 August, a satisfactory 150-gallon tank was developed, and work was progressing on a 75-gallon model for the P-51.[21] The last major problem in the tank program was surmounted in September with satisfactory completion of tests and the conclusion that no great fire hazard existed in the leakproof type. The way was now clear to accelerate production.

Meanwhile, another development of this story was unfolding in the United Kingdom. In January, 1943, Averell Harriman had approached an officer of the Procurement Section, Supply Division, regarding a query from General Andrews as to whether provisions had been made to supply droppable tanks for fighter aircraft in England. The Supply and Maintenance Divisions of VIII Air Force Service Command investigated possibilities of producing them in England, an investigation undertaken jointly with the Air Technical Section of VIII Fighter Command at the request of its commander, General Hunter.[22] The following month, ACM Sir Wilfred S. Freeman of the Ministry of Aircraft Production (MAP), suggested that the best means to solve the problem was to prefabricate tanks in the United States and assemble them in England. Since no definite policy had been reached, he told Maj. Gen. Henry Miller of VIII Air Force Service Command that the matter

should be settled so that later demands would not overwhelm production facilities in England. Freman's proposal was rejected.[23]

External tanks were no new problem in themselves, for they had been used on several types of aircraft, and the P-38's had employed them for their flight across the Atlantic. Preliminary studies on the type of tank needed for the P-47 was ordered by Hunter. This plane had arrived in the United Kingdom in late December, 1942, equipped like the P-38's with shackles primarily for ferrying purposes, but without any attached tanks. Col. Cass Hough of the Air Technical Section flight tested the P-47's to determine necessary operational data. It took Hough about two weeks to determine speeds, rates of climb, and endurance. General Hunter then posed the problem of long-range escort, and Hough proposed to use the 200-gallon ferrying tank. He pointed out that the range would depend entirely on how far from base they were jettisoned, whether at the enemy coast or at the point where the planes met enemy opposition. It was an indeterminate point, he said.[24] VIII Air Service Command was requested to secure some 200-gallon tanks for primary test purposes, but it was March before they were delivered. This tank proved unsatisfactory, primarily because it could not be pressurized; it leaked badly if fuel was left in it longer than a few hours and was aerodynamically unsatisfactory.[25] In a memo for the commanding general of Eighth Air Force

from Hunter, he said:[26]

> It is a composition tank which cannot be pressurized, and it therefore does not function satisfactorily above 20,000 feet. The present capacity of 200 gallons is too large because only approximately 100 to 125 gallons of gas are necessary for warm-up, take-off, climb to 30,000 feet, and reach to enemy territory. Experience in this war has demonstrated that belly tanks must be dropped before any engagements take place with enemy aircraft. The use of a 200-gallon tank to carry a lesser amount of gasoline is a waste of material and will adversely affect climbing performance due to added weight.

The A.T.S., therefore, preferred the P-39's 75-gallon tank which could be used for short ranges. While these tanks were a marked improvement over the larger ones, AAF regulations required that they be dropped at the enemy coast. Later experiences showed they could be carried to the point of combat and then dropped.[27]

Another problem facing engineers in England was to find a sufficient pressure head so that at high altitudes the fuel pump would supply enough gasoline. An Air Forces regulation forbade the carrying of gasoline under pressure, which thereby necessitated extra fuel pumps with added weight and chances of mechanical failure. Air Technical Section proposed to harness the air pressure going to waste in the exhaust from the vacuum pump, but needed a control valve to meter the changing pressure at varying altitudes to maintain a pressure differential between the outside atmosphere and the tank. The British Thermostat Company supplied the valve, and Langford Lodge Company built a prototype American 100-gallon metal tank. It was not delivered, however, until 20 May. The

flight tests were successful and the engine received adequate fuel up to 35,000 feet.[28]

In March, VIII Air Force Service Command experimented with a tank of approximately 125-gallon capacity, which it believed might be used for combat operations. This was a pressurized model, which permitted its use above 20,000 feet. Washington asked the Eighth Air Force to obtain 500 or 600 a month from British sources until arrangements could be made to assure arrival of large quantities from the United States.[29] On 17 March the Americans requested the following quantities in a revised schedule:[30]

March	270	August	6,480
April	1,430	September	7,290
May	3,240	October	7,290
June	4,860	November	5,000
July	5,670	December	5,000

The British companies pointed out they needed at least 45 days to get into production and approximately three months to satisfy current requirements. A small quantity of tanks had arrived from the United States, but enough to extend the range of fighters was not on hand. The VIII Fighter Command suggested, however, that non-pressurized 75-gallon models be used up to 25,000 feet and dropped when the fighters met the enemy.[31]

Early in June another problem arose. The difficulties and delays over delivery of tanks for P-47's had raised the question as to whether the P-38 might not be the better escort fighter. Hunter, who admitted that the P-38 appeared to be the ideal escort plane, was reluctant to ask for it

until he had given the P-47 a complete trial in combat.[32] It was in June, too, that Eaker placed the need for auxiliary tanks fourth on his list of priorities, though a month later, on 19 July, he wrote Maj. Gen. Oliver P. Echols, Chief of Materiel Command, that lack of leakproof droppable gas tanks "constitute the only reason why our P-47's are not going with our bombers as far as the Ruhr at least."[33] By mid-July Eaker wanted the P-47's "sent to limit of availability."[34] He was now willing to forego P-51 reconnaissance planes if he could obtain P-51 fighters instead.[35] Hunter told Eaker on 20 July that his fighters desperately needed long-range tanks, and that he would not assume responsibility for the fact that he did not have them. Furthermore, he estimated that VIII Fighter Command was approximately 130 planes under-strength. As a result of this statement, Eaker turned to General Miller for a statement concerning the tank program.[36]

General Miller attributed British failure to deliver the 100-gallon metal tanks after four and one-half months of effort to a steel shortage. The British, instead, had offered to manufacture a 108-gallon paper tank in order to save the critical metal. Eaker told Arnold in mid-June that the proposed paper tank might be used on theP-47. He had asked, however, for continued output of American metal tanks until tests were completed and manufacture could be handled in England.[37] Air Technical Service engineers reinforced the British made paper tank to withstand seven pounds per square

inch working pressure, and flight tested it. On 26 June, it appeared to be satisfactory, though some minor corrections were necessary.[38] The VIII Fighter Command approved it officially on 1 July. Miller told Baker that arrangements had been completed with MAP for delivery of paper tanks for the P-47 according to the following schedule:[39]

July	20
August	300
September	1,500
October	5,300
November	8,600
December	9,100

Miller's memo to Baker stated that these tanks could not be used until fighters were equipped with internal and external fuel connections and sway braces for their installation. The contract was given to the Bowater Corporation, with portions of the order consigned to other firms in order to meet the Eighth's needs in the shortest possible time.[40]

Early in July members of Air Service Command had ascertained that a large quantity of 200-gallon tanks was available at Base Air Depot at Burtonwood. Their supply division on 8 July reported the number of tanks in storage at 1,182. Although they were of inferior quality, the Service Command divided them among the 4th, 56th, and 78th Fighter Groups. Shipping them by rail resulted in difficulty because they had to be limited to 40 or 50 per train load. By 19 July, 169 tanks had been sent to the 4th Group, 50 to the 56th, and 121 to the 78th Group. Headquarters directed the fighter groups to test the tanks when they arrived to

determine the best method of using them. The trials were curtailed until after 25 July because of the weather, but by 27 July the 4th Group had completed its tests, and the other two groups had nearly finished theirs. Since most of these tanks were warped, they had to be carefully inspected and "hand-tailored" to fit individual airplanes. In addition, many of them were not leakproof. The 4th Group determined that a radius of action of 250 miles was practical when using the tanks with 110-gallons in a climb of 22,000 to 23,000 feet and then jettisoning them when the fuel was exhausted.[41]

For the mission of 28 July in support of 95 heavy bombers against Kassel and Oschersleben, the P-47's were equipped with these tanks. Combat resulted in a loss of 7 American fighters and 25 German planes. Though the tanks were not ideally suited to combat, fighter and bomber pilots on the mission praised the escort provided.[42] The use of the tanks had created an element of surprise and had caught the German pilots unawares.

While the Americans were trying to solve their own technical problems in England, Eaker turned to the United States for further aid. He asked the Air Force test agencies, the Tactical School, and the Proving Ground Command to undertake studies of German tactics against American bombers, and to devise defenses against air-to-air bombing, rockets, and the flying of captured aircraft into American

formations. On Eaker's suggestion the Assistant Chief of Air Staff on 21 July ordered a study of means to combat enemy efforts to neutralize the AAF's bombing offensive. A study by the Directorate of Tactical Development concluded that the ultimate answer to the problem of defense from all types of attacks would be the protective escort fighter airplane. The study proposed that the P-51B and the P-38 be equipped with auxiliary tanks for this purpose. Accordingly, the Proving Ground Command tested these two planes and also the P-47 to determine their ranges.[43] The Commandant of the School of Applied Tactics in his report to General Arnold stated that the latest developments in auxiliary tanks for fighter aircraft would result in an operating radius of more than 624 miles at bomber cruising speeds.[44]

On 17 August OC&R requested that a long-range program of developing tactical bombardment formations be instituted, using the following requirements as a basis: one, the employment of fighter escort with heavy bombardment formations to a maximum range of 750 miles, presuming continuous engagements with enemy aircraft for approximately 500 miles of this distance; and two, consideration of using successive waves of fighters in order to accomplish this 750-mile range. This meant employing a second wave of fighters equipped with auxiliary tanks, to follow the bombardment formations at a given distance to the rear. These fighters would take up the escort after the first wave had reached its maximum range

without the use of auxiliary tanks. The objective of the escort fighter was expected to prevent enemy fighters from using head-on attacks, pursuit air-to-air bombing, long-range, high-caliber gunfire, and rocket projectiles.[45]

An AAF board requested that the School of Applied Tactics thoroughly study long-range escort fighter tactics and prepare a report formulating tactical doctrine. Upon completion of the study the board on 17 December recommended the P-51B and the P-38 as the most practical escort fighters, and that necessary range be achieved by using pressurized, droppable fuel tanks.[46]

In view of the apparently satisfactory progress being made to produce tanks in England, VIII Fighter Command, in conjunction with the A-4 section of the Eighth Air Force, requested that all tank production in the United States be canceled. A shipment of 4,000, 75-gallon tanks was sent prior to this request. They were to be used pending the availability of the larger paper tanks.[47] On 8 August, VIII Air Force Service Command sent two paper tanks to the United States, to be examined with a view toward manufacturing them in this country for the AAF in all theaters.[48] The idea of manufacturing tanks from non-strategic materials appealed to American engineers, and they conducted a series of tests on the British models. Arnold insisted that everything be done to expedite the research and experiments on these tanks.[49] On 10 August Eaker urged Miller immediately to support the tank program with the highest priority and to "push it to the

maximum."[50]

On 29 August Maj. Gen. William E. Kepner succeeded Hunter as commander of VIII Fighter Command. Kepner could be counted on for aggressive leadership.[51] Prior to his leaving the United States, Arnold told him to press for maximum effort to extend the range of fighters. Kepner had earlier urged aircraft engineers to increase the range of planes then being built. His promotion reflected the increased effort to solve the range-extension problems.[52]

September saw the tank program still far short of the promised deliveries.[53] Although some tanks had already been sent to England, the amount was far from adequate. On 7 September, Eaker asked for immediate shipment of 1,500 each of the 75-gallon and 150-gallon leakproof types. He told Arnold they would be used for operational test purposes, since requirements for exact types and specifications could not be given until the tests were completed. He also said that if the leakproof tanks met the Eighth Air Force's needs for two-point suspension, capable of withstanding minimum internal pressure of seven pounds per square inch at altitudes up to 30,000 feet, then it would be desirable to begin production.[54]

In mid-September Material Division ordered 150,000, 150-gallon tanks for the AAF in England and North Africa.[55] Spaatz wrote Portal that tanks promised by the Ministry of Aircraft Production in early August were not forthcoming. He said, "MAP has not been able to make good the promised

deliveries. I have just received a cable from General Arnold which indicates that these long-range tanks cannot be supplied from the United States before December."[56] Upon learning of the delay in British tank production, the AAF shipped all 75-gallon tanks available in the United States to England. Eaker in a letter to Portal reminded him of the crisis growing out of the shortage.[57] He also wrote Freeman in a similar vein on 14 October, "As an example of how critical this situation is, I am quite certain that we lost at least twenty heavy bombers last Sunday on one mission because our fighters were not equipped with these tanks."[58] In his reply to Eaker, Freeman admitted that the British had falled behind their predicted figure and to date had delivered only 567 tanks when somewhere between 800 and 1,000 might have been expected. He estimated current production at between 400 and 500 tanks per week and hoped that the deficiency would be overcome by 10 November. The fault for the delay, Freeman insisted, was not solely that of the Ministry of Aircraft Production. He pointed out that not until the first week in October was the "all clear" given MAP for certain metal fittings, feed, and vent pipes, which were needed for producing the tanks. He reminded Eaker that in February he had asked that he not suddenly be faced with an overwhelming demand for tanks, and pointed out that not until June was urgent application made to him for the jettisonable tanks.[59]

British tank production reached a point in December which permitted American manufacture of 75-gallon models for the ETO to be canceled. By the end of 1943 between 2,000 and 3,000 tanks were available at each fighter station of the Eighth Air Force. Total British 108-gallon tank production had reached 7,554 by the end of the year.[60] British output continued to increase considerably in the early months of 1944. By March over 14,000 units of the 108-gallon model were being turned out monthly, and output of the 150-gallon paper-tank model exceeded 1,000.[61]

British contribution to the American tank program was handicapped by confusion in planning. Many agencies were engaged in this effort -- the VIII Air Force Service Command, the technical section of VIII Fighter Command, the Ministry of Aircraft Production, and several English manufacturing firms. The whole program, wherefore, suffered from too many hands, as well as from supply shortages and design problems. Too many orders emanated from uncoordinated sources. Lack of a clear-cut policy controlling the experimental work cost valuable time and effort.[62] The sudden demand for thousands of tanks, complicated by an absence of positive directions and instructions to expedite orderly assumption of production, placed a large burden on British capabilities. This was clearly the responsibility of American officials who did not provide their British allies with the necessary direction earlier in the year. Fortunately, the picture brightened by

late autumn of 1943, and thereafter the British provided the AAF in England with a ready supply of these urgently needed tanks.

The AAF can be legitimately criticized for its lack of planning for tank production. The air war had moved so quickly from minor forays by bombers and fighters against targets on the coasts of France and the Low Countries -- all within the radius of short-range fighters -- to deep penetration targets in Germany, that the Eighth Air Force was caught unprepared to offer escort to bombers on long missions.

The tank program had operated satisfactorily earlier in 1943 when a production summary listed the completion of 48,575, 75-gallon tanks out of 154,351 ordered, and 6,450, 150-gallon tanks out of 54,900 ordered.[63] But, when the AAF assumed later in the year that Eighth Air Force demands could be met by tanks manufactured in England, American production was cut back in keeping with that estimate. This vital miscalculation was bluntly brought home to Arnold by General Hume Peabody, Commandant of the School of Applied Tactics, who said, "It is agreed that our present lack of leak proof auxiliary tanks indicates a lack of forward thinking."[64]

In September when Requirements Division found that only 300, 150-gallon capacity tanks were being produced daily in the United States, arrangements were made to increase output to 1,000 per day. The Eighth Air Force was asking for tanks at the rate of 22,000 per month, and the North African Air

Force wanted 23,000.[65] On 18 September Materiel Command announced contracts for 150,000 droppable tanks to serve estimated demands through February, 1944. First priority went to the Eighth Air Force. Because final tests on the 150-gallon tanks were not finished, the order started by substituting the 100-gallon model until the larger tank was approved.[66]

American production was based on many variables and the disposition and size of the tanks were conditioned by the changing war picture. In an effort to coordinate the tank program, Maj. R.W. Johnson, project officer of MM&D for the fighter range-extension program, conducted a meeting on 25 October in Washington with representatives of the Army Service Forces Transportation Corps, Air Transport Command, Materiel Command, Fighter Division of OC&R, and other branches of MM&D. They discussed problems pertaining to production of additional fuel tanks for the P-38J, -47D, and -51B, the needs of the various war theaters, and methods of shipping fuel tanks to war theaters for modification. The main purpose of the meeting was to assure the Eighth Air Force of the required number of kits for scheduled modifications. In every case the group gave the Eighth Air Force requirements highest priority. Any surplus production would then go to other theaters in need of tanks. The Eighth Air Force required 1,600 per day.[67]

Meanwhile, though frantic efforts were being made to fill logistical demands for the escort necessary for success-

ful execution of the daylight bombing campaign by increasing the internal tankage of pursuit planes, pilots were able to fly with external tanks, many times hot of desired size, but which enabled them, nevertheless, to give the planes a long reach. For example, the AAF used a flat-top tank of 150-gallon capacity under the belly of the P-47 as a stopgap until it was equipped with a wing-rack installation to use the conventional tear-drop shape tank.[68] Fuel consumption varied with the type of fighter and model of tank used. The P-38 used two 150-gallon tanks as standard external fuel load and on occasion carried two 108-gallon paper tanks. The P-47 used two 108-gallon models, though it was equipped with bomb shackles which permitted use of the 150-gallon P-38 tank if necessary, and the 75-gallon tank as well. A 200-gallon model for the P-38, rejected for combat purposes, was considered satisfactory for ferrying.[69] Notwithstanding increased American and British production, tanks were still in short supply because of the great demand. By March, 1944, tank estimates were set at 1,500 per month per group, and thereafter the supply was coordinated with monthly theater estimates to facilitate planning and distribution of those available.[70]

Efforts to increase the internal fuel capacity of fighter planes represent another phase of the range-extension story. Here the problem was primarily one of increasing the internal

tankage without seriously reducing the operating efficiency of the airplane.[71] On 21 April 1943, MM&D ordered a study to determine the practicability of installing additional wing tanks in the P-38 to increase its maximum fuel load to 400 gallons. This order was modified on 8 June when the AAF learned that Lockheed was testing a cone-shape, 110-gallon self-sealing tank that would fit on the rear of the cockpit. Instead of adopting this model, Air Force engineers pressed for use of external fuel tanks. On 3 July Washington asked Wright Field to study possibilities of increasing the internal fuel load of the P-38, which was still considered to have the best long-range potentialities.[72] Four days later, General Giles, Assistant Chief of Air Staff, learned that 110 gallons of fuel could be put in the leading edge wings or 55 gallons in each wing of the P-38. It would take about four months to complete this modification on 100 planes, but would not interfere with current production. After a meeting with representatives from Lockheed and Wright Field, engineers decided that the wing fuel capacity could be increased to 120 gallons and that this installation would be ready for delivery to Eglin Field for testing in approximately 60 days. This modification increased the total internal tankage of the P-38 to 420 gallons.[73]

General Kepner contributed to this project by visiting Lockheed, Republic, and North American aircraft companies in the spring and summer of 1943 to urge their engineers to

put more range into the fighters. His prompting led them to examine the problem more closely, which eventually resulted in a wing-tank modification.[74] The leading wing-tank installation on the P-38J was at first used exclusively in those theaters urgently in need of long-range fighters. The P-47D also was used for long-range. To expedite shipment of both these aircraft, the Transport Command arranged to ferry them from modification centers to Newark, New Jersey, and then to war fronts.[75]

The program on the tank and range-extension program became the subject of a memorandum to the chiefs of all Headquarters' offices from the Air Adjutant General. In an effort to confirm and clarify the escort fighter program the memorandum stated:[76]

> The U.S. has in operation two Long Range fighter Aircraft, the P-51 and the P-38. The combat radius of action of fighter aircraft as offensive fighters is governed by the interal gasoline capacity, which must be sufficient to cover:
>
> 1. Warm-up and take-off.
> 2. Twenty minutes combat at full military power.
> 3. Return to base at desired cruising speed.
> 4. Thirty minutes of fuel reserve.
>
> External fuel can be used only after take-off and to the contact with the enemy. This distance can never exceed the distance other than the internal fuel list above in 2, 3, and 4. . . . An 85 gallon self-sealing fuselage tank has been developed for the P-51B, and within 60 days will be ready for installation in the modification centers. Similarly, self sealing tanks with a capacity of 120 gallons have been developed for installation in the leading wing of the P-38J and are scheduled to be in production within three months. Meanwhile, 120-gallon wing tank kits will be depot installed in the P-38J aircraft now coming off the production line. . . . Self sealing external droppable tanks have been developed to replace

> the present 75 and 150 gallon non self sealing external tanks. The 150 gallon self sealing external tank for the P-38J will be ready for production in three weeks and the 75 gallon self sealing external tank for the P-51B in about 60 days.

On 3 September Arnold informed General Marshall of the AAF's pressing need for long-range fighters in the ETO. Speculating on the future of this program, he told Marshall that, as the number of fighters accompanying bombers increased, their losses would correspondingly rise to a point where fighter losses would probably exceed bomber losses. He hoped that a plan could be worked out that fall to supply fighter replacements in numbers equal to bomber replacements.[77] The following day Wright Field was notified that the long-range pursuit development program had been given a Triple-A priority and should be pushed with maximum effort by all agencies.[78]

The problem of increasing internal fuel capacity was solved more easily in the P-38 than in the P-47, for the design of the latter necessitated a new approach. Republic Aviation Company had started modifying one P-47 about 1 September and attempted to increase fuel capacity by an additional 65 gallons. This required raising the cockpit floor and changing all the bulkheads and fittings in the front part of the fuselage. Republic engineers estimated that it would require about two months to finish this modification, and until March to incorporate this change into the production line.[79] This modified Thunderbolt, designated P-47D-15

had a combat radius of 430 miles. A later model, P-47D-25, incorporated an additional 65 gallons of fuel and was expected to have 100 to 125 miles greater radius of action than earlier models.[80] Its total gasoline capacity was 374 gallons. The extra fuel was located almost at the center of gravity and did not materially change the handling characteristics other than a loss in climb from the extra weight.[81]

The program to extend range in both the P-38 and P-47 by the end of 1943 resulted in the following progress: The P-47 without external tanks had a 175-mile radius; with one 75-gallon tank this increased to 280 miles, and with one 108-gallon tank it reached 325. The P-38 without external tanks had a 200- to 220-mile radius; with one 150-gallon tank it could achieve a maximum escort radius of 380 miles, and with two 150's could fly 430.[82] Further efforts to increase the P-47's tankage were made in early summer of 1944 when an extensive redesign of the wing section, allowing approximately 100 gallons of gasoline, was installed in each wing panel. This increased total tankage to 570 gallons. By putting 600 gallons in droppable tanks, and thus making a total load of 1,170 gallons, the Thunderbolt would have a combat radius of approximately 1,000 miles.[83] Successive modifications on the P-47 increased its range to the point where it could fly more than 2,000 miles.[84]

The YB-40 and Other Variants

As an alternative to a long-range fighter, the AAF in June, 1941, began to consider development of an escort bomber, known provisionally as the XB-40 or YB-40. The approach ultimately decided upon was to arm a B-17 heavily, add armor to it, and employ it as a "destroyer escort plane." This aircraft was designed specifically to protect heavy bomber formations in deep penetrations over Germany. The YB-40's, masquerading as bombers, were to fly in the most vulnerable positions of the combat boxes and thus deter German fighters from closing for combat.[85] The idea for such a plane was not new. Indeed, plans for a large aircraft to serve as escort can be traced to the early twenties, when the Air Service advocated employment of the two-seater as a support plane for bombers. From that time on, the idea of an escort hinged in part on a large plane, generally regarded as a multiplace type. Many airmen believed that escort bombers could supply a "hard crust" to bomber formations by increasing their defensive firepower.[86] While earlier attempts to adapt existing bombers to escort purposes proved impractical, the idea retained its appeal.

Late in June, 1941, the Experimental Engineering Section of the technical staff of Materiel Command requested that the design unit of the aircraft laboratory begin studies for a convoy-protector type aircraft, to determine the type of plane

needed, location and type of armament, crew arrangement, and armor protection. Military characteristics could then be written to better advantage. The plane was considered one of the most difficult but most important military aircraft problems at that time, and, therefore, the technical staff requested that a high priority be assigned to the project.[87] Because heavily-gunned power turrets increased the defensive powers of bombers, the convoy protector airplane seemed to offer a solution to the problem. Military characteristics for such a plane would be: one, multiengined, having a speed in excess of, and the same range as the bomber it was to protect; two, heavily armed for the protection of the engines and personnel; three, heavily leakproofed fuel tanks and oil lines; and, four, ability to carry a sufficient number of powerful multi-gunner turrets to match gunfire with any two modern fighters making simultaneous attacks on it. Materiel Command, however, felt that it was not expedient to design a new plane of this type and suggested that a convoy-protector could be made by converting an existing bomber.[88] The experimental engineering section asked for a directive authorizing the development of this type of aircraft.[89]

Little, if any action, was taken until seven months later on 1 April 1942 when a conference was held in Washington at the Office of the Director of Military Requirements to discuss an escort airplane. Again it was emphasized

that the necessary characteristics were ceiling, speed, range at least equivalent to that of any plane being escorted, and flexible armament. Since development of an entirely new airplane again was believed to be too time-consuming, the consensus was that both a B-17E and a B-24 should be modified.[90] Col. Millard E. Gross, director of Military Requirements, outlined proposed characteristics, which were similar to those submitted the previous September, and directed that steps begin at once to meet the requirements.[91] On 13 April Materiel Division issued instructions for development of this bombardment escort airplane.[82] On 2 August, Vega Aircraft Corporation at Burbank, California, received a B-17F, which had been modified at the Cheyenne Modification Center, with a power-operated tailgun and mock-up Bendix chin turret.[93]

Meanwhile, from England, Brig. Gen. A.L. Lyon appealed for an escort and submitted a plan in late August based on the board's recommendation to refit a B-17 and a B-24 for escorts. According to Lyon, the planes should carry no bombs, but devote their entire useful load to increased armor, ammunition, and armament. With a range of 1,700 miles, these planes would serve as support weapons to any practicable target. He hoped that by mixing them in ratio of one YB-40 to three or four bombers, they might free the latter from limitations of fighter range. Lyon believed that the YB-40's guns and the bombers' firepower could offset any fighter defense.[94] After considering Lyon's plan, an AAF board recom-

mended that the YB-40 should carry 1,100 pounds of engine armor, in addition to upper turrets in the radio operator's position and in the usual position; a lower ball turret; a Bendix chin turret and twin tailguns with 400 rounds of ammunition each. All other turrets were to have 1,600 rounds in each gun. The waist and tailguns were to be hydraulically controlled, and equipped with a special sight. If the plane proved successful, other planes were to be converted to use as escort bombers.[95]

Maj. Gen. Carl Spaatz, who commanded Eighth Air Force, gave the project his complete approval. He believed that to be effective it should be completed by 21 February 1943. He pointed out such planes should be designed for regular production since, if successful, they would be needed in considerable numbers.

Another impetus for this type of plane came from the European theater in October when an Eighth Air Force communication to Washington stated that evidence indicated that B-17's could penetrate beyond the tactical radius of the fighters and if successive attacks did not exhaust their ammunition. The Eighth's airmen at this time believed that they could go beyond fighter range, but that they lacked sufficient bombers to saturate enemy defenses. They tended to minimize the value of escort fighters and to argue that heavy bombers suitably armed and supported by a few escort bombers of the YB-40 type could successfully penetrate German defenses.[96] Eaker recommended that a B-17 be modified for

escort purposes by adding nose and tail turrets.[97] He believed losses could also be materially reduced by adding armor and more ammunition to the B-17 and placing it on the flanks of bomber formations. Eaker thought it was important that a squadron be provided at the earliest possible date for experimental purposes.[98]

In a report on his observations of the American effort in England in 1942, Eddie Rickenbacker concluded that a small fighter-escort plane would be impractical until bases were established on the Continent. He urged, instead, that "bomber escort be developed in the same manner as the bomber, but used as a 'flying battleship.'"[99] This reference to the escort plane in naval terms may have arisen from conversations earlier in the year between General Spaatz and members of the British Admiralty. In these talks the term "air battleship" was used in discussing increased armament and firepower.[100] Rickenbacker believed that the fighter plane should be employed as a defensive weapon until the Allies could occupy airdromes on the Continent. Furthermore, he thought that the long-range bomber should be the main attacking force and that its protection should consist of "battleships" of its own type, heavily armed without bomb load, but with extra amounts of ammunition.[101] Eaker employed a similar nautical parallel by stating that the YB-40 could serve ". . . much as the destroyer screen in naval warfare protects the battleship

flotilla."[102] However, while this project had been started officially in late summer of 1942 (and was not scheduled for appearance in the European theater until the spring of 1943), Baker was not overly enthusiastic about it. Many of his commanders hoped, however, that the YB-40 would permit bombers to operate over Germany as far as their fuel could carry them.[103] Spaatz, who was optimistic about the YB-40 project, wrote Arnold that development of a B-17, modified by nose and tail-guns, would insure of successful penetration to the maximum tactical radius of operation of heavy bombers. He wanted the initial squadron sent to the ETO.[104]

A group of Eighth Air Force officers who returned to the United States in the fall of 1942 inspected the XB-40 and XB-41 (a B-24) and said that these aircraft would "revolutionize daylight bombing in the U.K."[105] These airmen believed that the planes were capable of marauding and shot bombing missions as well as escort. In their estimation a sufficient number of these aircraft would permit daylight bombing raids without fighter protection, thereby enabling B-17's and B-24's to strike at the heart of the German industrial center. They suggested that crews for the aircraft be hand picked and trained "one hundred per cent in the United States without delay,"[106] and requested that spare parts be shipped to the United Kingdom. They then concluded, "The aircraft is the product of many well planned ideas and is a long stride forward in eliminating the German fighter force operating against

U.S. bombers based in the U.K."[107] This summary together with Lyon's request represented the most complete statements favoring the YB-40 project, as seen by Americans in the United Kingdom.

In the United States the XB-40 arrived at Eglin Field on 9 September 1942 equipped with a new tailgun installation and four turrets, including the Bendix chin turret. On the basis of tests conducted between 10-17 September, engineers concluded that the chin turret was a definite step toward providing frontal protection for the plane.[108] Materiel Command then took action to expedite completion of the XB-40 at Vega Aircraft in order to return it to Eglin Field for complete turret and evaluation tests. Originally, six B-17's were to be converted to bombardment escort models,[109] but on 11 October the Director of Military Requirements directed that 13 be modified as YB-40's as soon as the Eglin Field tests were finished. Provisions also were to be made for four minutes of ammunition supply for the tailguns. These planes were to be diverted from B-17 replacement aircraft for the United Kingdom.[110] On 17 October, Maj. Gen. Muir S. Fairchild of the Air Staff suggested that the work of converting additional XB-40's be classed as modification in order to secure the advantages of highest priority. He stated that the importance of the project rested on the fact that it might have a "deciding influence on extending our present penetrations into enemy territory."[111] The production engineering section

at Wright Field informed Materiel Command at Washington that every possible priority would be given to the YB-40 project. Actual conversion was assigned to the Douglas Modifications Center at Tulsa. All 13 planes were to be delivered there by 20 November and 1 March 1943 was set as the tentative date for their completion.[112] A considerable delay, caused by difficulties in design and failure to obtain necessary parts, prevented delivery of the 13 planes until May, 1943. Even then, delivery was made without the powered side and tailguns, but it was understood that their mounts could be installed later.[113]

Twelve YB-40's arrived in England in late May and were assigned to the 92d Bombardment Group (Heavy).[114] Engineers further modified them to facilitate passage of ammunition from the radio compartment to other sections of the plane.[115] Seven of the planes were dispatched on 29 May for a mission to St. Nazaire. This initial experience dictated the necessity for further modification of waist and tailgun feeds. The first mission also revealed one of the craft's basic defects, namely, its inability to keep up with the bomber formations, especially after the bombers had dropped their loads. However, enemy fighter opposition was light, and the YB-40's did not have an opportunity to test their firepower.[116] The plane, as developed, had different flight and performance characteristics from the bomber. Being heavily armed and loaded, it could not climb or keep in speed with the B-17,

which tended to disrupt the formation. In order to use the planes' unique firepower, which was 20 per cent greater than the B-17's, they were placed on either side of the combat wings but again their slow speed and rate of climb were drawbacks to the flight as a whole.[117] The increase of two to three inches more manifold pressure and 100 more revolutions per minute to keep in formation reduced the range and rate of climb, which strained the engines and caused the planes to become sluggish at high altitudes.[118] Subsequent missions flown by this plane failed to result in satisfactory performance. Moreover, the additional guns placed on each plane did not materially add to the combined firepower of a group formation.[119] The poor record of these planes prompted the AAF to abandon the idea of using the YB-40. The experiment, though largely negative, was not without some positive good, since it demonstrated the advantages of the chin turret, which became standard equipment on all subsequent bombers.[120]

The AAF also tried to convert the B-24 into an escort plane, the YB-41. The general modifications made in this plane were similar to those attempted in the YB-40. While armament installations in the YB-41 were reported functionally reliable and tactically suitable, the installations adversely affected the plane's stability.[121] Unable to overcome the unfavorable weight, performance, and center-of-gravity characteristics as reported by AAF Proving Ground tests, the War Department asked that the program be canceled.[122]

As in the case of the YB-40, one improvement in the B-24 was brought about -- increased firepower in the nose -- and, with this modification, it was hoped that the need for the YB-41 airplane would be eliminated.[123]

Having rejected the conversion of heavy bomber types, the AAF turned to the B-26 as an escort plane. General Giles informed the commandant of AAFSAT at Orlando of OC&R's desire that a high priority be given to determining the suitability of using a large-wing B-26 airplane as bomber escort on high altitude operations in the European theater. In addition to obtaining most effective service from the B-26's which were available in large numbers, Giles hoped that the suggested change might also solve the high rate of losses suffered in bombardment operations. B-26's, as escorts, would run interference for the bombers and would use both fixed and flexible guns as armament.[124] On learning of this proposal Eaker wrote Giles, "The B-26 is going to do all right at medium level against German airdromes and targets within its range, and will make a good support air weapon. It definitely is not, and never will be by any stretch of the imagination a satisfactory accompanying fighter."[125] Giles replied that he was not hopeful, but wanted to explore every possibility. "Tests are now being conducted for this purpose, but it is still too early to determine if we can make any changes in the airplane which will permit employment of this nature."[126] After a re-evaluation of this project, the experiment was dropped.

This episode in the story of the escort plane points up certain assumptions that had dominated so much pre-war thinking. In attempting to solve the problem in 1942 and early 1943 through use of a large plane, planners relied on superior firepower and armor to defend bomber formations. The element lacking was maneuverability, which the AAF had come to recognize as vital in solving the escort problem. Even with its increased armament, the escort bomber added little to the firepower of formations.[127] The YB-40 project represented a dissipation of energy which the AAF could ill afford. This chapter in the story of the air war was an understandable but wholly unsatisfactory answer to the problem of protection for bombers. The concept of employing a large plane was not necessarily unworkable, but this particular application was an unqualified failure.

The P-51 Mustang

The North American P-51 Mustang was one of the few planes designed and produced after the outbreak of war in 1939 which saw a major share of action. Its unique capabilities were recognized shortly after it entered combat. Some persons recognized the possibilities of using this plane for escort after it was equipped with a Merlin 61 engine, but took no immediate action in that direction. Its speed, maneuverability, firepower, and range made it preeminently suitable to accompany bombers. Once the decision

was made to equip VIII Fighter Command with the Mustangs, a great deal of effort was expended in their production. It was not until early December, 1943, in spite of the priority given the P-51, that pilots flew the first Mustang in Europe. Thereafter, it supplanted both the P-38 and P-47. By late 1944 only one VIII Fighter Command group was equipped with P-47's, and no units flew the P-38 after mid-summer, 1944. Units were equipped with Mustangs just as rapidly as they could be trained to fly it. In the Pacific theater it escorted the B-29's on raids against the Japanese home islands. Both American and British airmen regarded it as perhaps the finest fighter developed by the Allies during the course of the entire war.

The story of the P-51 is one of comedy and near-tragedy -- comedy in that the American plane was employed only after the British used it first; the tragedy in that it was neglected and not placed into mass operation until the spring of 1944, a mistake Arnold frankly admitted in his memoirs. He wrote, "It may be said that we could have had the long range P-51 in Europe rather sooner than we did. That we did not have it sooner was the Air Force's own fault."[128]

The P-51 story began in April, 1940, when the British Aircraft Commission approached North American Aviation Company with a view toward producing the Kittyhawk P-40 airplane for a British contract.[129] The company realized that this offered an opportunity to build a fighter incorporating new

features, including the laminar-flow wing.[130] After due consideration, North American suggested that it could produce a fighter of its own design with better characteristics in a shorter space of time (120 days) and at less cost than the P-40. To comply with existing regulations, North American signed a foreign release agreement with the AAF on 4 May 1940, which permitted sale of the NA-73, the first version of the P-51, provided the AAF received two for experimental purposes.[131] The British, upon receipt of North American's offer, agreed to this course, and requested that the design conform to the general operational characteristics of the P-40 except for improved armament. North American drafted a preliminary design which was considered satisfactory by Sir Henry Self, Air Vice Marshal G.B.A. Baker, and H.C.B. Thomas. The latter, who was New York representative for the BAC, wrote detailed specifications for the new plane. The fuselage shape, wing section, profile, and aerodynamical features were North American's designs, influenced to some extent by the P-40. The detailed design, installation, and mock-up were supervised by Group Captain Adams, RAF, and H.S. Howett of BAC, and by representatives of North American.[132] The company began production of the airplane shortly before the end of 1940 and delivered the first unit to the RAF in November, 1941.[133] The Mustang made its first flight in the British Isles that same month and went into operational use for the English the following July.[134]

Initially the Mustang was equipped with an Allison engine, which gave it a low altitude rating. This made the aircraft unsuitable for employment in the British Fighter Command, and it was used instead in the British Army Cooperation Command,[135] and saw much action in the Mediterranean Theater of Operations. Its speed and excellent controllability convinced RAF engineers that it had still greater possibilities.[136] Its potentialities indicated that with a high-altitude engine installed, the Mustang might develop into a first class high-altitude fighter.[137] This opinion was based on the fact that the P-51 with the Allison engine was 35 miles an hour faster than the Spitfire at an altitude of 15,000 feet. At 25,000 feet the Mustang was a few miles per hour faster, but pulled 290 less horsepower. This performance indicated to engineers that the plane was aerodynamically superior. Dr. Albert J. Warner, an American aeronautical engineer, went to England in 1942 to make a series of studies on the P-51. He decided that the Mustang possessed a very low drag coefficient as compared to the Spitfire, thus explaining its superior speed. Rolls Royce, a British aircraft engine manufacturing firm, was also impressed with the performance of the Mustang when fitted with the Allison engine. During May, 1942, this company made estimates of the P-51's performance fitted with a Merlin 61 engine. As a result of these estimates, instructions were given for a trial installation, and, ultimately, Rolls

Royce received a contract to modify five P-51's.[138] The company estimated that the installation of the Merlin engine would take approximately 12 weeks, but would give the Mustang a speed of more than 440 miles per hour.[139] Although this estimate proved to be excessive, the British decided to modify the Mustang in an effort to match the performance of the German Focke-Wulf at its operational altitude of about 21,000 feet. This necessitated changing the blower ratio. The plane then had a critical altitude of 21,000 feet and a speed of 426 miles per hour.[140] On 13 October 1942 the Mustang, equipped with the Merlin 61 engine, flew for the first time.[141] With this modification, the British had produced a potentially excellent high-altitude fighter which they believed would serve the need for high cover when necessary. The directional stability, poor at first, later was satisfactorily corrected by North American engineers.[142] The English planned to employ it in their fighter command for air defense of the British Isles, not as an escort fighter.

The American part of the story of the P-51 began with approval of the contract permitting North American to build it for the British and the acceptance of two planes for AAF test and experimental purposes. The contract for two XP-51's was approved on 20 September 1940 and North American delivered them to the AAF during the latter part of 1941.[143] The Air Force was not enthusiastic about them, being satis-

fied with the three fighters then in production, the P-38, -39, and -40. Some hesitancy on the part of the AAF may have arisen from the fact that the Mustang was built for a foreign government and did not fully conform to specifications set forth by the Wright Field handbook for fighter airplanes.[144] Maj. Gen. Orville Anderson described the AAF's reception of the Mustang in the following manner:[145]

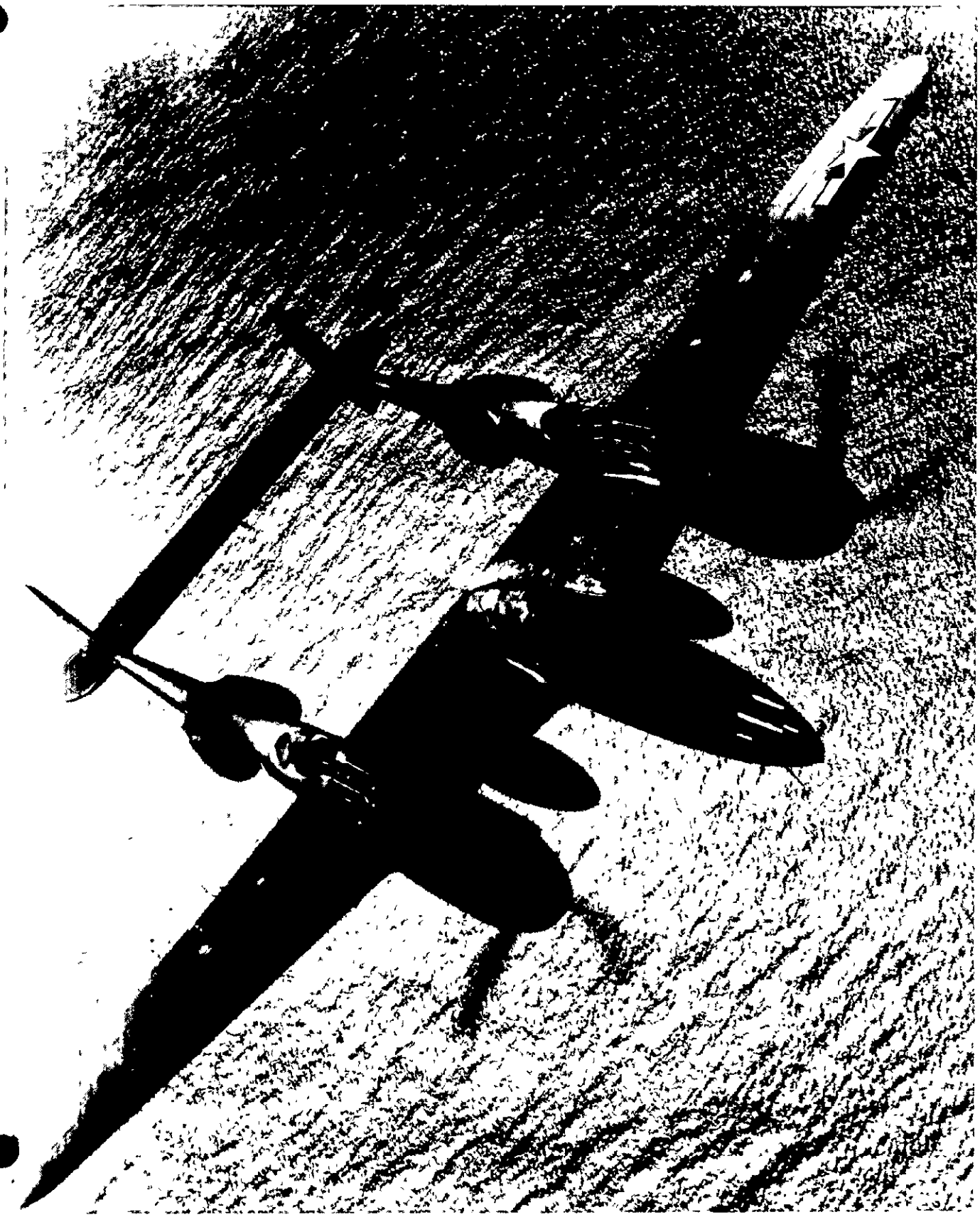
> And then it /the plan for the Mustang/ came to the Munitions Building at that time . . . with the request from the British that we build them at least 500 a month of this new airplane, this Mustang. Not having had anything to do with the design, growth, tests of the P-51, we looked with disfavor on that airplane. We leaned much more strongly to the P-39, the Airacobra, and the P-40, two antiquated aircraft in 1941. But because of the need for compromise, now that this thing had been really built, and apparently to protect ourselves from sticking our chin out too far, we said, "Well now maybe there is some use for this airplane. It's a liquid airplane, therefore rather vulnerable to frontal fire." So we assigned it to production and called it an A-36. And the first 500 airplanes of this new unit, , which was about six months late in its initial assignment, was /sic/ made into an A-36. A dive-bomber with a liquid engine. /sic/ After we had built 500, we then belatedly recognized that maybe it was good enough that we could /sic/ put it into our fighter echelon. This attitude of mind on the part of the Air Force policy makers and planners delayed the strategic deployment of this critical, almost decisive, weapon by well over nine months before it was actually deployed for combat.

Although the AAF in Washington did not immediately favor the new plane, two Americans in England urged the AAF to consider the Mustang in a more favorable light. They were Maj. Thomas Hitchcock, Assistant Military Air Attache, and John C. Winant, U.S. Ambassador to England. Their support of

the P-51 was shared also by Eddie Rickenbacker who favored the plane after he had talked with Sir Trafford Leigh-Mallory, Air Officer Commanding-in-Chief of the RAF Fighter Command, who held great hopes for it.[146] In October, 1942, Major Hitchcock wrote the following to Washington:[147]

> The Mustang is one of the best, if not the best, fighter airframes that has been developed in the war to date. It has no compressibility or flutter troubles, it is maneuverable at high speeds, has the most rapid rate of roll of any fighter except the Focke-Wulf 190, is easy to fly, and has no nasty tricks. Its development and use in this theater has suffered for various reasons. Sired by the English out of an American mother, the Mustang has no parent in the Army Air Corps or at Wright Field to appreciate and push its good points. It arrived in England at a time when great emphasis was placed on high altitude performance, and because it was equipped with a low altitude engine, was of no particular interest to English Fighter Command. The Mustang was turned over to the English Fighter Command for low altitude work. It performed well at Dieppe. The pilots who fly the Mustang are enthusiastic about its performance.

In the fall of 1942, North American completed production of the 500th A-36, a P-51 fitted for dive bombing operations, and the War Department followed this with an order for the company to begin work at once on production of the P-51A for AAF use.[148] Maj. Gen. Muir S. Fairchild, director of Military Requirements, wrote to the commanding general of Materiel Command on 31 August that "the Merlin should be introduced into the P-51 production as early as that airplane engine combination is determined practicable."[149] On 1 November the Proving Ground Command submitted a report to



General Arnold which embodied results of tests that had been conducted on the P-51. The report stated, "The subject aircraft is the best low altitude American Fighter yet developed, and should be used as the criterion for comparison of subsequent types."[150] North American, on receipt of the results of the British and their own tests with the Merlin/Mustang, redesigned the P-51 to take a new engine. A version of the Merlin was then in production by Packard, the MK XX or V-1650-1. Progress had been made in the design and tooling-up for the Packard development of the Merlin-61, known as the V-1650-3, which incorporated the two-speed, two-stage supercharger made famous by Rolls Royce.[151] Now convinced of the P-51's qualities, General Arnold wrote President Roosevelt: "The RAF is very keen about the P-51, and we have intalled Rolls Royce engines into two of them -- one in England and one in the U.S. Tests indicate that they will be a highly satisfactory pursuit plane for 1943. We think so much of them we have already given orders for 2,200."[152]

The AAF, having now accepted the Merlin/Mustang P-51B with the belief that it had great promise, began to contemplate using it in the range-extension project which was as yet not a critical AAF concern. Model B of the Mustang carried 180 gallons internally and had a total range of 740 miles.[153] Several reasons for delay in utilizing the P-51 as an escort fighter can be given. It must be remembered that the critical need for an escort was not seen until the

summer of 1943. Prior to that time hopes had rested on the YB-40 experiment. It must also be remembered that the crisis in the bombing offensive was not until late summer 1943. Because the P-38 had shown itself to be an outstanding fighter in the North African campaign, any thinking on the use of a fighter as an escort plane centered largely on the P-38, a tried and battle-tested weapon. The P-51B was an unknown quantity in the first half of 1943 save for the experimental tests that had been made on it. Indication of the apprehensiveness of AAF commanders can be seen in March, 1943, when Eaker admitted that the P-51A was an excellent fighter for low and medium altitudes, but that with the added weight of the British engine it would not make a good plane for high altitudes.[154]

When the need for a small escort fighter became apparent, the AAF began to consider the P-47 and the P-51B. Once the AAF decided to exploit the advantages of the P-51, it was modified to carry more fuel internally. A test to determine the effects of an additional 85 gallons of fuel on the handling of the Mustangs, led to the conclusion that this addition would be advisable. However, when the tank was full, the plane was unstable longitudinally. When half-filled, its performance was approximately normal.[155] On 3 July 1943 Col. Mervin E. Gross, AC/AS, MM&D, submitted to General Giles a detailed analysis of the planes then considered capable of being used as escort fighters. Colonel Gross considered the

P-51B as the most promising plane. It was designed, he said, with an internal fuel capacity of 184 gallons and an external fuel capacity of 150 gallons, and could remain in the air 4 hours and 45 minutes, consuming an average of 64 gallons of fuel per hour.[156]

The first modification to increase the internal tankage of the P-51 came in mid-August, 1943, with the installation of the extra 85-gallon tank. This increased the tankage to 269 gallons. The Requirements Division estimated that it would take about 75 days to install these tanks on production-line planes.[157] This weight increase reduced considerably the performance of the airplane.[158] The rate of climb was reduced about 470 feet per minute and the flying characteristics at altitudes above 25,000 feet were seriously affected. Furthermore, the plane was sluggish and the acceleration obtainable without stall was low. When the additional fuel tank was placed in the rear of the fuselage, the longitudinal stability was marginal until the rear tank was partially emptied. However, this marginal stability was capable of being overcome in flight since the fuel from this tank was used first. The production engineering section recommended that the 85-gallon fuselage tank be the only increase in the P-51's internal tankage capacity. The plane's poor flying characteristics indicated that this restriction should be observed "even if the space or desirability for maximum range existed."[159] Because the additional 85-gallon tank would not permit IFF

equipment, arrangements were made for modification to accommodate the tank or the IFF equipment. Alternate equipment was to be sent with each plane. The final decision as to which installation would be made was left to a future date.[160] Clarification of this came on 28 August when it was decided to proceed with the installation of the 85-gallon tank, after receipt of an urgent cable from the United Kingdom requesting that maximum range be built into the P-51. On 2 September the Requirements Division announced that work would be expedited to determine if IFF equipment could be installed in the engine compartment.[161] It was eventually installed in the forward section of the fuselage. Although additional fuel could be carried in the outer portion on the P-51's wing by means of a wing change, this was not advised by Wright Field engineers because the necessary redesigning would delay production until "far in the future." Moreover, they believed that the extra weight of leakproof tanks would decrease the Mustang's rate of roll and would be uneconomical in view of the small saving of fuel.[162] Having now decided to build the maximum number of P-51's possible for the task of escorting bombers, the AAF's next problem was to supply these planes to VIII Fighter Command.

General Arnold, while inspecting the Eighth Air Force in September, had requested by cable that P-51's be provided for the bombers in the shortest possible time. On 4 September OC&R, acting on the Arnold cable of the day before, proposed

that "immediate action be taken to re-equip two additional P-47 groups in the U.K. with P-51 airplanes and that these airplanes be obtained from other activities."[163] OC&R believed this action would increase the number of long-range escort fighter groups to 6 by December, 1943. Even with the highest priority to expedite shipment of the P-51's, the first Mustang did not arrive in England for VIII Fighter Command until 17 September 1943.

In the meantime members of the VIII Air Force Service Command had understood that upon completion of the P-51 tests by the VIII Fighter Command Air Technical Section a conference would be called to outline a program based on their findings. The date for this meeting was to be set by VIII Fighter Command after thorough study of the plane. When the Service Command inquired about the conference date, no answer was received. The Service Command then called a meeting for 6 October and requested that VIII Fighter Command send representatives. Until this meeting the Service Command had no indication of the Fighter Command's findings. Friction developed between them when the Fighter Command contacted Rolls Royce personnel to discuss engine modifications. This violated AAF procedure, which specified that the Service Command should handle all technical problems. Moreover, important correspondence to officials at Base Air Depot concerning modification of the plane seems to have been handled unduly slow. Technical difficulties caused additional

costly delays. These involved a shortage of gaskets for the air cooler, a correction for altitude metering on the carburetor, and adjustment of the front breather to prevent oil from being expelled. As late as 30 October, Rolls Royce engineers had not solved the latter two difficulties.[164] Because of all these complications the Mustang did not see action until December.

In the United States there were more delays, this time on the P-51F. Notwithstanding the problems involved in converting the P-51, production of these vitally needed fighters was pushed to the limit. The AAF wanted 500 per month, but gave Materiel Command authority to introduce the "F" model into production only if it did not interfere with current schedules.[165]

The long-range escort program had been given the highest priority. Early in November an AAF board submitted a report on the capabilities of long-range escort. Based on the work of Wright Field, the Proving Ground, and the AAF Board, this study, accepted as doctrine, achieved for the long-range escort program respectability and recognition from all responsible agencies in the AAF. Briefly, the report stated that the P-51 and the P-38J-5 were the two most capable planes for long-range escort. The P-47 was reported as being capable of a maximum radius of only 250 to 300 miles escort, at that time, while the P-38J-5 had a total range of 710 miles when using a droppable 165 gallon tank and built-

in containers holding an additional 60 gallons. Since the P-51-1 was capable of a maximum of 824 miles when equipped with an additional internal 85-gallon type, it was recommended for adoption as the standard long-range escort. The board, however, recommended sending both planes to the European theater.[166]

Shipments of Mustangs to the United Kingdom were estimated at 158 in November and 200 in December; for the P-47 at 971 and 1,126, part of which were sent to the Ninth Air Force.[167] The Eighth Air Force was promised 340 long-range fighters at the end of the year, with delivery not later than the middle of January. Additional complements were to arrive in a steady stream after the first of the year. Fortunately, jettisonable tanks for the Mustangs were already present in sufficient quantity in the theater to permit their immediate use for escort missions.[168] In still greater effort to increase the number of fighters in the United Kingdom, 262 kits were sent to England to permit the modification of the P-51's and -38's, to the long-range type by equipping them with additional internal fuel tanks. The VIII Fighter Command was to receive 630 by 5 January.[169] On 5 December, the 357th Fighter Group of IX Fighter Command (then under VIII Fighter Command control) flew the P-51's in combat mission in this theater for the first time.[170] Efforts had begun to bring results.

On the basis of tests in December, 1943, and January, 1944, the Eighth Air Force concluded that the Mustang was the best fighter for escorting bombers. When the Mustang arrived in England, it was equipped to carry two external 75-gallon tanks, but had no provision for pressurization and consequently could not be used above 20,000 feet. The P-47's pressurization system was installed on the P-51 and worked out satisfactorily. The flexibility and rate of acceleration peculiar to the P-51 were the chief reasons for concluding that it should become standard escort for VIII Fighter Command.[171] The P-51B without wing tanks was nearly 50 miles faster than the FW-190 at altitudes up to 28,000 feet. It was 70 miles faster above 28,000 feet, and had superior speeds at all altitudes in comparison with the Me-109G, its advantage increasing from 30 miles per hour at 16,000 feet to 50 miles per hour at 30,000 feet. The P-51 outdived the FW-190 from all altitudes and could outdistance the Me-109 in a prolonged dive. In turns it could outperform the FW-190, though not to any great degree, and was superior in that respect to the Me-109. The Fock-Wulf excelled slightly in the rate of roll, whereas the Messerschmitt and the P-51B had comparable rates of roll.[172] The obvious superiority of the Mustang made it a most sought-after fighter for escort purposes.

The Merlin/Mustang underwent many modifications after the Rolls Royce engine was incorporated into its frame. The

P-51D was a modified P-51B with added armament.[173] Another modification, the P-51F, embodied a major redesign. The weight of the plane was reduced by 1,100 pounds. Its speed was 450 miles per hour at 27,000 feet, with a rate of climb of 4,500 feet per minute.[174] Still another modification was the P-51H, which essentially was a new design giving increased performance.[175] By July, 1944, the P-51 was being flown successfully in combat. The installation of two 108-gallon droppable tanks had increased its combat escort and radius up to 500 to 600 miles.[176] In February, 1945, the P-51's were equipped with two 115-gallon belly tanks.[177] The range increase was noted in the Eighth Air Force history in the following statement:[178]

> By the end of July [1944], the Mustang groups of fighters were able to go to any target to which the bomber formations could fly. In the words of General Fred Anderson, the problem had now completely reversed itself. It was no longer a question of getting the escort to the bomber targets, but rather one of finding ways and means to increase the size of the fuel tanks and carrying capacity of the four-engine bombers so that they would be able to take full advantage of this increased fighter range and attack some of those vital targets which lay furthest from their bases in the United Kingdom.

The XP-75 and P-61 Variants

The AAF attempted to use two additional planes for escort purposes. These were the XP-75 and the P-61. In the fall of 1942 the Fisher Body Division of the General Motors Corporation submitted a proposal to build a long-range fighter escort. This XP-75 was to embody structural assemblies

from airplanes already in production. It was to consist of P-40 wings, F-4U landing gear, the A-24 tail assembly, and the Allison V-3420 engine. Only the fuselage was to be designed and produced by Fisher.[179] The fact that this plane could be produced from existing parts meant that very little tooling would be necessary. The military characteristics of the plane were to be: high speed, 440 miles per hour at 20,000 feet; rate of climb at sea level, 5,500 feet per minute; service ceiling, 38,000 feet; and armament, 4 to 6 .50-caliber guns.[180]

Work on the plane had progressed to the point where it was possible for Fisher to invite a mock-up inspection committee from Wright Field to visit their plant on 8 March 1943. The inspecting committee made numerous recommendations, but instructed the company to continue development of the plane.[181] On 6 July Production Division recommended that 100-gallon tanks be built into the wings and that the number of experimental planes be increased from 2 to 8. It also recommended that an order be placed immediately for 2,500 planes.[182] The urgency with which this program was pushed was reflected in a letter from Stratemeyer to Giles in July stating that Arnold had been informed that within six months the German Me-109 and the FW-190 would outperform the P-47. Accordingly, Arnold was concerned as to what type of fighter aircraft the AAF could use to meet this challenge. Stratemeyer wrote, "We are all thinking about the P-75 and are in hopes that it will

be the airplane that we should put into production."[183] On 17 November 1943 the XP-75 made its first test flight and was considered successful except for some directional instability.[184] The remainder of 1943 and the early months of 1944 were given over to eliminating defects that were apparent in the test models. Preliminary trials of the plane indicated that it could carry only two 150-gallon external tanks. In July, 1944, test flights of the XP-75 were reported as successful. Its radius of action was about 1,500 miles, but it had a slow roll. Its speed equalled that of any fighter, it had a good rate of climb, and its range possibilities made it potentially an excellent escort fighter.[185] In August Wright Field tested a modified long-range model P-47N, and airmen were impressed with its performance. This led the AAF to reexamine the need for continuing the XP-75 program in view of the fact that the modified P-47 was capable of providing the needed escort.[186]

On 3 October 1944 the Aircraft Requirements Board recommended that production of the XP-75 be limited to only 30 aircraft and that the contract be terminated. This decision was based on the failure of the XP-75 to compare favorably with the P-47 and P-51. This conviction was supported also by the findings of the Proving Ground Command which indicated that the plane had failed to meet the estimated performance. Fisher was notified of the contract canellation on 5 October 1944.[187]

There was one other attempt during the war to utilize an existing fighter type for escort. Some attention was given to adapting the P-61 for this purpose. General Kenney had originally proposed this idea to General Arnold on 3 July 1944, and following Arnold's reply expressing an interest in it, Kenney recommended a fuel capacity of 1,440 gallons for the P-61 in addition to other modifications.[188] A few kits for field installation to permit the carrying of additional oil and fuel were built. They enabled the P-61 to handle from 165 to 300 extra gallons.[189] General Giles, writing for Arnold, believed, however, that the proposed modification of the P-61 was not advisable at that time. The AAF had long-range fighters such as the P-51H and the P-47N, and in view of the fact that a delay would be necessary in producing P-61's, Giles did not deem it advisable to undertake the proposed modification.[190] Nevertheless, Wright Field was ordered to convert two P-61's for experimental purposes.[191] Radar equipment was replaced by a 4-gun .50-caliber installation. The 4x20-mm. installations remained the same. The upper turret was removed and the aft fuselage section was reduced in height to the level of the wing center section.[192] The first modified plane, designated as XP-61E, was scheduled for test flight on or about 15 December, but this was delayed until 13 January 1945. The results were regarded as most satisfactory,[193] but plans to develop the XP-61E as an escort fighter were canceled before V-J Day. Thus, only the original

two planes were ordered for the AAF.[194]

In retrospect, the problem of range extension, both in tank production and in increase of internal fuel capacity, seems to have been accompanied by no more confusion than existed in many similar projects under the stress of wartime conditions. To be sure, the air battle then raging over the Continent of Europe gave the program an urgency characterized by much duplication of effort and faulty planning. Yet, out this confusion came the progress which ultimately gave to fighters the range necessary for filling their escort role, though unhappily the full realization of the need for this program came only after a grave miscalculation of the air situation when the bombers began to strike deeper at targets in the summer and fall of 1943.

CHAPTER IV

THE DEFEAT OF THE GERMAN AIR FORCE

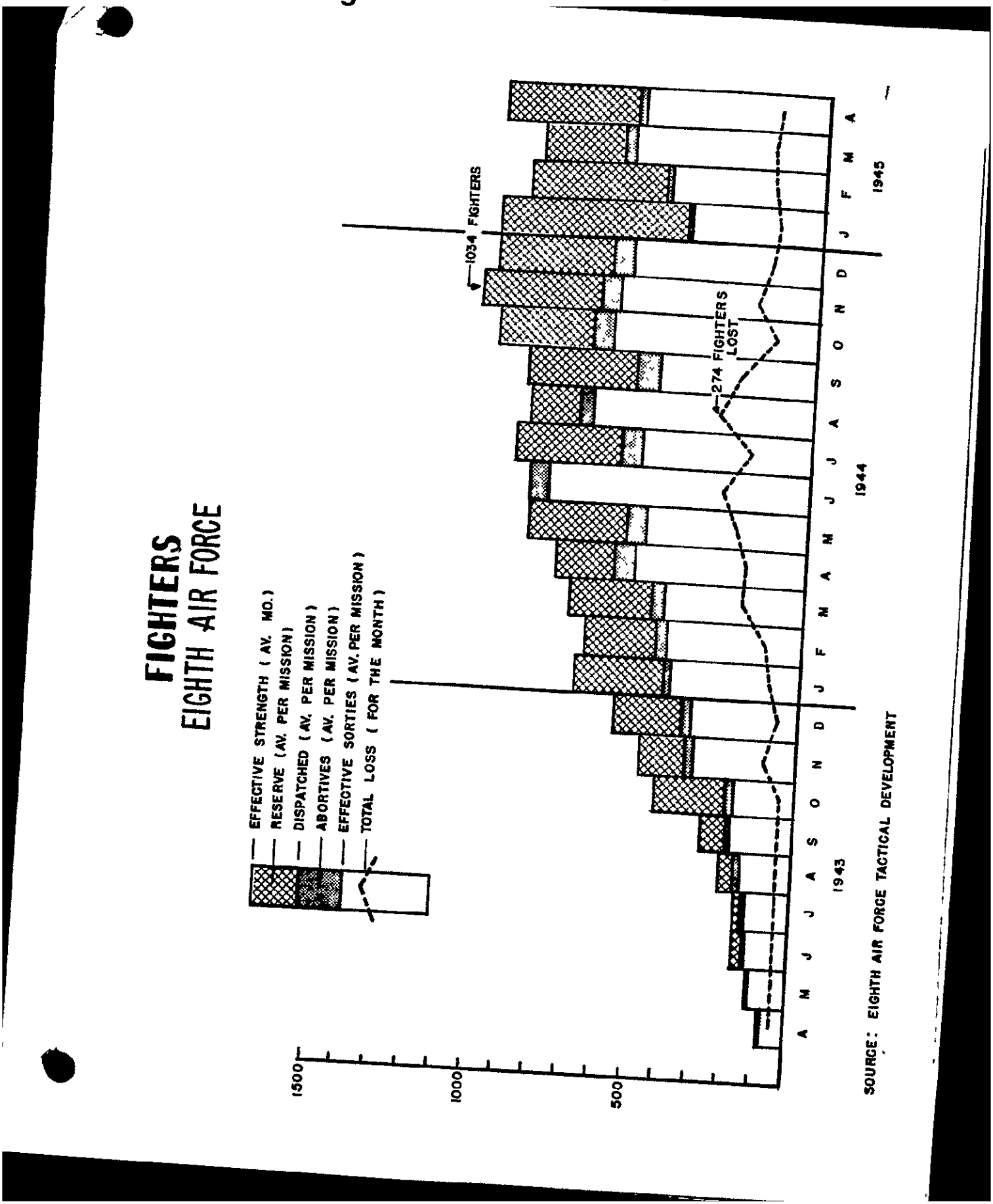
> . . . the destruction of the enemy's forces seems among all the objects which can be sought in war always to be that which overrules all else.
>
> Clausewitz

Escort Operations in 1944-1945

The Combined Operational Planning Committee originally had scheduled ARGUMENT for the week of 2 November 1943. This plan had been shaped with the idea of striking a coordinated and decisive blow at industries supplying the German fighter force. It materialized during late February, 1944, in the so-called "Big Week." The decision to launch ARGUMENT came none too soon for the time was running short if air superiority was to be gained before the invasion of western France, which had been tentatively scheduled for the late spring or early summer of 1944. On 20 February ARGUMENT was finally under way, with a majority of targets being aircraft factories in central Germany. To reach them, the planes had to penetrate far into enemy territory, exposing themselves to aggressive German fighter attacks. Thus, it was the opportune time to find out if long-range escorts could achieve the hoped-for tactical victory. If at the end of "Big Week", losses of American bombers were not alarming, the Air Force planners believed that this could be attributed to escort support. If ARGUMENT succeeded, the daylight bombing effort would be an

accomplished fact, and the escort fighter, indeed, the answer to the German fighter defense.

After the autumn crisis the Eighth Air Force underwent a rapid build-up of both bomber and fighter units in view of the forthcoming operations. Two new units joined VIII Fighter Command in time to participate in ARGUMENT. These were the 361st Group (P-47), which became operational on 21 January, and the 357th Fighter Group (P-51), which had been assigned first to the Ninth Air Force before becoming part of VIII Fighter Command on 5 February in exchange for the P-47 358th Group.[1] In addition, a series of conversions took place within VIII Fighter Command from the P-47 to the P-51. The 4th Fighter Group on 26 February was the first to convert to the Mustang, but during ARGUMENT only the 357th and 399th Groups flew the P-51.[2] Pilots of the 4th Group flew their planes after having spent a few days, and in some cases only a few hours, in practice.[3] On 8 February Doolittle ordered all pilots who had qualified to fly the P-51 to do so in all critical operations, even if it were necessary to borrow aircraft from the Ninth Air Force. In view of this order, the 399th Group, already equipped with the P-51, was assigned to the Eighth Air Force on 15 February, instead of the 50th equipped with P-38's as had been scheduled originally.[4] By mid-February some 539 P-38J's, 329 P-51B's and C's, and 416 P-47D's comprised the build-up of the Eighth's fighter groups.[5]



Heretofore fighters had been ordered to offer close support to bomber formations and under no circumstances to range any great distance from them. Intercepting enemy fighters were to be kept away from bomber formations, but not to be pursued.[6] The first variant of this tactic came in January when Doolittle permitted escort fighters to attack enemy fighters even though they were not pressing attacks on bomber formations.[7] This change made it possible for escorting fighters to move away from bombers and seek out enemy planes. No longer were the "little friends" limited to offering close protection to their "big brothers;" they were now committed to destroying anything in sight. The offensive implications of Doolittle's order were appreciated by General Adolf Galland, commanding general of the German fighter forces, who wrote, "Only now did the superiority of the American fighters come into its own. They were no longer glued to the slow-moving bomber formation, but took the law of action into their own hands."[8]

The fighters employed this law of action during the momentous air battles that soon developed. Their chance to prove their worth as escort and offensive fighters came in the missions of "Big Week." The first mission on 20 February went to Posen and Tutow, Poland, the major concentration being directed against targets in central Germany at Leipzig, Oschersleben, Bernburg, Brunswick, Halberstadt, and Gotha. The VIII Fighter Command supported the mission with 668 P-47's, 94 P-38's, and 73 P-51's, a total of 835 fighters.

German fighter opposition consisted of approximately 275 sorties. Total bomber losses were 21 out of an attacking force of 1,000. Fighter losses totaled 5 -- 2 P-47's, 1 P-38, 1 P-51, and 1 RAF Spitfire. The two groups of P-51's escorted bombers to the Leipzig and Bernburg areas, while the P-38's accompanied the B-24 groups to targets at Gotha and Brunswick. Although the bombers met fighter opposition in the final stages of penetration and in the target area, the enemy had not responded with the expected mass opposition defense.[9] American fighters claimed 61 enemy planes destroyed, 7 damaged, and 73 probables. The first day of ARGUMENT had proved very satisfactory. Although the Germans failed to offer battle on the scale previously encountered, American fighters had shown their ability to cope with enemy defenses.

The second mission was directed against two aircraft factories at Brunswick and six important airfields and aircraft storage parks in western Germany. Total bomber strength was 907 planes. The fighters consisted of 13 P-47 groups, 2 P-51 groups, and 2 P-38 groups, a force of 679 planes. They furnished initial penetration support and rendezvoused with the 3 bomber formations over the Zuider Zee according to plan. From that point they provided continuous protection to the target area by successive relays of P-47's. German opposition was intense but spotty, and generally not too aggressive. Because of this, American fighters supported the bombers for a

longer period of time than had been anticipated. Inclement weather supposedly accounted for the weak German opposition, but the severe strain imposed on the GAF by three simultaneous, large-scale missions conducted by the Eighth Air Force and the RAF also played a part. Estimated total enemy opposition consisted of 150 planes, evenly divided between single- and twin-engine fighters. Thirteen B-17 and 3 B-24 bombers failed to return home. Five fighters were lost, 3 P-51's and 2 P-47's, but the fighters claimed 33 enemy planes destroyed, 5 damaged, and 18 probables. The operation was supported by the 358th, 362d, and 354th Fighter Groups of the Ninth Tactical Air Force.[10] Post-war investigation of these and other operations indicates that claims of enemy planes destroyed were in many cases grossly exaggerated.

The third mission of the week proved costly for both the attacking force and the enemy. Some good bombing was achieved in spite of adverse weather conditions which hindered the day's effort. Of a total of 600 bombers airborne only 466 reached their targets. Bad weather caused many to turn back. Over the Continent, many bombers attacked targets of opportunity rather than those originally assigned. The enemy offered more opposition on this mission than on the preceding two. Enemy fighter attacks began immediately south of the Zuider Zee, and, in contrast to the other two operations, these were characterized by a vigor and an aggressiveness lacking previously. German fighters accounted for 35 American

bombers, and 5 more were lost to enemy antiaircraft fire. Most of the planes attacked were in unescorted bomber formations. The American force of 659 fighters lost 11 planes, but claimed 61 enemy planes destroyed, 7 damaged, and 27 probables. The Germans had sent approximately 250 aircraft aloft to challenge American bombers. Early opposition to penetrating forces marked a change from past enemy defensive tactics, supposedly for the purpose of hitting American bombers while unaccompanied during initial stages of penetration. Targets on 22 February had included Oschersleben, Bernburg, and Halberstadt.[11]

The weather, again stormy on the fourth day, 23 February, grounded the Eighth Air Force and gave bomber crews a rest after three full efforts. On 24 February the second half of "Big Week" began with an attack on ball-bearing factories at Schweinfurt and Gotha, where the target was Gothaer-Waggonfabrik, largest producer of Me-110's. A smaller force bombed aircraft component factories and assembly plants in northeastern Germany and Poland. The VIII Bomber Command effort was complemented by the Fifteenth Air Force, which bombed a ball-bearing and aircraft-component factory at Steyr, Austria. The Eighth sent out 834 heavy bombers against Schweinfurt, Gotha, and Rostock, the latter a diversionary target to confuse the Germans and force them to divert some of their fighter strength. American fighters consisted of 20 groups, 15 of P-47's, 3 of P-51's, and 2 of P-38's. Sup-

port for withdrawal was undertaken by 7 P-47 groups, while an additional P-47 group, 1 P-51 group, 2 RAF Mustang squadrons, and 8 RAF Spitfire squadrons provided general support for the remainder of the flight. Of the 236 bombers hitting Rostock, 5 were lost -- 4 to enemy aircraft and 1 to an unknown cause. Of the forces sent to Gotha and Schweinfurt, 11 bombers were lost from 359 attacking Schweinfurt, and 33 from the Gotha force. Enemy aircraft accounted for 36 of these. Four were lost by antiaircraft fire and 4 from unknown causes.[12]

Because of the great distance of the Rostock strike, no escort was provided. For the Gotha and Schweinfurt missions penetration was supported by 8 P-47 groups, in the course of which 20 to 40 enemy aircraft were dispersed. Target support came from two groups each of P-38's and P-51's. Here the fighters and bombers encountered large numbers of enemy planes. While the escort for the 834 bombers was considered good, the lead combat wings of the bomber forces were not fully covered during penetration and in the target area because they had reached rendezvous points several minutes early. American fighters claimed 37 enemy craft destroyed, 5 damaged, and 13 probables against a loss of 10; the bombers reported 79/9/31.[13]

In a resumé of the battle of the 24th, VIII Fighter Command noted that pilots saw very few twin-engine enemy planes,

and even those had single-engine escorts. The enemy hesitated to attack allied fighter craft and bombers accompanied by fighters. Though attacks began early, they were not concentrated when fighters were on hand for support. The only groups which met intense and concentrated attacks were the two leading B-24 wings of the Gotha force. In this case, the B-24's flew at lower altitudes than the B-17's, with which they were in visual contact, thereby making escort efforts more difficult. The Germans quickly took advantage of the B-24's vulnerable position and viciously attacked them with Me-109's and FW-190's. Flights of from 3 to 6 enemy aircraft attacked abreast and in trail, flew through the formation, and in many instances dropped parachute bombs that exploded on opening after head-on approaches from above.[14] The Fifteenth Air Force's 87 B-17's suffered from a series of aggressive and well-executed attacks. Although a P-38 escort met the bombers at the target to protect their withdrawal, the enemy succeeded in shooting down 17 heavy bombers.[15]

On 25 February, the last day of "Big Week," strikes were undertaken against targets at Augsburg, Stuttgart, Fürth, and Regensburg. Some 820 bombers, escorted by 899 fighters, including 20 AAF groups, 20 RAF Mustang, and 10 Spitfire squadrons, took part. Fighters and bombers were instructed to remain in one group until they had penetrated enemy territory 325 miles. From that point bombers and their accompanying fighters were to approach their own individual targets. The

leading combat wing of the first formation lacked support until it reached the vicinity of Regensburg, and its exposed position invited intermittent attacks. At the target area, however, two groups of P-38's and P-51's provided excellent support, which prevented enemy interference with the bombing. On the withdrawal, escort was furnished by 10 P-47 groups and 1 P-51 group that was flying its second sortie of the day. Antiaircraft fire and enemy fighters downed 5 additional American bombers and 12 more were lost from unknown causes. Bomber claims against enemy fighters totaled 33 destroyed, 3 damaged, and 9 probables; fighters claimed 26/4/13. Two P-51's and 1 P-47 were lost. A diversionary effort by 34 bombers of the Fifteenth Air Force took place simultaneously with the main raid. This diversionary attack against southern Germany achieved its purpose. In meeting two threats, the Germans dissipated their efforts, thus failing to challenge successfully either force. American pilots estimated that only 150 enemy fighters rose to challenge the bombers.[16]

The second half of this mission was an attack by the Fifteenth Air Force against Regensburg with 116 bombers. Escort was provided by 36 fighters of the 1st Fighter Group, 33 P-38's of the 14th Fighter Group, and 27 P-38's of the 82d Fighter Group, a total of 96 planes. This mission was one of the costliest of the war. The Germans attacked the bombers as they passed the northern tip of the Adriatic Sea

and continued to harass them for an hour to an hour-and-a half. They pressed their onslaught until after the bombers had passed the target and returned to the rendezvous point approximately 100 miles south of the target. There was no intention of the part of the enemy to attack the formation once escorts had arrived. The lead elements of the bomber formation bore the brunt of the attacks, with losses totaling 41 planes.[17]

The heroic efforts of ARGUMENT cost the Eighth Air Force 137 bombers and the Fifteenth Air Force 89. Fighter losses totaled 28 planes. Against this, VIII Fighter Command claimed 208 planes destroyed, 28 damaged, and 108 probables. These losses, exclusive of bomber claims, were indeed costly to GAF fighter strength, although after the war, Reichsmarschall Hermann Goering, commander of the Luftwaffe, said Americans exaggerated their claims.[18] ARGUMENT proved that long-range escort fighters could meet the threat of German fighter forces. Use of P-47 Thunderbolts for initial penetration and withdrawal portions of the missions, and of P-38's and -51's for covering the bombers over targets and back to the point where Thunderbolts could take over again, gave the bombers most constant escort. This required precision timing to insure that bombers and fighters would meet at planned rendezvous points. The RAF and RCAF fighters also contributed much support to the escort effort by flying direct support missions and engaging in feints and diversionary action to distract and tie down enemy fighter forces. Con-

sidering the size of bomber forces used during these operations and the losses suffered by them, as compared to the Schweinfurt missions the previous August and October, it is clear that the fighter escort was largely responsible for keeping bomber losses low. If bombing results were not as good as hoped for, the week's efforts went far toward giving the Allies the air superiority they needed to continue the air offensive. The pattern of activities during "Big Week" set the course of operations that continued in the spring.

Asher Lee, in his book The German Air Force, sums up the air situation in the spring of 1944:[19]

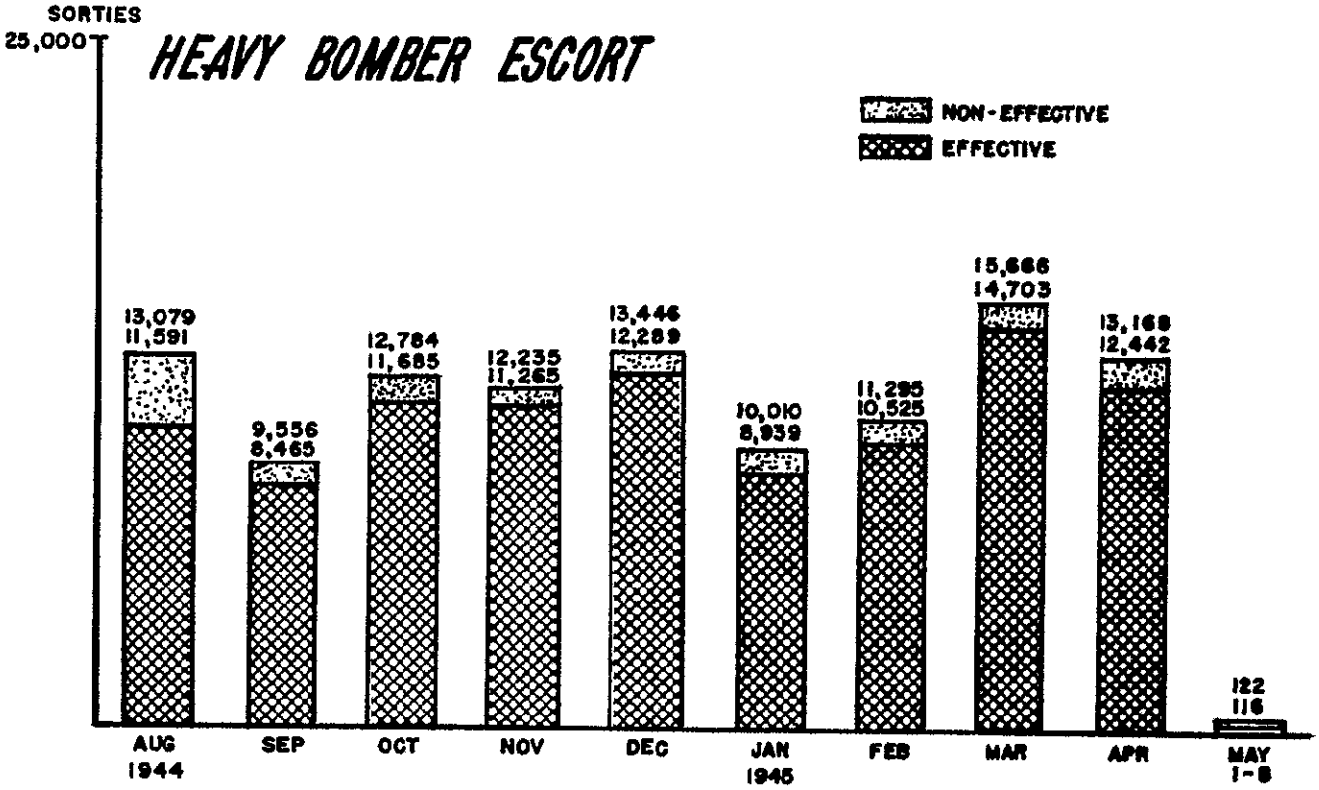
> At all events, the hundreds of Lightnings, Thunderbolts, and Mustangs which now covered and supported Fortresses and Liberators attacking the German aircraft industry in the spring of 1944 soon dominated the skies of Germany. Gone was the aggression and persistence of the Luftwaffe fighter defenses of 1943. The "Achtung Spitfire" of 1940 over Great Britain became the "Achtung Mustang!" over Germany in 1944. Many of the crack German fighter pilots who had braved the fire of the Fortresses and Liberators in 1943 were now killed. The number of experienced German fighter pilots in 1944 who could emulate them and cope with the close attention of American fighters was getting fewer as the year wore on. German twin-engined fighters who were a strong attacking force in the summer of 1943 now hardly dared to make an attack on escorted American bomber formations and themselves required single-engined German fighter escort. German fighter aircraft losses against escorted American raids were now normally about 10 per cent of sorties and often higher. Such a casualty rate is, to say the least, highly demoralizing. For many young German fighter pilots their baptism of American fire was also their funeral pyre. Small wonder

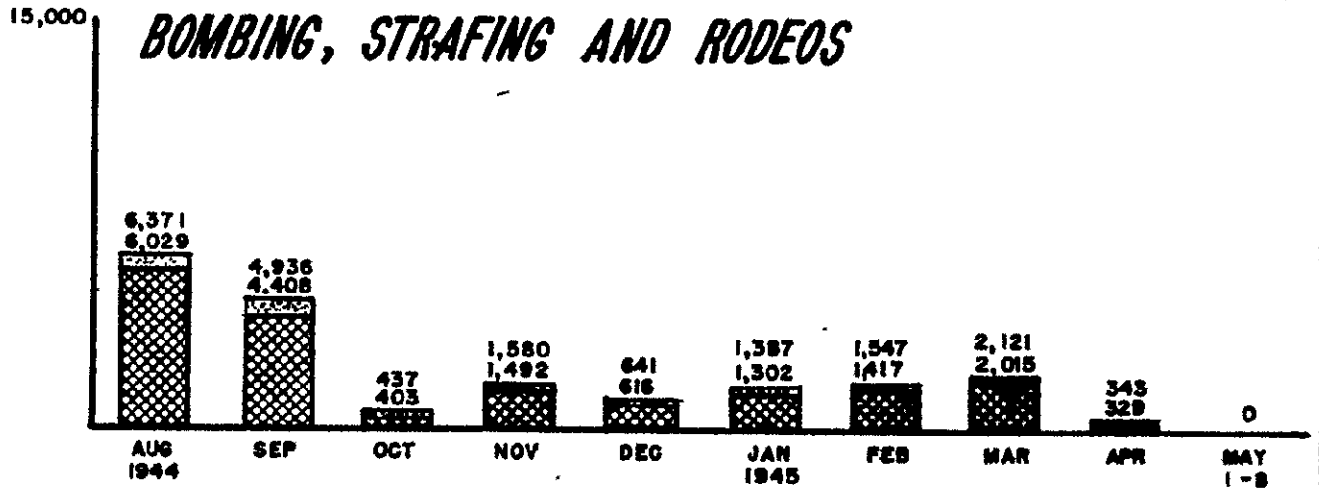
> that many German fighter formations would now evade combat, or dive hectically through a bomber formation and beat a hasty low level retreat from the scene of a battle. Choleric exhortations from Goering, the creation of special assault fighter squadrons, special high altitude cover, all were of no avail.

The lack of sufficient fighter escort during ARGUMENT was exemplified in tragic losses suffered by the Fifteenth Air Force on 25 February when protecting planes were unavailable for the bombers as they neared their target and began withdrawal. The Fifteenth had been promised a substantial build-up in bomber strength to push POINTBLANK (Combined Bomber Offensive) to the maximum. The 25 February mission showed only too clearly the need for escort fighters, and shortly afterwards Eaker urged Giles to speed deliveries, insisting that ". . . even on group in the target area will save us 75 per cent of our losses."[20] A week later Eaker wrote Arnold, "The principal handicap to the vigorous pursuit of POINTBLANK by the Fifteenth Air Force, other than the weather, is the lack of fighters with sufficient range to accompany them."[21]

Late in March, Giles was able to write Eaker that "the flow of P-38J's is sufficient to permit full re-equipment of P-38 groups in the Mediterranean theater with the long-range models, and we anticipate that the older P-38's thus released will be returned to the U.S. as soon as practicable."[22] In April the first long-range P-51's flown by the 31st Group arrived in the Mediterranean for the Fifteenth

Fighter Effort





SOURCE: EIGHTH AIR FORCE STATISTICAL SUMMARIES OF AIR CREWS, AIRCRAFT AND OPERATIONS

Air Force, and the shortage of P-38's was finally eliminated with all units brought to strength. In May the 52d and 325th Fighter Groups exchanged their P-47's for P-51's, while the 352d converted from P-39's to P-47's and P-51's in July.[23] In June Eaker reported to Arnold that he was very pleased over the build-up of fighter craft in his theater:[24]

> There has been no better chapter of our reorganization and re-equipment here than in the promptness and efficiency with which the Tactical Air Force Fighter Groups have been re-equipped with long-range fighters, transferred to the Strategic Air Force and initiated into combat accompanying our long-range bombers. . . . Our long-range fighter program is, therefore, practically complete and with the present status of the German Air Force it will be ample to provide protection our twenty-one groups of heavy bombers require. . . . I think we have done nothing better in this war than the working out in a thoroughly efficient manner of this technique of passing heavy bomber formations from group to group of fighters and by this relay system, affording the bombers thorough and efficient protection on deep penetrations into enemy territory.

By July the Fifteenth Air Force had achieved its authorized fighter strength of 3 P-38 and 4 P-51 groups, a level maintained through V-E Day. Fighter operations of the Fifteenth had formerly been conducted by the 306th Fighter Wing, which contained 7 groups. However, reorganization permitted a greater degree of tactical and training supervision. The 306th accordingly was divided into two groups. Three P-38 groups became the 305th Fighter Wing (Provisional) and the 306th retained control of 4 P-51 groups. The two wings made up the new XV Fighter Command, activated on 3 September at Torremaggiore, Italy. This gave the fighter force more

mobility and permitted it to accomplish special operations requiring the groups to be based away from home airdromes for several days.[25]

The VIII Fighter Command also achieved its authorized operational strength of 15 groups. On 3 March the 364th Fighter Group, which flew P-38's, became operational and converted to P-51's on 28 July. The 355th Fighter Group converted to P-51's from P-47's on 3 March. The 339th, flying P-51's, became operational on 30 April, and with the arrival of the 478th Group on 14 May, VIII Fighter Command was brought to full strength. Thereafter, a gradual conversion of groups from the P-38 and P-47 to the P-51 took place, until by May there was only one P-47 fighter group, the 56th, left.[26] VIII Fighter Command controlled approximately 1,000 fighters.[27]

Organizationally, VIII Fighter Command continued as a separate command until September, 1944, when it lost control of operational fighter groups. By Eighth Air Force Order Number 494, effective 15 September, the 15 fighter groups were assigned to 3 bombardment divisions. The 67th Fighter Wing, consisting of the 20th, 352d, 356th, and 364th Groups, was assigned to the 1st Bombardment Division. The 65th Wing, comprising the 4th, 56th, 355th, 361st, and 479th Fighter Groups, was assigned to the 2d Bombardment Division. To the 3d Bombardment Division went the 66th Fighter Wing, which comprised the 55th, 78th, 339th, 353d, and 357th

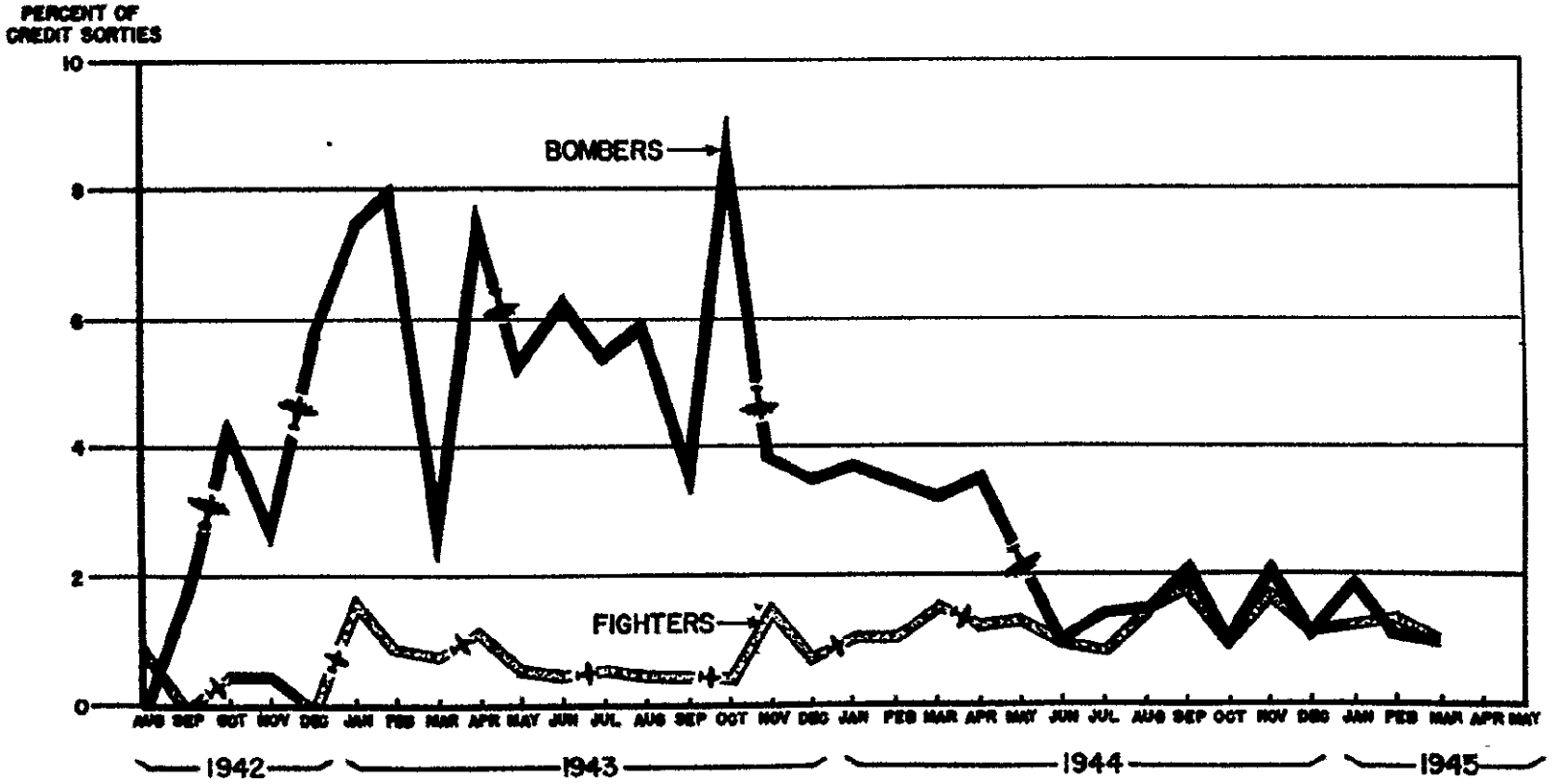
Fighter Groups. The actual transfer became effective on 1 October. Thereafter the Eighth Air Force planned operations rather than VIII Fighter Command.[28] This permitted a much closer integration of fighter and bomber control.

Conversion from the P-38 to the P-51 came when the former began to cause airmen considerable mechanical difficulties. The P-38's excessive fuel consumption led to a reworking of its fuel pump motor and gearadapter.[29] One squadron reported 25 failures as a result of defective fuel pumps and considerable leaking after only one hour's flight.[30] On 17 February Doolittle cabled Arnold that the 20th and 55th Fighter Groups had reported 40 per cent engine failures in their Lightnings,[31] and two weeks later he wrote that defective P-38's totaled 91. This increasing frequency of engine failure forced Doolittle to regard the situation as critical.[32] On 6 April the Ninth Air Force grounded its P-38's until defects could be corrected.[33] Fortunately, VIII Fighter Command was not forced to ground its Lightnings during the grueling spring air battles then being waged over Germany. The conversion to the P-51 helped to alleviate this problem. By July, Doolittle confessed to Arnold that the P-38 was a second-rate fighter when compared to the P-47 and P-51,[34] even though attempts had been made to improve its performance. Spaatz, however, seemed confident that the P-38 could be modified to make it a first-class fighter again, but admitted to Arnold that sizable improvements would be necessary.[35] As a result of these

AIRCRAFT LOSS RATE

OPERATIONAL LOSSES (MISSING AND CAT. E)

AS PERCENT OF AIRCRAFT ENTERING ENEMY TERRITORY
COMBAT UNITS ONLY



SOURCE: EIGHTH AIR FORCE STATISTICAL SUMMARIES OF AIR CREWS, AIRCRAFT, AND OPERATIONS

difficulties, and the prior commitments to replace P-38's by P-51's, the AAF withdrew the Lightning from VIII Fighter Command operations in mid-summer, 1944.

Meanwhile, the air war had moved into a fast tempo. On 4 March, soon after the "Big Week" effort, American bombers, escorted by P-51's of the 4th Fighter Group, reached Berlin. On the previous day elements of the 66th Fighter Wing, flying P-38's, had penetrated to the heart of the Reich capital.[36] With mass bombing of Berlin for the first time on 6 March, the daylight bombing offensive had passed a milestone along the path to victory, but the battle was by no means over. While enemy opposition in the spring and summer of 1944 lacked its earlier efficiency, German fighters, nonetheless, took advantage of any opportunity offered them. A cursory examination of bomber missions where losses were unusually high will reveal an almost continuous and effective German tactic. They concentrated on attacking bomber formations lacking escort planes or those points where fighter strength seemed weakest. Either situation produced results. The tactical mission report of 29 March stated, "The enemy fighters attacking the Brunswick force were aggressive as well as coordinated and they achieved considerable success in exploiting opportunities to attack unescorted formations."[37]

To check the Germans, VIII Fighter Command allowed long-range fighters to drop to the "deck" in enemy territory and sweep wide areas on their withdrawal. This followed Doolittle's

January directive. The Germans were subjected to interception not only when they attempted to attack bombers, but were now exposed to strafing attacks on airfields. General Galland recalls that whenever American fighters adopted low-level attacks on German airfields, "Nowhere were we safe from them; we had to skulk on our own bases."[38]

This tactic was initially tried on a large scale on 5 April when all VIII Fighter Command groups participated in sweeps of enemy airfields in an attempt to cripple planes on the ground.[39] The units were dispatched on low-level sweeps deep into the heart of Germany. Out of 10 groups participating on the mission, only 2, the 355th and 4th, were able to complete it, since the weather forced the others to cancel their flights. The two striking groups claimed the destruction of 3 locomotives, and damage to flak towers, gun emplacements, barracks, hangars, and motor barges. Claims of aircraft destroyed and damaged in the air were listed as 10/1/2; on the ground, 88/3/120. The VIII Fighter Command losses for the day totaled 9 planes, one of which was ditched in the English Channel.[40] This mission was a logical extension of tactics permitting fighters to leave bomber formations to seek out the enemy. After this mission the Germans strengthened flak defenses near their airfields, making it more difficult for VIII Fighter Command to repeat similar sweeps[41] without suffering heavier losses. In the belief

that such operations held great possibilities, Spaatz wrote to Arnold, "Our future operational planning includes fighter sweeps over enemy territory at low level during withdrawal from escort duties, normal fighter sweeps . . ." Spaatz expected fighters also to sweep ahead of the bomber spearhead, and promised that this scheme would be used whenever the tactical situation warranted.[42]

On a mission against Berlin on 18 April, "The principal attacks took place while the bombers were unescorted."[43] The story was repeated 8 May when " . . . the second force was off course and unescorted and subjected to intense opposition."[44] On 21 June "the escorting P-51's were first drawn off and engaged by approximately 25 Me-109's. Immediately thereafter, the twin-engine enemy aircraft, with some 15 Me-109's and FW-190's as top cover, directed well-coordinated and aggressive attacks at a single combat wing."[45] On 7 July a report stated that ". . . an entire squadron of 11 aircraft was wiped out within a few minutes and another squadron which was separated from its formation was heavily attacked."[46]

Examples of this tactic go far toward explaining losses of American bombers to enemy attacks even after the escort problem had been solved. Among reasons for the bombers' vulnerability were faulty navigation, failure to maintain effective fighter formations around the bombers, and failure of escort planes to provide close support instead of being drawn away by enemy ruses designed intentionally for that purpose.

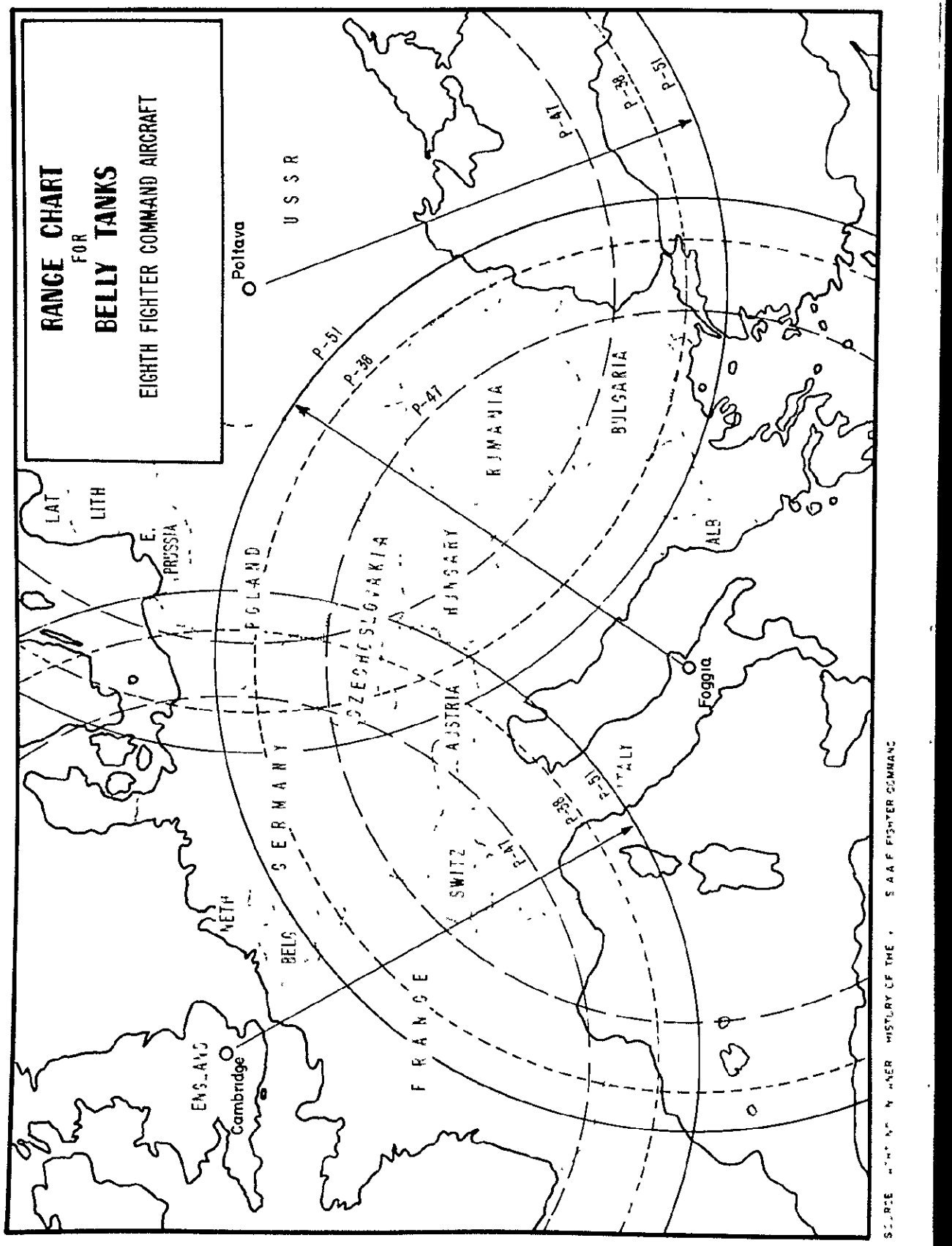
On the other hand, the liberty that could be taken by American fighters was possible only because the GAF did not consistently offer opposition as it had earlier in the war. By May only 2.7 per cent of the bombers reaching their targets were destroyed as against 9.7 per cent in October, 1943. In mid-1943, 18.2 per cent of the American attacking bombers were struck down by enemy fire, but in the last quarter of 1943 this declined to only 6.4 per cent. By mid-1944, it had fallen below 1 per cent. This was achieved, however, at an increased cost to American fighters, whose losses rose sharply through early 1944.[47]

A series of missions which demonstrated the effectiveness of long-range escort, beginning in June and ending in September, 1944, was designated as Operation FRANTIC. This involved a system of shuttle bombing through use of Russian bases. It permitted concentrated attack on targets in the East where the Germans were relocating many of their industrial sites. After considerable diplomatic and military negotiations between the United States and Russia, the latter built three airfields at Morogorod, Poltava, and Piryatin near Kiev as bases for American planes.[48] All of the bombing operations under FRANTIC were supported by long-range escort fighters, and their employment on such extended missions set records for combat distance in the ETO. The operations initially were conducted by the Fifteenth Air Force and later by the Eighth Air Force.[49] On 2 June 1944, 130

B-17's, escorted by a force of 69 P-51's of the XV Fighter Command's 325th Fighter Group, made the first shuttle trip between Italy and the Ukraine.[50] Each fighter was equipped with 2x75-gallon jettisonable tanks for extended range. The total distance covered was approximately 1,200 miles. The marshalling yards at Debrecen, Hungary, were bombed during the flight to Russia.[51]

The Eighth Air Force contribution to FRANTIC began on 21 June when 49 P-51's of the 4th Fighter Group, reinforced by 16 P-51's of the 352d Group, escorted 147 B-17's on a mission to bomb a synthetic oil plant at Ruhland, approximately 75 miles southeast of Berlin.[52] The fighters took 7 hours and 15 minutes to make the flight from the East Anglia bases in England to the landing field in the Ukraine, a distance of 1,470 miles.[53] Two P-47 groups accompanied the formation in penetration and as target support and then returned to their bases, while the 4th Group escorted the bombers to Russia.[54] On 26 June the Eighth's bombers and fighters flew to Italy after bombing an oil refinery at Drohobycz, Poland. After participating in one bomber mission and two fighter actions with the Fifteenth Air Force, the bombers and fighters returned to England, bombing en route the marshalling yards at Beziers, France, on 5 July. Seven fighters out of 65 were lost in action during this triangular mission.[55]

On 6 August the target for elements of the 3d Bombardment Division was the aircraft component factory at Rahmel



near Gdynia, Poland. Seventy-five of the Eighth's B-17's were to make the mission escorted by 2 P-51 fighter groups. The latter were to fly the initial penetration, offer target area cover, and return to bases in England, while the bombers were to receive support from Russian-based American escort fighters from the target to the Ukraine. In the penetration phase of the mission the 339th Fighter Group, which was to join the bombers northwest of Heligoland, failed to make the rendezvous, but the 55th Fighter Group joined the bombers about 60 miles east of Jutland and escorted them to the target. There they met the Russian-based American fighters.[56] The 55th Group flew 1,592 miles on that assignment, one of the longest, if not the longest, escort mission of the air war in Europe.[57] On 5 August and 18 September, the 355th and 357th Fighter Groups completed shuttle missions from England to Russia, returning via Italy. During all FRANTIC operations the P-51 employed 75- and 110-gallon jettisonable tanks for extra range.[58] This series of flights demonstrated conclusively the ability of small fighters to participate in very long-range combat missions.

In the last few months of 1944 the Germans menaced, and also greatly disturbed, the Allied air forces by introducing a jet fighter aircraft into combat, although the Allies had been aware of this possibility for some months. By great effort, the Germans, concentrating almost exclusively on production of fighter types, had rebuilt their battered air

force to sizeable proportions. Single-engine fighters had reached the 1,260 figure by September and were increasing.[59] With a greatly contracted area in which to operate, roughly 85 per cent of German fighter strength faced British and American air forces in the autumn of 1944. If the allies considered the rise in production of conventional single-engine types a challenge, they regarded jet aircraft as an even potentially greater destructive threat.

In early September Spaatz warned Arnold that these new planes had an "obvious performance superiority," and that they were being produced in small dispersed underground factories. Spaatz recommended P-51's for all escort groups in the Eighth and Fifteenth Air Forces, and sought increased production of the Mustang to counter the jet aircraft threat. In addition, he urged Arnold to put long-range jet fighters into the field as soon as possible.[60] On 21 September Arnold told Spaatz, he was recommending that the P-47N long-range Thunderbolt and P-80 jet fighter be committed to battle.[61] Though the problem at the end of September had not reached dangerous proportions, Spaatz told Arnold he was watching jet development carefully and hoped the Allies could stop the Germans in time.[62] On 2 November the Eighth Air Force planes encountered about 15 jet fighters, which inflicted only minor damage on the bomber formation.[63]

Fortunately for the Allies the threat of mass jet attacks never materialized. Though the plane had first been designed for use as a fighter, Hitler had inspected it in

June, 1944, and ordered it converted to a bomber for support of ground forces in meeting the invasion.[64] Before defeat of Germany, 1,400 jets were produced, but it was not until after October, 1944, that production reached a monthly figure of between 150-250. Late in 1944 the Germans had only 40 operational jets in combat. This small number can be explained in part through improper servicing and failure to provide adequate training for German pilots.[65] By the time technical difficulties were overcome, and there were many in the new plane, the end of the war was at hand. The spasmodic appearance of the jet was more of a scare than a real threat. By March the ME-262 began to be seen more frequently. However, according to Reichsmarschall Goering, timidity on the part of German pilots prevented the plane from becoming a serious menace in the last months of the war.[66]

The other aspect of the resurgence of German air strength in the fall of 1944 came in the increased production of conventional fighter types accompanied by a change in tactics. In late September the Germans began to employ large numbers of fighters against planes escorting bomber formations. While the escorts were thus engaged, a second fighter formation would attack the bombers. By maintaining radio silence and carefully camouflaging their planes to resemble Allied fighters, the Germans inflicted heavy losses on bomber formations.[67] To overcome this tactic, the AAF employed a top-cover fighter force of one or two groups to attack enemy fighters before they could intercept the

planes engaged in close support.[68] On 28 September mass saturation attacks against bomber formations resulted in good dividends for the enemy. Though fighters played an important role in keeping the losses from becoming higher, they were ". . . not adequate during the heaviest saturation attacks which were pressed home vigorously by the enemy . . . in spite of the presence of escort."[69]

In view of this and other missions, Eighth Air Force commanders met on 29 September to revamp their strategy. Since there was little chance of adding fighter units to VIII Fighter Command, Eighth Air Force bomber personnel suggested that particular attention be paid to the bomber formation in an attempt to permit fighters to cover it more adequately. Doolittle ordered the fighters at once to "Destroy the Luftwaffe!" If an escort closed in combat with an enemy fighter, that escort was to do battle with it "all the way to the deck if necessary to effect a kill." The commanders hoped that execution of this order would lessen the German pilots' eagerness to attack formations and increase the number of enemy planes destroyed.[70]

The Germans had decided to use their fighter force almost exclusively against the bombers rather than for ground support and interception. This decision increased the number of German fighters sent against the bombers.[71] In four days in September, 144 Allied bombers were lost, more than half attributed to enemy fighters.[72] By concentrating

fighter forces against one formation in overwhelming numbers, the Germans could effect a heavy loss on bombers. Early in November, when American heavies struck the Merseburg-Leuna oil plant they faced an attack by 400 enemy fighters. Other formations that day reported negligible opposition.[73] The German fighter position also improved because of technical advances. Many German planes began using a new 30-mm. cannon which the Allies regarded as a distinct menace.

On 13 October Spaatz requested Lt. Gen. Hoyt S. Vandenberg, Ninth Air Force commander, to support bombing operations indirectly by ordering his tactical fighters to make sweeps in the path of the bomber force, thus permitting Doolittle to plan the distribution of his fighters for maximum protection of the heavies in the further stages of the penetration.[74] A week later Spaatz issued an order "to effect the utmost possible use of Ninth Air Force fighters in support of the Eighth Air Force bombers." Spaatz wrote that the increasing effectiveness of German Air Force operations against bomber penetrations necessitated using every possible means to improve efficiency of Allied fighter operations. He also recommended that voice and teletype facilities be established between the Ninth Air Force Advance and the Eighth Air Force to increase cooperation.[75] One week later Doolittle requested that the Ninth's fighter groups "be made available in the number necessary, dependent upon the contemplated

heavy bomber missions as to strength of force, depth of penetration, and expected weather conditions over the route and the target." This request was to be considered in conjunction with the priority and direct value of the Army support missions scheduled for the Ninth's fighter groups. Doolittle perceived that on very deep penetrations all four of the Ninth's fighter groups would be needed and that under certain other conditions several of the shorter-range P-47 groups would also be required.[76] In a letter reviewing the situation, Spaatz told Arnold:[77]

> . . . it must be realized that our bomber forces were considerably increased without a corresponding increase of escort fighters available for strategic use. The ratio between escort fighters available and bombers has steadily decreased to the point where it is now one to two. . . . With the present resurgence of the GAF and a concentration of fighter strength caused by a steady retraction of forces in the German homeland, the present ratio of fighter density is entirely inadequate.

Spaatz recommended use of long-range fighters for sweeps when weather grounded the strategic air forces, continuation of the bombing of oil plants, use of Ninth Air Force fighters to aid in deep penetrations, and use by the Eighth's fighters of Ninth Air Force bases in France.[78] These recommendations were followed in an attempt to counter the sporadic GAF offensive during the fall and winter of 1944.[79] The battles that raged at that time were not all German victories, despite the local numerical superiority with which they sometimes attacked, and the heavy toll they took of American bombers. The Germans were unable to replace their own heavy

losses. In a battle on 21 November they claimed 39 Allied planes, but American escorting fighters in the same engagement claimed 78 enemy planes destroyed, 7 damaged, and 26 probables.[80] More impressive were the totals of a mission on 26 November when, for a loss of 34 bombers, the AAF was credited with claims of 134/22/44.[81]

One of the Luftwaffe's most costly errors occurred on 27 November. Because of a low cloud formation blanketing Germany and Holland, the enemy apparently mistook American fighter penetration over the Zuider Zee for the principal bomber formation. The Germans ordered maximum effort against the American planes, a large group of Mustangs attempting a rendezvous with Fortresses bombing targets in southwest Germany. The mistake was soon discovered, but too late, and resulted in an estimated 98 fighters being destroyed as against a loss of 11 P-51's.[82]

At the end of the year Spaatz reported that GAF threats would be met by "continuing pressure on the oil system of targets . . . and by attrition in the air under conditions which are favorable to us. . . . while an additional 500 fighters would have gone a long way toward solving our escort problem, I am confident that by the two methods outlined . . . we can keep the German Air Force relatively impotent."[83]

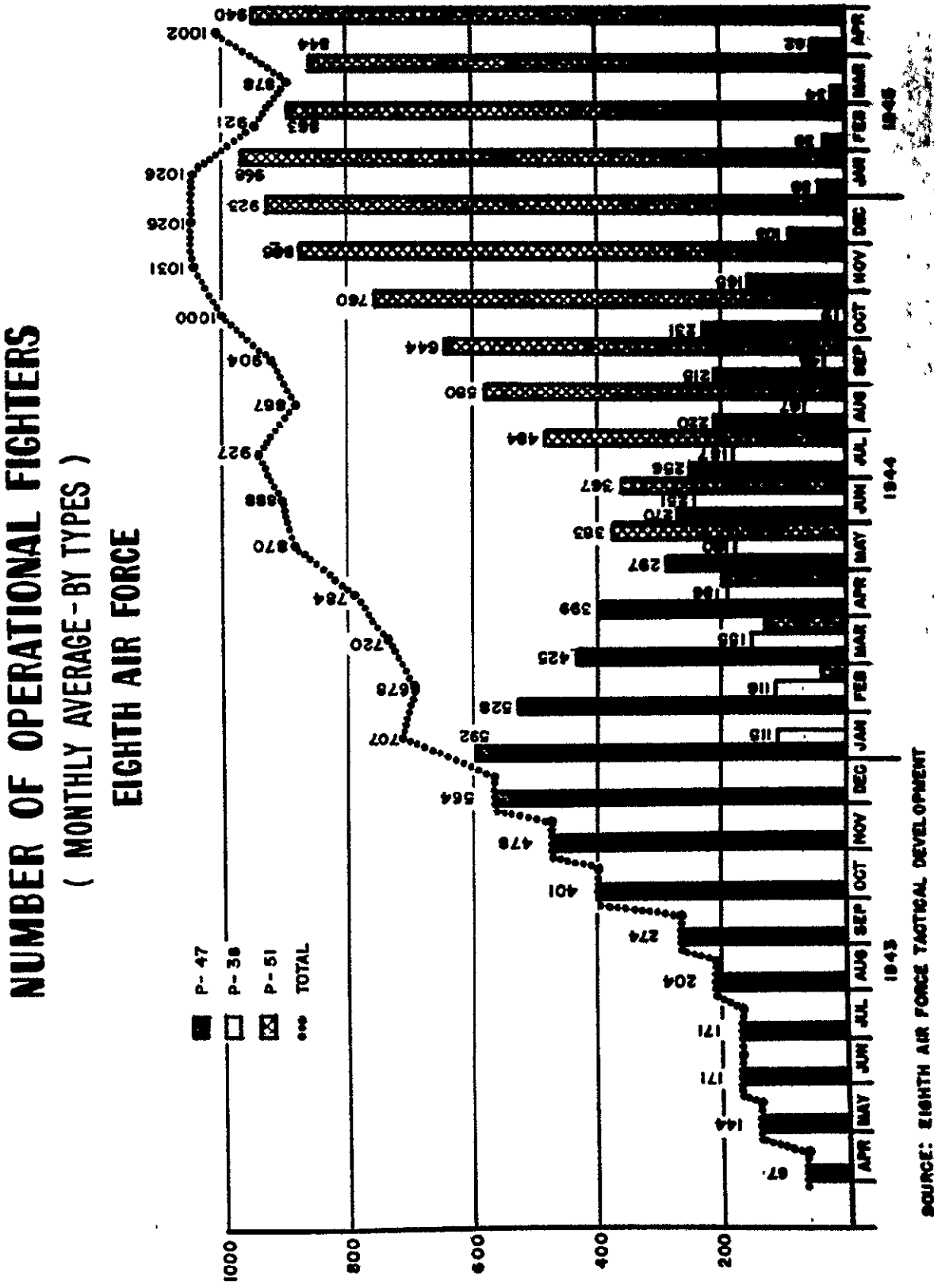
After German attempts to break through the Ardennes region had failed, Germany's potential power to wage aggressive war either on land or in the air grew continually weaker, though Allied commanders remained fearful of jet fighter

attacks well into 1945. The ever-shrinking arena of the Reich permitted a more concentrated series of attacks on German air targets. The campaign against the oil industry and transportation, and the general advance of allied armies continually reduced the German Air Force threat. In the last days of the war the Luftwaffe ceased to be militarily important. It simply dissolved in the chaos of the German state. Fighters continued to escort American bombers in the early months of 1945, although the opposition lacked any pattern and had diminished both in quality and quantity. With the announcement in early May that the Eighth Air Force had not further assignments to fulfill, bombers and escorts alike had completed their mission.

German Reaction to the Long-Range Escort Fighter

After the war ended in May, 1945, captured Luftwaffe officers almost unanimously agreed that the escort fighter had been a decisive factor in the air conflict over Germany. In addition, many admitted the ineffectual effort by Germany to find a means to stop it.

Any discussion of reaction to the escort fighter by the GAF must be seen within the framework of a larger picture, namely the German effort to stop American daylight bombing. So preoccupied were the Germans in crushing the bombers that their attention to halting the escort fighter never found a positive or decisive plan. Indeed, after 1943 German fighter



effort was characterized by an attempt to ignore escort fighters and to concentrate on destruction of bombers. With an increasingly deteriorating war situation, coupled with a faulty analysis of the escort-fighter problem, the Germans hastened disintegration of their own war effort by failing to cope with the bomber's "little friend."

The Germans studied early escorted missions, but expended little effort on challenging penetrations along the coast of western Europe. To Luftwaffe commanders, fighter aircraft simply did not fit into the picture of the strategic air-arm, but were looked upon as tactical weapons only. The Germans believed that fighters should be used for local air defense and to win superiority over a front, or, if necessary, to assist in army land operations as ground support planes.[84] Hence, they did not appreciate the potentialities of American long-range escort fighters.

In late 1942, the Germans established a defensive wing in the vicinity of the Heligoland Bight, but made little if any effort to modify armament on their planes. GAF fighter defenses in the West were weak and unprepared for maximum effort against well-defended bomber formations. Nor did the Germans consider American targets crucial to the Reich's prosecution of the war. As a result, they believed AAF bombers were not worth the expenditure of German fighters on missions outside the Reich. Aware that bombing operations would become more serious, it would seem that the Germans should have taken immediate steps to meet this expected threat.

There were several reasons why the GAF had offered little opposition. First, they were probing the American bomber and its defensive capabilities. Second, since missions against the French and Belgian coasts were all heavily escorted, attacks against the Americans were costly. Third, the Germans did not believe these shallow missions were affecting their war effort to any appreciable extent. Fourth, Germany lacked a program for mass production of fighters. Fifth, German air power was tied down in Sicily and on the Eastern front.[85] Lastly, the Germans were reorganizing their western air defenses in anticipation of heavier air blows. The Germans in late 1942 had only about 100 fighters stationed along the entire western coast from the Heligoland Bight to Biarritz.[86]

In 1943 the Luftwaffe had to adopt a defensive role, and fighter defensives were accordingly reorganized to challenge Allied bombers striking industrial targets in Germany. In belated recognition of the air battle facing them, the Germans initiated steps to halt the menacing American daylight bombing operations. Increased aircraft production was one answer to the problem. The Oberkommando der Luftwaffe (OKL) believed that production of single-and twin-engine fighter planes could be increased to 3,000 per month. As a result, however, of conflicting interests among bomber, fighter, and transport commands within the GAF, production of all types of aircraft was neither adjusted according to

facilities nor coordinated with Luftwaffe requirements. This confusion actually led to increased output of bombers and transports, and to neglect of fighter demands. By the autumn of 1943 the Germans were trying desperately to increase their fighter production and had set their goal at 2,230 single-engine fighters for December. This figure rose to 4,150 single-engine planes and 1,750 twin-engine fighters by December, 1944.[87] Between 1 December 1942 and 1 June 1943, German fighter strength increased about 40 per cent, with 55 per cent of all German fighters now concentrated on the Western Front.[88] During 1943 German fighter forces in the West were augmented by approximately 1,000 planes. The overall change in fighter distribution on the three main fronts -- Russian, Mediterranean, and Wester -- between 1 January and 1 November 1943, according to Allied Intelligence estimates, is shown in the following table:[89]

	1 January	1 November	Difference
Western Front	670	1,660	+ 990
Mediterranean	400	300	- 100
Russian	525	450	- 75
Nonoperational	65	110	+ 45
Total	1,660	2,520	+ 860

Further efforts to strengthen Germany's position in the West resulted in a redistribution of air strength. The concept of a linear defense was change to a defense-in-depth. The Germans divided fighter defenses from Trondheim to Hen-

daye into six main day-fighter areas; developed a radar system to warn of approaching aircraft; and established a ground control system to direct intercepting fighters to hostile aircraft.[90] The Germans also developed a system of airfields which enabled them to launch as many as four sorties. They equipped airfields with servicing facilities so that German fighter pilots could break off combat anywhere and still find a landing field. This defense-in-depth arrangement greatly increased German operational capabilities.[91] In addition to increasing their fighter strength in the West, the Germans used their best pilots for defense of Germany proper and employed less capable fliers over France. In order to build up a larger air defense of Germany itself, the pilots were transferred from the Russian front.[92] This regrouping became evident in April, when during an attack of 106 B-17's against Bremen, the bombers lost 16 planes to an enemy that displayed vicious and skilled opposition.[93]

Having completed these improvements, the German high command believed that American bombers would be unable to penetrate deeply in daytime and that German fighters could now cope with bombing attempts by inflicting high losses.[94] By 1943 some AAF commanders considered the GAF fighter force as the primary obstacle to the daylight bombing campaign. It is true that the American bombing program did not diminish until October, 1943, but there had been a growing awareness that air battles would assume more dangerous proportions because of the increase in German fighter opposition.[95]

The Germans had also found an effective way to take a prohibitive toll of unescorted bombers. This was by use of 21-cm. mortars mounted under the wings of their fighters and fired from an 800-yard range. The German offensive against American Fortresses and Liberators reached its high point in the fall of 1943. GAF victories in August and October made the Luftwaffe appear to be a strong and vigorous group. But deterioration of the GAF was well under way and became increasingly clear in 1944 in air battles with the long-range escort fighter airplane.[96]

The additional of jettisonable fuel tanks to American fighters, along with other modifications, created a marked need for the enemy to counter with a new weapon or tactic. The Germans noted the use of belly tanks, and in September Goering told representatives of the German aircraft industry that the Me-109 and the FW-190 were no longer superior to Allied fighters. "To my great annoyance," the Reichsmarschall told his audience, "the British and American fighters appear to be able to increase their range quite easily by the addition of extra fuel tanks; this is naturally unpleasant."[97]

This unpleasantness caused a re-examination of strategy. Late in 1943 Galland suggested to Hitler that the Germans send a fighter to meet every enemy fighter. Galland was convinced that an 80 per cent loss could be inflicted on every raid. This figure was based on the quality of aircraft and pilots of both sides, but later deterioration in the German pilot training program, fuel shortages, and Ameri-

can radar bombings were not considered.[98] When Hitler was reluctant to accept his suggestion, Galland made another proposal. This was to commit at least a part of each wing againhst American escort fighters.[99] Hitler rejected Galland's warning about increased range for American escort fighters since he believed Goering's conclusion that this was impossible. Another plan devised by the Luftwaffe staff provided for use of a part of the wing based in France and Belgium to attack escorting fighters on their way in, thus forcing them to drop their belly tanks. This was tried once and proved successful, but it left France and the Low Countries exposed to bombing and strafing attacks by American fighters and medium bombers, which the high command would not permit.[100]

Prior to mid-February, 1944, the main duty of enemy single-engine aircraft in the area west of Germany consisted of repulsing escort fighters. Thus, it was hoped that the main defenses could be directed against unescorted bombers. To protect the Reich, the GAF employed both single- and twin-engine day-and-night fighters. Emphasis was placed on defending approaches to Germany through occupied territory. However, there remained a substantial need for coastal protection. For this purpose a fighter radio control unit was assembled to direct a number of aircraft from different air defense sectors. At this time all German fighters were operating on a single radio frequency. This system resulted in substantial flexibility of control for fighters based near the

coast and farther inland, and enabled a rapid reinforcement of one area by another.[101] When long-range fighters of VIII Fighter Command began to penetrate deeply, areas of close control, assembly, and attack moved eastward to the Dummer Lake, Hamburg, and Kiel areas to afford greater protection to the Reich.[102]

At this point the Germans committed a major tactical blunder. Having failed to stop Allied bombers and fighters at the coast after only a few skirmishes, the Germans partially withdrew their fighters from coastal areas along the Channel and the North Sea to bolster the inner defenses of the Reich. Primary defense against American bombers was then organized along the Hanover-Berlin line, with a strong secondary defense centered near Munich and Vienna. To conserve the fighter force as much as possible, only small groups, or none at all, were put up when weather conditions were unfavorable. A usual German tactic was to position attacking fighters above and behind a bomber formation, dive through the escort, shoot at the bombers, and dive away. At first fighters were ordered to attack only the bombers, but later a portion was allowed to harass escort fighters. German fighter losses reached serious proportions as a result of Luftwaffe failure to disperse opposition fighters before concentrating on the bombers. When the Luftwaffe did begin to operate against fighters, a favorite trick was for a number of German fighters to attack on the top cover to gain attention,

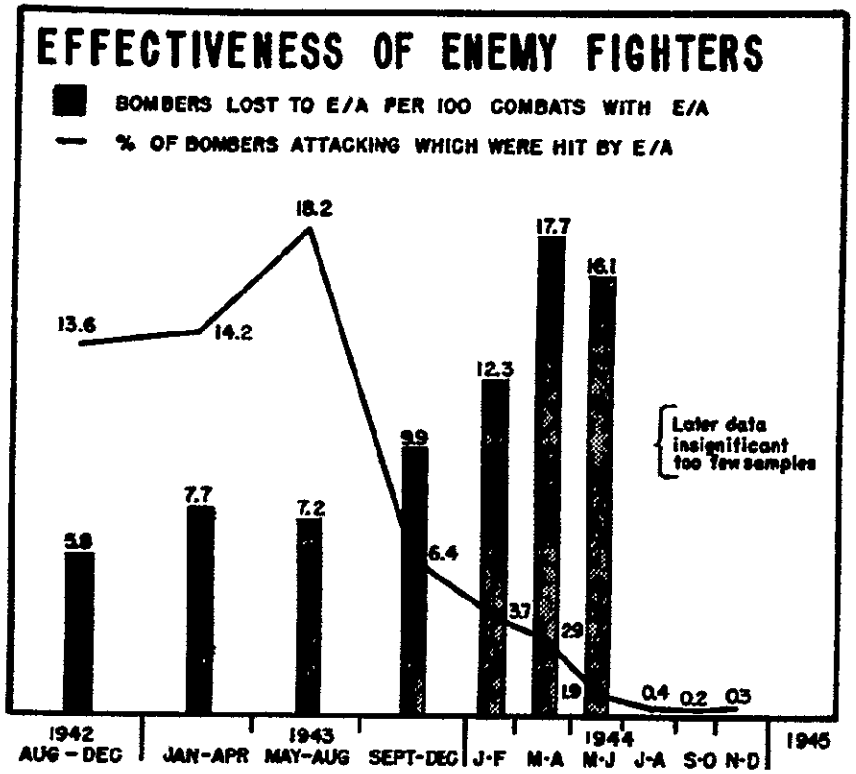
while another formation of German fighters climbed out of a cloud cover under the bombers, attacked, and left beneath the clouds. Since their speed was low during the climb to attack, it was a dangerous tactic unless timing was perfect.[103]

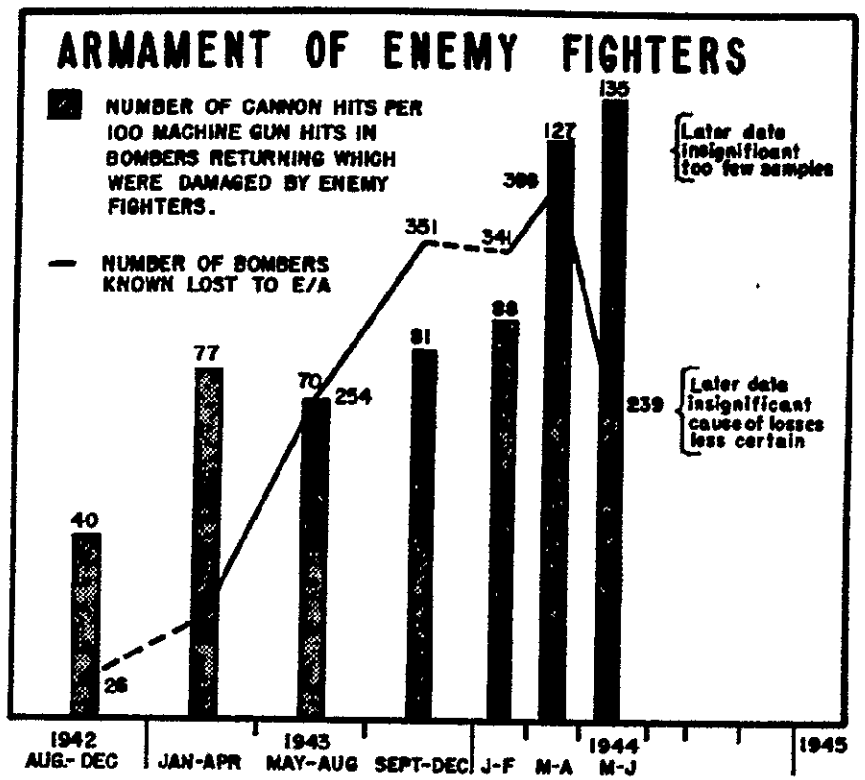
Other German tactics included assembling and controlling during battle one or two large forces comprising practically all fighters available for defense; attacking bombers only when unescorted or when escort could be overwhelmed by superior numbers; and devising methods for plotting the course of American bombers and fighters in order to detect and quickly exploit any gaps in the escort. These tactics resulted in severe losses to formations caut with limited or no support. This latter development was particularly common during the fall and winter of 1944 when the Germans conserved their fighter strength to challenge one part of a formation with their full fighter force. The net result was severe losses for isolated or straggling formations.[104] The Germans were willing to pay a high price for destroying American bombers, though they believed this would cost them 600 to 700 pilots a month.[105] Had they been able to stop the bombers' attacks at that price, it would have been worth the loss, but such was not the case, primarily because they were unable to find means to neutralize long-range escort fighters. Until the range of escorts had been lengthened to permit them to accompany bombers to the deepest targets, the German reaction had been to wait for the escort to leave bomber formations

and then to attack. Once the fighter had long range, this tactic became ineffective, and the Germans showed little disposition to close in for combat if it could be avoided.

Late in 1943 Goering approved a plan to provide certain groups in each wing with heavier armament. These groups, escorted by either Me-109's or FW-190's, were equipped with 20-mm. cannon for use against the bombers.[106] Since this heavy external armament seriously reduced their performance,[107] they were escorted by Me-109's powered with high-altitude DB-605AS engines, which were expected to destroy or disperse Allied fighter escorts. Equipping the groups in this manner progressed slowly, and those wings which did not complete the transition had no need for lighter planes to attack Allied fighters. Instead, they were used as close support for heavy groups and thus actually lost the aggressiveness necessary to down Allied fighters or to break up the protective ring around bomber. The distinction between light and heavy groups became more marked in 1944 when the ponderous Sturmgruppe formations were created.

In early 1944, when the tempo of American daylight bomber raids increased, it became clear that the German fighter forces could not attack in strength against every mission. The AAF fighter escort made such deep and strong penetrations that only large German formations could hope to break through the fighter screen and inflict damage on the bombers. Since the Allied escorts were using external tanks, German fighters attacked to force them to drop their extra





SOURCE: EIGHTH AIR FORCE TACTICAL DEVELOPMENT

fuel. This was against Luftwaffe orders, but operational commanders realized the importance of this tactic and disobeyed the high command's regulation.[108]

In December, 1943, Goering ordered his airmen to concentrate on bombers and to avoid Allied fighters. In addition, he instructed his pilots to close to 400 meters before firing and to attack the bombers from the rear. The result of this order was catastrophic when obeyed. At times 50 to 70 per cent of the German pilots who attacked Allied formations failed to return. The obvious reaction of pilots to this order was to disobey it, since to follow it made survival almost impossible. Enemy pilots would have preferred to attack the escorts, forcing them into a defensive position. Allied fighters flew above bombers as well as on their flanks, thus preventing the attacking Germans from reaching the formation without being intercepted. The frustration that developed in coping with this situation on mission after mission led to a considerable weakening of the German airman's morale.[109]

In a series of post-war lectures at the Air War College, Maj. Gen. Orville A. Anderson developed at some length the implications of Goering's 27 December order. He explained that Goering had violated the basic tenet of tactical doctrine -- fighter versus fighter. Anderson observed:[110]

> That is the two airplanes have approximately the same speed and maneuverability sufficient that one can get onto the tail of the other, and that fighter airplane which tried to avoid the other commits suicide; it invites disaster. This dictate, this order of Goering's on 27 December, was a suicidal order to the Luftwaffe.

The Goering order, however, was not made with consent of all his air generals. Galland opposed it, but was overruled. This conflict was only one example of the struggle between such an expert fighter tactician as Galland, and Goering. Hitler at times ordered certain air tactics though he knew little about air warfare. Thus, the persons capable of formulating policies for employment of fighters were often overruled by Hitler and his Luftwaffe chief.[111] Notwithstanding the 27 December decree and instances of violation by German pilots, air battles in the first six months of 1944 proved once and for all the value of escort.[112] In the fall of 1944 German fighter tactics called for employment of high altitude fighters against Allied escort fighters. The resurgence of the GAF at that time and minor use of jet fighters during the following winter and spring failed to change the course of the air war, not did it delay Allied victory, insured by German inability to meet the escort problem successfully.

When hostilities ended the Allies queried German officers on the effectiveness of escort fighters. Luftwaffe officers were virtually unanimous in the belief that the turning point in the daylight bombing campaign came when long-range escort fighters were brought into use. General Spaatz posed this question to Goering: "When did you know that the Luftwaffe was losing control of the air?" The Reichsmarschall replied, "When the American long-range fighters were able to escort the bombers as far as Hanover, and it was not long

until they got to Berlin."[113] Continuing his appraisal of the escort fighter, Goering observed:[114]

> The reason for the failure of the Luftwaffe against the Allied Air Forces was the success of the American Air Forces in putting out a long-range escort fighter airplane, which enabled the bombers to penetrate deep into Reich territory and still have a constant and strong fighter cover. Without this escort the air offensive would never have succeeded.

When Goering first saw bombers over Germany, he could not believe his eyes. He was convinced, however, that escort alone made this possible. The appearance of escort fighters over Berlin was a tragic sight to him.[115]

The importance which Goering attached to the escort fighters was emphasized also by Luftwaffe officer, Lt. Gen. Werner Junk, who declared, "The American fighter escort was of great effectiveness from the very beginning and caused the Germans heavy fighter losses."[116] Another officer, Lt. Gen. Karl Koller, Chief of Staff of the Luftwaffe, said that the American long-range fighter cover came as something new and fatal to Germany. Without this cover he had hoped to inflict losses as high as 30 per cent on unescorted bombers which, in his opinion, would have made daylight bombing attacks impossible. He laid considerable stress on the fact that neither the British nor the Germans had thought of fighters except in terms of the first World War and of the narrow ranges associated with land warfare in Europe.[117] A post-war analysis of the German air effort, written by former Luftwaffe officers, stated: "Thus it can be seen that it was

not the American bomber force that was new, final, and the decisive medium, but that it was actually the strong long-range fighter which first created the requisites for the operation of the bombers and gave the key to the escort of the free daylight operations."[118]

What were the reasons for the success of the long-range fighter? Mention has been made of German inability to take the initiative in developing a long-range defensive program to challenge Allied planes. By 1943, following the initial decision to concentrate on fighter defenses within the Reich, the way was open for movement of the air war to the heart of Germany. An indirect reason for the success of the escort was Hitler's interference with matters pertaining to the Reich's air defenses. Two events occurred in 1943 which caused Hitler to interfere. Before that time the Reich chancellor had generally concerned himself with directing the army, but the impact of escort fighters and the use of WINDOW, which disrupted the German radar system, caused him to assume direction in dealing with those problems. Moreover the introduction of the escort fighter had caused Hitler to lose faith in his Luftwaffe generals and in Goering's direction of the GAF.[119] Fortunately for the Allies, Hitler's interference had a disastrous effect on the course of the German air defense. Typical of his misdirection was his insistence that the Me-262 jet fighter plane be used as a bomber. This order held for six months, until late in 1944, when he ordered

that the plane be used once again as a fighter.[120]

In the face of mounting attacks on Germany by American bombers in late 1943, Galland suggested to Hitler a plan to increase fighter production. Hitler agreed to it, regardless of whether it entailed reducing bomber output. But as Galland points out:[121]

> The lack of recruits and the insufficiently trained young airmen became an increasingly urgent and ultimately a crucial problem. In the beginning training had suffered from the shortage of aircraft; later on there were no instructors and fuel became scarcer and scarcer because the fighter arm was not strong enough to prevent Allied raids on our synthetic oil plants. It was a vicious circle from which the Luftwaffe could no longer escape.

When by summer, 1944, Hitler lost his faith in the ability of German fighters to protect the Reich, the air defense of Germany suffered materially.[122] By consolidating and placing aircraft production underground the Germans reached a new high in airplane output, but in late 1944 fuel shortages affected the pilot training program to an alarming extent, so much so that employment of the Luftwaffe was influenced decisively by lack of fuel, indeed, a vicious circle as Galland has pointed out.[123]

Underlying the problems which beset the Germans in their conduct of air defense was their inability to comprehend implications of the escort fighter. At best, the American escort fighter was a modified interceptor-type plane, which even with increased internal fuel capacity could not have accompanied bombers in deep penetrations had the Germans

challenged the fighters at the coast of France and forced them to drop the jettisonable tanks. General Anderson stated the point thus:[124]

> In terms of the reaction to the wing tanks to our P-51's and P-47's here again he /Goering/ had the opportunity to apply his forces which were causing the fighter forces so much concern at a time when the fighter forces had tanks on their wing tips. Now when a P-51 had a tank on its wing tip, then if a Luftwaffe Me-109 or FW-190 didn't have any tactical advantage over it there, there was nothing left for them to do but surrender, to give up. But they did have the tactical advantage there; they could have forced the stripping. It was a tactical mandate that they forced the stripping of the wing tanks as near the Channel shores as possible with the forces necessary to achieve that stripping. Having that stripping then, they could move back in and meet the undefended bombers over the target area and have exacted a heavy toll. But they decided it was better to meet the enemy with his wing tanks over a target area and they gave us free access to the deeper targets before we had to strip these tanks. These were gifts; these were gratuities from Goering and his staff, and they make major contributions to the seeming success and to the tactical soundness of the application, the commitment, the employed of the so-called strategic Air Forces, daylight Strategic Air Forces. We owe much to Goering for the lessons, the successful lessons that we got in the war.

The result of this tactical blunder permitted American bombers and fighters to go as far as Berlin oftentimes before jettisoning fuel tanks. At that point conflict was in order, but the Germans had denied themselves full employment of their own fighters on the periphery of Germany proper. Had they forced escorts to drop their tanks on the coast, the Germans would have seen bombers flying the long stretch of deep penetrations alone, with the probable repeat of the reception which had awaited American planes when they struck at Schweinfurt and Regensburg in August and October, 1943.

It is perhaps academic to speculate on what might have happened had German fighters forced escorts to drop their tanks near the coast of France. Presumably, a series of large-scale battles would have been fought at the point of contact by the two forces, and the outcome would have been determined in favor of the force which could bring to bear the greatest mass of airpower. If it is assumed that the Allies could have built a superiority of force, then the battle line would have been pushed inland, until by attrition of German fighters, the air battle would have permitted escort fighters to fly farther inland and the Germans would have been unable to offer effective resistance.

The Germans in employing a point defense would not or could not see advantages in moving out and providing defensive depth.[125] General Anderson believed that the Germans thought they were providing defense in depth when they initially began at the coastline and offered some fighter defense to the target system. They moved back of the Ruhr, but they still considered that they were fighting in depth defense when they met the enemy as he passed that area.[126] Exploitation of initiative and surprise would have paid strategic dividends to the Luftwaffe. Except for two or three instances the Germans never used their fighter forces for a real defense in depth. Concluding, Anderson stated, "Because of these limitations, because of the reduction it imposed upon the effectiveness of the Luftwaffe, not because of the

brilliance of the leadership from the British Isles, we had achieved in large measure our success."[127] Even the rocket-carrying, twin-engine German fighter planes used at Schweinfurt were themselves a liability and had to be escorted by single-engine fighters.[128] The effectiveness of the rocket by the beginning of 1944 had become so questionable that rocket launchers were taken off the airplanes. With the extension of the range of American fighter planes, the value of the German destroyers, well established in the fight against unescorted bomber formations, decreased. According to Galland, "they suffered heavy losses when they got into dog fights with enemy fighters, and from the end of 1943 this happened in nearly every raid."[129]

The deficiency in the technical development of German aircraft was pointed out, although overstated, in the memoirs of one of Hitler's top-flight pilots who wrote, "The inescapable fact is that on the technical side our performance is inferior in every respect. The victories in Poland and France resulted in the High Command of the German Air Force going to sleep on its laurels."[130]

The Germans failed to see that their control of the air depended on stopping escort fighters. They had been fairly successful in halting unescorted bombers, but they were unable to prevent deep penetrations by escort fighters. In their failure to challenge the escorts as far away as possible from vital German targets, they permitted air battles to be fought

virtually above the very targets Americans were trying to strike. Having failed to force escort fighters to drop their tanks early in flight, the Germans were moved to desperate measures which never became decisive. Had the Germans realized the vulnerability of American fighters without their jettisonable tanks and their overall importance in the air battle, the course of the air war might have taken an entirely different turn.

CHAPTER V

THE WAR IN THE PACIFIC

The Role of the Escort Fighter

In the Pacific the AAF had to modify its tactics to meet conditions peculiar to that theater of operations. Targets were located on islands rather than on a land mass as in Europe. This necessitated flying over vast stretches of ocean to reach objectives. Pilots generally encountered enemy resistance in the target area, rather than in depth as in the European air war. As a result, Pacific commanders realized the need to develop long-range fighters to accompany and protect bomber formations. In addition, fighter forces were needed to support ground operations. This two-fold demand hastened consideration of the escort problem. In sharp contrast to the ETO, Pacific commanders seemed to have wasted little time in debating the need for long-range fighters. Very early, therefore, they recognized escort fighters as an indisputable requirement. For them, the problem early in the war consisted of how to conduct operations with fighters of limited range.

Although the Philippine campaign in 1941-42 did not fully test the heavy bomber's ability to defend itself, Japanese fighters took sufficient toll to exact a sobering effect. During a battle on 8 February 1942 9 unescorted B-17's encountered 9 Japanese Zeros, which inflicted heavy damage on the bombers. None of the heavies reached the target, 2 were

lost, and a third returned to base early during the fight. The mission proved the lack of adequate firepower in the B-17's, particularly an inability in top and nose turrets to turn away attacks. The nose turret, as a rule, carried only a single .30-caliber gun.[1] In March, Lt. Gen. George H. Brett, Deputy Commander of United States Army Forces in Australia, recognized the need for escort fighters in a report to General Arnold: "Fighter protection for bomber formations seems to be a rigid rule when bombers are operating in a defended area."[2] Bombing operations without escort continued only because long-range fighters were not available, rather than not wanted. The very tactics employed on unsupported missions suggest an early respect for Japanese fighters and a desire to conserve the few bombers available in the Pacific.[3]

Many targets were bombed at night. Fifth Air Force reduction of Rabaul on New Britain Island amply demonstrates the reason why. Here was a key Japanese base in the Southwest Pacific, covering sea routes north to the Philippines. The port itself was located in the northeastern corner of the island, and was protected by numerous Japanese airfields and Navy patrol bases around the Bismarck Archipelago off New Guinea. Early in 1943, Fifth Air Force bombers attacked the port in daylight to destroy airfields and shipping anchored in the harbor. The loss of 3 bombers out of the small attacking force prompted the Fifth Air Force to switch to night operations, thus permitting continuation of bombing with less chance of enemy interception. Lt. Gen. George C. Kenney,

commander of Fifth Air Force, wrote Arnold, "To be in a position to deliver even this small effort, I have found it necessary to omit day bombing in an emergency, due to the fact that daylight operations do put many more planes out of commission than the night missions.[4]

Even before the Rabaul strikes Kenney had written Arnold that, "The lack of underneath protection, the make-shift nose, and the fact that the B-24 has about five thousand feet less ceiling than the B-17 makes it unwise to gamble on using the bomber for daytime operations unless well convoyed by fighters."[5] Because of strong antiaircraft concentration at Rabaul, bombing had to be conducted from heights of 20,000 to 24,000 feet. The resort to night bombing also indicated the menace that enemy fighters posed for American bombers. When American fighters were able to use advanced airfields at Dobodura and Kiriwina, and thus escort the bombers, night operations against Rabaul were abandoned.[6] American daylight attacks on the port culminated in a series of missions flown between 12 October and 29 October 1943, when Rabaul was hit by mass attacks of American heavy and medium bombers accompanied by American escort and Australian Beaufighters.[7] During these missions escort fighters claimed 159 Japanese planes destroyed and 32 probables. The Fifth Air Force summary of the Rabaul strikes described the escort as "magnificent," and stated that the "unparalleled fighter cover enabled the bombers to operate effectively at all altitudes, with a minimum of interception."[8]

Escort fighters also participated in daylight bombing operations on Guadalcanal. Lt. Gen. Millard F. Harmon, air commander on Guadalcanal, urged Washington to send him P-38's to protect bombers under his command during the campaign to conquer that island.[9] These Lightnings afforded considerable protection to his bombers.[10] The P-38 landed at Henderson Field on Guadalcanal in mid-November, 1942.[11] Shortly, thereafter they took part in a combined mission against Buin.[12] These fighters employed standard Lockheed 150-gallon droppable tanks, and Harmon was highly pleased with them because of their long range.[13] After the P-38's were withdrawn from Guadalcanal in January and February, 1943, bombers resumed night sorties until the latter part of May when the return of the Lightnings permitted resumption of daylight attacks.[14]

The Thirteenth Air Force, activated 13 January 1943, also conducted many of its operations without fighter escort, though some of its missions received support from Navy and Marine fighters. During the first half of 1943, the Thirteenth had only 1 P-38 squadron, with the remainder of its fighter force composed of short-range P-39's and P-400's. The latter was an export version of the P-39.[15] Like other air forces in the Pacific, the Thirteenth experienced severe losses in daylight missions. An operation on 13 February 1943 against Buin on Bougainville cost the 307th Bombardment Group 3 of its 6 planes. This raid and one the following day, which cost the attackers an additional 2 bombers, caused the 307th

to adopt night operations until fighter cover was provided on the missions over Bougainville.[16] This sequence of tactics, from an initial day mission to a series of night missions, against key Japanese targets typified Pacific operations when escort fighters were not available. When they were provided, the bombers could then attack during daylight.

In the absence of escort fighters, bombers in the Southwest Pacific Area were strengthened by increased firepower and armor. These modifications, originally made in the theater, became regular equipment on later planes built in the United States. Ironically, about the same time that armor plating reached adequate proportions, sufficient long-range fighter planes became available to the Pacific theater. Since the heavy armor had impaired efficiency of the bomber, it was then removed.[17]

The supply of long-range fighters became more plentiful after mid-1943, and the Pacific air forces either acquired new fighter groups or converted existing units from P-39's and -400's to the P-38. Use of these to accompany large bomber formations permitted daylight missions without prohibitive losses. An historian of V Bomber Command summed up this change:[18]

> Gradually as the strength of the groups grew, the small-scale hit-and-run night missions that characterized the majority of the heavy strikes began to shift in favor of daylight precision bombing carried out by whole groups and squadrons. Not an abrupt change of tactics, it was a gradual process that didn't come into full flower until the latter half of 1943.

At times, even after mid-1943, the use of escort depended upon securing forward fighter fields, particularly for long missions.

The story of how these escort fighters were brought into the Pacific air war, like its European counterpart, comprises a three-part development: first, the struggle to obtain droppable tanks from the United States and to a lesser degree through local manufacturers; second, the effort to extend fighter range by increasing the internal fuel capacity of the planes; and third, the constant effort of theater commanders to obtain fighters in sufficient quantities to satisfy their requirements.

Because the Pacific theater was more active than the European immediately following the declaration of war in December, 1941, and also first revealed the need for long-range fighters, a request for planes with more range was soon forthcoming from that part of the world. As early as 19 February, scarcely six weeks after Pearl Harbor, General Brett was urging Washington to provide auxiliary belly tanks for every fighter plane. He suggested that auxiliary fuel should equal 75 per cent of the normal fuel load.[19] In compliance with Brett's request, AAF A-4 asked that, as soon as tanks were fabricated, the forces in Australia be furnished 52-gallon belly tanks at the rate of 6 per plane for the P-40, and 75-gallon models for the P-39's at the same rate.[20] Materiel Division ordered production of 52-gallon tanks for air forces in the Far Eastern, European, and other war theaters.[21] Maj. Gen. Lewis H. Brereton, commanding general

of Tenth Air Force, sent a similar appeal to Washington for tanks.[22] Brereton also requested that blueprints of 100-gallon tanks be sent to Delhi, India, since he had arranged for manufacture of jettisonable tanks there.[23] On 10 August a memorandum embodying a basis for procurement and shipment of combat tanks was issued alloting to the Pacific islands and Australia 8 tanks for each single-engine fighter and 16 for each twin-engine fighter, while Hawaii was to receive 12 and 24 tanks respectively for each fighter type.[24] A critical need existed for these tanks because of the small internal fuel capacity of the P-39 and -400, each of which held only 120 gallons of gasoline. The first P-38's had arrived in Brisbane in August. To extend their range, Kenney contracted with the Australian sheet-metal industry in September to manufacture approximately 10,000x150-gallon jettisonable tanks.[25] By the end of 1942, use of 52-, 75-, and 100-gallon belly tanks was standard practice.[26]

During the first years of the Pacific war, the P-38 served as the major long-range escort fighter. They were first committed to action in December, nearly four months after their arrival in the Pacific area. Thereafter, they were used as escort fighters as soon as AAF commanders could obtain them, and in some instances only for such duties.[27] The 39th Fighter Squadron of V Fighter Command flew them initially during the battle for Guadalcanal.[28] Thereafter, their contribution to the air war was outstanding. They dis-

tinguished themselves during the Battle of Bismarck Sea, 1-4 March, 1943, as escorts for heavy, medium, and light bombardment units.[29] When available, escort became a standard procedure for bombers and for all transport planes as well.[30]

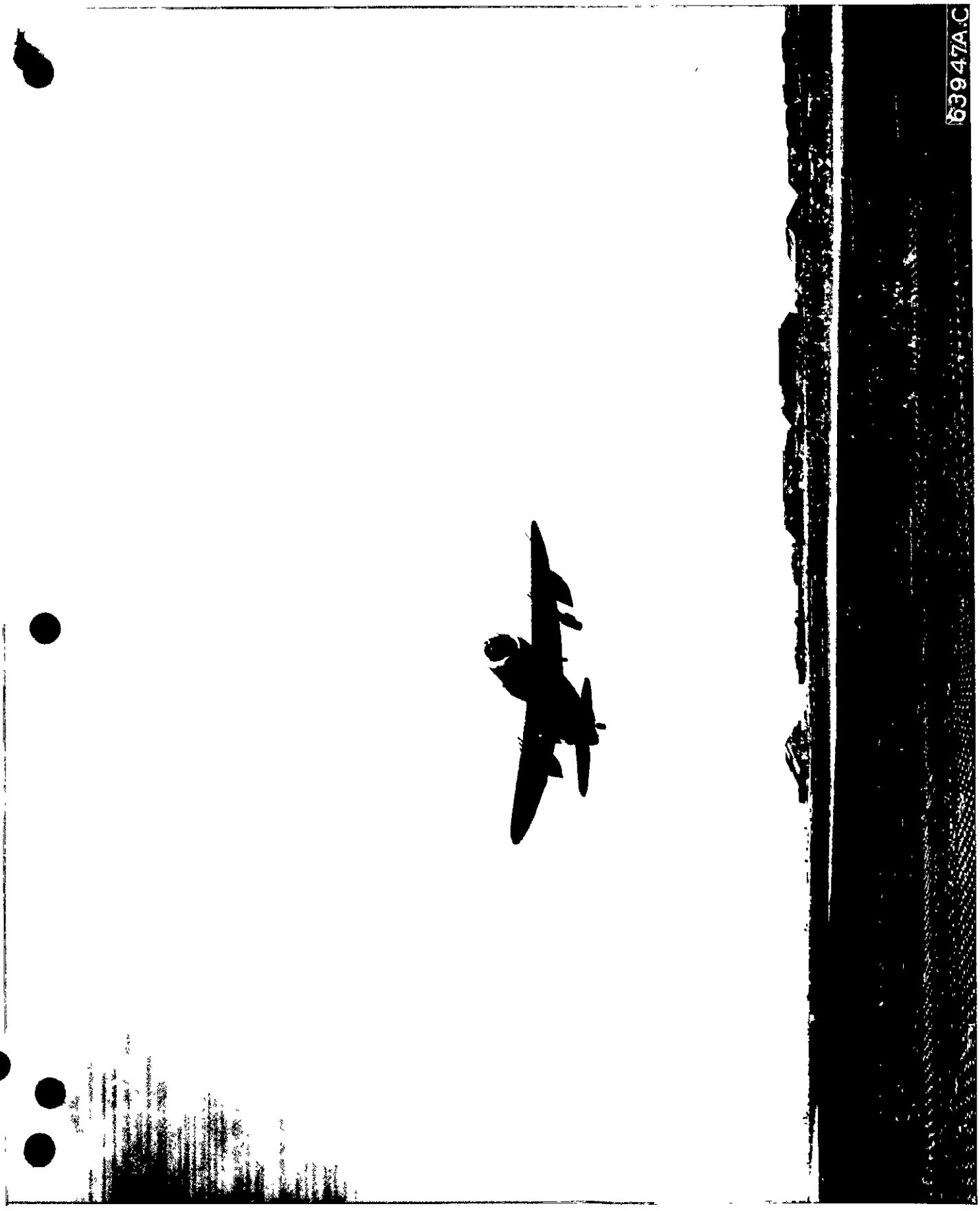
The unit responsible for Fifth Air Force escort operations was V Interceptor Command, which was activated at Fort George Wright, Washington, in April 1942.[31] It was redesignated V Fighter Command at Seattle the following August, and Col. Paul B. Wurtsmith assumed command on 11 November with temporary headquarters at Port Moresby, New Guinea.[32] Wurtsmith's prodding and Kenney's constant urging of Washington to send newer model planes hastened the build-up of long-range fighters in the Pacific.[33]

On 1 April Wurtsmith asked Kenney to investigate the practicability of installing additional fuel tanks on the P-38 to raise its integral fuel load to 400 gallons. Wurtsmith observed that the Lightning would then have a radius of action of 550 miles or an escort radius of about 425 miles.[34] Kenney, in turn, urged Wright Field to increase the P-38's fuel load.[35] Then, on 21 April Materiel Command authorized a study to determine the practicability of increasing the P-38's fuel load to 400 gallons by installing extra wing tanks.[36] In the meantime, Kenney had heard that the range of newer models of the P-39 and the P-40 would be reduced. He wrote Arnold on 5 May that such changes would greatly curtail the effectiveness of these planes. He wanted the P-39's

internal tankage increased to 120 gallons in place of the proposed 87, and that of the P-40 to 157 gallons instead of the proposed 120.[37] Three days later Arnold assured Kenney that his suggestion would be followed.[38]

AAF headquarters requested a memorandum from V Fighter Command pilots concerning their views on questions dealing with escort aircraft. The airmen recommended using the same type of aircraft as the bomber for this purpose, and omitting the bomb load in favor of twin .50-caliber power gun turrets. The pilots said, "These aircraft should be assigned to the long-range bomber unit, which would simplify maintenance, training, and coordination of escort and cover." The pilots also believed that a long-range fighter model might consist of a twin-engine design comparable to the A-26 or Mosquito class in speed and range, with a speed of 400 miles per hour at 20,000 feet and a combat radius of 650 miles. Its armament should consist of eight .50-caliber fixed, forward free-firing machine guns. Moreover, the pilots thought that the P-38 might also serve as possible long-range fighter, but that it would require an increase of 50 gallons of fuel per engine carried in integral leakproof tanks to qualify for such service.[39]

These opinions closely paralleled ideas held by AAF commanders in Washington and the ETO. The first suggestion, to utilize a plane similar to the long-range bomber, developed into the abortive YB-40 experiment. The second recommendation, that of converting a medium bomber, was



rejected, but the third proposal, to use a P-38 with increased tankage, proved feasible.

The 35th Fighter Group, exemplifying the growing doctrine on employment of long-range fighters submitted to V Fighter Command its version of the duties of escort planes:[40]

> The primary purpose of escort is protection for the planes escorted. Care must be exercised that the flights do not attack those planes first sighted, until it is definitely ascertained that it is not merely a decoy flight, with a stronger force waiting to attack. When using three or more flights it is a practice to keep at least two flights as close cover for the transports or bombers escorted. These two flights continually weave over escorted aircraft, not over 2,000 feet above and slightly behind the aircraft. The third and fourth flights fly approximately 5,000 feet above No. 1 and 2 flights, the third flight flys high and behind the complete formation. This type formation has proved most satisfactory for escort work in this theater. If a larger formation is to be escorted, more fighter cover should be employed in the above relative positions.

Toward mid-1943, a new plane was assigned to fighter units of the Fifth Air Force, the P-47, of which 59 were supplied to the 348th Fighter Group of V Fighter Command by 2 July.[41] These planes, however, lacked additional fuel tanks, and, without them, they ". . . did not have enough range to get into the war."[42] Kenney immediately dispatched a cable to Arnold requesting P-47 tanks be sent at once, and by air if possible. Within a week two samples arrived, but neither held enough fuel. They also required too many alterations to install and were difficult to release in an emergency. In order to make the P-47 usuable, the Fifth Air Force designed and built a 200-gallon tank in two months.

Though a Wright Field handbook had shown that this size tank was unsatisfactory because of tail burfeting, Kenney was not dissuaded from the idea that it could be used. Early in July the 27th Depot Repair Squadron at Port Moresby was given a rush job of designing a suitable belly tank with a reliable release mechanism. Using the tools and equipment on hand, the 27th worked around the clock. Soon they were able to attach the modified tanks on P-47's at the rate of 7 per day. Some 100 planes were equipped with these belly tanks.[43] In late July, Kenney told Arnold of the effort by his Air Depot personnel to increase the range of the Thunderbolt. "If further tests prove satisfactory," he declared, "I will go into production on this installation here without waiting for the kits to arrive from the United States."[44] The first plan was to modify the flat, oval-shaped 110-gallon tank used on the P-39's and -40's, and Kenney requested Wright Field to send him 100 kits to make this modification.[45] When tank tests were finished Fifth Air Force contracted with the Ford Company of Australia to manufacture them.[46]

Air Service Command at Wright Field sent Kenney information on the installation and manufacture of belly tanks for P-47's. Kenney was also promised 10 modification kits weekly for connecting P-39 and -40 belly tanks to the P-47.[47] The demands of other theaters and low production capacity did not permit sending more than this number weekly, a figure which seemed ridiculously low to Kenney. The general informed

Washington that the 200-gallon tanks designed and manufactured in Brisbane greatly surpassed those developed in the United States, and that he was cancelling the order for American 200-gallon form-fitting tanks which, he said, would not release when empty and affected the P-47's directional stability. Kenney also cancelled all orders for 150-gallon tanks.[48] The Australian 200-gallon model became standard in the Southwest Pacific. The 27th Repair Squadron began to replace the older model with the newer tank -- not a difficult change since only minor modifications were needed for installation of booster pumps and motors.[49]

In summing up his own tank needs, Kenney wrote Arnold, "I wish I could get the engineers back home to realize that our problem requires a lot more range than is needed to defend London or to make a fighter sweep across a ditch that is no bigger than Chesapeake Bay."[50] Arnold directed his Deputy Chief of Staff, Maj. Gen. J.E. Hull, to take immediate action on Kenney's letter. He wrote Hall, ". . . there is no reason why General Kenney should have to develop his own belly tanks. If he can develop one over there in two months, we should be able to develop one here in the United States in one month."[51]

The effort expended in designing 200-gallon tanks for the P-47 permitted the 348th Group to begin combat operations in late August.[52] At the same time Kenney informed Arnold that SWPA no longer required leakproof, external, combat

range-extension tanks for any type of fighter aircraft. He believed, however, that planes needed additional built-in leakproof tanks to provide extra range. He told Arnold that lightweight jettisonable tanks were the only kind of external tanks he needed in his theater, but wanted these in relatively large numbers for all types of fighter aircraft.[53] In September Arnold reported to Kenney that the P-38 had undergone modifications to permit inclusion of 110 gallons of fuel in the leading edge of the wing and that tests would take place about 1 October.

The autumn crisis in the ETO necessitated sending as many long-range fighters to that theater as possible, even at the expense of curtailing fighter shipments elsewhere. The limited supply of long-range P-38's and the overriding priority given the ETO forced the AAF temporarily to halt shipments to the Fifth Air Force.[55] Kenney, realizing Arnold's predicament, wrote him, "I am not going to offer any objection to the curtailing of P-38 deliveries to this theater. I am considerably disturbed about our ability to keep these long-range day bomber operations going without prohibitive losses."[56] In order to compensate for the absence of additional P-38's, Kenney told Arnold of another P-47 modification on which Fifth Air Force technicians had been working. This involved moving the IFF equipment to the top of the fuselage, forward of the pilot's windshield, and transferring the radio from the rear of the pilot's armor to

the cockpit on each side of the seat. A 75-gallon leakproof fuel tank was installed in the space formerly occupied by the radio equipment. "This modification will give me one more squadron of P-47's so equipped by January and with this increased range they will be able to cover bomber operations to Rabaul and Kiriwina," Kenney wrote. However, he worried because his fighter losses would undoubtedly rise, since the P-47 "after all has only one engine." He continued, "Many of our P-38's are constantly returning from combat after one engine has been shot out, and there is a vast difference in morale between pilots flying two-engined fighters and those flying the single-engined fighters over the long expanses of water in this area."[57] Even in the last year of the war Kenney still favored the twin-boomed Lightning, and fought to keep it when AAF leaders in Washington and the ETO wanted to curtail its production on the grounds that the P-47 and P-51 were superior planes. During a trip to the United States in March, 1945, Kenney argued the matter with Lt. Gen. William Knudsen. His arguments in favor of the P-38 evidently convinced Knudsen, who agreed to continue Lightning production.[58]

In the latter part of 1943 three units joined V Fighter Command. A P-47 group, the 58th, came into the organization in December, and two night fighter groups, the 418th and the 421s, joined in November and December respectively. During the last half of 1943 V Fighter Command flew 6,607 sorties in support of bombers and 10,215 to protect transports, with total sorties for the period amounting to 24,397.[59]

In March, 1944, both the P-47 and P-38 were again modified. Flight tests of the former with a 250-gallon tank proved favorable. A shell mock-up was sent to Sydney as a guide for manufacturing a prototype tank, with work again being done under the Ford Company's direction. At the same time, 113 kits for installing leading edge wing tanks on the P-38 were sent to V Air Force Service Command. Since this modification gave the Lightning a longer reach, it was included on later planes sent from the United States.[60] The 348th Fighter Group, which joined V Fighter Command on 7 June 1943, flew the P-47 for the first time in that command. This group was also the first to be re-equipped with the P-51 in January, 1945, followed by the 35th Group in March.[61]

In July, 1944, Charles A. Lindbergh, who was visiting the Fifth Air Force area as a civilian observer, taught pilots how to obtain additional range by economical operation of their engines. His instructions to pilots of the 475th Group (P-38's) called for a wider spread between revolutions per minute and more manifold pressure settings than had been customary. These changes did not harm engines or foul spark plugs. They were recognized as an important technique in long-range cruising. Lindbergh decided that the most economical indicated airspeed for maximum range in the P-38 and P-47 with 2x165-gallon external tanks was 180 miles per hour.[62] Lindbergh proved his arguments by making long test flights

with less gasoline than could any other pilot. As a result, pilots of the 475th adopted his suggestions. Lindbergh visited other P-38 groups and also spent some time instructing a P-47 unit.[63] The new technique increased combat radius of the P-38's to 600 miles, a gain of some 30 per cent.[64] This additional radius permitted fighters to reach new targets, spend more time over an objective, and avoid air zones where notoriously tricky weather prevailed.[65]

The new cruise control techniques prompted a new appreciation of the range capabilities of the P-47N and led to the conclusion that ". . . the P-47 with tanks has become a long-range airplane capable of operating five or six hundred miles from the nearest target base."[66] Pilots considered Lindbergh's advice important enough to pass on to Washington, with the suggestion that techniques of long-range cruise settings be included in future pilot training.[67]

An effort was made to increase the range of P-40's in the V Fighter Command's 49th Group still more by equipping them with three external droppable fuel tanks, one belly tank, and two wing tanks, instead of the two normally considered maximum. Thus equipped and with the pilot using the cruise-control technique, the plane flew for 7 hours and 35 minutes and still had sufficient fuel for another hour and one-quarter. This indicated that the P-40 could achieve an effective radius of 650 miles.[68]

Escort techniques were perfected to such an extent that the overall operations from take-off to landing became a carefully planned system designed to minimize fuel consumption as much as possible. For example, take-off time was arranged so that a minimum amount of gas was used in taxiing or waiting at the end of the runway for other fighters to clear the strip. A flight did not start until the preceding one was out of the way, thus permitting immediate taxiing, acceleration of (rev-up) engines, and take-off. Pilots revved their engines, checked them quickly, and took off in pairs or from opposite sides of the runway at intervals of about eight seconds. Gasoline for taxiing and take-off came from reserve tanks. As soon as a plane reached 1,000 feet, the pilot switched over to external auxiliary fuel. As soon as possible the pilot used manifold pressure to permit him to operate his engine or engines in an automatic lean.[69] By then he had ascertained whether gas could be drawn separately from each tank. In the case of the P-38 this meant using the cross-feed system in order for both engines to draw fuel from an external tank at the same time. Joining other planes in the formation was accomplished without any loss of time. In the case of a squadron, 16 planes joined the formation while the squadron leader was making a wide circle to gain the desired economical airspeed before setting the target course. The other planes flew in loose formation in order to maintain the recommended airspeed. All pilots adjusted engine settings for economical fuel con-

sumption. As tanks became empty, they were immediately dropped.

Planes flew at higher speeds in target areas as a protective measure. At such times, fighters usually cruised at over 250 miles per hour, and at more than 300 miles per hour when enemy planes were in sight. They dropped their external tanks before engaging enemy fighters or when conditions made this advisable. On long-range escort missions with bombers, strafers, or rescue aircraft, rendezvous points were set as close to the target as possible. This saved gasoline for the fighters, since they could proceed directly to the rendezvous point and were spared the necessity of weaving for long periods near the slower escorted planes. After escorting planes out of the danger area, the fighters left them and proceeded to their respective bases.[70]

On 3 October, unescorted bombers attacking oil refineries at Balikpapan, Borneo, lost 7 B-24's, making it imperative that escort fighters be provided on future missions. On the 10th and 14th of October the longest escort mission of the Pacific war took place. On the 10th, 16 P-47's of the 35th Group and 18 P-38's of the 8th and 49th Groups, flying from Morotai, escorted 125 B-24's to Balikpapan, some 845 miles, where the target was one of the largest oil refineries serving the Japanese. This mission called for the P-47's to range ahead and sweep the area on an "offensive escort," while the P-38's lingered behind. Nearing the target, the P-47's

encountered approximately 40 enemy planes, and in the ensuing combat 9 enemy aircraft were destroyed, and 4 others probably destroyed in action between Balikpapan and Manggar airdrome. The P-38's destroyed 6 enemy planes. Total score for the fighters was 15 victories, and 4 probables. American losses totaled 1 P-47, 1 pilot, and 3 B-24 bombers. On the second mission, some 100 Liberators dropped 125 tons of bombs on the same target. Fifteen P-47's of the 35th Group and 29 P-38's of the 8th, 49th, and 475th Groups took part in the escort. The P-47's, repeating their performance of four days before, were again on the "offensive escort", and again saw most of the day's fighter action. Their opposition numbered between 35 and 40 enemy fighters. In the ensuing combat the Thunderbolts claimed 19 planes and probably destroyed 3 more. P-38 escort, in addition, brought the combined score to 35 destroyed and 5 probables, the escorting fighters lost 4 P-47's and 1 P-38; 3 of the P-47 pilots were rescued. Only one bomber was lost.[71]

The success of these missions resulted from much preliminary planning and experimentation. To provide escort over such a long distance, it had been necessary to increase fighter range beyond that of normal operations. Engineers experimented with internal and external gasoline tanks, collected cruising data, and worked out endurance charts.[72] Before these missions took place, the fighters, including late model P-47's and P-38J's with leading edge wing tanks, were equipped with jettisonable tanks. External tanks of 310-

and 165-gallon capacity were available in limited quantities. Two 310-gallon tanks constituted an overload for the fighters, even if enough had been readily available to equip all the planes. Two 165-gallon tanks were not sufficient. Consequently, each plane received one 310-gallon tank under one wing and one 165-gallon tank under the other.[73] This arrangement, combined with the technique of cruise control, permitted the fighters to reach their target and return with some fuel to spare. The fighters for these missions staged out of Morotai after a hasty extension of the runway.[74]

The SWPA Air Evaluation Board, summarizing effectiveness of these missions, stated, "The lost and damaged B-24's on unescorted missions were four times as great as those with fighter escort. Fighter escort should be provided for all bombardment missions against targets defended by enemy fighters."[75] The effect of fighter escort on operations can be measured as follows:[76]

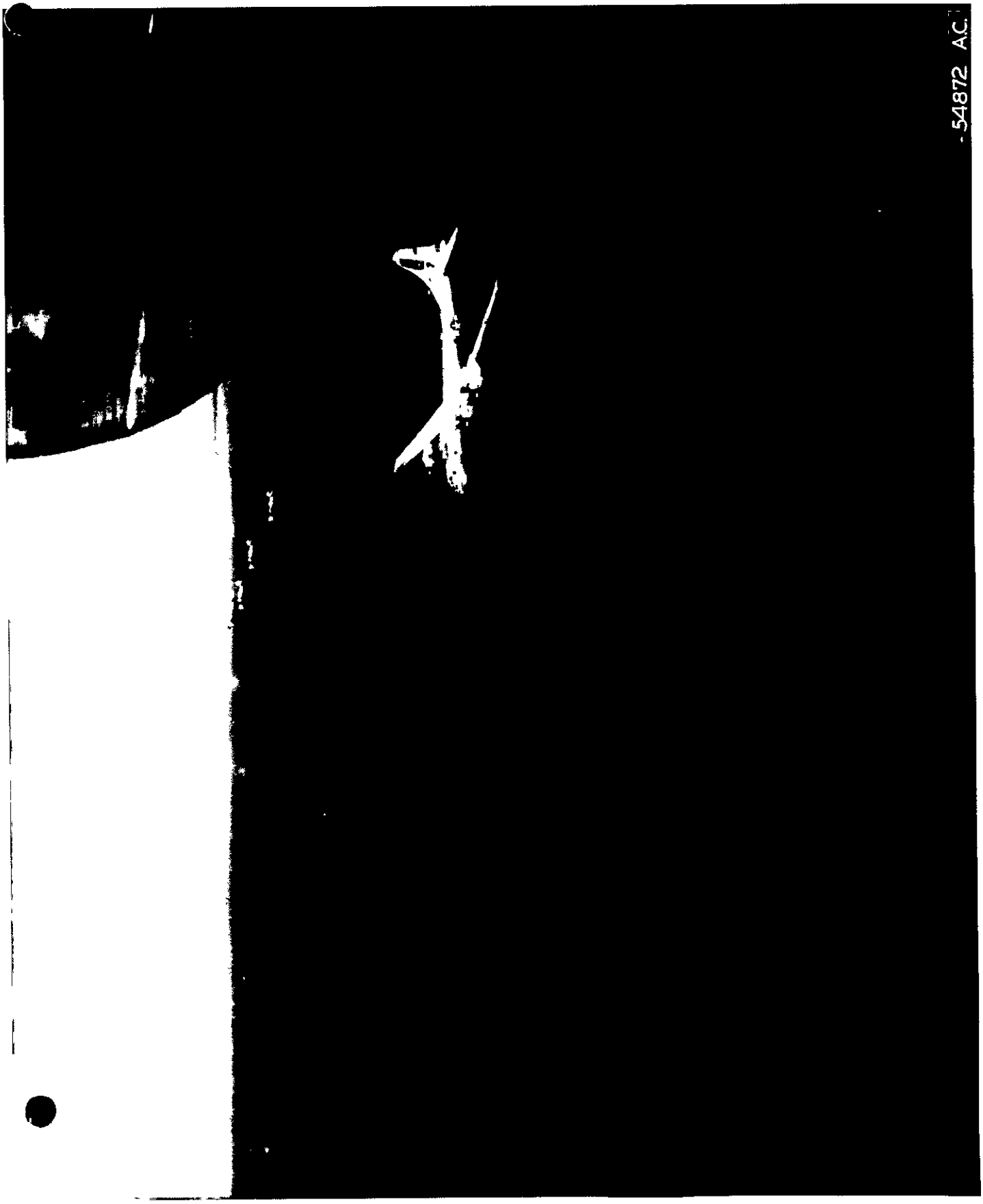
	Total B-24's Over Targets	Total B-24's Lost or Damaged by Enemy Aircraft	Per Cent of Total Lost Or Damaged
On Raids 30 Sept. and 3 Oct. without escort	100	37	37 %
On Raids 10 Oct. and 14 Oct. with escort	204	19	9.3%

Another raid on the oil target proved much less successful because of poor weather. On 18 October heavy bombers found the target completely obscured by clouds and had to bomb by estimated time of arrival. The XIII Fighter Command dispatched 75 escorts from Sansapor for support, but only 8 arrived at Balikpapan. Fortunately, no enemy fighters rose to challenge the bombers. This anti-climactic mission concluded the strikes against Balikpapan.[77]

As the war in the Pacific entered its closing phase, pre-invasion plans called for a concentrated series of bombing attacks against Japanese home islands by the very heavy B-29 bombers. They were to be accompanied by escort fighters based near Japan. In May a member of the Plans Division recommended capture of the Bonins and Ryukyus for this purpose,[78] a proposal which the Army disliked. As an alternative, Arnold, on 14 July, suggested seizure of Iwo Jima as within P-51 radius of Tokyo. In addition, fighters stationed there could eventually conduct offensive sweeps over Japan. He suggested to the Joint Planning Staff that Iwo's runways might also serve as emergency landing fields for the B-29's.[79] At that time Iwo was the principal Japanese base in the Volcano Islands and lay on the route which the XXI Bomber Command's Superfortresses followed in making their long flights from the Marianas to Japan. Japanese intercepting planes from Iwo's two operating airfields had been attacking the B-29s. Consequently Iwo held considerable importance for American operations. The island had been under periodic attack by American planes and ships from 7 August 1944 onward. The

final decision to seize it came on 7 October. Daily bombing operations began on 8 December and continued through 19 February. Iwo was completely in American hands on 16 March 1945.

In the preceding October VII Fighter Command had been assigned to Iwo whenever it could be captured, and thus became the principal fighter unit to undertake escort operations from that island.[80] Elements of the 12th and 15th Fighter Groups, flying P-51's,[81] began to arrive on Iwo on 6 March and the entire command was ashore and ready for operations by the 26th.[82] Before escort operations began, such problems as navigational escort, air-sea rescue, liaison and communications, weather, and flak targets had to be considered. In addition, a standard procedure was established to coordinate the bomber and escort fighter command operations. Two types of escort support were used. Close (direct) support was the first type, in which the escorts remained within visual or radio contact of the bomber force. Operating under this type of escort, fighters were to provide cover until the bombers returned to friendly territory. The second type of escort was area (indirect) support, which was usually provided when large numbers of bombers attacked several targets in a general area. Fighters in this case patrolled an area while the heavies were passing through or bombing. Fighters arrived in advance in order to engage enemy aircraft attempting to assemble before the bombers arrived. A combination of area and close support was used when many bombers pene-



trated deeply into enemy territory as a single force. When the bombers dispersed in small groups to attack different targets, escort fighters again provided area support.[83]

From April to June the weather hampered missions against the enemy more than any other factor.[84] In spite of the weather, VII Fighter Command, which was composed of the 15th, 21st, and 506th Fighter Groups and the 5th Marine Torpedo Squadron, flew its first mission to Japan on 7 April.[85] On this mission 96 fighters escorted the Marianas-based B-29's to Tokyo and Nagoya. Of the 135 to 160 Japanese fighters sent to challenge the American planes, 21 were destroyed, with 4 probables, and 8 damaged. One pilot and two fighter planes were lost to enemy action. Another plane was ditched, and one was damaged.[86] This first escort proved its effectiveness since the last two B-29 formations had no fighter protection and had to withstand 62 per cent of all enemy attacks.[87]

In the first missions flown from Iwo the fighters carried 110-gallon tanks, two for each plane, giving them a combat radius of 950 miles. Seventy-five-gallon tanks had been sent to Iwo for P-51 use but could not be attached to fittings designed for still larger tanks. VII Fighter Command had asked for 165-gallon tanks, but used the 110-gallon size until larger tanks arrived.[88] Two 165-gallon tanks gave the P-51 a combat range of 1,200 miles.[89] When the VIIth began to use the larger external models in July, technicians had to install braces on the P-51's to eliminate swaying. When equipped with larger tanks, the Mustang carried

more fuel externally than internally.[90]

During a second escort mission on 12 April the B-29's again attacked Tokyo. The enemy lost 15 planes, with 6 probably destroyed and 3 damaged. Four P-51's and two pilots were lost; two pilots were reported missing.

A bad weather fron on 1 June accounted for the highest loss suffered by VII Fighter Command for any one day during the last phase of the Pacific war. Twenty-seven planes and 24 pilots failed to return either because of air collisions or loss of control.[91] On 10 June, while supporting the bombers against targets near Tokyo, the escorts claimed 27 out of approximately 110 enemy fighters, with 7 probably destroyed and 10 damaged. The P-51's suffered no losses. By the end of the first month of escort operations there appeared to be a marked deterioration in the enemy air force, characterized by an unwillingness on the part of Japanese fighter pilots to intercept B-29's. The Japanese withdrew their planes, dispersing them widely. This absence of consistent opposition to American air attacks resulted from a Japanese order issued in the middle of June, which cancelled past instructions requiring positive interception. Japan now hoped to husband all possible strength for the decisive battle in the home islands. Interception flights were to be made only at opportune moments.[92] This change in enemy tactics enabled American fighter planes to make long-range sweeps in an effort to weaken the Japanese still further.[93]

The first long-range fighter strikes against targets in Japan had been undertaken in mid-April against Kanoya, Kanoya East, and Kushira airfields on Kyushu. No enemy air opposition met the 104 P-51's on these strikes. Thereafter, 13 more fighter sweeps were undertaken. From mid-April through 30 June, the American fighters claimed 156 enemy planes shot down in combat and approximately 1,144 destroyed on the ground, a considerably higher figure than was achieved on escort missions. VII. Fighter Command losses totaled 21 destroyed over the targets and 39 missing in action. Thirty-nine planes were damaged. Pilot casualties totaled 64 for this period.[94]

VII Fighter Command flew no escort missions from 27 June through 6 August, and after the latter date all operations combined strike and escort duties. On 16 July about 55 to 60 enemy planes challenged fighters of the 15th and 506th Groups when they attempted to strike Nagoya airfields. In the ensuing combat the enemy lost 22 aircraft, 2 probably destroyed, and 19 damaged, compared to the loss of 1 American plane and pilot. This was the last mission in which heavy damage was inflicted on the Japanese air force by the fighter command. Thereafter, the enemy offered little opposition to American fighter sweeps.[95] A combined mission was conducted on 7 August, when the 15th Fighter Group escorted the B-29's from Nagoya to Land's End. The escort was successful and no enemy aircraft were encountered. Other such missions were flown on the 10th and 14th. On 10 August, 6 enemy planes were destroyed, 1 probably destroyed, and 11 damaged. On

14 August a maximum effort received protection by four groups of fighters, the escort phase of the mission being flown without incident. It is estimated that escort operations had reduced enemy interception by as much as 70 per cent.[96]

Five groups made up the VII Fighter Command during the last phase of the war: 3 P-51 groups (the 15th, 21st, and 506th), 1 P-47N group (the 414th), and 1 P-61 group (the 549th Night Fighter Squadron).[97] In the closing period of operations these fighter groups used rockets and napalm bombs to destroy enemy airplanes on the group. On 29 August, 31 August, and 1 September, immediately preceding cessation of hostilities on 2 September, four fighter groups made "displays of power" to intimidate the Japanese.[98]

In retrospect, the story of long-range escort in the Pacific during the closing months of the war was largely anti-climactic. Few could foresee the rapid deterioration of the Japanese military situation in the early months of 1945, when strenuous efforts were being made for a final onslaught against the enemy's home islands. Highly successful night fire raids by large B-29 forces in late spring and summer of 1945 needed no escort help. Escort missions flown from Iwo met with less opposition than the Japanese had afforded in the earlier stages of the Pacific war. Even daylight attacks by B-29's produced less opposition than expected, and enemy fighters took a smaller toll of long-range American fighters on any one day than were lost in the calamitous American mission against Osaka on 1 June. Furthermore

it cannot be claimed that missions flown from Iwo Jima were decisive in the collapse of Japan. Although fighter aircraft destroyed many enemy planes, deterioration leading to capitulation of Japan, like Germany, was due to causes much more fundamental than action by long-range fighters. If the overall air effort against the Japanese is considered, however, the role of the long-range escort is more significant. From the first small bombing missions of 1942 to the B-29 raids against Japan in 1945, the contribution of the escort fighter was considerable. It was unfortunately, however, that the value of cruise control was not realized before late summer of 1944, since it greatly increased the range of fighters.

Japanese Reaction to the Long-Range Escort Fighter

Throughout the war the Japanese never developed satisfactory methods of attacking escorted bomber formations. Indeed, their combat tactics against American planes lacked a consistent pattern, though some were better than others. However, the Japanese had well-trained pilots when the war broke out.[99] By early 1943 most of Japan's first team had been killed. Replacements lacked training and displayed little combat efficiency. On the other hand, the Japanese continued to improve their combat planes in design and performance. At the same time, America's air force was gaining

strength in every way. The course of operations clearly displayed a diminishing Japanese vigor and an ascending American air strength.

Early in the war the Japanese concentrated their attacks against American bombers in an effort to discover their weak spots. As successive modifications minimized other weaknesses, the Japanese shifted their tactics to rear areas of bombers, having found weak firepower there. When this situation was remedied, the Japanese tried frontal attacks,[100] but installation of the nose turret strengthened that quarter also. Like their Axis partners in Europe, they were quick to take advantage of any disabled plane, and stragglers were certain to draw attention. If a gun emplacement not firing was noticed by the enemy, this, too, was certain to bring on a concentration of fire on that area.[101] Enemy pilots tended to desert battle formations when attacked and to operate independently.[102] Having made an attack, often in pairs, they employed a steep chandelle to avoid the fighters or a sharp turn to move away from the bombers.[103] Because the majority of daylight missions had been given fighter protection almost from the start of the war, Japanese pilots became familiar with their structure, but little evidence indicates any tactical changes to meet the challenge of escort fighters. At times Japanese fighters tried to attack the heavy bombers immediately after a bomb run. They also attempted to disrupt the formations or to disable flight leaders. Bombers farthest away from the center of a formation often received the brunt

of enemy attacks. Some of these developed from frontal positions, between 10 and 2 o'clock, followed by a break-away down to the left or right. Approaches varied constantly and almost in cycles - front, rear, and then beam attacks. In some instances hit-and-run methods were used; in other cases the Japanese dived vertically through a formation. In addition to using machinegun fire comparable to American 30- and 50-caliber and 20-mm. cannon fire, the Japanese attempted air bombing but with minimum results.[104]

American fighter sweeps often terminated in battles with Japanese combat planes, thus diverting attention from bomber formations.[105] With a few exceptions, such as the Balikpapan strikes, where the enemy offered maximum resistance, aggressiveness and persistency were sadly lacking in Japanese fighter attacks on escorted bombers.[106]

From the first B-29 strike from the Marianas, 24 November 1944 against the Japanese homeland until the end of hostilities in September, 1945, the enemy destroyed a total of 58 B-29's by fighter action and 29 from combined flak and damage.[107] Japanese resistance to the bombers decreased steadily after 25 February 1945.[108] American fighter-escort operations had become so formidable according to a post-war study of Japanese air defenses that:[109]

> Extreme caution was used in determining what planes to use in mounting a defense against enemy raiders since efforts against enemy fighters were considered a waste of planes and personnel. Our radars, as usual,

> were unable to distinguish light aircraft, especially when they were mixed with bombers on missions. Thus there was danger in making decisions on defense operations when it was not clear whether the planes were fighters or bombers. Careful study was made each time it was believed B-29's were accompanied by fighters.

Japanese home defenses never constituted a serious threat against the B-29. A summary of B-29 strategic air operations against Japan declared: "It is apparent after a survey of the home islands, the Japanese air strategy and concept was distinctly limited, and little appreciable effect would have been felt on the employment of very heavy bombardment."[110]

CONCLUSION

The United States failed to develop a properly balanced air force before the second World War. It seriously erred in failing to recognize that defense in depth for bomber formations would be necessary. As a result, America built short-range fighter aircraft capable of interceptor defense, but useless for accompanying bombardment on deep penetrations. Under World War II conditions, limited bomb power demanded a sustained bombing effort. It therefore became mandatory for bombers to penetrate enemy territory deeply time after time. The course of the war showed that bombers could be defended best of all by destruction of the opposing air force, rather than by shielding bomber formations with fighter aircraft on each mission, or by relying on the defensive firepower of bombers themselves. Once this was realized, the range of escort-fighter aircraft was greatly extended, which in turn led to a sustained air war. This policy of all-out destruction of enemy air power was not inaugurated in Europe until after January, 1944.

The long-range escort fighter was not a product of continuous development. For many years the task of accompanying a bomber was seen only as an auxiliary role for the pursuit arm, and no clear-cut or pressing need for a specialized fighter was realized before World War II. The supporting role for pursuit was not forgotten during the inter-war period,

but opinion of its importance ran the gamut from acceptance to indifference, and finally in World War II to an effort to develop it to its utmost capabilities. The Air Corps disliked the idea of an interceptor-type fighter for escort purposes because it believed that the plane would be forced to carry additional fuel in external tanks, thus making it vulnerable to hostile aircraft. This reasonable analysis deterred large-scale development of the plane for an escort role.

The technical phase of the attempt to increase fighter range began early in the 1920's, but progressed slowly until 1939. However, the idea of range extension had been developed substantially, particularly as a means to permit long-range ferrying of aircraft. Later, when the need for combat tanks became apparent, the earlier development of ferrying tanks permitted a rapid solution of the related problem.

After 1938, faith in the supremacy of the bomber gave way to a reappraisal of the fighter's capabilities. This was strengthened by combat experiences during the Spanish Civil War and in the early months of the European struggle. Though the problem remained unsolved when the United States entered the war, the Air Corps had started a searching investigation to determine whether bombers could successfully penetrate deep into enemy territory without fighter support. Since the war itself was fought on widely separated fronts, the need for fighter escort was decided independently by commanders in each theater.

In the ETO a basic plan to guide Eighth Air Force operations called for a three-fold development of the bomber offensive. The first two phases utilized short-range escort fighters only as preparation for the final phase, which was a full-scale effort by unescorted heavy bombers over Germany. This optimistic plan proved inadequate. In the late summer of 1942 Eighth Air Force commanders decided, on the basis of a few short-range missions with escort, that they could send large bomber formations on deep penetrations without fighter support. They concluded that escort was necessary only to support bombers over the linear enemy-fighter dispositions along the coasts of France and Belgium. This belief, that once the "fighter belt" was crossed little if any opposition would be encountered, displayed a lack of understanding of enemy capabilities. When, shortly thereafter, the Germans offered fighter opposition in depth, it became apparent that the AAF linear concept would have to be abandoned. In the spring of 1943, AAF leaders in the United Kingdom appealed for more bombers to permit a "saturation of the defenses." They had believed that approximately 300 heavy bombers could accomplish this task but by the spring of 1943 they asked for twice that figure.

Belated use of the escort fighter in Europe resulted from several factors, among which was the inability of AAF commanders to see that the problem of strategic bombing was more than simply target selection and precision bombing. Nor

did the AAF immediately see how bombers could reach their targets without suffering prohibitive losses. For a time bombers simply lacked adequate protection. The Air Force's inability to provide jettisonable tanks early in the war and poor administration of the tank program in the United Kingdom also contributed to late entry of escort fighters into the war picture. In addition, efforts to solve the problem by using an escort bomber resulted in the fruitless YB-40 and YB-41 experiments.

The two Schweinfurt missions in August and October, 1943, led to the most serious crisis experienced by the AAF during the war. The fact was that the Eighth Air Force had for the time being lost air superiority over Germany. And it was obvious that superiority could not be regained until sufficient long-range escort became available. These two missions proved conclusively that daylight bombing could not be accomplished under existing conditions without fighter support. These debacles demonstrated that long-range fighters were needed not only as a defensive means to protect bombers and also as offensive weapons to seek out and destroy the German fighter force, and thus shattered the myth of bomber invincibility. Operations against strategic targets from mid-February to about 1 May 1944 indicated that the German Air Force had passed the point where it could offer sustained maximum opposition. This favorable situation came about largely through employment of escort fighters. The presence

of American bombers in the air over Germany forced enemy planes to rise to meet the challenge. This in turn permitted American fighters to destroy many enemy planes. The double threat now posed by the escorted bomber formations -- their ability to bomb strategic targets and to destroy intercepting forces -- led to the air victory which permitted completion of the bombing campaign in Europe. The dependence of bombers on escort fighters proved that many airmen had followed false assumptions during the pre-war period.

In the Pacific, the air war was fought initially against an enemy air force in the perimeter of Japanese-held territory and then against the production echelon as the air war moved closer to the home islands. The course of air operations in the Pacific was conditions by the nature of the geography and the enemy, resulting in a vast difference in utilizing the escort plane. Unlike commanders in Europe, those in the Pacific used escort fighters, when available, and turned to night operations until enough fighters with requisite range were supplied them. The final phase of the battle against Japan was largely anti-climactic. Employment of heavy bomber units in night operations without escort fighters, and the rapidly deteriorating Japanese air opposition to escort fighter sweeps and daylight operations, permitted American fighters to range over all of southern Japan looking for suitable targets. The contribution of the escort fighter plane both in Europe and the Pacific was a major factor in attaining air superiority and victory over the Axis powers.

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GLOSSARY

AAF	Army Air Forces
AAFSAT	Army Air Forces School of Applied Tactics
AAG	Air Adjutant General
ABDACOM	American British Dutch Australian Command
ABFOR	American British Forces
AC	Air Corps
A/C	Air Craft
AC/AS	Assistant Chief of Air Staff
ACM	Air Chief Marshal
ACTS	Air Corps Tactical School
ADVON	Advanced Echelon
AEB	Air Evaluation Board
AFB	Air Force Base
AGO	Adjutant General Office
AGWAR	Adjutant General, War Department
AHS	Air Historical Study
ANVIL	Invasion of Southern France
ARGUMENT	Coordinated Attack by Eighth And Fifteenth Air Forces on German Aircraft Industries
AS	Air Service
ASC	Air Service Command
ATC	Air Transport Command
ATS	Air Technical Section
AVM	Air Vice Marshal
AWC	Air War College
AWPD	Air War Plans Division
BADA	Base Air Depot
BC	Bomber Command
Bd.	Board
BOLERO	Build-up of American armed forces in United Kingdom
Bomb.	Bombardment.
Bmb.	Bomber
Br.	Branch
C/	Chief
C/AC	Chief of Air Corps
C/AS	Chief of Air Staff
CBO	Combined Bomber Offensive
C/Exp.	Chief of Experimental Section
CG	Commanding General
CM	Cable Message
C/Mat. Div.	Chief of Materiel Division
Comdt.	Commandant
C/Proc.	Chief of Procurement

C/Prod.	Chief of Production
CTI	Technical Instructions
C/T&O	Chief of Training and Operations
Ctr.	Center
DC/AS	Deputy Chief of Air Staff
DC/S	Deputy Chief of Staff
DD	Daily Diary
Dir.	Director
Div.	Division
DMR	Director of Military Requirements
ETO	European Theater of Operations
ETOUSA	European Theater of Operations, U.S. Army
Exp. Engr. Sec.	Experimental Engineering Section
FC	Fighter Command
FEAF	Far Eastern Air Force
Fld.	Field
FO	Field Order
FRANTIC	Shuttle missions to Russia
Ftr.	Fighter
FW	Focke-Wulf
GAF	German Air Force
G/C	Group Captain
GHQ	General Headquarters
GO	General Order
Gp.	Group
Hq.	Headquarters
IFF	Identification: Friend or Foe
Ind.	Indorsement
Info. Cir.	Information Circular
Intel.	Intelligence
IOM	Inter-Office Memorandum
JCS	Joint Chiefs of Staff
Ltr.	Letter
Luftwaffe	German Air Force

MAAF	Mediterranean Allied Air Force
MAP	Ministry of Aircraft Production
Mat. Comd.	Materiel Command
Memo	Memorandum
Me-109	Messerschmitt 109 (A single-engine German fighter)
Me-110	Messerschmitt 110 (A twin-engine German fighter)
Me-262	Messerschmitt 262 (A German jet aircraft)
MM&D	Materiel, Maintenance, and Distribution
NAAF	North African Air Force
Narr. Hist.	Narrative History
Nat. Archives	National Archives
OAC/AS	Office of the Assistant Chief of Air Staff
OAS/W	Office of the Assistant Secretary of War
OAS/WA	Office of the Assistant Secretary of War for Air
OCAC	Office of the Chief of Air Corps
OC&R	Operations, Commitments, and Requirements
OCSO	Office of the Chief of Signal Operations
OKL	Oberkommando der Luftwaffe (High Command of the German Air Force)
Opns.	Operations
OVERLORD	Overall Plan for Invasion of Western Europe, 1944
PGC	Proving Ground Command
POA	Pacific Ocean Area
POINTBLANK	Combined Bomber Offensive
Prov.	Provisional
Rpt.	Report
R&R	Routing and Record sheet
R/V	Rendezvous
Sec.	Section
SHAEF	Supreme Headquarters, Allied Expeditionary Forces
SOP	Standard Operating Procedure
SPOBS	Special Observers Group
Stat. Sum.	Statistical Summary
Subj.	Subject
SWPA	Southwest Pacific Area
Tab.	Table
Tac.	Tactical
Tech. Bull.	Technical Bulletin
TI	Technical Instructions
TMR	Tactical Mission Report
TORCH	Plan for Allied Landings in North Africa
TT	Teletype

UK	United Kingdo,
USAFE	U.S. Strategic Air Forces in Europe
USAF HD	U.S. Air Force Historical Document
USAFIA	United States Air Forces in Australia
USAFISPA	U.S. Air Forces in South Pacific Area
USFOR	U.S. Forces
USSBS	U.S. Strategic Bombing Survey
USSTAF	U.S. Strategic Air Force
VHB	Very Heavy Bomber
VLR	Very Long Range
WD	War Department
Wg.	Wing