

*...THEY WERE FAST... THEY WERE DEADLY... THEY WERE
OUTNUMBERED! THEY WERE THE...*

SECRET WEAPONS OF THE LUFTWAFFE



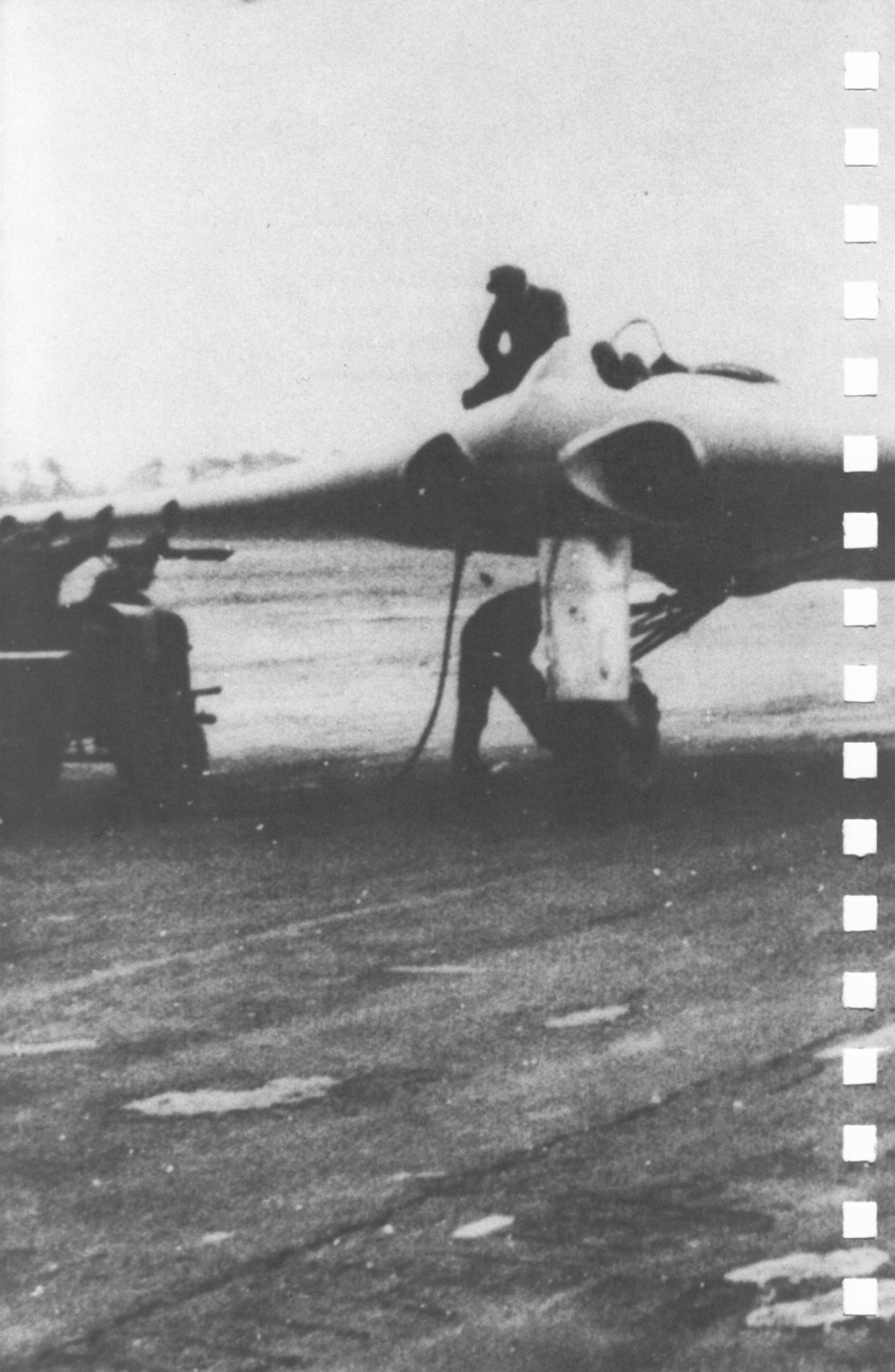
by **LAWRENCE HOLLAND**

*...A WORLD WAR II AIR COMBAT
SIMULATION THAT PITS THE
U.S. EIGHTH AIR FORCE AGAINST
THE AWESOME AERIAL WEAPONRY
OF THE THIRD REICH...*

LUCASFILM™
GAMES

*“Only the spirit of attack
born in a brave heart will
bring success to any fighter
aircraft, no matter how
highly developed it may be.”*

Luftwaffe General Adolf Galland



SECRET WEAPONS OF THE LUFTWAFFE™

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**Preceding page: The prototype
of the Go 229, the Horten Ho IX,
being prepared for a test flight in
early 1945. This plane crashed on
its second flight because of
engine failure.**

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INTRODUCTION

Secret Weapons of the Luftwaffe is a World War II air combat simulation that allows you to fly the aircraft of the United States Eighth Air Force and the German Luftwaffe, and to reenact the fierce air battles fought over western Europe between 1943 and 1945. Like previous Lucasfilm air combat simulations, *Secret Weapons of the Luftwaffe* allows you to fly and fight on both sides of the conflict. As a German, you can fly those two truly revolutionary jet and rocket aircraft, the Messerschmitt Me 262 and the Me 163. You can also fly another advanced weapon, the Gotha Go 229, which was developed too late to see action, and find out for yourself how this remarkable “flying wing” might have performed in combat against conventional aircraft. You’ll be able to fly the Luftwaffe’s two deadly mainstay fighters against the United States: the Messerschmitt Bf 109 and the Focke-Wulf FW 190. As an American, you can take on these formidable Luftwaffe aircraft and attack ground targets in three of the most storied warplanes ever to see combat: the P-51 Mustang, the P-47 Thunderbolt, and the B-17 Flying Fortress.

Whichever side you choose, you’ll be able to select from a wide variety of historically accurate combat missions in *Secret Weapons of the Luftwaffe*. If you fly as a Luftwaffe pilot, your main mission objective will be to stop the U.S. aerial armadas from pulverizing key Third Reich industrial and strategic installations. If you fly as an Eighth Air Force pilot or crew, you’ll be trying to destroy these vital German ground targets, as well as gain air superiority over the Luftwaffe in air-to-air combat. Flying both the U.S. and the German sides will give you a greater appreciation of those fierce aerial engagements that amounted to a virtual third front over Europe.

P-47 pilot James Finnegan (left) takes a break on the fuselage of his Thunderbolt with his crew chief. Courtesy of James Finnegan



In addition to what could be the most realistic action graphics of any computer simulation, *Secret Weapons of the Luftwaffe* gives you a host of all-new simulation features. For example, an advanced flight control mode lets you try your hand at expert aerial maneuvers. With the new Tour of Duty option, you can try to survive a set number of missions just like World War II pilots did. Other features, such as the replay gun camera and the In-Flight Map, have been enhanced and improved. And, of course, you'll be able to create your own custom missions with the Mission Builder. In Campaign Missions, you'll direct the war effort, setting the strategy for the side you choose. This can include dictating German war production, if you're directing the German side, and selecting which German targets to bomb, if you're directing the U.S. side. You'll see if your command decisions can affect the outcome of the air war over Europe.

How to Use This Manual

Once again, we've produced an enormous manual for our simulation. However, the volume's size doesn't mean that the simulation instructions are lengthy and complex. Actually, the opposite is true, as we've attempted to make our instructions more concise, better organized, and easier

to understand. This manual contains a more detailed *Historical Overview* chapter, plus interviews with World War II veterans and experts. The chapters on aircraft and tactics have also been expanded.

To get started, take a look at the Reference Card inside the simulation box, and turn to the *Loading Instructions*, which tell you how to load the program and start it up. For your convenience, the Reference Card also lists all the keyboard commands you'll use in the simulation. The *Quick Start* instructions on the Reference Card can get you in the air on a sample mission right away. Next, turn to the three *Mission Instructions* chapters. *Pre-Flight* tells you how to select a mission, choose the aircraft you want to fly, create a pilot or crew to fly your mission, and get a briefing before taking off. *In-Flight* gives you information on the various flight controls and weapons you'll use while flying your mission. *Post-Flight* describes how to end your mission and get a post-flight review, which could include a medal or promotion if you distinguish yourself in battle.

Whenever you're ready to learn more about the aerial battles, strategies, and

"Armies and navies have clashed for centuries, and their battles, strategies, and tactics have been recorded, studied, and analyzed by historians and war colleges of many nations. Prior to World War II, air power had never had similar experience. Although Lord Trenchard of Britain, General Douhet of Italy, and General William Mitchell of the U.S. had prophesized that strategic air power could exercise a decisive influence on warfare, those theories had never been tested....

"For the first time, the U.S. Eighth Air Force, operating out of Britain, and Britain's own Royal Air Force were to be given the resources to test those theories of the use of strategic air power. General H. H. Arnold, head of the U.S. Army Air Force, was a dedicated Mitchell disciple. His instructions to General Carl Spaatz and to me were clear-cut, specific, unmistakable. We were to take the heavy bombers General Arnold would send us and demonstrate what air power could do."

**U.S. Army Air Force
Brigadier General Ira Eaker**

weaponry of the time, read the *Historical Overview* chapter, which concludes with an interview with Professor Williamson Murray, a World War II expert from Ohio State University. The chapter titled *German and U.S. Aircraft and Weapons* gives you detailed information on the warplanes you'll fly and the armaments you'll use in combat, and includes cockpit screen shots to help you familiarize yourself with the instruments of each aircraft. And if you'd like to become even better at air-to-air dogfighting, bombing, shooting, and more, read the *Combat Tactics* chapter.

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Our project was aided tremendously by the following individuals, to whom we owe our gratitude and our thanks:

Robert Davila, a B-17 pilot who flew bombing missions against German oil, rail, and other key targets with the Eighth Air Force from 1944 to 1945.

James Finnegan, a P-47 pilot with the 50th Fighter Group, 10th Fighter Squadron of the Ninth Air Force, who led his flight in strafing and destroying heavily armed ground transport from 1944 to 1945, and whose 127 combat missions included the downing, in April 1945, of an Me 262 flown by Luftwaffe General Adolf Galland.

Walter Krupinski, one of the Luftwaffe's most successful fighter pilots, who flew Bf 109s on the eastern front from 1941 to 1943 and on the western front from 1943 to 1945 against U.S. bombers and fighters, and who flew Me 262s in Jagdverband 44, Adolf Galland's "squadron of experts," in the final months of the war, for a total of 197 aerial victories.

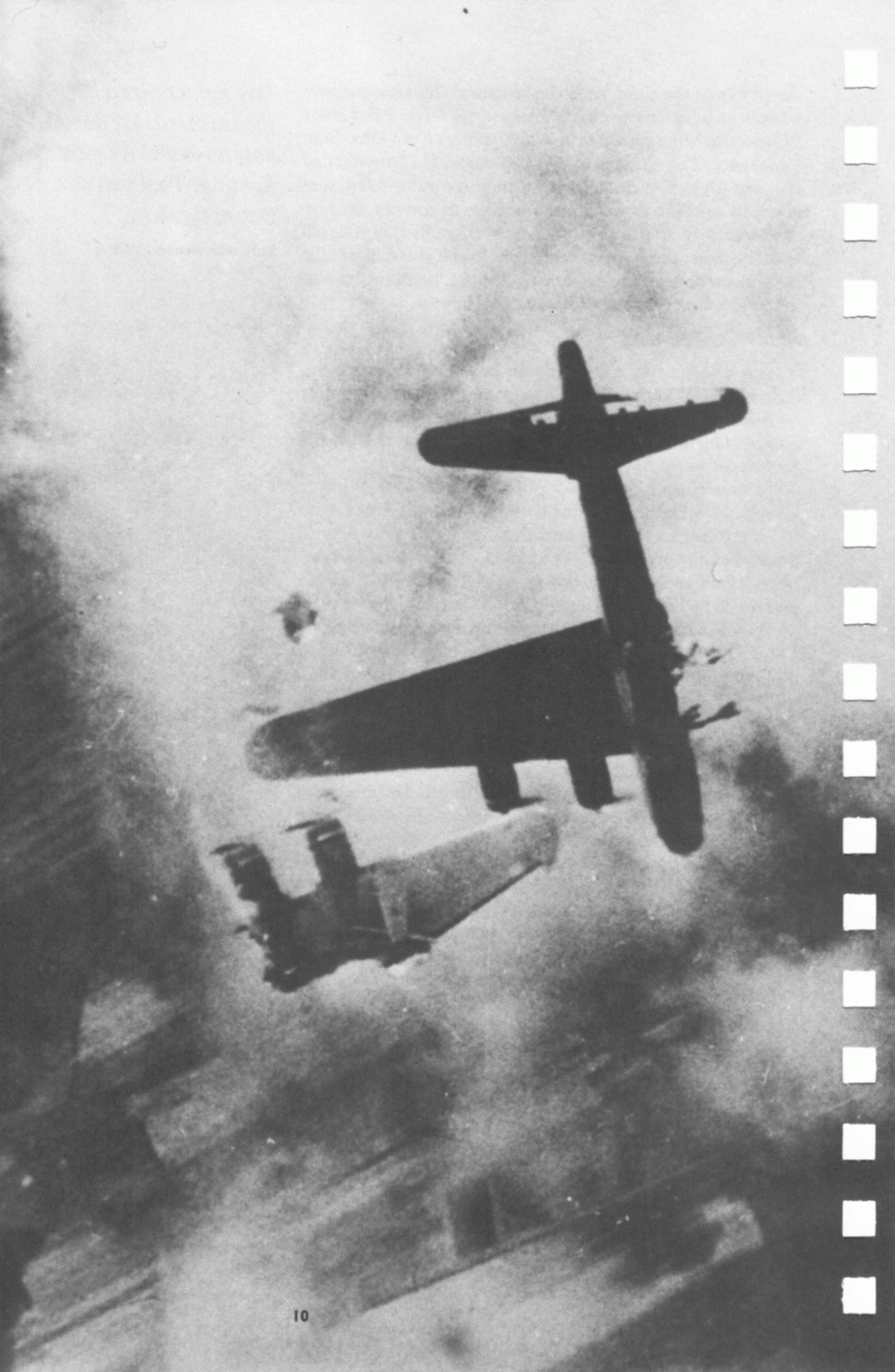
Thomas Marsters, who flew P-47s in ground support and fighter escort missions with the Twelfth Tactical Command of the Ninth Air Force, and who also flew P-51 Mustangs after the war.

Finally, a special thanks to **Larry Wilson** of the National Air and Space Museum, for his help with the photographs and in helping us locate key facts and people, and to the aforementioned **Professor Williamson Murray**, who generously gave his time and his expertise to our project.

"We fighters are a special breed. We do not hate anybody. We were fighting. That was our way of thinking."

Luftwaffe General Walter Krupinski

Next page: Ripped apart by cannon fire from an Me 262, this B-17, "Wee Willie," goes down during a raid on April 10, 1945. Courtesy of the United States Air Force



HISTORICAL OVERVIEW

One of the longest and bloodiest campaigns of World War II was fought in broad daylight in the skies over western Europe from 1943 to 1945. This air battle, the greatest the world has ever witnessed, pitted two formidable adversaries against each other. On the offensive was the United States Army Air Force, which sought to destroy the industrial might of Germany through precision bombing, and thus prove that air power could win war single-handedly. On the defensive was the German air force, the Luftwaffe, desperately battling the American bombers with experienced pilots and a variety of fighter aircraft, including the proven Messerschmitt Bf 109 and the outstanding Focke-Wulf FW 190. As this air war slowly shifted in favor of the United States, a succession of highly advanced German jet and rocket aircraft were unleashed against the hordes of American aircraft. Two of these weapons, the Me 262 jet fighter and the Me 163 rocket fighter, proved to be far deadlier in combat than anything the Americans could counter with. German technological advances at this time exceeded similar Allied research developments, but the resulting weapons were plagued by development problems, and Adolf Hitler and others in the Third Reich's leadership ultimately squandered any advantage they might have given the Germans. Still, some historians have called these advanced German warplanes "war-winning weapons"; had they seen action earlier, perhaps they would have had a chance to fully live up to their frightening potential — and alter the outcome of the war.

THE "GRAND ALLIANCE" **(June 1940–December 1941)**

With nearly all of continental Europe under German control by 1940, only Great Britain remained as an active opponent. In the summer of 1940, the fighters and bombers of the Luftwaffe pushed the fighter defense of the British Royal Air Force to the brink of defeat. But the Germans, in a strategic blunder, ceased their attacks on RAF airfields and began bombing London at the moment when victory was within reach. This four-month aerial struggle, the Battle of Britain, marked the first German setback of the war. Germany canceled Operation Sea Lion, the planned invasion of England, but continued to bomb England by night. Though supplying the British with aid through the Lend-Lease program, the United States was reluctant to help Britain further by entering a new war.

Meanwhile, in other battlefields of the

"War, no matter how it may be glorified, is unspeakably horrible in every form. The bomber simply adds to the extent of the horror, especially if not used with discretion; but when used with the proper degree of understanding, it becomes, in effect, the most humane of weapons."

**U.S. Army Air Force General
Henry H. "Hap" Arnold**



world, German victories mounted. Adolf Hitler rescued his Axis partner Benito Mussolini following Italy's unsuccessful attack on Greece, and in April of 1941 launched his own invasions of Greece and Yugoslavia, both of which fell a short time later. After British forces routed the Italians in East Africa, German desert troops pushed back the British in Libya and Egypt. On May 20, German paratroopers landed on Crete, and the former British stronghold was captured eleven days later. But the most important German offensive began on June 22 as Operation Barbarossa — the invasion of Russia. Over the ensuing months, the German army, supported by the Luftwaffe, pushed deep into Russian territory. Though they suffered heavy losses, the Russians held,

and on December 4, the German drive on Moscow was halted.

But events taking place on the other side of the world would greatly affect the course of the European war. On December 7, 1941, Japanese aircraft attacked and sank most of the U.S. Pacific Fleet at Pearl Harbor. The next day, in a show of support for his Axis ally Japan, Hitler declared war on the United States. At last, Britain had a powerful ally in its struggle against Germany, and thus the "Grand Alliance" was born.

THE RAF'S FIRST BOMBING MISSIONS (August 1940–June 1942)

During the Battle of Britain and the Blitz of London, the British people wanted desperately to show that they were still in the fight, and were demanding vengeance for their bombed-out cities. The RAF's Bomber Command launched

a series of retaliatory "nuisance raids," first against Berlin, then against German military targets. Later, in an effort to break the morale of the German people, this bombing campaign was increasingly directed at cities. Missions flown in daylight resulted in heavy British losses, and the RAF decided to switch to night bombing, hoping the darkness might offer some protection. Unfortunately, precision bombing proved nearly impossible at night, since few of the bombers could even find their targets, let alone hit them. With only one-third of the bombs landing within five miles of their target, the RAF attacks were more hazardous to sheep and cows than to Germans. Moreover, the RAF bombers were without fighter escort, and losses to German night fighters mounted.

Recognizing that their bomber force was too weak to do the job, in November of 1941 British prime minister Winston

Churchill curtailed the bombing offensive against Germany and won cabinet approval to build up Bomber Command to 4,000 aircraft. Then, in February of 1942, Air Chief Marshal Arthur Harris took over as head of Bomber Command. "Bomber" Harris, as the dynamic new leader was known, opposed precision bombing, arguing that damage caused by what he called "panacea" attacks on pinpoint targets could be easily repaired. Instead, he favored large-scale area-bombing attacks on population centers, which would leave the inhabitants homeless and lower civilian morale, particularly among industrial workers. Moreover, he was



**A bombed-out cathedral at
Fürth.**

convinced that this type of bombing could by itself actually win the war against Germany.

Fortunately for Harris, the British aircraft industry was just starting to turn out large numbers of four-engined, long-range bombers, including the Lancaster and the Halifax, that could carry the heavy bombloads and huge bombs he had envisioned. To test his theory of area bombing, Harris decided to strike several German cities, choosing them for their vulnerability and their proximity to England, rather than for their military importance. The first of these cities was the German port of Lübeck, which the RAF bombed on the night of March 28. Over half the city, whose buildings were mainly of wood construction, went up in flames. Next, the German city of Rostock-Warnemünde, home to a Heinkel aircraft factory, was bombed over four nights, with even better results. Buoyed by these successes, Harris ordered Operation Millenium, a thousand-plane raid on Cologne, for the night of May 27. This bomber force, by far the largest aerial armada ever assembled, leveled 600 acres of the city, destroyed 250 factories, and killed 469 people. Only forty-one bombers were lost in the mission, which set a fire that could be seen for 200 miles.

The success of the Cologne raid was a tremendous boost for the confidence of Bomber Command, and the newly knighted "Sir Bomber" Harris ordered similar raids during June on the German cities of Essen, home of the gigantic Krupp armaments works, and Bremen, where the Focke-Wulf factory was located. However, these raids were largely unsuccessful, and many RAF bombers were lost to flak and

"Victory, speedy and complete, awaits the side which first employs air power as it should be employed."

**RAF Air Chief Marshal
Arthur Harris**

An early prototype of the Me 262, with a tail wheel instead of a nose wheel.



"The trouble with Yanks is, they're overpaid, oversexed, and over here."

Common quip of English civilians from 1942 to 1945

fighters. The difficulties of assembling such large numbers of planes ruled out any further large-scale attacks until Bomber Command regained full strength. More disturbing was the news that Cologne and the other bombed cities had gradually come to life again and that German wartime production was relatively unaffected. Intelligence reports that even the morale of German civilians was good provoked surprise, since the British believed that only they could keep up their spirits amid bombing attacks, as witnessed during the Blitz of London.

Obviously, Harris needed assistance if his Bomber Command was to win the war according to his strategy. And he had hopes that the U.S. Eighth Air Force, which was gradually forming in England, could supply exactly what he needed.

THE AMERICANS BRING CONTROVERSY (February 1942–May 1942)

On February 20, 1942, U.S. Army Air Force Brigadier General Ira C. Eaker arrived in London with the immediate task of procuring sites which could be used as U.S. bomber bases. His superior, General Henry H. "Hap" Arnold, the head of the U.S. Army Air Force, had also ordered Eaker to observe Bomber Command, and to lead the U.S. bombing offensive once enough bombers had been flown in from the States.

Both Eaker and Arnold were supporters of former U.S. general "Billy" Mitchell and the theories of air power he had developed after World War I. Mitchell believed that the coming war would be decided in the skies, and that bombing important military production targets would destroy the enemy's ability to wage war, while crushing its will to fight. Italian general Giulio Douhet and the RAF's first air chief marshal, Hugh Trenchard, had also promoted air power as a war-winning strategy in the 1920s. Trenchard, in particular, contended that the breakdown in civilian morale following such an aerial onslaught would lead to revolution. Mitchell, Douhet, and Trenchard all believed that the bomber would be the principal weapon in the future war; to these three men, and those generals who would follow them, this aircraft was invincible. "A slower, heavily armed plane, able to clear its way with its own armament, can always get the best of a faster pursuit plane," wrote Douhet, continuing, "A unit of combat composed of slower heavily armed planes is in a position to stand up to the fire of enemy pursuit planes and carry out its mission successfully." Another believer, former British prime minister Stanley Baldwin, declared, "The bomber will always get through." Luftwaffe bombers had not, in fact, always gotten through in the Battle of Britain; still, the American generals insisted that

their much heavier-armed bombers were destined to succeed against the Germans.

The American generals' tactical point of view was also based on theories evolved at the Air Corps Tactical School in Maxwell Field, Alabama. These theories held that every industrialized nation contained vulnerable economic sectors which, if destroyed, would cause that nation's entire economy to collapse. Such "bottleneck industries" included ball bearing manufacturing plants, petroleum production facilities, and transportation systems. This approach would eventually dictate the choice of many American military targets.

Shortly after arriving in London, Eaker met with his British counterpart, Harris, and the two soon realized that their respective sides differed widely on the best way to carry out the bombing offensive. First there was the question of day versus night bombing. The British had suffered heavy casualties in the daytime and found that night missions were more successful, with fewer losses. Harris tried to convince Eaker to join with the RAF in their night bombing missions. But Eaker argued that the American bomber crews who would soon be arriving in England were trained in daylight missions only, and retraining would take months. Moreover, participation by the fledgling U.S. bomber force in the RAF's night missions would hinder the start of the Eighth Air Force's own operations, scheduled to get under way later that year.

The next topic of debate was precision versus area bombing. Though less accurate, area bombing could be devastating, as the RAF raid on Cologne had proved. It was also better suited for the conditions of night missions. Pinpoint precision bombing, on the other hand, could cripple vital German installations, such as factories and oil plants, while minimizing civilian casualties. And the American bombers were equipped with an amazing instrument that made precision bombing possible: the Norden bombsight. It was hooked up to the bomber's automatic pilot, so that when the bombardier was looking at the bombsight, he could position the plane more accurately over the target. The Norden bombsight was said to be so accurate that it could "drop a bomb in a pickle barrel from 20,000 feet." But, argued Harris, the cloudy weather that covered Europe sixty to seventy percent of the time, plus the smoke from German industry, could render this bombsight useless. "In order to hit a barrel from 20,000 feet," he concluded, "you must first see the barrel."

Finally, the two Allies differed over the bombers that were to be used. The main U.S. Army Air Force heavy bomber in 1942 was the Boeing B-17. Nicknamed the "Flying Fortress," it bristled with ten .50-caliber machine guns, which gave it more firepower than the main British heavy



Brigadier General Ira Eaker, commander of Strategic Forces for the U.S. Eighth Air Force, oversaw the buildup of U.S. bombers in England during 1942–43. Eaker was a capable promoter of the doctrine of daylight strategic bombing at a time when many Allied leaders were doubting its effectiveness. But his belief that this type of bombing could be accomplished without fighter escort proved disastrous when, in the first two raids on Schweinfurt, 120 U.S. bombers were lost. In 1944, Eaker became commander in chief of the Mediterranean Air Command, and successfully directed air operations for the August 1944 invasion of southern France.

"At present the United States are persevering with the idea of the daylight bombing of Germany... in formation without escort. They will probably experience a heavy disaster as soon as they do so."

Prime Minister Winston Churchill, in 1942

bomber, the Lancaster. Eaker, faithful to the doctrine of the heavy bomber, asserted that the B-17's firepower would allow it to withstand daylight Luftwaffe fighter attacks, even without protective fighter escort. (Later, General Arnold refused the British request that the United States build Lancasters, because he felt they were underarmed.) The British were skeptical of the performance of the B-17, since its bombload of around 4,000 pounds was much smaller than that of the Lancaster, which when modified could carry 10,000 pounds of bombs. (Later, the Lancaster would carry the 22,000-pound "Big Boy" bomb against the German battleship *Tirpitz*.) Moreover, several Flying Fortresses that Bomber Command had actually used in a few raids in 1941 had been shot to pieces by German fighters. But Eaker countered that the British had misused the B-17, which was designed to be operated in large formations of a dozen or more, where it was felt that its collective firepower would be murderous. He conceded that for additional protection, the Fortresses should have fighter escort as far as the fighters' range permitted.

It was Eaker's belief that if the Americans began to bomb by day while the British continued to bomb at night, it would wear out the German defenses by keeping them on alert at all times. It would also force the Luftwaffe to draw some of its aircraft from the Russian offensive, and thus take some of the pressure off the Soviets, who were clamoring for Britain and the United States to establish a second front. Harris remained skeptical of the U.S. ability to bomb by daylight, and debates between the two stubborn commanders went on incessantly during the first few months of Eaker's stay in England.

BAPTISM BY FIRE **(June 1942–October 1942)**

In the spring of 1942, Harris and the RAF turned over some old RAF bases to Eaker and the Eighth Air Force, and helped the Americans acquire land on which to build additional airfields. The majority of these bases were located northeast of London in East Anglia, within easy reach of Europe and, eventually, Germany. By June, final preparations were completed on the first of the 127 bases that the Eighth Air Force would occupy. Before long, the first B-17s and their crews began to arrive, after flying 2,119 miles from the United States via Newfoundland, Greenland, and Scotland. The RAF lent a hand by providing some badly needed gunnery training to the American crews. At this time, the new commander of the Eighth Air Force, Major General Carl Spaatz, also arrived. Slowly, the Eighth was assembling as a fighting force.

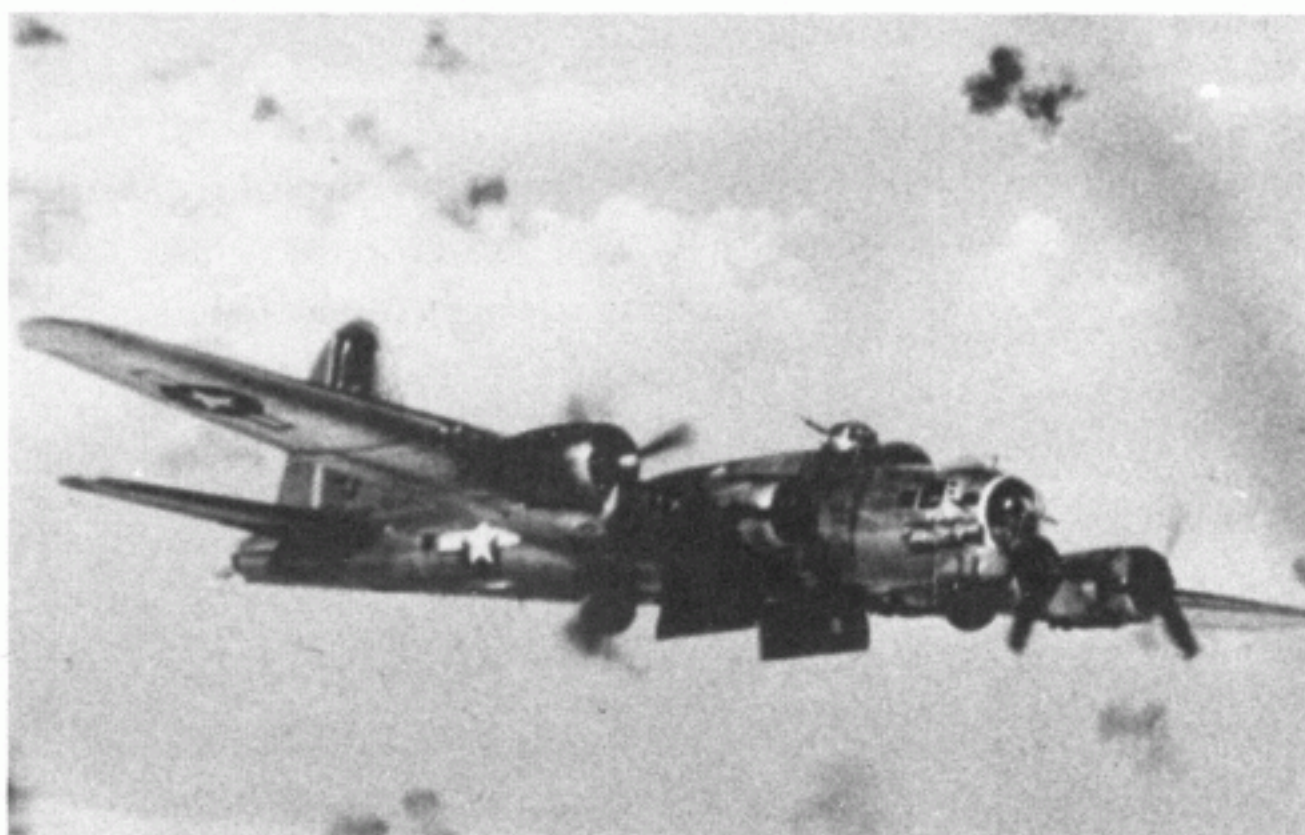
On August 17, the Eighth's 97th Bomb Group made the first U.S. Army Air Force daylight bombing run over occu-

pied Europe. Twelve B-17s, escorted by RAF Spitfires to the coast of France, bombed the railroad marshaling yards and repair shops at Rouen, sixty-five miles northwest of Paris. About half the bombs landed on target, and all the bombers returned to base safely after encountering minimal resistance from some Luftwaffe FW 190 fighters. Eaker, who had gone on the mission as an observer, was pleased with the results of this, the first American test of daylight bombing. But, he noted, "One swallow doesn't make a summer."

Two days later, twenty-four B-17s attacked a Luftwaffe fighter base at Abbeville, France, again achieving a high degree of bombing accuracy while suffering no aircraft losses. On September 5, the Eighth Air Force suffered its first heavy bomber losses when two B-17s were shot down during a raid on an aircraft factory near Rouen. Owing to a missed rendezvous, nine Flying Fortresses without fighter escort had to take on twenty attacking Bf 109s and FW 190s. Despite the losses, Eaker felt that the B-17 had proven it could defend itself from enemy fighter attack if it had to.

A bigger test was to come on October 9. The largest U.S. attacking force yet, consisting of 108 bombers, was to attack the steelworks at Lille, France. Among these aircraft was the other main U.S. heavy bomber, the Consolidated B-24. The ungainly looking "Liberator" could fly faster and carry a greater bombload than the B-17, but it was felt that the Flying Fortress could sustain more battle damage. Neither bomber fared well in the raid, which was heavily opposed by Luftwaffe fighters. Only nine bombs fell near the target, and the force lost three B-17s and one B-24. But after the raid the Americans were jubilant, because gunners had reported shooting down fifty-six Luftwaffe fighters. (This claim proved to be a wild exaggeration; only one German fighter was actually lost.)

By the fall of 1942, the Eighth Air Force was brimming with confidence. Overall in its first few missions it had suffered few losses while vindicating the U.S. belief in daylight precision bombing. The British themselves were beginning to ease up on their demands for the Americans to switch to night bombing. And even with fighter escort only as far as the coast of France, the Americans believed that their bombers could take whatever the Luftwaffe could dish out. But conditions during these first few missions had favored the United States. The weather had been excellent, and



Courtesy of the United States Air Force

antiaircraft fire and fighter attacks had not been severe. Moreover, while the British were flying raids deep into German airspace, these early U.S. missions had targeted sites in France, Belgium, and the Netherlands that were relatively close to their home bases.

Most importantly, they had yet to experience the full power of the Luftwaffe.

THE STATE OF THE LUFTWAFFE (February 1941–October 1942)

In early 1941, as it was becoming obvious that the Luftwaffe was not going to defeat the RAF or destroy the spirit of the British people, many fighter and bomber *Geschwader* were transferred away from the English Channel area. Despite the denials of Reichsmarschall Hermann Göring, the head of the Luftwaffe, Germany was abandoning the conquest of Britain for a goal which became apparent on June 22 — the conquest of Russia. Though Hitler had promised not to repeat the mistake of World War I and force Germany to fight a two-front war, the reality was that in 1942 Germany was in a multifront war. German troops were fighting in Russia, in North Africa, and in the Mediterranean, as well as engaging the British in France and Norway. With most of its aircraft scattered from Scandinavia to the Middle East, the Luftwaffe was stretched to the breaking point, and had few aircraft left to battle the RAF in western Europe.

As Luftwaffe opposition lessened, the RAF became more aggressive and began making daytime fighter sweeps across France along with night bombing raids on France and Germany. To counter the bombing, Göring formed a special night fighter branch, headed by Generalleutnant Joseph Kammhuber. A radar defense system known as the “Kammhuber Line” was built to locate incoming enemy bombers and vector night fighters to intercept them. Large, twin-engined aircraft such as the Messerschmitt Bf 110 and the Junkers Ju 88 began to enjoy success as night fighters.

Göring had ridiculed the first American daylight bombing raids. But Adolf Galland, the Battle of Britain ace who had recently become the Luftwaffe’s general of the fighter arm, could see the dangers that lay ahead. The United States, rich in resources and far out of the range of German bombers, could conceivably produce thousands of bombers. If these aircraft were all launched from England, Germany could be destroyed while Luftwaffe fighters were battling on other fronts. Galland also discovered that Luftwaffe fighter production had been virtually neglected since the Bat-

The poor marksmanship of antiaircraft gunners during the first U.S. bombing raids became the source of a German joke. A soldier who was sentenced to die was told to choose the means of his execution. He chose death by antiaircraft fire, and was tied to the top of a tower. Three German antiaircraft batteries fired away at him for three weeks. When the gunners went to retrieve the soldier, they found that he had not been hit by their fire but had starved to death instead.

tle of Britain, and that the bomber arm had been built up instead. This was in keeping with Hitler's military philosophy, which emphasized offensive, rather than defensive, measures.

To counter the growing U.S. threat and build up the fighter arm, Galland implemented a training program in which new pilots were given operational experience by active fighter units. He also convinced Feldmarschall Erhard Milch, the chief of Luftwaffe procurement and supply and the number two man in the Luftwaffe, to increase fighter production from 250 a month to 1,000 a month by mid-1943.

At that time, Galland was fortunate to have two excellent fighter aircraft under his command: the Messerschmitt Bf 109 and the Focke-Wulf FW 190. The Bf 109 had proven itself early in the war in the conquest of Europe, and the newest model, the 109G, had a more powerful engine and could reach speeds of nearly 400 miles per hour. However, the extra weight of the new engine cut back on maneuverability and added to the Bf 109's other problems, including a short range and a narrow landing gear that was prone to collapse. The FW 190, introduced in 1941, had quickly earned a reputation as the most advanced fighter in the world. Faster, sturdier, and more maneuverable than the Bf 109, the FW 190 had quickly found favor with Luftwaffe

"[It is] not enough to shoot down all the birds in flight if you want to wipe out the species; there remain the eggs and the nests."

Italian General Giulio Douhet, an advocate of bombing attacks against aircraft factories and other industrial targets



squadrons after engine problems in the earlier versions were corrected.

And in the development stage were two even deadlier fighters, the likes of which had never before been seen in air combat.

THE BIRTH OF THE “SECRET WEAPONS”

During the 1930s, many of Germany's leading scientists and scholars had been victimized by the anti-intellectualism, racism, and religious persecution that marked the Nazi regime, and fled the country. Many of the Germans who had taken their place were not so much theoretical scientists as technicians, and the fields of research and development came to be dominated by these engineers. Incited by Nazi propaganda regarding the “intellectual superiority” of the German people, the emphasis on militarism, and the German tradition of workmanship and discipline, these German engineers had spurred an incredible push in the development of new warfare technologies. Research facilities, sponsored by profit-seeking businesses in collaboration with the government, had sprung up all over Germany, and the most secret of these were the Luftwaffe's. Inside their facilities, plans for advanced aircraft, as well as for solid- and liquid-fueled rockets and jet engines, were already on the drawing boards by the mid-1930s.

In 1936, Ernst Heinkel's aircraft company began to take an interest in the possibilities of jet propulsion. After much experimentation, the first German jet engine, the HeS 3, was developed. The prototype that used the engine, the He 178, made the world's first jet-powered flight on August 24, 1939, just before the outbreak of World War II. This plane was later demonstrated to Feldmarschall Milch and General Ernst Udet, the Luftwaffe's chief of the technical office, but

amazingly, neither of them was impressed. Because both men felt that the Luftwaffe's resources should be committed to other areas, and that such an aircraft would not be needed, the jet fighter that emerged from the He 178 prototype, the He 280, was left to languish.

Other manufacturers started developing their own jet engines, including Junkers, who was commissioned by the German air ministry to begin work on the 1,300-horsepower Jumo 004 engine in

1938. The Messerschmitt company, in turn, was asked to develop a suitable aircraft for the new engine, testing of which began in 1940, at the time of the Battle of Britain. The airframe was completed a year later, and the earliest version of the new aircraft, dubbed the Me 262 *Schwalbe*, or

When flying on a bombing mission, gunners used the “clock face” system to note which direction an enemy fighter attack was coming from. “Twelve o'clock” signified straight ahead, while “six o'clock” meant straight behind. If a gunner called out “Bandits at two o'clock,” it meant that fighters were attacking from ahead and sixty degrees to the right.

“swallow,” made its first flight in 1942.

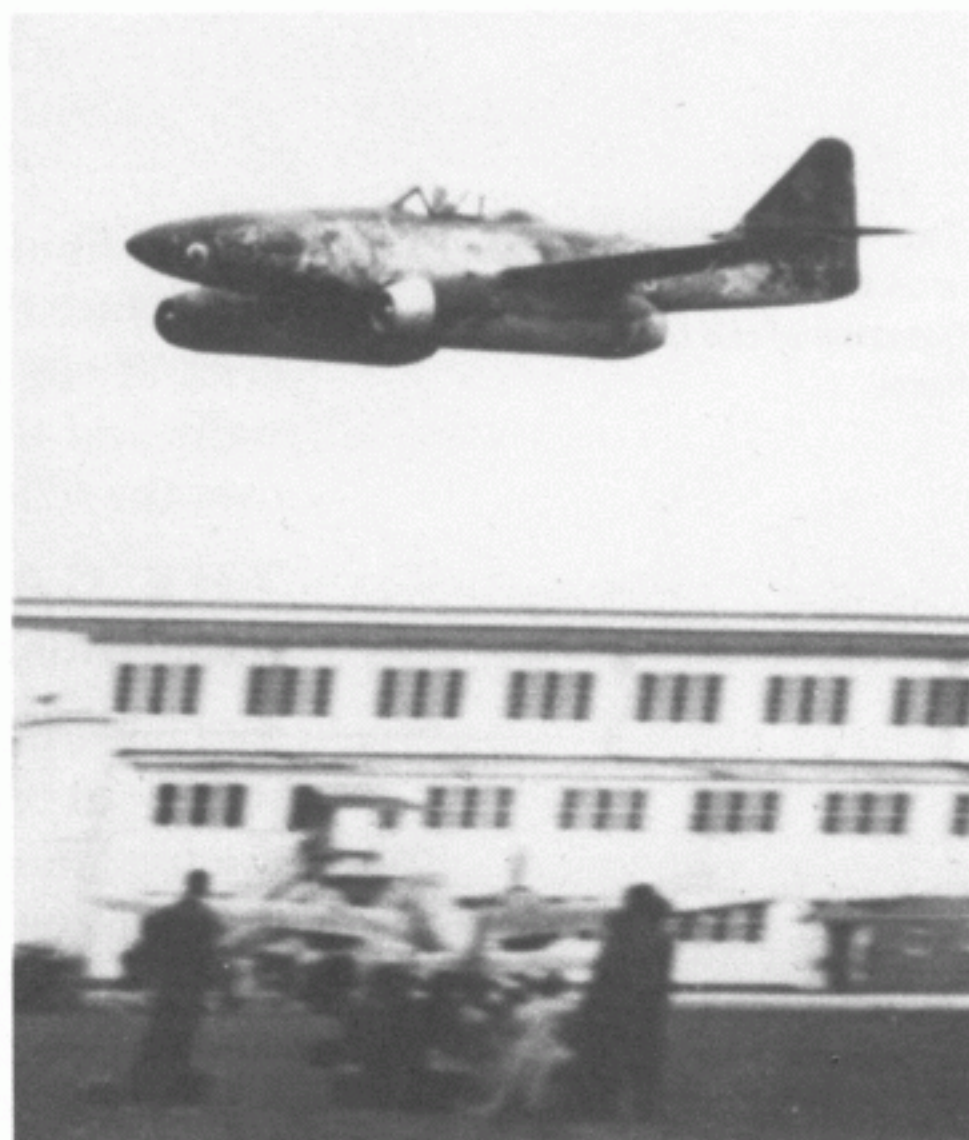
But fears and mistrust stemming from previous failures of the German aircraft industry hampered the early development of this jet aircraft. One project, the He 177 heavy bomber, had been delayed by repeated engine fires, and the prototypes had had an unnerving tendency to explode in midair. (The He 177 was later nicknamed *Luftwaffenfeuerzeug*, or “the Luftwaffe’s lighter.”) Feldmarschall Milch worried that similar problems could develop with the Me 262’s Jumo jet engines once they were in mass production. Furthermore, he had little faith in company head Willy Messerschmitt, largely because of problems that had plagued, and ultimately doomed, the two-seat Me 210 fighter. Originally designed as a replacement for the Bf 110, the unstable Me 210, which tended to go into spins, had nevertheless been brought into production. But the crashes had mounted, and the Me 210 program was eventually cancelled. Blaming Messerschmitt for this, Milch had then ordered him to cease work on the Me 262. Ignoring this order, Messerschmitt had proceeded with the Me 262 in secrecy. However, the Luftwaffe’s failure to push for the jet’s development meant that valuable time was lost.

Meanwhile, Messerschmitt’s company was also developing an even more revolutionary airplane: the Me 163 rocket fighter. Germany’s experimentation with rockets had actually begun back in the 1920s, when a group known as the German Rocket Society had conducted experiments with liquid-fuel rockets. At the same time, Fritz von Opel, of automobile fame, had been researching solid-fuel rockets and had used one to power a sailplane in 1929. In total secrecy, the German army weapons department had established a liquid-fuel rocket research department in 1929, with a facility at a site south of Berlin. After the Nazis had taken power in 1933, they had moved this facility to Peenemünde, on the Baltic coast. Under the leadership of Wernher von Braun, a liquid-fuel rocket had been developed and flight-tested on a piston-engined aircraft, the He 112, in April 1936.

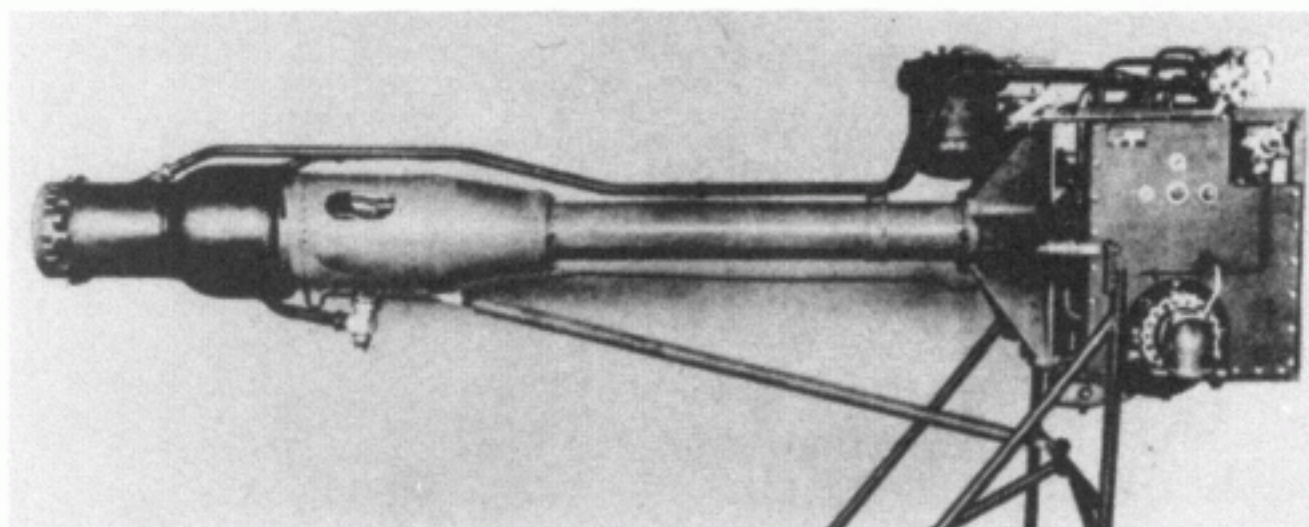
At another facility, Hellmuth Walther had designed a rocket motor that utilized a hydrogen peroxide propellant. In 1936, he was commissioned to develop an engine for *Projekt X*, an experimental high-speed aircraft designed by Alexander Lippisch, a proponent of delta-winged and tailless planes. Walther’s new engine was first successfully flight-tested on an He 72 biplane in 1937.

“This is not a step forward; this is a leap!”

Luftwaffe General Adolf Galland, after test-flying the Me 262 jet on May 22, 1943



In 1939, Projekt X was moved to the Messerschmitt company. In 1940, they test-flew a new rocket-powered Lipisch prototype, a tailless single-seater called the DFS 194. Its performance exceeded expectations. With its Walther liquid-fuel rocket engine, it boasted a top speed of 342 miles per hour, and could climb at a rate of 5,300 feet per minute. It was decided to put this aircraft into production, and the new model was designated the Me 163, and nicknamed the



The Walther rocket that powered the Me 163 Komet.
Courtesy of the United States Air Force

Komet. The first Me 163A flew in August 1941 and set a secret world speed record of 623 miles per hour two months later.

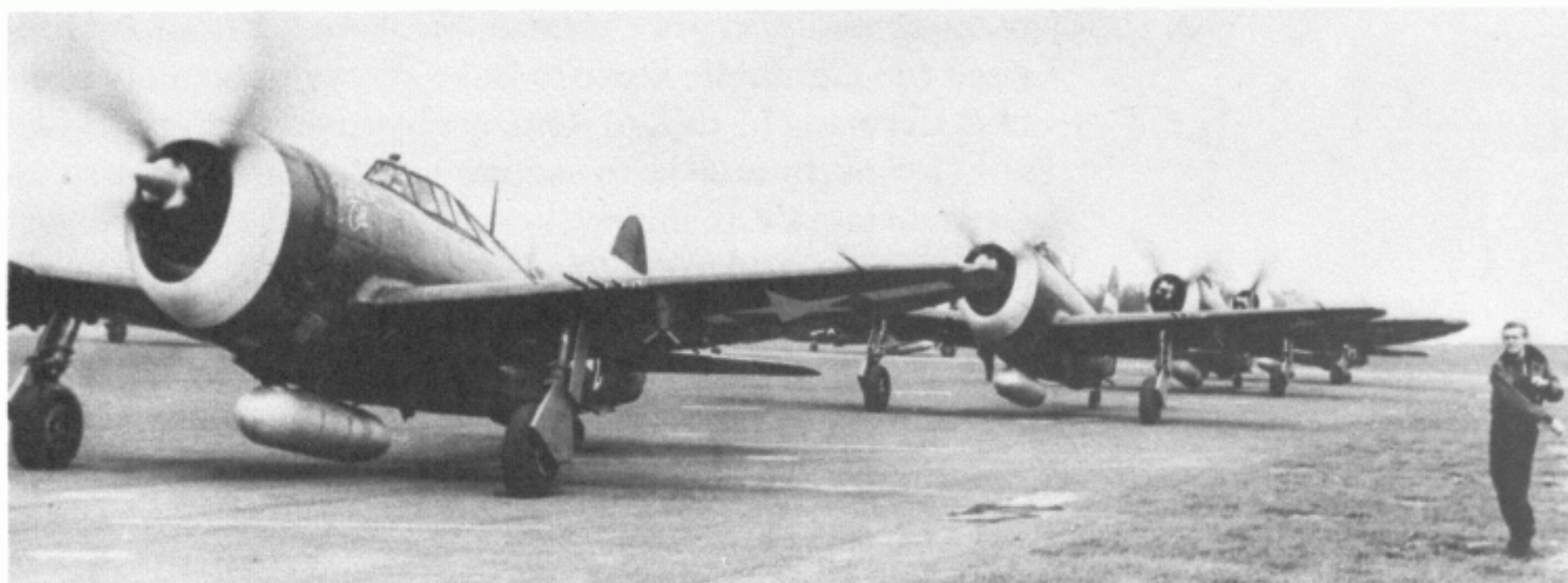
In an age when the biplane was still seeing military service, the Me 262 and the Me 163 represented a huge leap forward in avia-

tion technology, a leap necessitated by the urgency of the war, which had pushed the imaginations of German designers and engineers to their limits. But how would the Luftwaffe and the German high command use this advantage over the Allies and the Eighth Air Force?

THE CASABLANCA DIRECTIVE (November 1942–January 1943)

The euphoria brought on by the Eighth Air Force's first successful bombing raids on France was quickly snuffed in the final months of 1942. Bad weather forced the cancellation of numerous missions, and only twelve were flown during the months of November and December. Another blow came when the Eighth was ordered to transfer nearly one hundred bombers and crews to support Operation Torch, the Allied invasion of North Africa. This action also made General Eaker the new head of the Eighth, in place of General Spaatz, who was now in charge of the air offensive in North Africa. Most of the bombing raids made by the Eighth during this period were against U-boat yards in France, in response to the growing U-boat menace in the Atlantic. But these raids did little damage to the U-boat pens, whose thick concrete walls and roofs could withstand direct hits by one-ton bombs. The pens, moreover, were heavily defended by anti-aircraft guns and fighters, and U.S. losses were heavy.

As 1943 dawned, Winston Churchill was increasingly critical of the U.S. bombing operations. Not one U.S. mission had been flown over Germany, which was being bombed nightly by the RAF. It was obvious to the British prime minister that U.S. generals were reluctant to put their daylight bombing theory to its toughest test. Moreover, the United States lacked a long-range escort fighter



P-47C Thunderbolts, with the early "razorback" canopy design, ready for takeoff. Courtesy of Acme Newspictures, New York City

which could protect the bombers over Germany. The newest U.S. fighter, the P-47 Thunderbolt, had an operating range of only 175 miles, which meant that for over half the distance to the German targets the bombers would be unescorted and under the attacking guns of Luftwaffe fighters.

At an Allied strategy meeting on January 14, 1943, at Casablanca, Churchill spoke with President Franklin Roosevelt in an effort to convince him that the Eighth Air Force should join the RAF in night bombing. Although there was no danger that Roosevelt would side with Churchill against his generals in this matter, when General Arnold learned of Churchill's intentions, he immediately ordered Eaker from London to speak with the prime minister. With his arguments written out on a single sheet of paper, Eaker met with Churchill, and after declaring his beliefs in favor of daylight bombing, handed over the paper. Churchill read through the arguments until he came to one which asserted, "By bombing the devils around the clock, we can prevent the German defenses from getting any rest." He read this sentence aloud twice, the second time very slowly, then turned to Eaker and stated, "You've made a strong case here. While you have not convinced me that you are right, you have convinced me that you should have further opportunity to prove your case." Churchill then told Eaker that he would meet with Roosevelt and take back his statement that the United States should join with the British in night bombing.

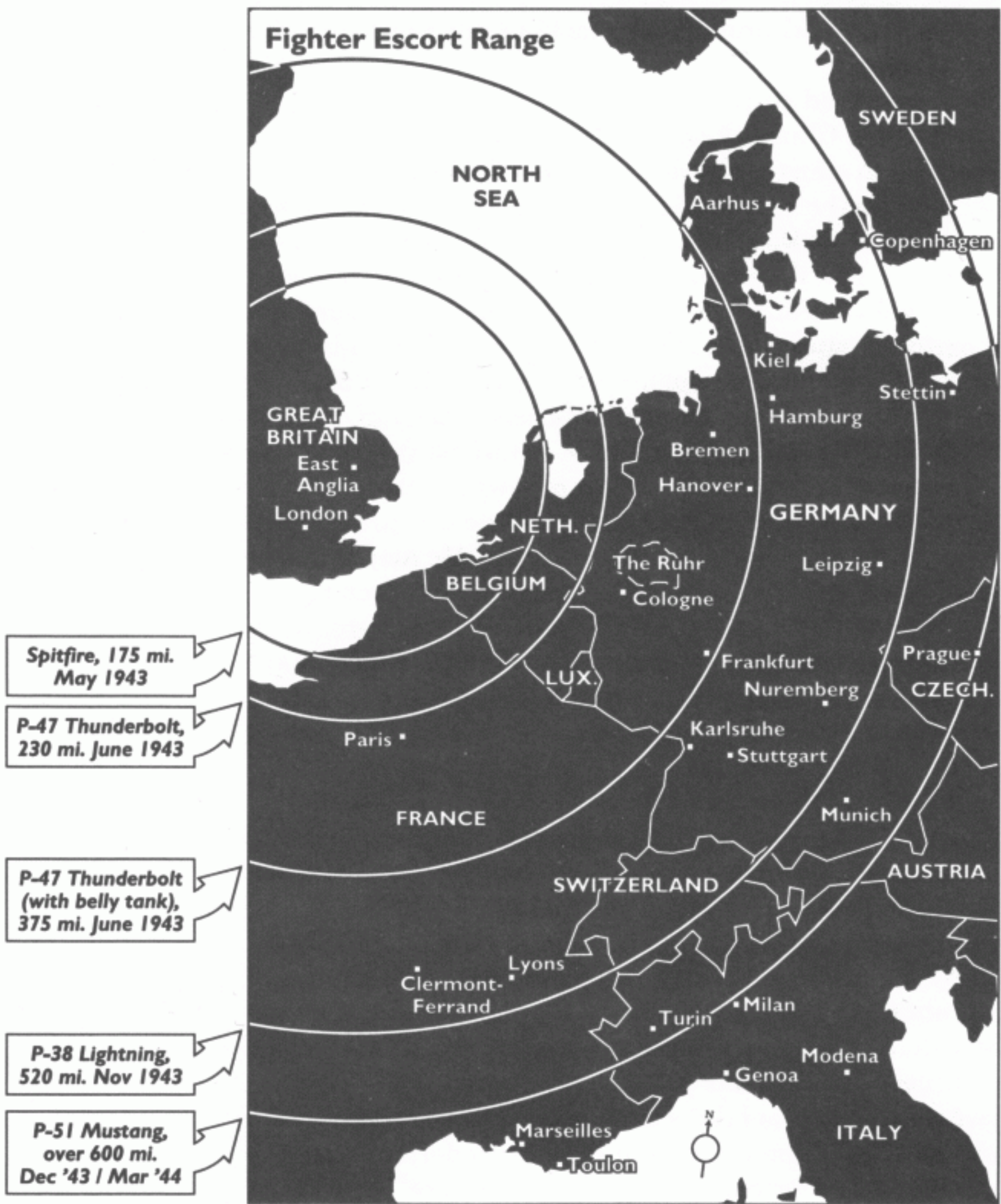
Ecstatic that the U.S. daylight bombing strategy had survived, and convinced that this agreement would be one of the great decisions of the war, Eaker immediately left for London. On January 21, the U.S. and British leaders issued the Casablanca Directive, which outlined their position on a number of points, including the bombing of Germany. Worded for the men who would be flying the missions, the directive stated, "Your primary object will be the progressive destruction and dislocation of the German military, industrial, and economic system, and the undermining of the morale of the German people to a point where their capaci-

ty for armed resistance is fatally weakened.” It also authorized the Eighth Air Force to “take every opportunity to attack Germany by day, to destroy objectives that are unsuitable for night attack, to sustain continuous pressure on German morale, to impose heavy losses on the German day fighter force, and to contain German fighter strength away from the Russian and Mediterranean theatres of war.”

Two days after Eaker returned to London, he authorized the first Eighth Air Force bombing mission against Germany.

“THE BIG LEAGUE”
(January 1943–May 1943)

On January 27, 1943, a force of fifty-three B-17s and B-24s headed toward the submarine factories at Vegesack, Germany. When it was discovered that the target was ob-



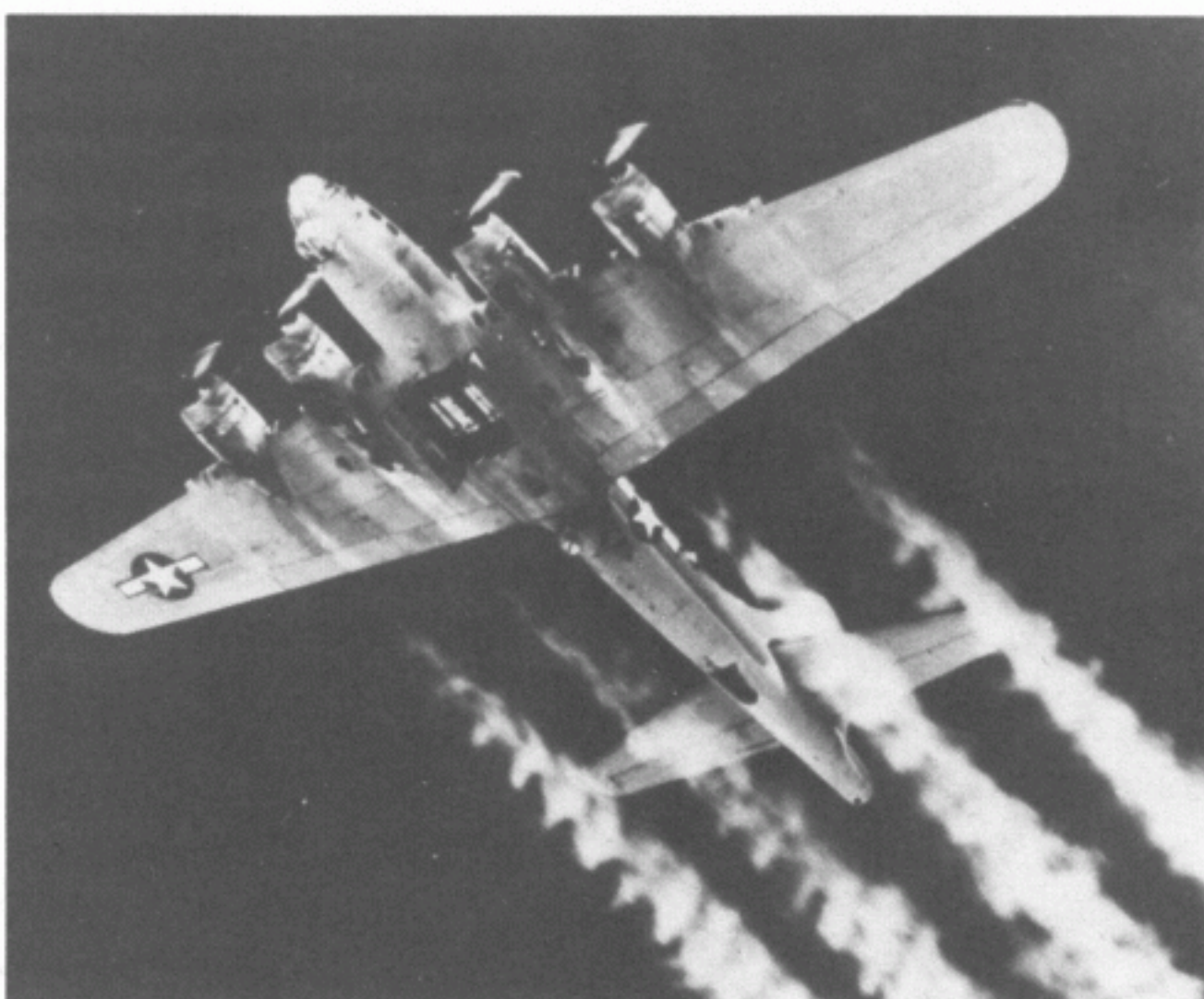
scured by clouds, the bombers changed course for Wilhelmshaven and dropped their bombs on the U-boat facilities there. The unescorted force lost only three bombers to enemy fighters, and shot down seven of the German attackers. Although bombing accuracy was marginal, the day was momentous, for the U.S. Eighth Air Force had finally flown a mission on a target within Germany.

When Wilhelmshaven was bombed again a month later, resistance was stiffer and seven U.S. bombers were shot down. On March 18, ninety-seven U.S. bombers destroyed two-thirds of the U-boat shipyards at Vegesack. Only two bombers were lost, and American gunners claimed to have shot down a staggering fifty-two German fighters.

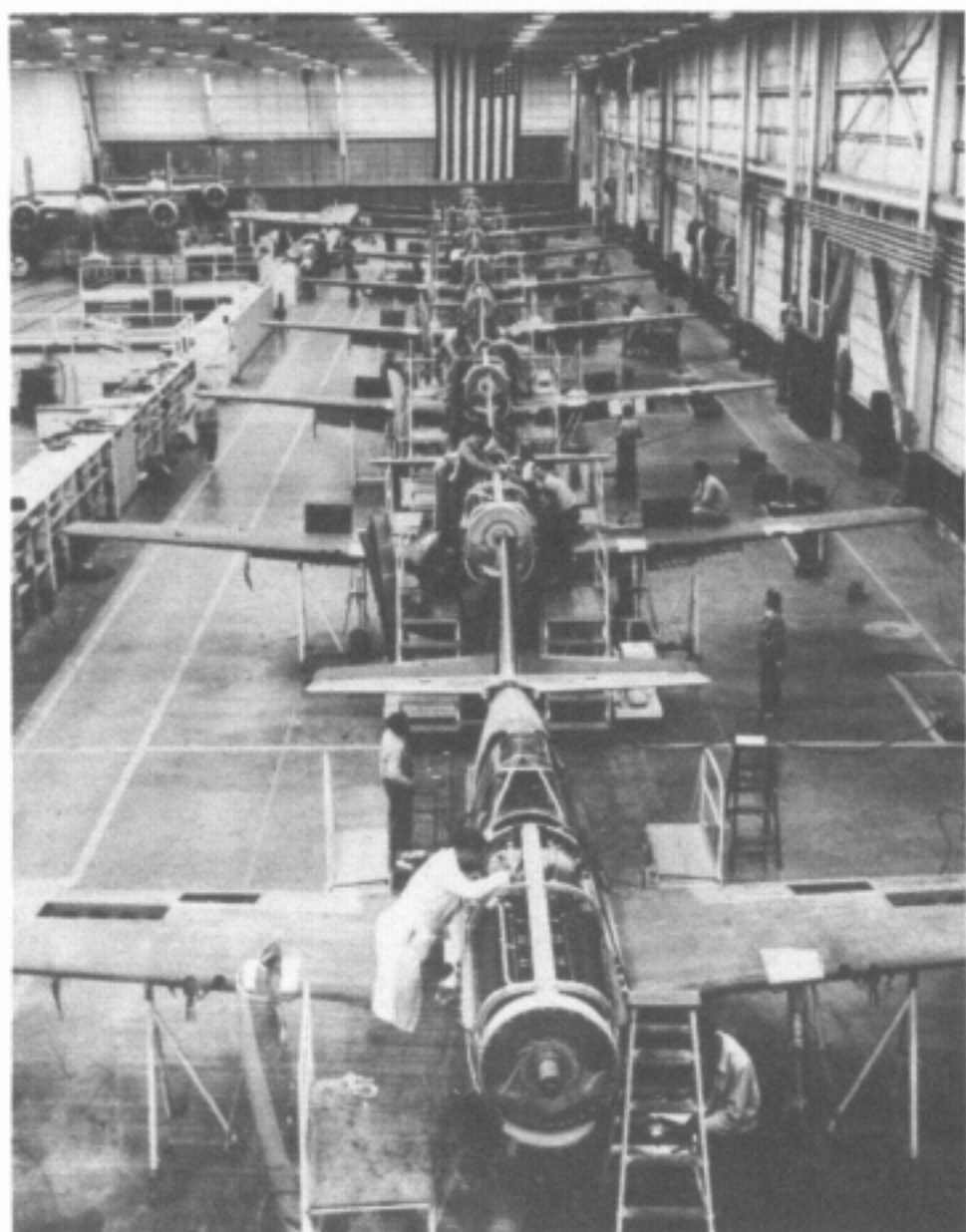
Nearly a week after the Vegesack raid, General Eaker gave a gathering of war correspondents the Eighth's totals for the past thirteen months: 51 missions, 90 bombers lost, and 356 German fighters shot down. Eaker knew that the totals against the German aircraft were inflated, as several different gunners often took credit for shooting down the same plane. Moreover, German fighter pilots sometimes nosed their planes toward the ground, pretending to have been shot down. But Eaker knew he would be a poor leader if he continually questioned the reports of his own crews, and the high numbers were good for morale.

Exaggerated totals and all, the early success of the Eighth validated the U.S. generals' belief that their heavy bombers could fly unescorted on daylight raids over Germany without suffering heavy losses. Their faith in the doctrine that "the bomber will always get through" was unshaken. What remained a nagging question in the generals' minds was whether the Luftwaffe had the capability to shoot down enough U.S. bombers to make daylight bombing too costly to continue. So far, despite Adolf Galland's urgings to fortify fighter defenses in the West, his superiors simply did not see the Allied air attacks as a looming threat. As a result, most of the Luftwaffe's fighters were seeing action in the doomed Mediterranean campaign, and resistance to the U.S. and British bombers over western Europe was weaker than it could have been.

With more unescorted raids into Germany planned,



B-17. *Courtesy of the Boeing Aircraft Company*



P-51B Mustangs being assembled at a North American Aviation factory. In the background to the left are several partially assembled B-25 Mitchell medium bombers. Courtesy of the Sherman Fairchild Collection

Arnold and Eaker were busy prodding Washington to beef up the Eighth with more bombers and fighters. On a single day in May 1943, the number of Eighth Air Force bombers jumped from 100 to 215. That same month, the Allies approved their Combined Bomber Offensive Plan, under which the Eighth was to receive nearly 3,000 more heavy bombers by the end of the year.

Though the generals were convinced that unescorted bombers would survive without fighter escort, the lack of a long-range, maneuverable escort fighter that could go deep into Germany and back remained a pressing issue. In combat over the Channel and France, the P-47 Thunderbolt was more durable and could dive faster than the FW 190, but could not climb as fast. It was felt that another U.S. fighter, the P-38 Lightning, would be a good long-

range escort because of its twin-engined durability, plus a distinctive twin-boom design that was easily recognized by the trigger-happy U.S. bomber gunners. However, the P-38 proved to be far less maneuverable than the Bf 109 and the FW 190, and its Allison engines developed problems at high altitudes. Finally, before either the P-47 or the P-38 could be tried out as a long-range escort, a satisfactory external drop tank, which U.S. Army Air Force brass had assigned a low priority to until 1938, would have to be developed. For the time being, the bombers would go it alone once the fighter escort had turned around over France and the Low Countries.

This decision would prove to be a tragic one for the bomber crews, made even more so by the fact that the U.S. Army Air Force had stalled the production of an excellent long-range escort fighter, maintaining that there was no need for one at the time. This fighter was the P-51 Mustang, which had originally been developed for the British in 1941. Its Allison engine was underpowered at high altitudes, but when the British installed the Rolls-Royce Merlin engine, the Mustang's performance picked up incredibly. Moreover, the Mustang had greater range than the Thunderbolt, since it had an additional internal fuel tank behind the pilot, and its Merlin engine used up roughly less than half the fuel used by the P-47. But the U.S. Army Air Force's material division decided that, being liquid-cooled, the Merlin engine was too vulnerable to gunfire. They reached this conclusion despite the fact that the RAF's Spitfire and the Luftwaffe's Bf 109, two of the most successful fighters in the world during the early part of the war, were both pow-

ered by liquid-cooled engines. Moreover, since the Mustang had been designed for the British and had a British-made engine, there was less interest in this fighter than there would have been if it were strictly an American plane. This error in judgment critically delayed production of the P-51.

But events would prove that the United States was not alone in making poor decisions about its own aircraft.

THE TRIALS OF THE SCHWALBE **(May 1943–June 1943)**

Frustrated by the indifference of Hermann Göring and Erhard Milch toward his new jet fighter, Willy Messerschmitt invited General Galland to test-fly the Me 262. On May 22, 1943, Galland climbed into the cockpit of one of the jet prototypes and quickly climbed out again when one of its engines caught on fire. A second prototype was readied, and soon Galland took off.

To say he was impressed by the Me 262 is an understatement. The jet's handling was much smoother and quieter than that of any piston-engined aircraft, even at speeds of 520 miles per hour. Galland made a simulated attack on the prototype four-engine Me 264 *Amerika-Bomber* that was flying nearby, and quickly realized that the jet could be an effective deterrent to the growing U.S. bombing threat. Galland was ecstatic as he climbed out of the Me 262's cockpit. In a report to Milch, he noted:

1. This model is a tremendous stroke of luck for us; it puts us way out in front, provided the enemy continues to use piston engines.

2. As far as I could tell, the fuselage appears to be entirely satisfactory.

3. The engines are everything that has been claimed for them, except for their performance during takeoff and landing.

4. The aircraft opens up entirely new possibilities as far as tactics are concerned.

Galland pushed for an accelerated testing and production program. Surprisingly, Milch and Göring, who rarely agreed on anything, went along with him, and only Hitler's approval was needed to get the Me 262 program under way. But Hitler, who had lost faith in Göring and was beginning to distrust Milch, killed the idea. Citing the He 177 bomber mishaps, along with other German aircraft failures, Hitler announced to Göring that the Me 262 program was not going to be rushed before he had made a decision about the jet's value. In the meantime, mass production was forbidden and only a few prototypes were to be developed.

Although Milch still agreed with Galland, he told the general that he had no choice but to go along with Hitler's order. For the time being, the only fighters that were to be produced were piston-engined ones. A saddened Galland

“Now we have fighters with us all the way. Our P-47s take us as far as Aachen. The Messerschmitts and Focke-Wulfs take us to the target and back. Then the 47s pick us up again when we reach the Channel. If we reach the Channel.”

Remark frequently made by B-17 crewmen in 1943



Feldmarschall Erhard Milch, a pilot in World War I, became head of the German airline Lufthansa during the period between wars. In this position, he secretly laid the groundwork for the future Luftwaffe, and helped build it into a formidable force. In 1933 he became deputy air minister of the Luftwaffe, and was second in command to Hermann Göring. A brilliant organizer and capable administrator, the ambitious Milch continually pushed for great numbers of existing models of aircraft to be produced, a move which hampered the development of newer models. However, Milch backed the Me 262 jet fighter once Adolf Galland convinced him of its worthiness. As the war progressed, Milch began losing influence with Hitler and Göring, and was removed from office after he argued with Hitler that the Me 262 should be used as a fighter instead of a bomber. After the war, Milch was sentenced to life imprisonment at the Nuremberg Trials, but was released after serving ten years.

realized that a golden opportunity to regain air superiority and counter the bombing offensive was being needlessly thrown away.

OPERATION GOMORRAH **(July 1943)**

While the Eighth Air Force had been making its first raids on Germany, the RAF's Bomber Command had taken the night offensive into Germany's industrial center, the Ruhr valley. On one raid, on May 16, 1943, the RAF made an out-of-character display of pinpoint bombing when a squadron of Lancasters dropped bombs specially designed to bounce on water on three of the Ruhr's reservoirs, knocking out two dams. The "dam busters" raid failed to stop industrial production in the Ruhr, however, and Harris decided to continue with his area bombing strategy. Subsequent RAF raids crippled the Ruhr, and Harris then began planning a large-scale attack on Germany's largest port, Hamburg. For the first time, American daylight bombing and RAF night bombing were both to be concentrated on a single target. The code name for this mission, which was to last for ten days, was Operation Gomorrah, for reasons that would soon become obvious.

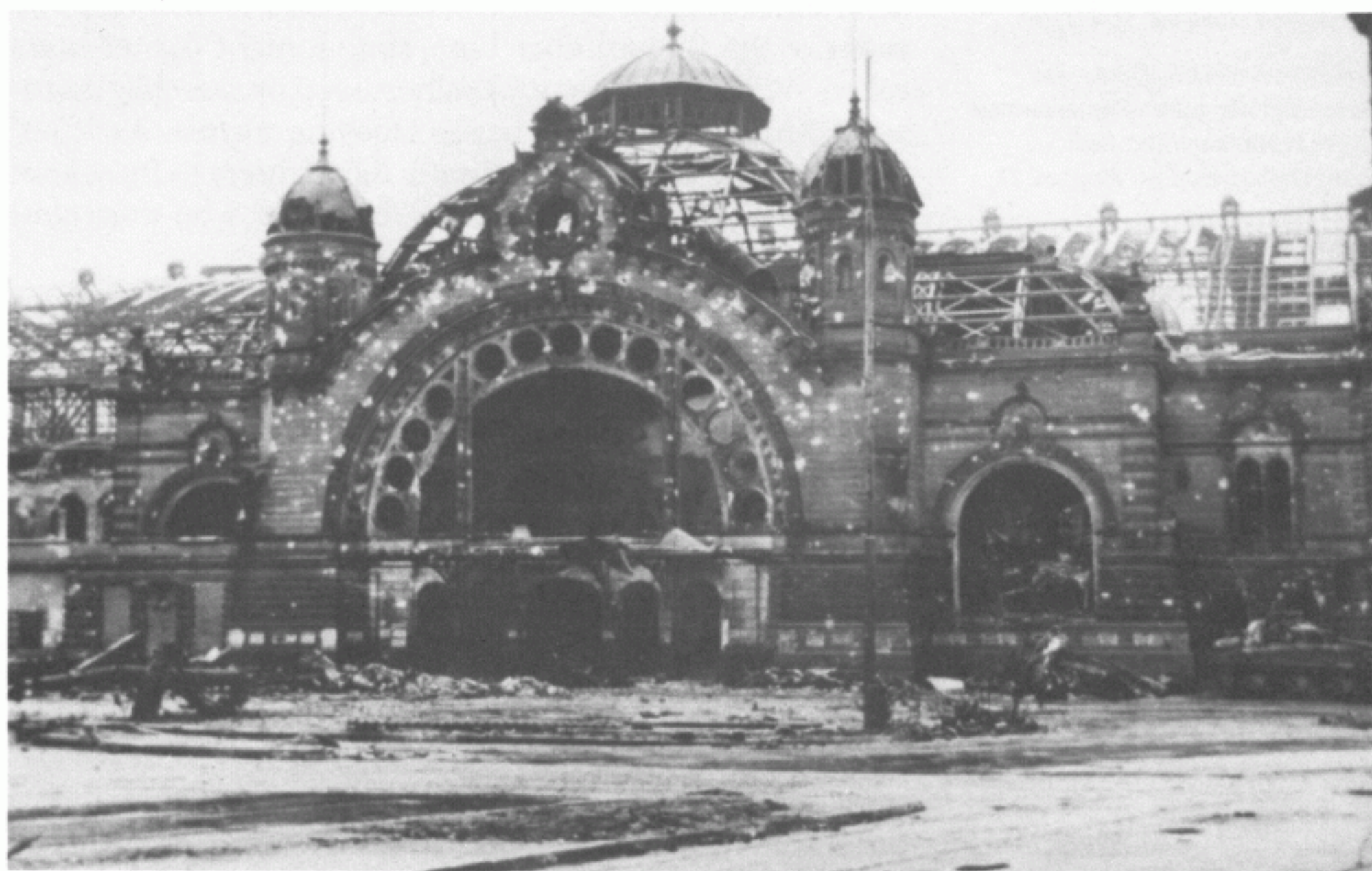
Meanwhile, the Eighth was finding that Luftwaffe fighter attacks and antiaircraft fire were becoming more and more effective against their B-17s and B-24s. On May 7, just three days after a successful raid on Antwerp that saw all the bombers return to base safely, 7 bombers out of a force of 31 were shot down over Saint-Nazaire. Two mid-May raids on the U-boat yards at Kiel resulted in only 14 losses for the Eighth, yet on a return raid on June 13, a stunning 26 out of 182 bombers were shot down. Nine days later, the Eighth made its first attack on the Ruhr. Despite fierce fighter opposition, 182 B-17s and B-24s bombed the synthetic rubber plant at Huls, effectively knocking out production for months.

During July, only a few Allied bombing raids were made, mainly on targets in coastal France. But this was the calm before the storm, as on the evening of July 24, nearly eight hundred RAF bombers took off for Hamburg, signaling the beginning of Operation Gomorrah. Dropping strips of tinfoil to confuse the radar of the Kammhuber Line, the force successfully unloaded nearly 3,000 tons of bombs on Hamburg. The next day, U.S. bombers largely avoided the city itself and attacked the Hamburg shipyards and docks, losing nineteen B-17s out of sixty-nine.

That evening, the returning RAF bombers dropped incendiary bombs on the burning city, whose water mains had burst under the earlier attacks. As more fires sprang up all over Hamburg, the air above the city became superheated, and as the hot air rose, cool air rushed in to replace it. This

effect created tornadoes of fire all over the city, which merged into one enormous whirling inferno two-and-a-half miles high and one-and-a-half miles in diameter. Nothing could stop this horrifying firestorm as it swept across Hamburg, burning or melting everything in its path. Thousands of people were sucked into the inferno, or instantly incinerated in the 1,800°F heat, many as they sat in air raid shelters. Those inhabitants who were not burned either suffocated, were poisoned by carbon monoxide, or were crushed by collapsing buildings.

The bombing of Hamburg, in which the Eighth Air Force had played a very minor role, unleashed a hellish spectacle of death and devastation, the likes of which had



never been inflicted on a city or its people before. Not until 1957 was it finally determined that some 50,000 inhabitants died in the raids. The last bombs fell on Hamburg on August 2, and word of *die Katastrophe* quickly spread across Germany. Albert Speer, the German minister of armaments, told Hitler that if the Allies continued to bomb in this manner, the war would quickly be lost. The leaders of the Luftwaffe vowed that the destruction that Hamburg had suffered would never be inflicted on another German city. From Göring on down, they decided that building up the fighter arm at the expense of the bombers would now be a top priority, and that the Luftwaffe would now become a defensive force, to fight off the U.S. and British bombers and regain air superiority for Germany.

Göring met with Hitler to get approval of these strategy changes. But the enraged führer would not listen to any

A burned-out railway station in Cologne. Scenes like this littered the German landscape in 1944–45.

"There were gaping holes in their precise formations.... More than half the bombers we nursed over the North Sea were shot up. One or two ditched in the sea. Others, carrying dead and badly wounded crew members, had to make crash landings."

Unidentified U.S. Army Air Force fighter pilot who escorted B-17s back from the first Schweinfurt raid on August 17, 1943

talk of a defensive war, especially from Göring. Instead, the bombing of Hamburg was to be avenged by a renewed Luftwaffe bombing offensive against London! A badly shaken Göring left the meeting, and Adolf Galland later found him sobbing uncontrollably. (The aerial bombing of London did not begin until January 1944 and was so ineffective that it was referred to as the "baby blitz" by the British.)

If the destruction of Hamburg had little effect on Hitler, it certainly had a unifying effect on the Luftwaffe's leaders. For the first time they all agreed with Galland that the Allied bombing offensive was a grave threat, and that radical measures needed to be taken. Milch announced a production target of 4,000 fighters per month to bolster the fighter arm. Since British countermeasures had neutralized the radar of the Kammhuber Line, special night fighter units called "Wild Boars" were visually guided by searchlights toward RAF bombers, and began enjoying success. And Galland continued to urge Luftwaffe day fighters to fly at least three missions a day against U.S. bombers, who were continuing to fly unescorted over Germany.

CARNAGE IN THE SKIES (August 1943)

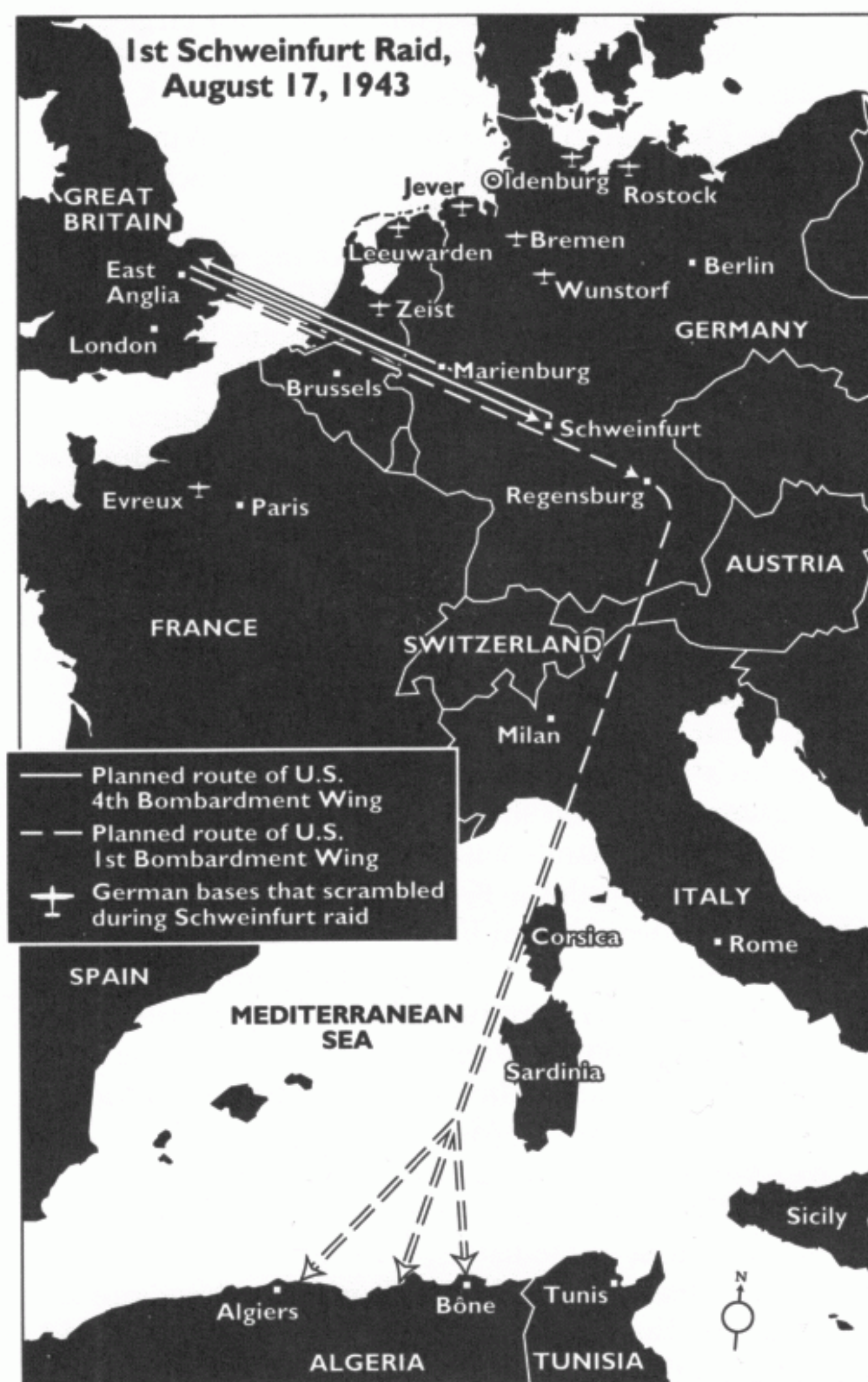
On August 1, the day that Speer was warning Hitler of the dangers of Allied bombing, the U.S. Ninth Air Force, with three bomber groups on loan from the Eighth, launched a massive raid against the oil refineries at Ploesti, Romania. Taking off from their base in Benghazi, Libya, some 177 B-24s flew at low altitude toward the heavily defended refineries, which supplied Germany with over one-third of its oil. A series of mechanical breakdowns caused eleven of the bombers to drop out of the force, and navigational errors put the remaining aircraft on a course over the most heavily defended approach to Ploesti. Murderous, point-blank antiaircraft fire ripped into the B-24s as they made their bombing run, and one Liberator after another was blasted out of the skies at treetop level. Dodging chimneys and explosions from refinery storage tanks, many of the surviving bombers were scorched by flames from the Ploesti inferno. Those that made it through the bombing run were quickly attacked by swarms of Luftwaffe fighters. Only half the attacking force made it back to Benghazi.

With 579 men killed, wounded, or captured, 53 B-24s lost, and another 55 severely damaged, the raid on Ploesti was a disaster for the Ninth Air Force. Although forty percent of Ploesti's refinery capacity was destroyed, production was stepped up in the idle refinery units so that the oil flow to the German military continued uninterrupted. The mission was deemed a failure when no immediate follow-up raid was ordered.

Between the bomber groups loaned to the Ninth for the

Ploesti raid and a 200-plane lag in bomber deliveries from the States, the Eighth was not up to full strength in August. Moreover, problems still plagued the development of drop tanks for the escort fighters. The P-47s could not yet accompany the bombers all the way to targets deep inside Germany and back, and the first P-51s would not be delivered until late autumn. But the lack of a long-range escort fighter did not stop Eaker, who felt that his bombers would be wasted if they sat idle until all of the Eighth's problems were solved. Every day that the Eighth waited, German industry was producing more and more weapons and materials to be used against the Allies. Something had to be done, and soon.

For months, plans had been made for the Eighth to bomb the Bavarian town of Schweinfurt, home to five plants that produced an estimated fifty-two percent of the





U.S. Army Air Force General Curtis E. LeMay, a tactical innovator, proponent of strategic bombing, and ruthless taskmaster, was affectionately dubbed "Iron Ass" by the men who served under him in the Eighth Air Force's Fourth Bombardment Wing. Leading many raids himself, he developed the B-17 combat box formation, which gave the Fortresses better mutual firepower and protection. He also drilled his crews relentlessly on instrument flying, a skill that enabled them to take off on the historic August 17, 1943, raid on Regensburg, even though the English airfields were socked in by fog. LeMay went on to direct B-29 bombing raids from the Marianas against Japan, and after the war became head of Strategic Air Command.

ball bearings used by Germany. Destruction of these factories could seriously hamper the German war effort, since without ball bearings, no airplanes, tanks, ships, artillery guns, or other equipment which depended upon precision machinery could be built. This "bottleneck target," considered to be too small for the night bombers of the RAF to find in the darkness, was the ideal target for the Eighth's program of precision daylight bombing. It would also be a test of the generals' fixed belief that the heavily armed B-17s could survive without fighter escort. The raid on Schweinfurt would mark the furthest penetration into German airspace by U.S. aircraft thus far.

Also to be bombed was the Messerschmitt aircraft factory at Regensburg, which turned out nearly two hundred fighters a month. It was believed that if Regensburg was attacked first, it would draw the Luftwaffe fighters away from Schweinfurt, the more important of the two targets. The Eighth's Fourth Bombardment Wing, led by Colonel Curtis LeMay, was to bomb Regensburg, then land at U.S. bases in Algeria. The Eighth's First Bombardment Wing, led by Brigadier General Robert Williams, was to attack Schweinfurt, then return to its bases in England.

On the morning of August 17, thick fog surrounded the Eighth's airfields. Since LeMay had drilled his men repeatedly in the art of blind instrument takeoffs, his 146 B-17s were delayed only a few minutes before taking off for Regensburg. However, Williams's aircraft, scheduled to take off ten minutes after LeMay's, were grounded for over three hours. The tactical advantage of the two-pronged raid was now lost, but it was decided not to cancel the mission, since the hazards of landing with a full load of bombs meant that all of LeMay's returning bombers would have to salvo their bombs in the English Channel, where they could possibly hit Allied ships. When the fog finally lifted, the First Bombardment Wing took off, way behind schedule.

LeMay's B-17s encountered anti-aircraft fire and minimal fighter opposition shortly after they crossed into German-occupied Holland. But most of the Luftwaffe fighters avoided tangling with the P-47 escort fighters, knowing the Thunderbolts would soon have to return to their bases in England. Although the P-47s now had paper drop tanks, these leaked badly, were unusable at high altitudes, and could safely hold only 100 gallons of fuel. With these tanks, the range of the Thunderbolt was now extended to Aachen, just inside the German border.

As LeMay's armada crossed into Germany, the fuel-depleted U.S. escort fighters were forced to head back to England. Almost immediately, Luftwaffe FW 190s and Bf 109s began tearing into the B-17s with machine gun and cannon fire. Twin-engined Bf 110 fighters, flying outside the range of the American machine guns, fired four-foot-

long rockets into the bomber formations. Some Luftwaffe fighters even dropped 500-pound time-fused bombs on the Fortresses. One B-17 after another fell out of the formations in flames, and the sky was littered with debris and parachutes from scores of broken aircraft. Since Luftwaffe fighter bases were spread out from the German border to Regensburg, as soon as one fighter unit had exhausted its fuel and ammunition, another one rose to take its place. As a result, the American bombers were attacked unceasingly in the most awesome display of Luftwaffe firepower that the surviving U.S. crews had ever witnessed.

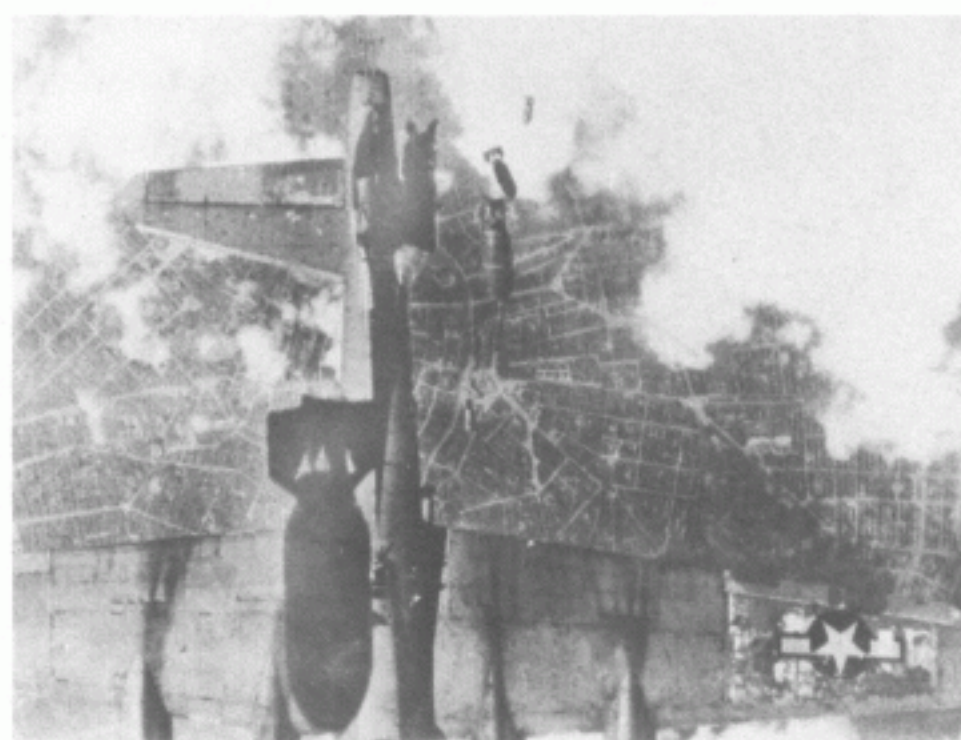
By the time the Fourth Bombardment Wing reached Regensburg, 15 B-17s had been shot down. But the 131 remaining Fortresses, many of which were damaged and riddled with holes, managed to find their targets, and nearly all of the Messerschmitt buildings were hit by high-explosive and incendiary bombs. Satisfied that they had destroyed their target, LeMay's bombers headed south toward Algeria. Three more B-17s were lost before the last of the Luftwaffe fighters gave up the chase near the Alps.

Meanwhile, the 230 B-17s of Williams's First Bombardment Wing had just crossed the border into Germany, where they encountered the full fury of a refueled and rearmed Luftwaffe. Again avoiding all-out attacks on the bombers until the P-47 escort had departed, 200 FW 190s and 100 Bf 109s shot down even more B-17s than they had that morning. Despite the loss of 21 bombers, the First Bombardment Wing pressed on and finally located the target factories. Over 420 tons of bombs were dropped on Schweinfurt, inflicting severe damage on the ball-bearing works. But the Fortresses still had to run the gauntlet of enemy fighters that awaited them on their return trip to England. Again, Luftwaffe firepower pulverized the bomber formations, bringing down one B-17 after another until the P-47s arrived near the German border to escort the shot-up survivors home across the English Channel.

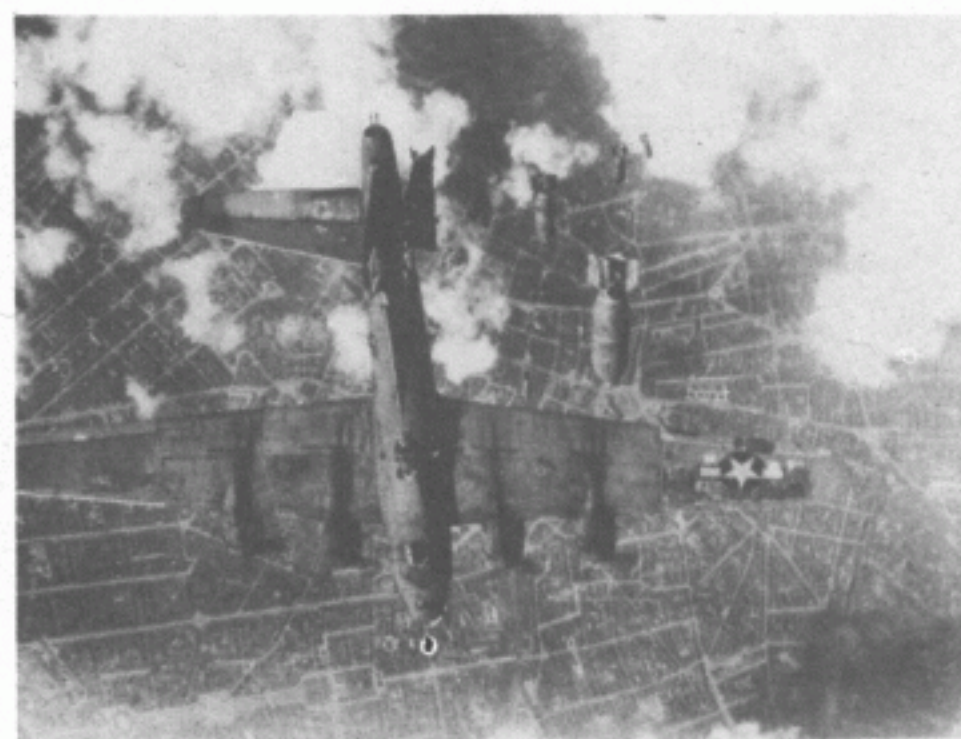
Soon after the surviving crews had landed, it was realized that the Schweinfurt-Regensburg raids had taken a fearsome toll on the Eighth Air Force, with 60 B-17s shot down and 600 crewmen lost. Of the



Taken during a raid on Berlin, this sequence of photographs shows bombs from the aircraft above hitting an out-of-position B-17, cutting off its horizontal stabilizer.



None of the crew was seen bailing out of the stricken bomber as it plummeted to earth. Courtesy of the Boeing Aircraft Company



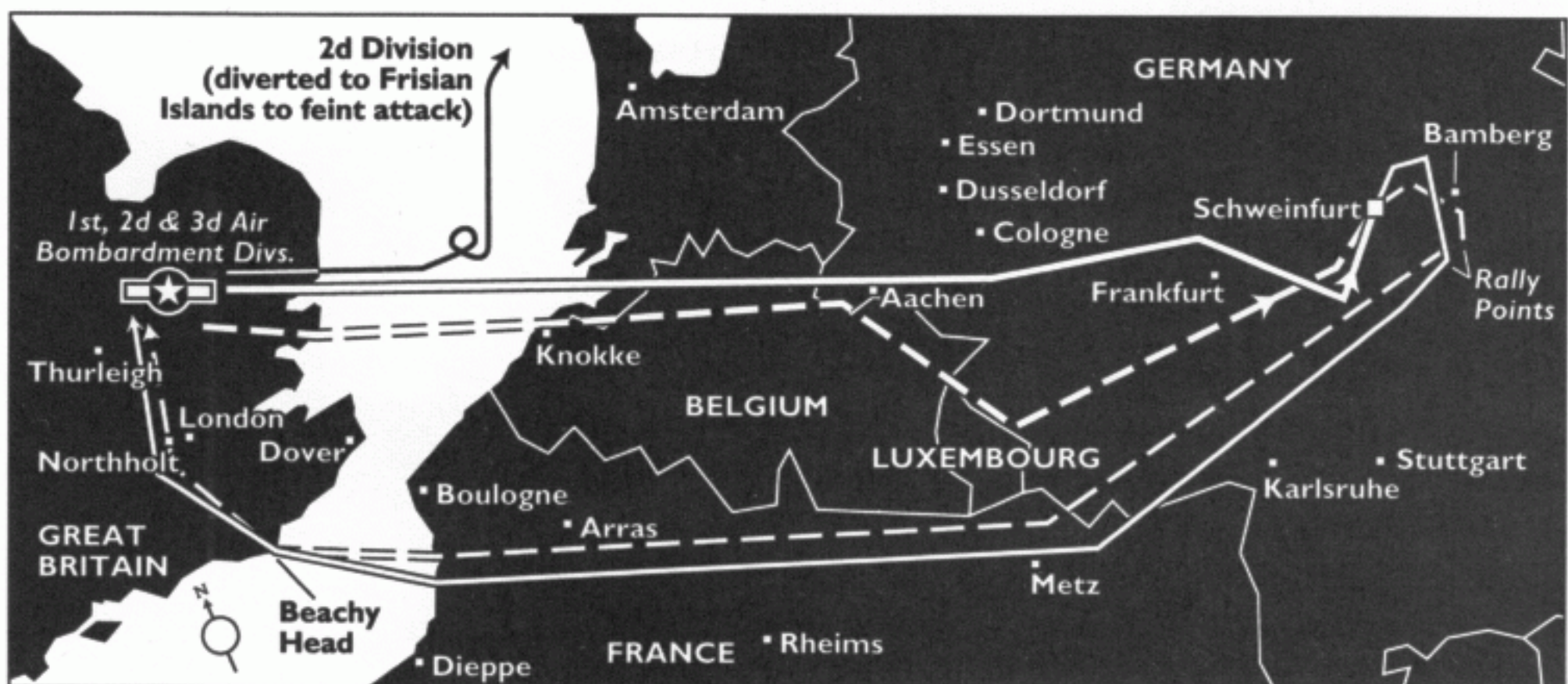
bombers that landed safely in England and North Africa, 122 were damaged and 27 of those had to be scrapped. Many Americans wondered if the damage done by these raids was worth the horrendous losses. To Adolf Galland, whose Luftwaffe fighter arm had lost 36 aircraft out of some 300, with another 12 written off, this was positive proof that the American heavy bomber offensive could be made too costly by a strong German fighter defense, though his forces could ill afford the losses they too had suffered. Moreover, these raids disputed the air power theorists' doctrine that "the bomber will always get through." Sadly, the U.S. leaders would be slow in grasping this lesson.

"BLACK THURSDAY"— RETURN TO SCHWEINFURT (October 1943)

Crews of the Eighth were disappointed to find out that instead of making a follow-up night raid on Schweinfurt, the RAF had bombed the German secret weapons facility at Peenemünde on the night of August 17. The Baltic island was now the test site for two *Vergeltungswaffen*, or "vengeance weapons," the V-1 jet-powered flying bomb and the V-2 liquid-fueled rocket. The raid had killed many top German scientists and would delay the V-1 and V-2 programs for months. The RAF bombing of Peenemünde following the U.S. attack on Schweinfurt typified the lack of cooperation between the two air forces in what was mistakenly called the "Combined Bomber Offensive."

The next few weeks saw the battered Eighth bombing targets in northern France, well within range of fighter escort. Additional bomber reinforcements were flown in from the States, including the new B-17G, which had a gun turret in its nose to ward off frontal attacks. General Arnold continued to call for attacks on Germany, and several unescorted raids were made on targets in East Prussia and

2d Schweinfurt Raid, October 14th, 1943



Poland. In a frightful three-day stretch, the Eighth lost eighty-eight bombers in raids on Frankfurt, Bremen, Gdynia, Marienburg, Anklam, and Münster.

While photo reconnaissance had confirmed the destruction of the Messerschmitt plants at Regensburg, photos of Schweinfurt showed that the damage there was being repaired with astonishing speed. Intelligence reports also confirmed that ball bearings were frantically being sought from every corner of the Third Reich — proof that the German ball bearing industry had indeed been crippled by the August 17 raid. What was needed now was a follow-up raid to finish the plants off before repairs made them fully operational. This time, the Eighth would not split its forces with a diversionary raid; instead, it would hit Schweinfurt with everything it had. Again, there was no time to wait for the arrival of the promised long-range escort fighters; the Fortresses would once again have to go it alone.

On the morning of October 14, a fleet of 291 B-17s and nearly 200 escort fighters took off from their bases in England. Before the B-17s, which had been divided into two groups flying thirty miles apart, even crossed the Dutch coast, the escort fighters were attacked by 20 Bf 109s. The P-47s drove them off, but other Luftwaffe aircraft flew at a safe distance from the huge aerial armadas, waiting for them to pass the city of Aachen, where the P-47s would have to turn around. As soon as the Thunderbolts headed back to England, the sky filled with attacking Luftwaffe aircraft. Waves of Bf 109s, FW 190s, Bf 110s, Me 210s, Ju 88s, and even Ju 87 Stuka dive bombers and He 111 medium bombers joined in the melee with the same weaponry that had been used with such devastating effects on August 17. Bf 109s and FW 190s riddled the formations with 20-mm cannon and machine-gun fire. Stukas climbed above the bomber formations and dropped time-fused bombs on the Fortresses. Twin-engined Bf 110s, Me 220s, and He 111s fired rockets which packed four times the explosive force of an anti-aircraft shell. As broken, burning, shrapnel-ridden Fortresses fell from the sky, the gaps in the formations were quickly filled by the surviving B-17s, seeking the protection of each other's guns.

The fighting was even fiercer than in the first Schweinfurt mission. The crew of one bomber counted forty separate attacks by German fighters in the space of a minute. One of the American commanders, Colonel Budd Peaslee, noted eleven columns of smoke on the ground where B-17s had crashed. By the time the two armadas neared the outskirts of Schweinfurt, twenty-eight bombers had been shot down and

“The loss of sixty American bombers in the Schweinfurt raid was incidental.”

U.S. Army Air Force Brigadier General Ira Eaker, after the second raid on Schweinfurt on October 14, 1943

“This one FW 190 ... obviously was attempting a head-on ram on my aircraft. He was not firing at all when he was well within his own range. Our rate of closure had to be about 400 to 450 miles per hour, and I eased the [B-17] down. It required split-second timing, but my timing was good. I pulled the aircraft up and he went about fifty feet under me. I will never forget the green scarf that German pilot had around his neck.”

U.S. Army Air Force Lieutenant David Shelhamer, a survivor of the second raid on Schweinfurt on October 14, 1943

“Wherever one looked in the sky there were Germans attacking and B-17s smoking, burning, spinning down.”

Unidentified survivor of the second raid on Schweinfurt on October 14, 1943

thirty-four more had headed home with damage or mechanical problems. Those bombers which had reached Schweinfurt now had to face the murderous fire of new anti-aircraft batteries that had been installed after the first raid. Luftwaffe fighters, ignoring the fierce fire of their own flak, continued to attack the formations relentlessly. Fortunately for the surviving Americans, their formations had remained tight, so that they were able to deliver 500 tons of bombs on the factories with high accuracy within the space of twelve minutes.

But the flight home was even worse than the flight in. Just as in the first raid, the tired crews of the B-17s were met by waves of refueled and rearmed Luftwaffe aircraft along the route from Schweinfurt. Another thirty-two bombers were shot down on the return trip. After over three hours of the most savage aerial fighting ever displayed, the surviving bombers, many badly damaged and full of dead, dying, and wounded, reached the English Channel.

Once again, 60 bombers and their crews had been lost over Germany, in the bloodiest mission ever flown by the United States. Of the planes that returned, 142 were damaged. Although the Americans claimed to have shot down 186 German fighters, the Luftwaffe had actually lost 31, with another 12 written off. As for the raid itself, Eaker was initially optimistic, based on photographs of Schweinfurt which showed even greater damage than after the first raid. On the German side, Albert Speer estimated that 67 percent of the factories' production capability had been destroyed: if the Allies could follow up the October 14 attacks

Flak hit this B-17 over Cologne, killing both the bombardier and the navigator. Amazingly, the pilot, Lieutenant Lawrence Delany, managed to fly the bomber safely back to England. Courtesy of the United States Air Force



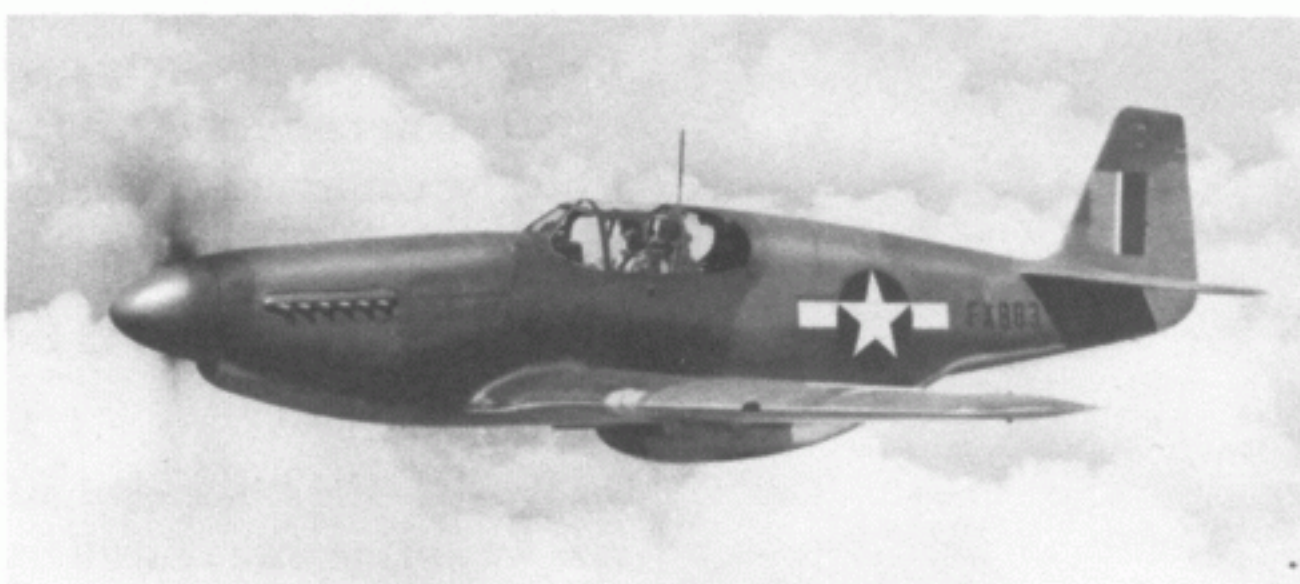
with raids on the ball-bearing industry every two weeks, Germany would be defenseless within four months. But the Eighth was so badly decimated that follow-up raids were not only impractical but impossible, and Harris and the RAF would not cooperate. After what the American crews were calling "Black Thursday," it was apparent that despite the heavy German losses, the Luftwaffe still ruled the skies over Germany.

THE MUSTANG ARRIVES (November 1943–December 1943)

The cost of the second disastrous Schweinfurt raid stunned the Americans, including Roosevelt, who declared that sixty bombers were too many to lose. Many wondered if the daylight bombing offensive should be canceled altogether. Eaker, whose initial optimism had quickly faded, stopped planning any more unescorted missions into Germany. It was finally apparent to him that unless the bombers were escorted by long-range fighters, the Eighth Air Force would soon be obliterated. He received good news two weeks after the Schweinfurt raid: Arnold had ordered stepped-up production of the P-51, with the first Mustangs going to the Eighth Air Force.

Only a few raids, mostly on occupied France and with fighter escort, were carried out over the next few weeks. In mid-November, the first P-51B Mustangs began arriving in England by ship. By the end of the month, a new fighter group, the 354th, was training in twenty-four P-51s. On December 1, the commander of the 354th, Lieutenant Colonel Don Blakeslee, decided to take the Mustangs across the Channel to show them off to the German defenders. On December 11 they made their first escort mission to Emden, Germany, and on December 16 they claimed their first Luftwaffe victim.

The Mustang's performance immediately established it as the leading active fighter in the West. More maneuverable than either the Bf 109 or the FW 190, it was also faster, with a top speed of 440 miles per hour at 30,000 feet. Most importantly, it solved the problem of long-range escort once and for all. With its fuel-efficient engine and internal fuel tank, the P-51 had the range to take the B-17s and B-24s deep into Germany and back. U.S. bomber crews were hopeful that they would never again have to endure missions as bloody as the two Schweinfurt raids. They had another reason to rejoice when a 150-gallon drop tank was



Courtesy of Aero Digest

"I would rather have one Me 262 than five [Me]109s."

Luftwaffe General Adolf Galland, in 1944

finally developed to extend the range of the P-47 to deep within German airspace. The Eighth also received a steady supply of trained crews and replacement bombers, and some five hundred B-17s and B-24s were available by the end of October.

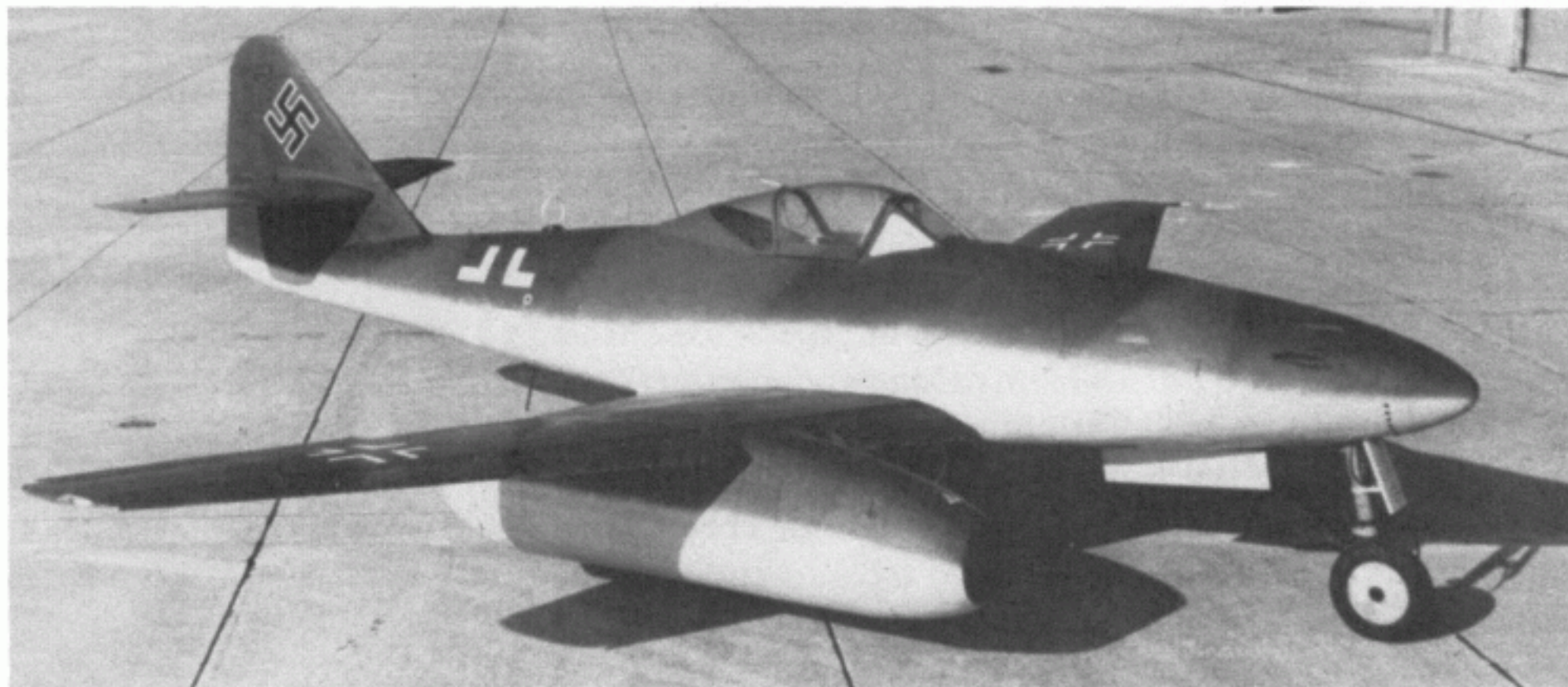
While the Eighth was regaining strength, the RAF's Bomber Command continued to attack German targets by night. On October 22, the industrial city of Kassel was hit by 1,800 tons of bombs, causing a fire storm like the one that had swept through Hamburg. Next, Harris turned his attention toward Berlin, maintaining that if the German capital were destroyed, the war would be ended. The U.S. generals did not share Harris's belief, but the stubborn Bomber Command leader sent large numbers of RAF aircraft on raid after raid on Berlin. Bad weather and heavy losses to German night fighters hampered what was being called the Battle of Berlin. Despite pressure to switch to industrial targets, Harris continued the raids through the spring of 1944, when he commanded his forces to assist in preparations for the invasion of France.

HITLER BLUNDERS AGAIN (November 1943)

By late 1943, the embattled empire of the Third Reich was withering away on all fronts in the face of the combined Allied offensives. The German campaign in North Africa had collapsed. U.S. and British troops had captured Sicily and were working their way up the "boot" of Italy. Russian troops were pushing back the German army on the eastern front. And even Hitler himself conceded that the Allied invasion of France was only a matter of time and would probably take place in the spring of 1944.

For years Hitler had embraced the concept of the "blitz bomber," a plane that would fly faster than any pursuing enemy fighters. He spoke with Göring of how the "blitz bomber" would wreak havoc strafing and bombing the in-

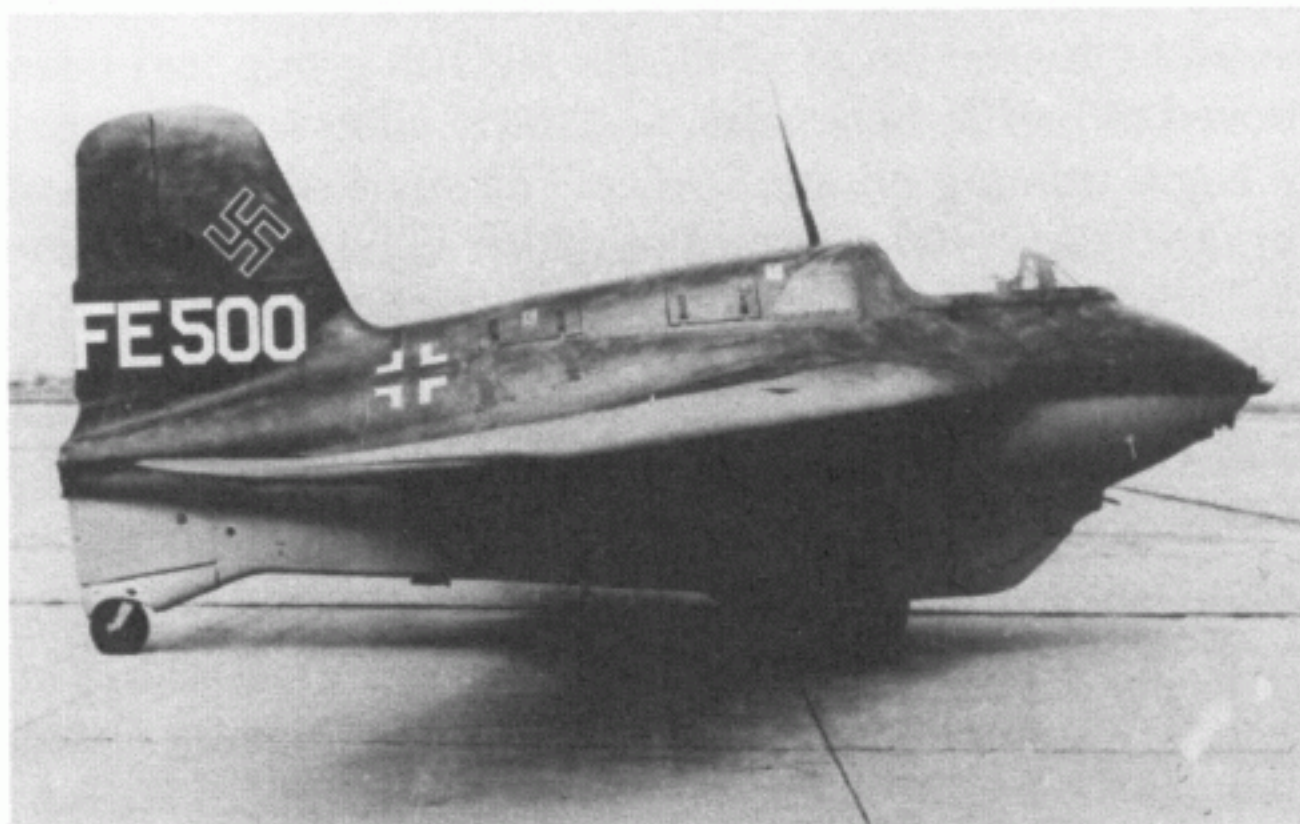
A restored Me 262.



vasion beaches. The Me 262, left to languish in the belief that there would be no need for such an advanced weapon in the face of Germany's eventual victory, now began to occupy a special place in Hitler's plans.

On November 2, 1943, Göring visited the Messerschmitt works at Augsburg. He asked Messerschmitt if the Me 262 could carry one or two bombs. Messerschmitt replied that it was possible for the new plane to carry two 1,100-pound bombs or one 2,200-pound bomb. The bomb racks had not been developed, but Messerschmitt falsely assured Göring that this would take only two weeks.

At an air show at Insterburg on November 26, Hitler saw the Me 262 in flight for the first time. As Messerschmitt, Göring, and Galland all stood together with the führer watching the jet swoop by, Hitler asked Messerschmitt if the Me 262 could carry bombs. Messerschmitt gave Hitler the



A captured Me 163 that was flown by Allied pilots for evaluation after the war.

same reply he had earlier given Göring. Hitler nodded, then announced, "For years I have demanded from the Luftwaffe a fast bomber which can reach its target in spite of enemy fighter defense. In this aircraft you present to me as a fighter plane, I see the Blitz Bomber, with which I will repel the invasion in its first and weakest phase. Regardless of the enemy air umbrella, it will strike the recently landed mass of material and troops, creating panic, death, and destruction. At last this is the Blitz Bomber!" He paused and then added, "Of course, none of you thought of that!"

A stunned Galland realized that he had just witnessed another setback for the Me 262 jet fighter. This superb interceptor had many drawbacks as a bomber. The external bombload would reduce its speed. Its high fuel consumption would result in a minimal bombing range. Dive-bombing was out, as the Me 262 was uncontrollable at speeds over 600 miles per hour. A special bombsight would need to be developed. But nobody, especially not Göring or Messerschmitt, would present these problems to Hitler.

Back at the Messerschmitt factory, work continued on

the jet prototypes. Despite Hitler's decision, only one Me 262 was fitted with bomb racks while the rest were built as fighters. By March 1944, the first evaluation prototype was ready for combat. However, its Junkers Jumo 004B turbojet engines had numerous technological problems, and production of this powerplant crept along at a slow rate. In June 1944, before all the problems had been worked out, it was finally decided to "freeze" the design of the engine for mass production. The resulting engine would frequently break down at the high temperatures it generated.

Meanwhile, work on another secret weapon, the Me 163, was continuing without interference from Hitler, although the rocket fighter was plagued by technical problems, and its volatile fuels often caused it to explode. From 1941 on, several flights had been made with various powered and unpowered prototypes, and on June 24, 1943, the Me 163 made its first takeoff and landing from the airfield at Peenemünde. By the fall of 1943, the Me 163 group had been moved to Bad Zwischenahn, and thirty pilots were selected to begin training on the Komet. This marked the birth of *Jagdgeschwader 400*, a group of rocket fighter pilots whose skill could only be equaled by their courage in flying this volatile aircraft.

GATHERING STRENGTH FOR "BIG WEEK" (December 1943–March 1944)

With the appointment of General Dwight D. Eisenhower as supreme commander of the Allied Expeditionary Force, changes were in store for the Eighth Air Force. On December 18, General Eaker was notified that he was being transferred to head the Fifteenth Air Force in the Mediterranean. His replacement was Lieutenant General James H. Doolittle, who had led the famous B-25 carrier raid on

Tokyo in 1942. General Spaatz was brought back from North Africa to supervise the air offensive over Europe. Doolittle and Spaatz had served with Eisenhower before, and he valued the close working relationship they had established.

Extremely disappointed at the prospect of leaving the Eighth just as it was about to gain the upper hand against the Luftwaffe, Eaker departed London on January 1, 1944. On his way to his new headquarters in Italy, he was told that a certain "Colonel Holt" wanted to see him in Casablanca.

This turned out to be Winston Churchill, who received Eaker in the same villa where the two had discussed bombing operations a year ago. Eaker was consoled by Churchill, who told him, "Your representations regarding daylight

The volatile T-Stoff and C-Stoff fuels that powered the Me 163 were extremely dangerous even when they were not ignited. On one occasion, a pilot crash-landed his Komet while attempting to take off. Ground crews smothered the rocket plane with foam, then inspected the accident scene. They found that the fuel lines had ruptured and the two fuels had doused the pilot, literally dissolving him in his seat.

and night bombing... have been and are being verified. Round-the-clock bombing is achieving the results you predicted."

In a New Year's message, General Arnold told his commanders in Europe to "destroy the Enemy Air Force wherever you find them, in the air, on the ground and in the factories." When Doolittle took over the Eighth on January 6, he was presented with an intelligence report that stressed the importance of wiping out the Luftwaffe's fighters before the invasion of France, Operation Overlord, could take place. With more and more P-51s arriving from the States, Doolittle decided that he could take more risks with his own fighters: instead of sticking in formation to escort the heavy bombers, U.S. fighters would go on the offensive and hunt down German fighters, either in the air or on the ground. The unleashing of the fighters was welcomed enthusiastically



B-17s stockpiled in England.

cally by the fighter pilots, but the beleaguered bomber crews were highly critical of Doolittle's decision. Doolittle insisted that by going after the Luftwaffe fighters before they could get to the bombers, the Eighth would gain the upper hand in the air war in Europe. Perhaps he was demonstrating a lesson learned from the Battle of Britain, in which German fighter pilots had racked up huge "kill" totals in the "free-chasing" role before being ordered to fly close to the bombers, where the fighters' effectiveness was greatly reduced.

In addition to changing fighter tactics, the Allied commanders drew up plans for Operation Argument, which called for strategic bombing of any enemy factories that produced fighter aircraft and components, to begin when there were a few days of good weather, a rarity in Europe during January and February. Argument was to be a coordinated attack between the Eighth, the Fifteenth, based in Italy, and the RAF.

The first Eighth Air Force raid of 1944 saw 633 B-17s

and B-24s take off to attack three targets in Germany, including a Focke-Wulf factory at Oschersleben. The raid marked the successful debut of the P-51 as an escort fighter for the Eighth: fifteen German fighters were shot down by the Mustangs. Although most of the bombers had to turn back because of bad weather, the remaining aircraft badly damaged the Focke-Wulf factory and other targets in the raid, which cost the Eighth thirty-four bombers.

Another raid on Frankfurt was made on January 27, but, again hampered by bad weather, fewer than sixty bombers reached the target. Mission after mission was canceled because of the weather, and Spaatz, impatient for Operation Argument to begin, ordered that it be completed by March 1. On February 20, meteorologists forecast fair skies for a few days over Europe. Even though it was overcast and snowing in England, Spaatz gave the orders to "let 'em go." "Big Week" had begun.

Following an RAF night bombing mission against Leipzig, over 1,000 bombers, the largest number ever assembled by the Americans, headed for targets in central Germany and Poland, escorted by 700 fighters. The Luftwaffe, ordered by Göring to avoid the fighters and attack

the bombers, had trouble penetrating the thick fighter formations, and managed to shoot down only 21 bombers. That night, the ball-bearing works at Stuttgart were blasted by the RAF. The next day, bad weather moved in, and although 764 B-17s and B-24s were in the air, the results were minimal. February 23 saw the Fifteenth Air Force wipe out the Messerschmitt factory at Regensburg while losing 33 bombers. Schweinfurt, the most dreaded target in Germany, was hit by the Eighth on February 24, and the RAF dropped even more bombs onto the burning city later that evening. The Gotha factory, where Bf 110s were built, was heavily damaged by 238 Liberators.

Bad weather terminated Big Week on February 25, but not before the Eighth and the Fifteenth had hit the Bf 109 production centers at Augsburg and Regensburg, losing 64 bombers. As the RAF dropped the final Big Week bombs on the flames at Augsburg, it appeared to the Allies that the German aircraft industry had been wiped out, at a cost of 229 bombers and 29 fighters. Dropping over 19,000 tons of bombs, the Allies had destroyed 700 Bf 109s that were either combat-ready or in the

In September of 1943, several American fighter planes were shot down just inside the German border at Aachen, the first sign that the U.S. escorting aircraft were extending their range deeper into the Reich. When Adolf Galland reported the news to Adolf Hitler, Hermann Göring confronted Galland, calling the reports "pure bluff." Galland replied, "Those are the facts, Herr Reichsmarschall! American fighters have been shot down over Aachen. There is no doubt about it." Cried Göring, "That is simply not true.... What must have happened is that they were shot down much further to the west. I mean, if they were very high when they were shot down they could have glided quite a distance farther before they crashed." Keeping a straight face, Galland replied, "Glided to the east, sir? If my plane were shot up...." Before he could continue, Göring barked, "I herewith give you an official order that they weren't there! Do you understand? The American fighters were not there! Get that! I intend to report that to the Führer. You have my official order!" Smirked Galland, "Orders are orders, Sir!"

final production stages, along with hundreds more fighter aircraft. Additionally, the Allies claimed over 600 Luftwaffe fighters shot down during Big Week.

At a time when Germany was trying to build its fighter forces in preparation for the Allied invasion, Big Week was a resounding success for the Allies, as it took hundreds of fighters out of the hands of the Luftwaffe. But although seventy-five percent of the fighter production facilities had been hit, German aircraft production capability had not been destroyed altogether. In the wake of Big Week, the ministry of armaments, headed by Albert Speer, took charge of fighter production from the Luftwaffe and gave top priority to increasing fighter output. Large numbers of machine tools were salvaged from the wrecked plants, and many serviceable aircraft and components were removed from the rubble. Production facilities were dispersed into wooded areas and even caves, and under Speer's emergency program the output of fighters was stepped up to the unprecedented level of nearly two thousand a month by April. For Adolf Galland, a sign of hope amidst the rubble was found at Augsburg, where all of the Me 262 prototypes had emerged from the bombings undamaged.

"Hitler built a fortress around Europe, but he forgot to put a roof on it."

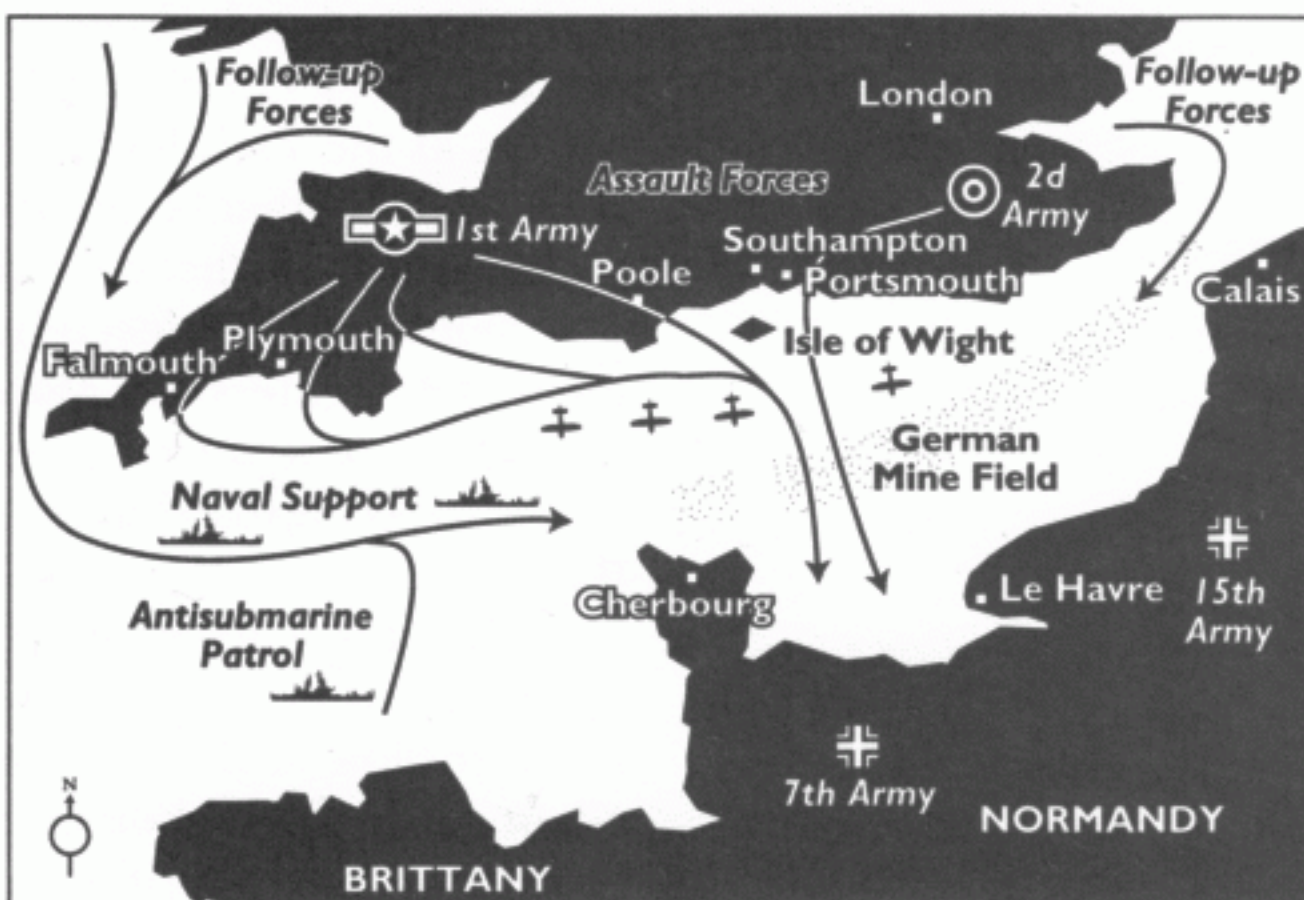
President Franklin D. Roosevelt, in 1943

PREPARATION FOR INVASION (March 1944–May 1944)

With only a few months left until D-Day, the planned invasion of France, the Allied leaders were divided on which course the bombing offensive should take. Eisenhower wanted to "soften up" the landing areas and hamper German troop and supply movements in the vicinity of Normandy. Spaatz and Harris felt that Operation Overlord could best be served by continuing the day-and-night bombing of Germany's key industries. Spaatz also argued that bombing the Reich's synthetic oil production facilities would keep fuel away from German army units and Luftwaffe aircraft in the invasion area, as well as tie up valuable Luftwaffe fighters who would have to protect the refineries.

Winston Churchill backed up Spaatz and Harris. But Eisenhower and some British leaders backed a strategy known as the Transportation Plan. It called for U.S. and British bombers to attack roads, bridges, and rail lines in France and the Low Coun-

D-Day Invasion Strategy





A U.S. bombing raid on an oil refinery in Bremen on March 30, 1945. Ten Me 262s attacked the B-17s of the 306th Bomb Group after they had dropped their bombs; six of the German jets were shot down by escorting P-51 Mustangs and B-17 gunners.

they now proved him wrong again by successfully knocking out several rail centers in France. Eisenhower, who felt that the Transportation Plan would support the invasion plans more directly than would Spaatz's tactic of attacking oil centers, faced stubborn opposition from Churchill and others who felt that many French civilians would be killed in the attacks. But when Roosevelt refused to intervene in the matter, Churchill dropped his opposition. Spaatz won a concession from Eisenhower: the Eighth's bombers would be allowed to attack oil centers and other industrial targets in Germany when they were not needed to carry out the Transportation Plan.

Meanwhile, the RAF attacks on Berlin raged on. The German capital was heavily damaged, but the morale of its inhabitants had not been crushed by Harris's bombers, and many Lancasters had been shot from the skies by Luftwaffe night fighters. On March 4, the United States joined in the attacks as the Eighth's bombers, escorted by P-51s and P-47s, dropped their bombloads on Berlin. Two days later, the Eighth made another daylight attack on Berlin, losing sixty-nine bombers and eleven fighters, while the Luftwaffe lost eighty-two fighters. On March 24, the RAF lost seventy-two bombers in a night raid over the target that, like London years before, refused to be pounded into submission from the air.

While it was becoming obvious that the Battle of Berlin was resulting in a defeat for Harris and Bomber Command, another blow to the RAF came on the night of March 30, when nearly 1,000 bombers were sent to hit Nuremberg. Owing to faulty British meteorological forecasts, the

tries, concentrating on some eighty railroad marshaling yards and adjacent repair facilities and depots. Knocking these vital rail centers out and bombing them repeatedly to keep them from being repaired would prevent the Germans from reinforcing the invasion beaches on D-Day.

The RAF decided to test out the precision attacks called for under the Transportation Plan. Though Harris had stated that his bomber crews were unskilled in anything but area bombing, they had proved him wrong before, in the "dam busters" raid, and

bombers ended up flying over the target area illuminated by a full moon in a cloudless sky. In what would go down as the greatest fighter victory of the war, some 108 RAF bombers were shot down by Luftwaffe night fighters. After this disastrous mission, the RAF began cutting back on its deep raids into Germany.

Although the Luftwaffe night fighters were shooting down staggering numbers of British bombers, U.S. long-range escort fighters were making their daytime presence felt in the spring of 1944. Hundreds of Luftwaffe fighters and their irreplaceable pilots were now falling to the guns of Mustangs and Thunderbolts, and more U.S. bombers were surviving to drop their destructive payloads. Many P-51 and P-47 pilots developed a rivalry as they aggressively sought out Luftwaffe pilots to duel. In particular, the Mustangs of the 4th Fighter Group (the "Eagles"), led by Blakeslee, and the Thunderbolts of the 56th Fighter Group (the "Wolf Pack"), led by Colonel Hubert Zemke, were as fiercely competitive with each other regarding their "kill" totals as they were against the Luftwaffe. With each U.S. mission, fewer German fighters were rising in opposition. In April, the Eighth's fighters began massive strafing sweeps over Luftwaffe airfields, destroying hundreds of German fighters on the ground. But at this stage of the war, the loss of aircraft was the least of the Luftwaffe's concerns.

THE LUFTWAFFE'S STRUGGLE FOR SURVIVAL (May 1944)

The results of Albert Speer's herculean efforts to step up fighter production were nothing short of miraculous: German industry was turning out more of these aircraft than ever. What was hampering the Luftwaffe was a shortage of trained pilots. In the first four months of 1944, over one thousand Luftwaffe fighters had been shot down: many of these fallen pilots were officers who were irreplaceable at this stage of the war, veterans who could have taught young pilots invaluable lessons in air combat. Instead, hurrying to make up the losses, the Luftwaffe now threw raw, inexperienced pilots into the skies with little training, usually to meet with disaster. Moreover, General Eaker's Fifteenth Air Force had badly damaged the oil refineries at Ploesti, and as a result, oil supplies to Germany were dwindling. Speer and Galland both realized that if the German synthetic oil plants were destroyed, Germany would be out of fuel, and out of the war. The fuel shortage further devastated the pilot training program, since the Luftwaffe could not spare the fuel for training flights.

Despite the crisis, Hitler and Göring still clung to their deluded visions of a massive bomber counteroffensive and ordered bomber production to continue, though Speer qui-

"The greatest single factor differentiating the Eighth Air Force operations from those of other theaters is the extremely high proportion of battle damage resulting from combat with the best German fighters."

**U.S. Assistant Secretary of War
for Air Robert Lovett, in 1943**

“If you see fighting aircraft over you, they will be ours.”

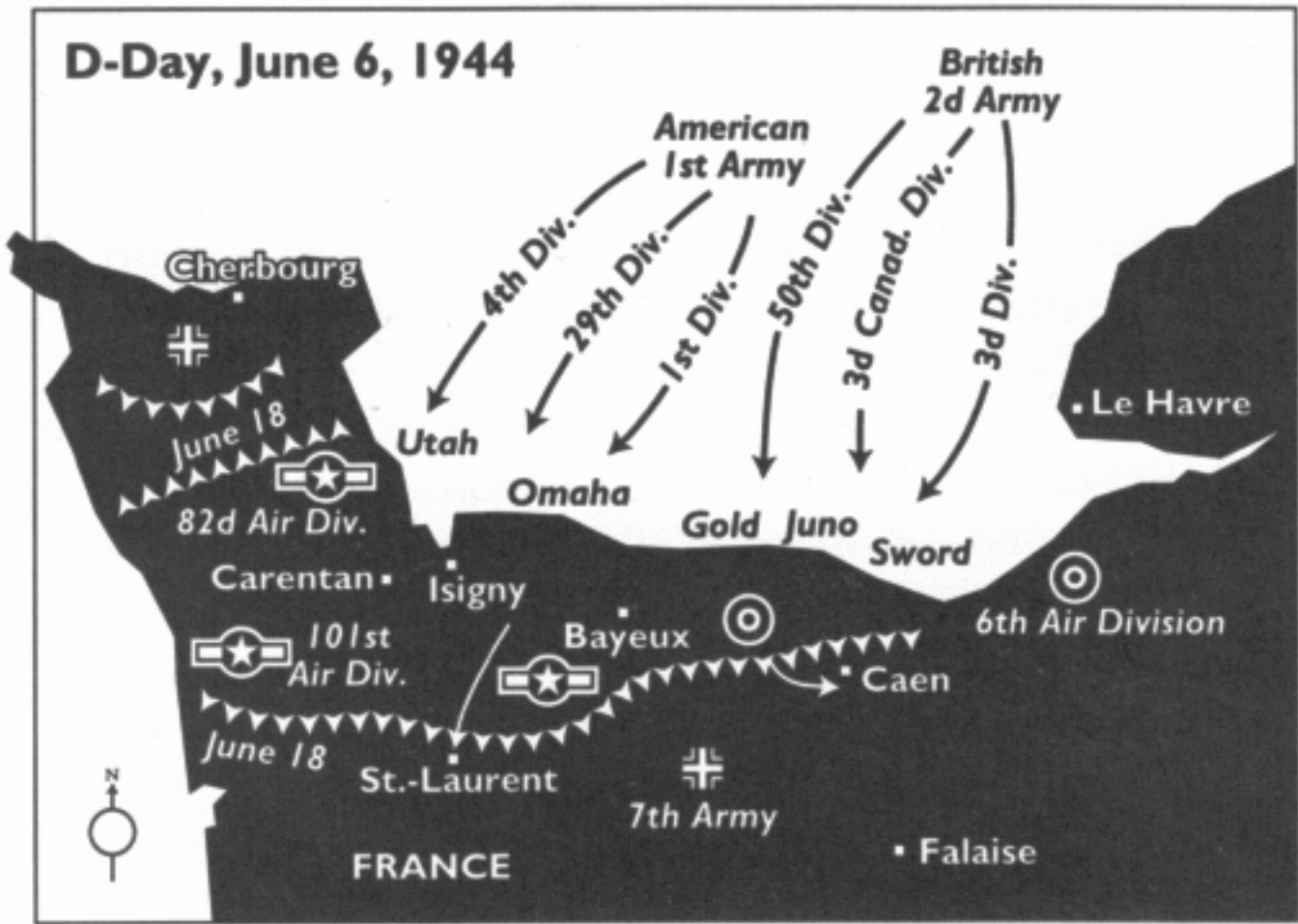
General Dwight D. Eisenhower,
to his troops on D-Day, June 6,
1944

etly countermanded this order. When Hitler met with Speer, Erhard Milch, and others on May 23, he was startled to hear production estimates calling for 1,000 Me 262 fighters per month. “I thought the Me 262 was coming out as a speed bomber,” snapped the agitated führer. “How many of the Me 262s already produced can carry bombs?” “None, my Führer,” explained Milch. “The Me 262 is being manufactured exclusively as a fighter aircraft.” Hitler exploded, screaming that Milch had deceived him. Milch blurted that “even the smallest child could see that it was a fighter aircraft.” With these ill-chosen words, his career as the Luftwaffe’s number two man was effectively terminated.

A furious Hitler ordered the immediate conversion of all Me 262 fighters to bombers, and transferred all the Me 262s being used for testing and training from Galland’s fighter arm to the bomber arm. No more prototypes were to be supplied to Galland, and the general was forced to secretly appropriate what few Me 262s he could. What made Hitler’s decision so disheartening for Galland was the fact that the Me 262 had flown in combat a few times during testing, with superb results against Allied aircraft. Moreover, the Me 262’s engines used diesel fuel, which was in less demand than the high-octane fuel used by prop aircraft. All in all, the potential of the Me 262, Galland’s hope for ending the Allied air raids, was being squandered for the sake of dropping one or two bombs.

D - DAY
(May 1944–June 1944)

As the invasion date neared, the Transportation Plan was achieving devastating results. The B-25 Mitchell and B-25 Marauder medium bombers, and other fighter-bombers of the Ninth Air Force, newly relocated to England, dropped 33,000 tons of bombs on vital rail centers in France. Fifty-one of these centers were destroyed, along with 1,500 loco-



motives. All twenty-four bridges on the Seine between Paris and the ocean were severed, and by June the rail system was a shambles. Nearly one hundred airfields in the invasion area were hard-hit, and hundreds of fighters on the ground were destroyed in bombing and strafing attacks. Altogether, some 200,000 sorties were flown against selected invasion targets; other coastal areas were also targeted, to confuse the Germans about the location of the invasion. (Information about many of these targets had been gained by Allied intelligence, using a replica of the German Enigma coding device to break German communications codes, in a program classified "Ultra Secret.")

U.S. fighter pilots who took part in ground-target strafing missions were encountering a set of hazards much different from those of air-to-air combat. Flying a fighter near the ground at speeds of 400 miles per hour was tricky, and German anti-aircraft gunners quickly adjusted to the low-level attacks. Ground fire was a special problem for the P-51, whose liquid-cooled engine would seize up if even a single bullet ripped its coolant tanks or tubes. The larger, air-cooled engine of the P-47 could sustain battle damage better than the Mustang's engine, and soon most of the Ninth's P-51s were transferred to the Eighth Air Force for bomber escort duty, while additional Eighth P-47s were switched over to the Ninth for ground attack.

General Spaatz's request that the Eighth be allowed to hit oil targets was finally granted by Eisenhower. On May 12, a fleet of 1,500 aircraft from the Eighth and the Fifteenth bombed twelve German synthetic plants and refineries, losing forty-six bombers. Attacks on synthetic plants were repeated on May 28, and oil production plummeted. Göring told his commanders to send fighters against Allied bombers only if they were heading for oil targets. This kept German fighters bottled up in Germany, away from the invasion area.

On June 5, the night before D-Day, more than 5,000 tons of bombs were dropped on the fortifications of the Atlantic Wall. The next day, as 150,000 invasion troops stormed the beaches of Normandy, more than 8,000 fighters and bombers flew more than 14,600 sorties in their support, strafing and bombing gun batteries and continuing the Transportation Plan attacks. So many rails and roads had been knocked

One of the keys to the eventual Allied victory in World War II was provided by a team of Polish cryptographers who escaped from Poland after the German invasion with several working replicas of the German *Enigma* coding machine. With these machines, Allied intelligence was able to break the top-secret German communications codes, and gather a wealth of "ultra secret" information about German air, land, and sea movements, including the status of every Luftwaffe unit in the Battle of Britain, as well as many of their plans for attacking British targets. Also divulged were the identities of many German intelligence agents in Britain, plans for the invasion of Russia, the location of supply convoys in the Mediterranean, and many more German secrets. In the air war over Europe, *Ultra* decoders alerted U.S. generals to how much the 1944 offensive against German oil production was hurting the Third Reich—and how fast repair efforts were going. They also revealed the existence of German jet and rocket aircraft, and the location of their bases. Many precautions were taken so as not to tip off the Germans that their communications were being monitored, and as a result most *Ultra* disclosures remained top secret until some three decades after the war had ended; several others remain secret to this very day.

A few of the P-47 pilots of the 56th Fighter Group, the "Wolfpack." On the left is Colonel Francis Gabreski, the leading U.S. ace in the European theater with 31 "kills."



out that many German reserves had to travel by foot toward the invasion sites.

On D-Day the Luftwaffe was in a state of utter chaos. Many German airfields in the invasion area had been so devastated by Allied bombing that they were unusable, and when 600 fighters were ordered from Germany to Normandy, they found the surviving airfields under constant attack. Some Luftwaffe fighters were forced to dogfight Allied fighters before they could land. Fewer than 300 sorties were flown by the Luftwaffe over France on D-Day, as the Allies thoroughly controlled the skies. This successful Allied strategy of attacking air bases was identical to the pre-invasion strategy the Luftwaffe had used against the RAF airfields in the Battle of Britain, before the fateful decision had been made to bomb London instead.

In the weeks immediately following the Normandy invasion, additional U.S. air support helped the Allied troops break out from their landing areas and push inland. U.S. fighters kept the Luftwaffe from mounting any effective opposition, and over one thousand German fighters were destroyed. P-47 and P-38 fighter-bombers demolished German tanks, bombed supply dumps, and attacked roads and rails to hamper German troop movements. Heavy bombers concentrated their payloads on German strongholds, blasting them to rubble to clear the way for Allied troops. (This last tactic required utmost precision: over one hundred U.S. soldiers were accidentally killed by U.S. bombs.) Air support would continue to be invaluable to the Allied armies as they drove through France toward Germany itself.

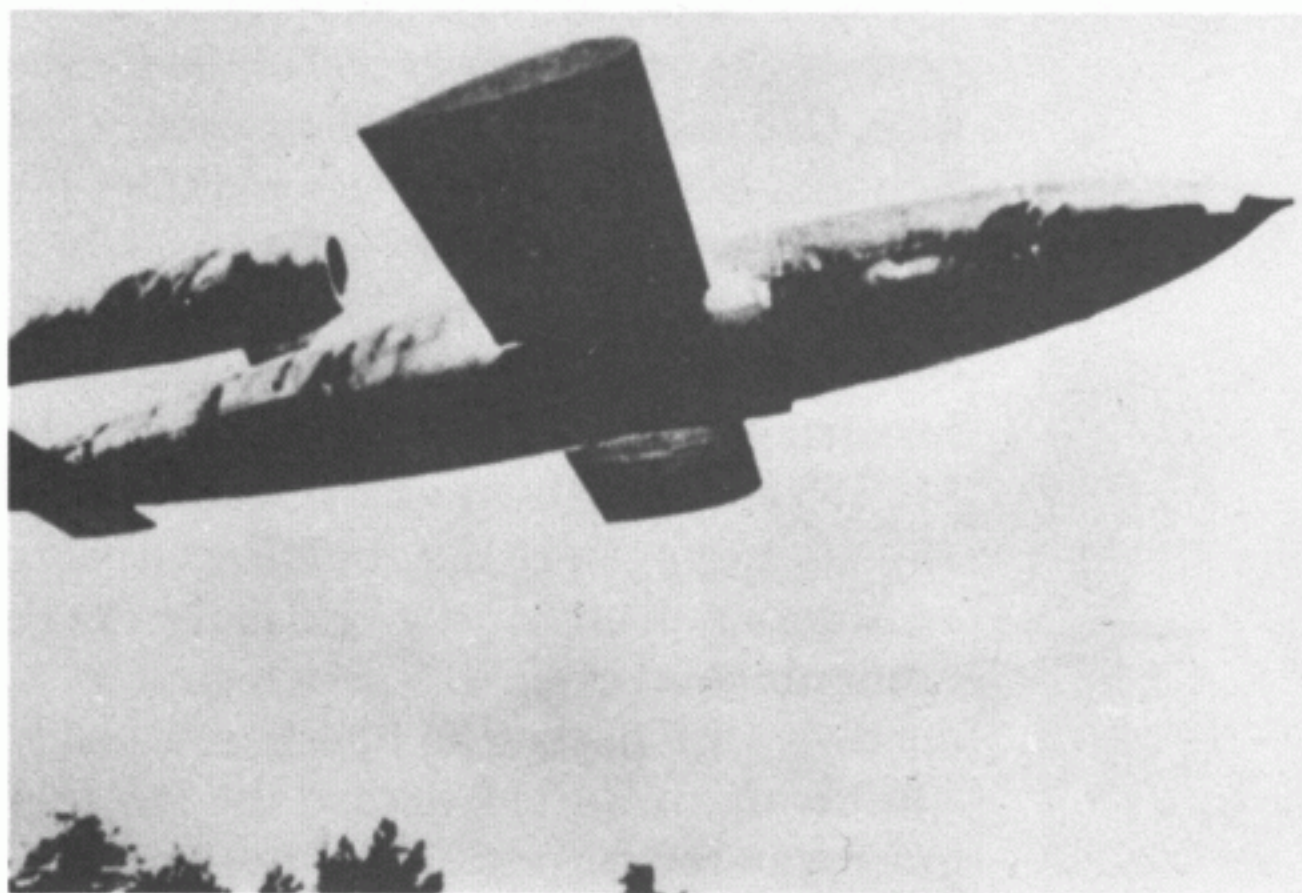
General Spaatz took advantage of his agreement with Eisenhower, and heavy bomber raids on June 15 and June 20 destroyed even more synthetic oil plants. Coded German communications that were broken by "Ultra" revealed to the Allies that these and other attacks were gravely disrupting oil production. But because Eisenhower had tem-

porary control of the bombers and wanted them to continue supporting U.S. troop movements, Spaatz could not unleash an all-out offensive against oil targets. Not until September did Eisenhower relinquish full control of the bombers back to Spaatz. And despite the RAF's demonstrated success in strategic bombing, Harris went back to area bombing after D-Day.

ON THE BRINK OF DEFEAT **(June 1944–January 1945)**

Germany was in tumult following the Allied invasion. A reserve of fighters that Adolf Galland had painstakingly assembled was thrown into the fighting in France and was completely destroyed. The June raids on the synthetic oil facilities reduced oil production to a trickle. Hitler, recognizing that without oil, German armament production would be halted, ordered that only fighters be produced, with the exception of the Me 262, which was still his "blitz bomber." The Ploesti refineries were hit repeatedly by the Fifteenth Air Force and finally put out of action when the advancing Red Army captured them. Many night fighter bases and radar sites were overrun by Allied troops. Bombing attacks similar to those of the Transportation Plan destroyed German transportation systems, disrupted troop movements, and slowed the German economy. The July 20 attempt on Hitler's life only added to the confusion.

The first of the much-heralded "vengeance weapons," the V-1, was finally launched against London a week after D-Day, in response to the demands of the German popula-



Seconds after takeoff, a V-1 "vengeance weapon" heads toward England. Courtesy of the Imperial War Museum, London

tion, who wanted revenge for RAF bombings. Over the next few months, thousands of these flying bombs, each carrying 2,000 pounds of high explosives and traveling at speeds of around 400 miles per hour, landed on target in greater London, while thousands more either crashed into the sea or were shot down by Allied fighters. Although 5,000 Lon-

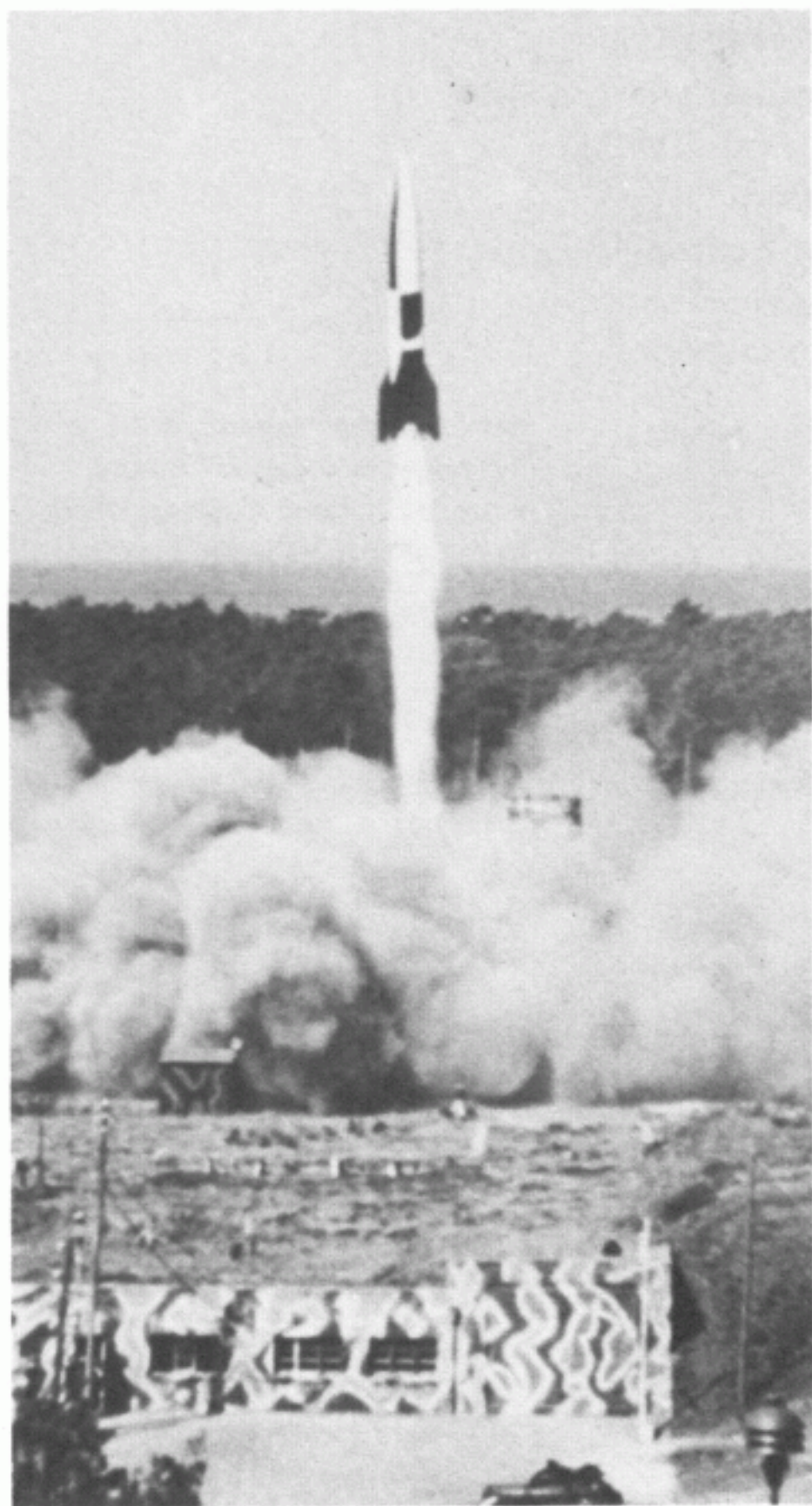
doners were killed by V-1 attacks, these bombs did not devastate the city to the extent that the Blitz had, and many of the V-1 bases in France and Holland were soon overrun by Allied troops. The V-2 liquid-fuel guided missile, with its one-ton warhead, was even deadlier than the V-1, and since it flew at supersonic speeds, it was impossible to defend against. Moreover, it required no specialized launching sites, and could be fired from any cleared space. From September 1944 on, more than 3,000 V-2 guided missiles were fired on London, as well as on those European cities that had been recaptured by the Allies. But at this stage of the war, it was obvious that even these Vergeltungswaffen had arrived too late to turn the tide in favor of Nazi Germany. In fact, the V-1 and the V-2 actually helped the Allies by consuming valuable raw materials that could have gone into increased fighter production.

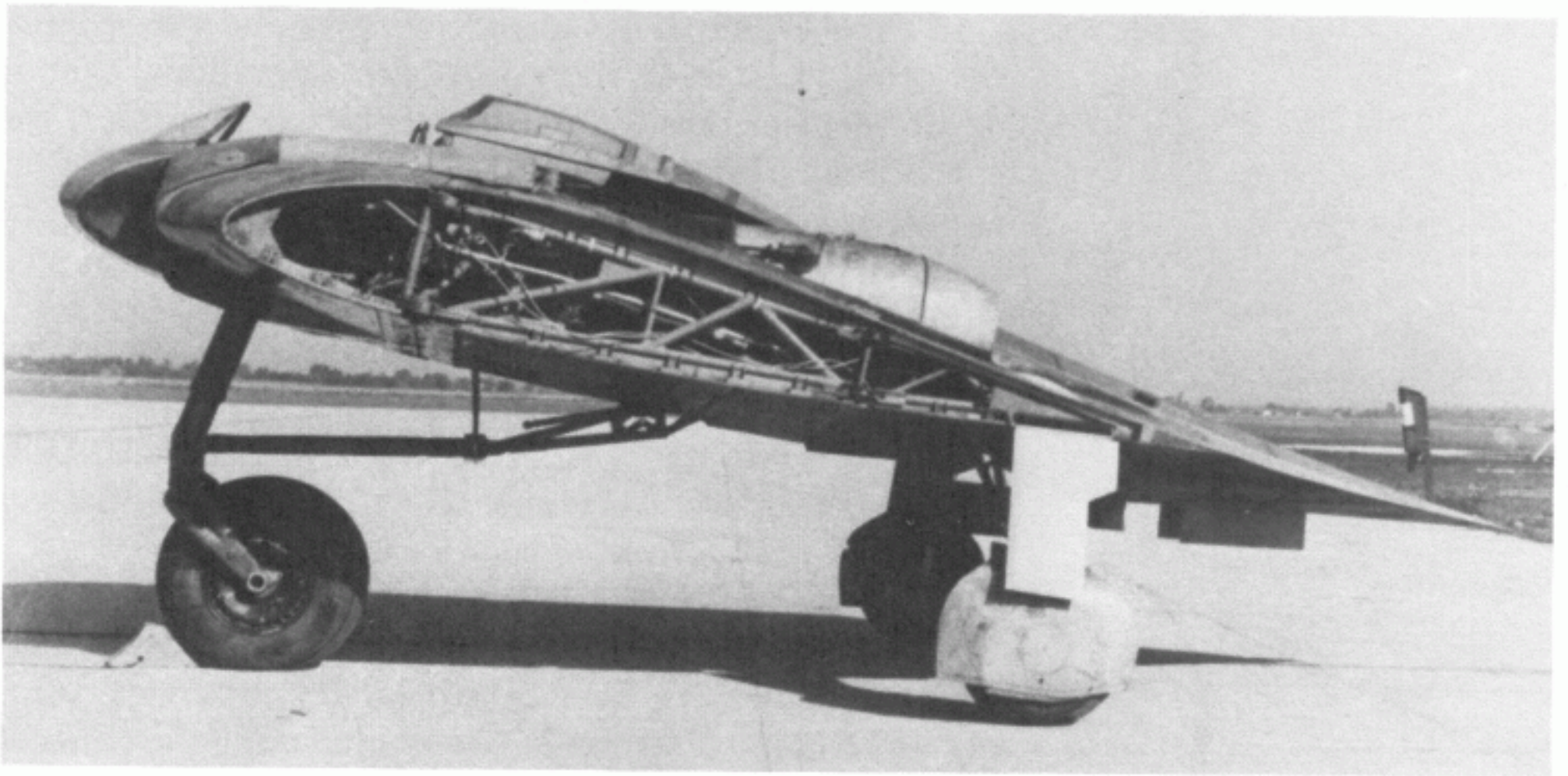
To Adolf Galland, Germany's only hope lay in a massive fighter strike against the American bombers. Amazingly, despite the intense Allied bombing, fighter production was steadily increasing and by November would reach 4,000 per month, the highest level of the war. If enough of these

fighters could be launched against the American heavy bombers, which were now numbering 1,000 per raid, they could perhaps shoot down 400 to 500 bombers and 4,000 to 5,000 crewmen. A "Big Blow" like this would damage the Eighth Air Force materially and psychologically, and perhaps lead to the curtailment of the paralyzing daylight raids, though the respite would probably be only temporary. For the second time, Galland began assembling a reserve of fighters; his "Big Blow" was planned for sometime in November.

Meanwhile, one of the "secret weapons" Galland was hoping to use was seeing its first action against the enemy. This was the Me 163 rocket fighter, which made its first appearance against U.S. bombers during an August raid on Leipzig. Still in the developmental stages, it was proving to be as deadly to the pilots who flew it as it was to American aircraft. Because the landing gear was jettisoned upon takeoff, the Komet touched down on a landing skid at 120 miles per hour. Any fuel vapors remaining in its tank would often be ignited by a rough landing. Moreover, its fuel supply was exhausted in four to seven minutes, leaving it precious little time to engage Allied aircraft. When its fuel ran out, it was

A V-2 rocket blasts off from its launching pad in Peenemünde in 1943.





forced to glide to earth, which was usually when U.S. fighters would attack it.

Even with its drawbacks, the Komet showed glimpses of deadly potential. It could climb straight up at 33,000 feet per minute and could fly much faster than Allied aircraft, with a top speed of 590 miles per hour. One Komet actually shot down three B-17s during its time aloft.

Another aircraft which Galland was hoping to add to the Luftwaffe's inventory was the Dornier 335. Nicknamed the *Pfeil*, or "arrow," the Do 335 featured an unusual tandem engine arrangement, with one mounted in the nose and one in the tail. This "push-pull" effect made the Pfeil one of the fastest prop-driven aircraft ever built, with a top speed of 475 miles per hour. But mutual interference problems stemming from the two propellers, plus the continued push for Dornier to produce bombers, delayed production of this promising fighter.

One "secret weapon" which Galland vehemently opposed was the He 162 *Volksjager*, or "people's fighter." Also known as the Salamander, it had a single jet engine mounted on a slender fuselage with plywood wings. Because the He 162 was hastily designed, and produced in an amazing sixty-nine days, Göring and others believed that thousands of these fighters could be churned out in a short time, and turn back the Allied aircraft. To overcome the pilot shortage, it was hoped that boys from the Hitler Youth could be quickly trained in gliders and then thrown into battle in the Salamander. This desperation measure was never implemented, since the He 162 had numerous structural defects and was difficult for even an experienced pilot to fly. Galland opposed the He 162 because he felt that it would keep resources away from the production of the Me 262, which had proven itself to be combat-worthy. Circumstances were now favoring this much-delayed jet.

One German secret weapon that was in the developmental stage for over a decade was the Gotha Go 229. Although prop-powered versions of this "flying wing" appeared in the late 1930s, high German officials did not trust their radical design. However, because of the outstanding flying characteristics of a jet-powered "flying wing" prototype, the Horten Ho IX V2, several versions were put into production in 1944 by order of Reichsmarschall Hermann Göring. A single-seat fighter-bomber (shown here), two all-weather fighters, and a two-seat trainer were all on the assembly line, and plans for a long-range bomber and an inexpensive "people's fighter" were being drawn up when U.S. troops overran the Gotha factory in April 1945.

In October, much to Galland's surprise, he was ordered by Göring to establish the world's first operational unit of Me 262 jet fighters. Evidently, Heinrich Himmler, the feared head of the S.S., had taken an interest in the jet fighter, and in Göring's declining position within the Third Reich. With visions of an eventual S.S. jet group, Himmler had pressured the reichsmarschall to establish a test unit. Galland appointed 24-year-old Major Walter Nowotny, who had scored 250 aerial victories, as the leader of this new group, and two bases were set up near the main U.S. bomber routes into Germany. "Blitz Bomber" versions of the Me 262 were converted back for use as fighters.

The thirty Me 262s of *Kommando Nowotny* were soon tangling with Eighth Air Force bombers and fighters with deadly effectiveness. Twenty-two American aircraft were shot down in the first month of operations, and the crews of the surviving bombers and fighters were awestruck by the German jet's capabilities. It could attack with four 30-mm cannons, and then fly away so fast that few machine guns could be trained on it. The appearance of the jet forced the free-ranging U.S. fighters to provide closer escort to the heavy bombers. By early 1945, General Spaatz worried that the Me 262 could actually give Germany the upper hand in the air again.

Fortunately for Spaatz and the Allies, the Me 262 had been delayed too many times to change the outcome of the war. Now, just as the world's first operational jet fighter unit was proving itself in combat, the overwhelming success of the Allied forces was proving to be too much for even this remarkable aircraft to overcome. By September, the Allied advances had forced the German army out of France, where Allied fighter bases were now being set up. The two Me 262 bases were under constant harassment from Allied fighters hoping to catch the jet when it was most vulnerable, during takeoff and landing. On November 8, this tactic claimed Major Nowotny, whose crash while attempting to land was witnessed by a shaken Galland. After Nowotny's death, Galland relocated the jet unit deeper into Germany, and used the surviving core of *Kommando Nowotny* to form *Jagdgeschwader 7*.

Galland continued to prepare for the "Big Blow" attack. Although 300 fighters had recently been lost in a four-day stretch while defending oil facilities, thousands more were amassed for the one-day assault on the American heavy bomber fleet. On November 12, Galland notified Göring that he was ready to proceed. All that was required was a day of good weather, and a large U.S. bomber formation headed for Germany. But day after day, the skies above Germany remained overcast as Galland and his Luftwaffe fighter pilots waited. Then, in late November, came orders from Hitler: 1,200 of Galland's fighters were to be trans-



Luftwaffe Major Walter Nowotny, the first German pilot to reach the 250-victory mark, was considered to be the best young fighter ace of the Luftwaffe at only 24 years of age. Holder of the Knight's Cross with Oak Leaves, Swords, and Diamonds, he was given command of the first operational jet fighter unit, *Kommando Nowotny*, in the fall of 1944, and worked with Adolf Galland to develop jet fighter tactics. After downing a U.S. bomber on November 8, 1944, he was killed when his Me 262 was jumped by U.S. fighters.

ferred to the western front for the German army's surprise winter counteroffensive in the Ardennes. The fighters were to attack Allied bases in France, Belgium, and Holland, as well as to provide air cover for the advancing German tanks. The "Big Blow" was canceled.

On December 16, the German army launched its counteroffensive, which would later be called the "Battle of the Bulge." A week later, German troops had advanced sixty miles through weakly held American ground positions. But lack of fuel stalled the German advance, and as the weather cleared, Allied aircraft pounded the German tanks and strafed Luftwaffe fighters on the ground. On New Year's Day, 1945, some 900 German FW 190s and Bf 109s finally attacked the Allied airfields, destroying 228 aircraft on the ground and damaging 146 more. The cost to the Germans was enormous: 237 pilots were lost. Inflicting Allied losses that could easily be made up, Hitler and his commanders had sacrificed most of the Luftwaffe fighter arm for nothing.

DRESDEN

(February 1945)

After the Luftwaffe's ill-conceived New Year's Day strike, Germany was nearly defenseless. Allied bombers droned over the ruins of the Third Reich virtually unmolested, except for the occasional jet attacks. The German army had collapsed on both fronts, thanks largely to the Allied bombing attacks on transportation systems, which had virtually



A rail yard at Buir, near Cologne, destroyed by U.S. bombs. Note the bomb crater in the foreground.

shut down wartime production by stifling the movement of raw materials and finished goods. More bombs fell, and by February nearly every German city with a population of over 100,000 had been severely damaged.

One large city that had escaped the Allied bombing was Dresden, 100 miles south of Berlin in eastern Germany. With the exception of its rail yards, Dresden had no targets of military significance and in fact had no antiaircraft guns

and only one bomb shelter. This city, often called the Florence of Germany, was better known for its splendid architecture, with buildings that dated back to the thirteenth century. Dresden normally had a population of 633,000, but in early 1945 that figure had doubled, as its streets and rail stations were choked with thousands of refugees fleeing the pillaging Russian army.

For some time, Russia's premier, Josef Stalin, had been pressing the Allied leaders for strategic bombing to support

his army's major offensive in eastern Germany. The leaders of Britain, the United States, and the USSR were soon to meet at Yalta, and Winston Churchill was eager to show Stalin a sign that the British and the Americans were indeed supporting the Soviets. Since the Ardennes counteroffensive had stalled the advances of the British and American armies, Churchill decided that bombing Dresden would visibly demonstrate to Stalin that Britain and the United States were doing their part to end the war. It would also demonstrate to the Russians the destructive punch of the combined Anglo-American bombing offensive, a gesture whose ramifications went beyond the war with Germany.

General Spaatz was unhappy about the decision to bomb Dresden but did not actively resist the order. Spaatz was already embroiled in controversy over Operation Thunderclap, the plan to bomb Berlin round-the-clock and force the Germans to sue for peace. He opposed this plan, since he was against wholesale bombing of cities and preferred to attack more strategic targets. Nevertheless, he gave in to the pressure to end the war with one stroke, and on February 3, nearly one thousand B-17s headed for Berlin. An estimated 25,000 residents died in the bombings, and Spaatz later admitted that little effort had been made to hit targets of military importance.

Ten days later, on the night of February 13, a wave of 244 RAF Lancasters dropped incendiary and high-explosive bombs on Dresden. Flames swept the old wooden buildings, creating a firestorm like the one that had engulfed Hamburg. It roared through eight square miles of the old city, uprooting huge trees, ripping roofs off buildings, and sucking hundreds of human

"Five jet-propelled enemy aircraft, Me 163s, flying in two separate formations, one element of two and one element of three, were seen in the target area around Merseburg. The element of two was seen to approach the bombers from the rear at about 32,000 feet. They were leaving very dense white contrails. Their formation was reported as very good and they maintained formation position in their diving attack. They made a slight diving turn attack at the rear of the bombers at very high speed, reported as between 500 and 600 miles per hour. Eight of the 359th [Fighter] Group turned into them but they only turned slightly away and continued. The Group did not get a shot. After attacking, the jet wingman pulled up into the sun at a fifty-degree angle. In climb the jet gave off smoke in bursts which was assumed to indicate the use of full power at intervals. It is believed that we can expect to see more of these aircraft immediately, and that we can expect attacks on the bombers from the rear in formations or waves. To be able to counter and have time to turn into them, our units are going to have to be in position relatively close to the bombers to be between them and our heavies. It is believed that these tactics will keep them from making effective, repeat effective, attacks on the bombers. Attention is called to the fact that probably the first thing seen will be dense contrails probably as high as 30,000 feet approaching from the rear of the bombers."

U.S. Army Air Force Major General William Kepner, commander of the fighter element of the Eighth Air Force, after eight P-51 Mustangs encountered Me 163s for the first time, on July 28, 1944

beings into its flaming maw. Into this inferno a second wave of 550 RAF bombers dropped even more bombs, and the heat from the city could be felt from 20,000 feet above. The next day, Ash Wednesday, 450 U.S. bombers flew toward the city to bomb its rail yards. When the B-17s failed to find the yards, hidden by clouds and smoke, they dropped their bombs on the city itself, thus adding to the devastation.

For seven days and eight nights, Dresden burned, and the flames could be seen for 200 miles. There were literally not enough able-bodied survivors left to bury the vast numbers of dead, which were initially estimated at 135,000. With the war so close to conclusion, horrified Americans and Britons wondered why Dresden had been sacrificed. In the face of this outrage, even Churchill began to second-guess his own decision. He wrote, "It seems to me that the moment has come when the question of bombing German cities, simply for the sake of increasing the terror, though under other pretexts, should be reviewed. The destruction of Dresden remains a serious query against the conduct of Allied bombing. I feel the need for more precise concentrations on military objectives such as oil and communications behind the immediate battle zone, rather than on acts of terror and wanton destruction, however impressive."

For the dead of Dresden, Churchill's change of strategy came far too late.

JAGDVERBAND 44 **(January 1945–May 1945)**

For years, Hermann Göring had blamed the men under him, including his fighter pilots, for failures which largely stemmed from his lack of leadership and poor decisions. In January of 1945, Göring dismissed Adolf Galland from his position as general of the fighter arm. Furious at the news of this action, a group of Luftwaffe fighter *Kommodoren* demanded an audience with Hitler to air their grievances against Göring. Instead, the reichsmarschall met with the *Kommodoren*, whose spokesman, Colonel Guenther Luetzow, read a resolution demanding Galland's reinstatement. The resolution also blamed Göring for the chaos within the Luftwaffe, while calling for the immediate release of all Me 262 jet bombers to the fighter arm.

Growing angrier by the minute, Göring blamed Galland for the Luftwaffe's problems. "Are you suggesting that I didn't build up a strong Luftwaffe?" he bellowed. "Yes, Herr Reichsmarschall," replied Luetzow, "you did build a strong Luftwaffe. And it won you many victories in Poland and France. But afterwards you went to sleep." When Luetzow called for Göring's resignation, the reichsmarschall exploded.

After a U.S. bombing raid that did extensive damage, Reichsmarschall Hermann Göring circulated a notice that one pilot from each Luftwaffe fighter group was to be court-martialed for cowardice. Göring changed his mind after every unit commander volunteered for court-martial.

“Allied air power was the greatest single reason for the German defeat.”

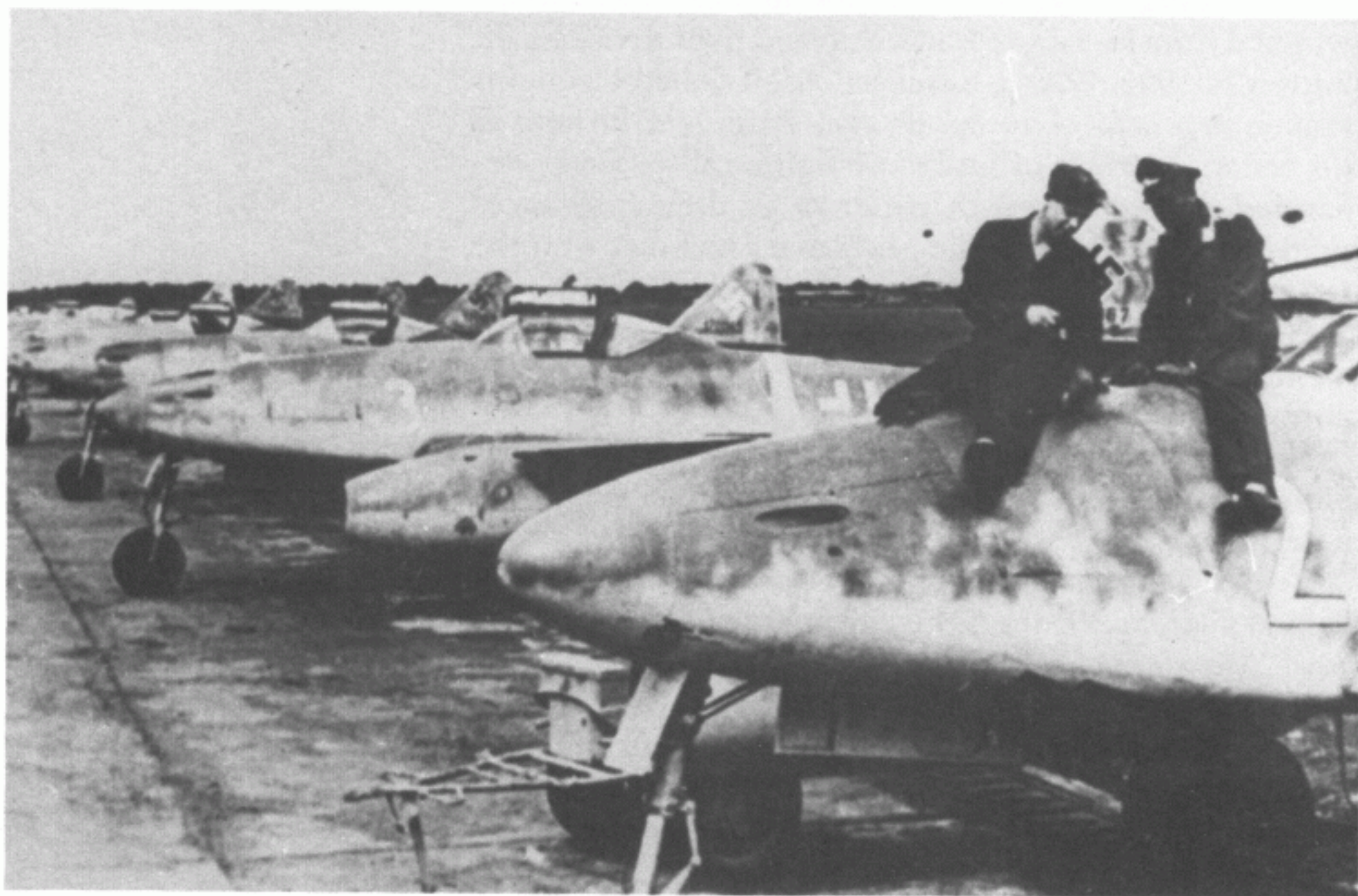
Feldmarschall Albert Kesselring

“You’re all mutineers,” he screamed. As he left the room, he threatened to have Luetzow shot. The next day, he ordered Galland to leave Berlin under house arrest.

In deepest despair, Galland thought about suicide. But word of Göring’s vendetta against Galland reached Hitler, who ordered the reichsmarschall to back off. Galland could not be reinstated, but since he had long called for the use of the Me 262 as a jet fighter, Hitler decided to let him form his own jet fighter unit. Furthermore, this unit was to be completely outside the Luftwaffe chain of command, reporting only to Galland, who would be able to choose his own pilots. Göring suggested that Galland choose many of the “mutineers” for his new squadron, secretly believing the unit to be a death sentence at this stage of the war. The ecstatic Galland was only too willing to oblige, since these rebellious pilots were among the finest in the Luftwaffe.

Word of the formation of this remarkable new unit, *Jagdverband 44*, spread through the Luftwaffe. Many pilots reported to Galland without permission or transfer orders, and a few even rode bicycles in their eagerness to get to the jet unit’s base. Others left Luftwaffe hospital beds, where they were recovering from battle stress. Among the pilots who formed the core of this elite group were Major Gerd Barkhorn, with 300 victories, Oberstleutnant Heinz Bar, with 220 victories, and Oberst Johannes Steinhoff, with 170 victories. The “mutineer” Luetzow also found his way to *Jagdverband 44*, which was now unquestionably the most talented group of fighter pilots ever assembled. “The Knight’s Cross was, so to speak, the badge of our unit,” Gal-

A Gruppe of Me 262s. Courtesy of the Messerschmitt Archives



land later wrote. "I was the fortunate man who was allowed to form and lead the most powerful squadron of fighters in the history of war."

Jagdverband 44 became operational in March of 1945, and its skilled pilots quickly began to score kills against the swarms of Allied aircraft. The speed of the jet fighter posed an initial problem to its pilots, who found themselves closing on their target so fast that they would often pass it before they had a chance to fire. But by diving away from or out-running any fighter opposition, the jet pilots could quickly return for another pass. Other Me 262 units were proving the worth of the jet fighter, which became even deadlier with the addition of twenty-four wing-mounted R4M rockets, capable of destroying a heavy bomber with a single hit. Six Me 262s of Jagdgeschwader 7, equipped with R4M rockets, shot down fifteen B-17s without losing a single jet. Another twenty-five B-17s along with five P-51s were shot down by Me 262s over Berlin on March 18.

But time had nearly run out on the Third Reich — and on the jet fighter units as well. With the Russian army advancing on Berlin and U.S. and British forces crossing the Rhine, Germany was hemmed in from the east and the west, and the destruction of German transportation systems by Allied bombing prevented the German military from making a bloody last stand. The jet fighter bases were under frequent bombing and strafing attack, as Allied fighters tried to catch the jets as they were taxiing, taking off, or landing. On April 18, as Johannes Steinhoff was taking off, one of the wheels of his Me 262 caught a badly patched crater in the runway, and the jet crashed, severely burning him. Other jet pilots were lost to the overwhelming numbers of Allied aircraft. After shooting down a U.S. bomber on April 24, Guenther Luetzow was reported missing in action. Two days later, Adolf Galland's own Me 262 was riddled with bullets from a Ninth Air Force P-47 flown by First Lieutenant James Finnegan, and he was forced to crash-land his jet under heavy attack with only one engine functioning. Wounded in the knee, Galland was taken to a hospital. For the leader of Jagdverband 44, the war was over.

On April 30, as the Russian army moved into the rubble of Berlin, Adolf Hitler committed suicide in his bunker. Galland, having been rebuffed in his attempt to surrender his jet fighter unit to the United States Army, ordered it destroyed. As P-47s flew

"One of the guys I came over to Europe on the ship with, Joe Cagney, he and I slept in the same tent. This one particular day, everybody from the C.O. on down decided to get drunk, and I mean drunk. After we ran through all our booze, the flight surgeon pulled out his alcohol, and we mixed it with grape powder and water. Suffice to say, all of us were in pretty bad shape. I had an early morning mission the next day, and they came in and roused me, and I said, "Aw, jeez, I can't make it," and Joe, the nice guy he was, said, "Aw, Finnegan, you flake, I'll do it," and I switched missions with him. This early morning flight was led by a captain who I swear had a death wish, and everybody hated to fly with him. And this captain led the flight down a valley, and he was flying low and the valley was lined with anti-aircraft. He got through, but Joe didn't, he got it. I was over in Normandy in '84, and I went through the American cemetery and found his grave there."

**U.S. Army Air Force Captain
James Finnegan**

overhead and U.S. tanks rumbled toward the airfield at Salzburg, Austria, the parked Me 262s burst into flames, one by one. Thus was ended the remarkable saga of Jagdverband 44, which had shot down fifty Allied aircraft while in operation.

CONCLUSION

The destruction of Jagdverband 44 signaled the end of the long and costly war in the skies over Europe. Some 79,265 American pilots and crewmen were killed, while the British lost 79,281 airmen. Although it is not known exactly

This U.S. flier, Second Lieutenant Kenneth Meidigh, was shot down on March 31, 1945, and escaped captivity ten days later.



how many Luftwaffe pilots died while fighting the Allied aircraft, an estimated 305,000 German civilians were killed in the combined Allied bombing offensive.

What can be concluded from this long air war? It is generally agreed that for the United States, the turning point came when the U.S. leaders realized that their long-held air power theories were flawed, and that the bomber was not invincible to fighter attack. Only when the long-range escort fighter, the P-51, arrived, could the bombers be escort-

ed deep into Germany, and only then were the Allies able to wrestle air superiority from the Luftwaffe and inflict major damage on German industry. The lack of cooperation between the RAF and the U.S. Army Air Force weakened the overall bombing effort. Strategic pinpoint bombing to knock out “bottleneck industries” initially failed to choke off German war production, which in the case of aircraft actually went up during the period of heaviest bombing. Finally, though, oil production facilities proved to be a vulnerable target whose obliteration hastened the collapse of the Third Reich. The Transportation Plan attacks on France and Germany, along with Doolittle’s decision to unleash the Eighth Air Force’s fighters, were both successful Allied strategies. For Germany, Hitler’s continued meddling with the Me 262 and his belief in a bomber and a V-weapons offensive, rather than fighter defense, crippled the Luftwaffe’s efforts against the Allies and contributed to Germany’s defeat.

But many questions about the air war in the West remain the subject of endless discussion and debate. We posed some of them to Professor Williamson Murray, a World War II historian from Ohio State University. The text of our discussion follows.

“Our aces fought until they were killed.”

Luftwaffe General Adolf Galland

INTERVIEW WITH PROFESSOR WILLIAMSON MURRAY

Professor Williamson Murray is a World War II and aviation history specialist who is the director of the military history and strategic studies program at Ohio State University. A 1963 graduate of Yale University, Professor Murray spent five years in the United States Air Force, then returned to Yale for his Ph.D. before joining the faculty at Ohio State. He has served as a research associate at the Air War College, and taught as a visiting professor of military history at West Point and at the Naval War College. Professor Murray is the author of numerous articles and books, including *Luftwaffe; The Change in the European Balance of Power, 1938–1939; and The Path to Ruin.*

Lucasfilm: First of all, if Germany had been able to come out with advanced warplanes like the Me 262 sooner, what effect would that have had on the outcome of the war?

Murray: Well, Germany would probably have still lost the war. And the reason is that the one secret weapon that clearly was decisive in and of itself was the atomic bomb. And only the United States was capable of spending the huge amount of money for the atomic bomb in addition to fighting a world war. We would have been in a position to drop that bomb on Germany in increasing numbers in 1945. No number of Me 262s, no number of special glide bombs, no number of V-2s could have changed that equation.

Lucasfilm: How close did Germany ever come to developing an atomic bomb?

Murray: Not close at all. The Germans thought they had the technological lead, and so since they weren't close to developing the bomb, they assumed that nobody else was — because in their minds nobody else was as smart or as good in terms of atomic physics as the Germans. Therefore there was no pressure to develop such a weapon.

Lucasfilm: Why did Germany squander their huge technological advantage in the development of other weapons?

Murray: So many of their weapons never got past the prototype stage because of the problems involved in putting them on a production line. It's extremely difficult to speed that process up, even by throwing more money at it. In the case of the Me 262, by early 1945 the Germans were in a position to turn out several hundred of these aircraft a month, but by that point they'd lost the war. Another problem for the Germans was that it wasn't quite so easy to see which of their weapons were war winners. Knowing what we now know, it's very easy to say that they should have put their money into the Me 262, the anti-aircraft rocket, and other weapons which would have changed the balance of the air war or made it much more difficult for the U.S. to win. But along with these weapons, the Germans spent huge

amounts of money on weapons that were completely counterproductive in terms of cost-effectiveness. The V-2 is a good example of that. It was wonderful from a technological point of view, but the best target you could aim for with a V-2 was southern England. Given how expensive it was, it really got them nothing! The rocket aircraft — the Me 163 — was a disaster in terms of the amount of technology and effort put into it. The He 162 People's Fighter? Everybody in the Luftwaffe said that was a disastrous program.

Lucasfilm: Did the U.S. have similar developmental problems?

Murray: Yes. Many of our projects, like the German projects, were completely nonsensical, wasted money. But the United States had the capacity to follow a broad spectrum of weapons development, regardless of cost, including this hugely expensive atomic bomb project, which a large number of scientists didn't think was going to work. We could fund the good and the bad, while the Germans could only fund the good. The problem was, there was no way of deciding what was good in 1942 and 1943.

Lucasfilm: When do you think the very first production versions of the Me 262 could have been put in the air if, starting in 1939, when they were flying the first jet planes, the Luftwaffe had committed to it?

Murray: It's hard to say, since the the real problem was twofold. First, Germany had decided to shelve many pro-

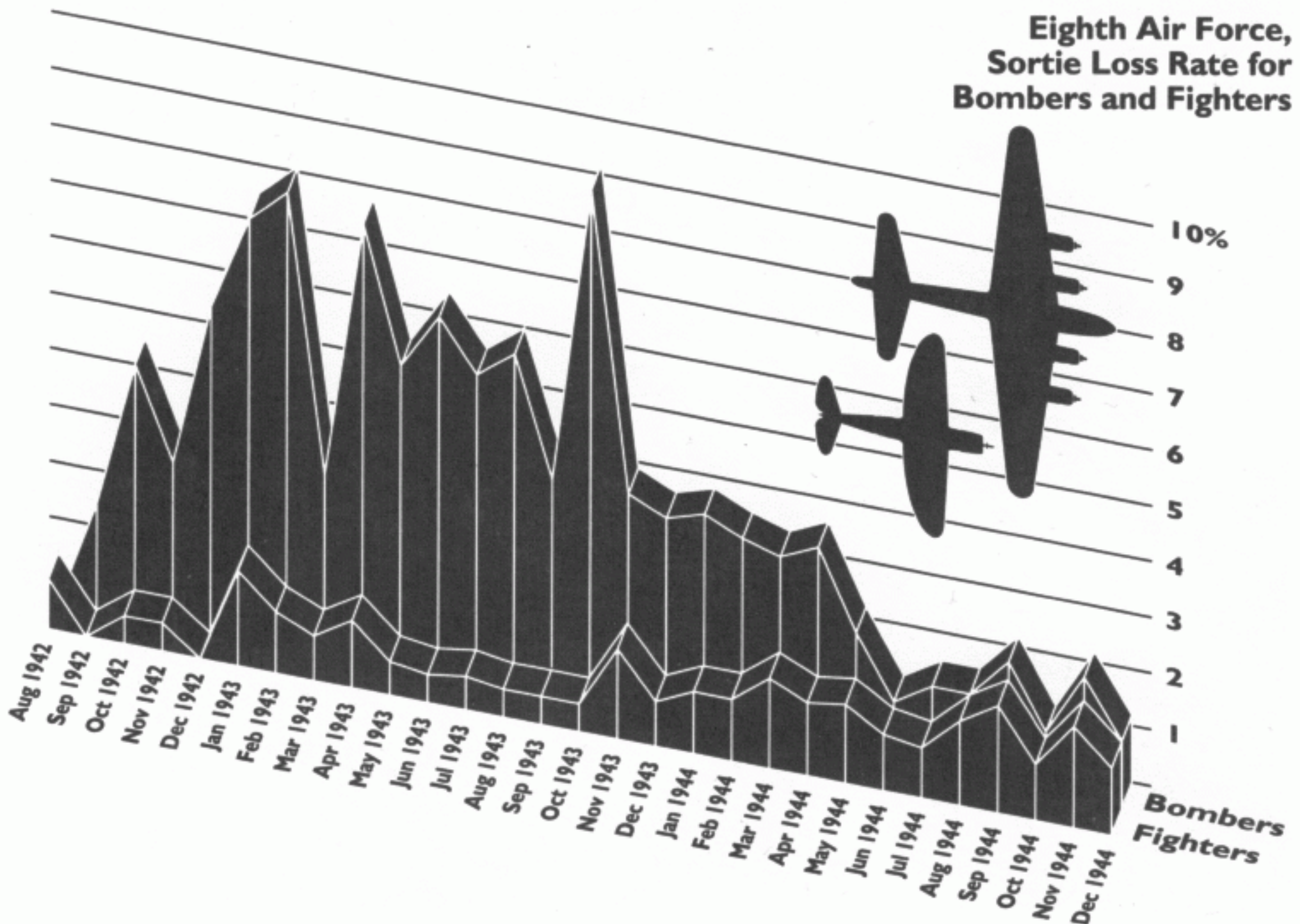
B-17s being assembled at the Boeing Aircraft Company factory in Seattle, Washington. Courtesy of the Boeing Aircraft Company



jects because of the desperate situation it was in until May-June, 1940. After that, the Germans had victory disease for a year and a half and believed that the war was won and nothing more had to be done. To get around that mindset would have required a level of political wisdom so high that had they possessed it, they would have realized that they didn't need to fight a whole world war to dominate the continent. When it became apparent that the war was going to last a long time, and they had this large number of fantastic weapons systems in development, they still had trouble picking the winners from the losers, as I mentioned earlier.

The second part of the problem is technological: taking prototype design and going to mass production. In the case of the Me 262, the problem wasn't the airframe production — the Germans were capable of doing that, since they were building other aircraft. The problem was the engine production. And it's clear that they did not get a satisfactory model of the 262 engine until June of 1944. I've heard, indirectly, from those in the Luftwaffe that while the hand-tooled, hand-constructed turbine had a life of seventy-five or one hundred hours, when they went into mass production they suddenly went down to five hours in the initial runs. They put these engines on the 262 and took it out and, suddenly, during the second flight, one of the engines would eat the turbine blades and the engine would blow up — and that was the end of the 262, and maybe the pilot, too.

My sense is that when the war was over the Germans



threw up a lot of smokescreens, partially driven by the national catastrophe, which they still couldn't believe — their country wrecked from one end to the other. It was convenient to say that Hitler turned the 262 into a bomber and that's why they didn't have them. But the fact was that there weren't any until June of 1944. So, whether he turned it into a bomber or not didn't make any difference in terms of the air battles that mattered. Those air battles were fought from February to April of 1944. After that point, they didn't have the guys to fly the airplane!

Lucasfilm: How much did the German leadership affect weapons development?

Murray: The people at the top, Hitler and Göring, knew nothing about technology and weapons development — what was possible, and what was not possible. They were really antediluvian in all sorts of ways. If Germany had had wise leaders, then things would have turned out differently. But if Germany had had wise leaders, they would have never gotten involved in World War II.

Lucasfilm: How did their decisions influence the air war?

Murray: The top German leadership was never interested in shooting bombers down! Never! And they felt the way to beat a strategic bombing offensive was not to beat it in the classical sense of defeating the enemy on your territory, but to go and smash his cities up in equal measure. It was almost an ideological thing in terms of how air forces looked at air power in the thirties and forties. Both air forces came very close to losing the war simply because they were incapable of looking at air war as being similar to war throughout history, whether you're talking about naval war or ground war.

They looked at this as something entirely new, with new rules, and it didn't have new rules. It just had different dimensions.

Lucasfilm: What influenced the prewar theories of air power?

Murray: First, there was a reaction to the First World War. Clearly, military theorists and thinkers were looking to escape the catastrophe of the ground war of World War I, and air war seemed to offer a cheap solution. The irony is that the evidence was available to suggest that air war was going to be just as catastrophic in terms of losses and expenses as ground war — if not more so. You look at air war casualties in World War I — it was an absolute nightmare. Survival rates for British pilots in 1916 were about zero — four missions and they were dead. They just kept grinding them through. But somehow, the public and airmen came to believe that air war was cheaper, cleaner, easier, swifter, and offered a promise of a decisive, quick, easy victory. The second part is the romance element. There's

"The appearance of bombers in 1943 over the Reich was the turning point in World War II aerial warfare."

**Luftwaffe Generalleutnant
Johannes Steinhoff**

The notorious English weather was an additional obstacle for bomber crews, and missions were canceled if visibility was less than a half-mile. During one particularly foggy morning, the lead B-17 took off and radioed, "Okay to take off here. Visibility at least 500 yards." From one of the bombers on the ground an exasperated voice exclaimed, "I don't know what runway he took off on, but I can't even see my goddamn copilot."

something beautiful about airplanes — whether they're flying or on the ground — they're simply fascinating. And there was sort of a romance to aircraft flying.

Lucasfilm: How was air power to be employed?

Murray: The sense was that civilians were more vulnerable to attack, since they were considered undisciplined and incapable of bearing pressure and sacrifice the way military organizations do. So the idea was that you blast the enemy's cities just a little bit, and the workers will be rioting and mothers and children will be out in the street and the government will fall, and we'll win the war. Now, the U.S. Army Air Corps didn't go in that direction for political reasons. They understood that killing women and children was something that Congress, in the late twenties and early thirties, would have shut them down for. Something that nasty would have been so appalling to your average congressman from upstate New York or even Alabama or California that it would have been rejected out of hand, so they had to look elsewhere.

Lucasfilm: So they looked at economies?

Murray: Right. If you could break the enemy's economy, this would have an enormous impact on the civilian society, would collapse a civil government, and win the war quickly and easily. And American military strategists did all sorts of studies before the war, looking for nodules in the American economy which would, by knocking them out, create such economic difficulties that economic life would grind to a halt. An obvious one was ball bearings. If you knocked out three plants in the Northeast, suddenly half of the U.S. automotive industry would grind to a halt. Electric power was a very attractive target, because if you hit one or two crucial stations, the Northeast grid went down.

The problem is, there's no way of testing any of these ideas. Military organizations have generally found it difficult to predict what's going to work in a war and what's

not. It's not because they are made up of very stupid, ignorant people. The problem is that military organizations are asked to prepare for the most horrible conditions that human beings ever face in this world; conditions that you simply cannot replicate in peacetime. When the airmen did get into conflict, they did not adapt very well, because they tried to imprint their prewar framework on the conditions they were facing, rather than adapt to these conditions. The result was that air power ran into severe problems almost right from the beginning.

Lucasfilm: What were some of these problems?

Having been being hit by numerous antiaircraft shells during a raid on the German city of Kassel, a B-17 named *Tondelayo* nevertheless managed to make it back to its base in England. Amazingly, eleven unexploded shells were found in the bomber's fuel tanks. Had even one of these shells gone off, the bomber would have been blown to bits. Upon closer inspection, the shells were found to contain no explosive charges, and one actually had a rolled-up note inside it. The note, in Czech, read, "This is all we can do for you now."

Murray: In all fairness, one can criticize prewar airmen too much, since they could not see then what we see today. Nevertheless, the main problem was that they simply did not think their basic doctrine through enough. For example, the U.S. Army Air Force emphasized precision bombing so much because it flew in the deserts of Arizona and in the relatively good weather over Alabama, and everything worked perfectly. And then, when the Eighth Air Force went to Europe, it was discovered that there was relatively little chance for precision bombing, because the weather conditions in Europe were much worse.

Lucasfilm: Why did the U.S. leaders believe so strongly that their heavy bombers could survive without fighter escort?

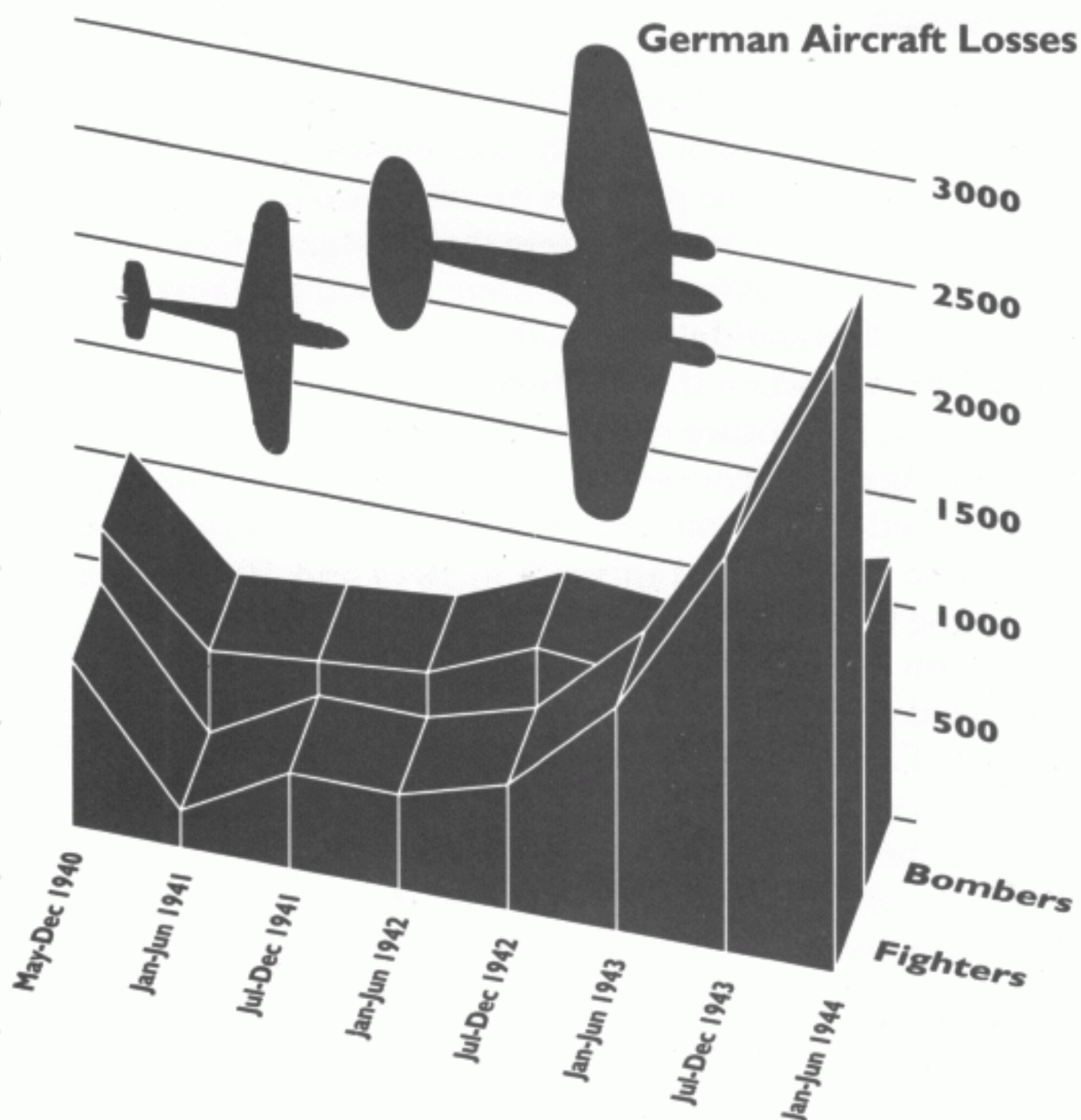
Murray: They felt that large formations of B-17s flying in close proximity to each other, all heavily armored, all carrying lots of .50-caliber machine guns would put an enormous number of slugs into the air over Germany. And, initially, in late 1942 and early 1943, the Luftwaffe ran into real problems flying against the B-17 formations because they'd never run into such dense fire. They could see the tracers coming at them, and that was pretty frightening.

Lucasfilm: It must have been hard for the B-17 formations to avoid shooting down other B-17s with all those guns firing at once.

Murray: Well, actually, a number of B-17 guys were wounded by gunners in their own group who were following some German fighter through. But by March and April of 1944,

"I think that if the Germans in the Battle of Britain, even with their same number, had had aircraft with the performance, armament, and precision bombsights of the B-17, the answer might have been very different."

RAF Air Marshal Sir John Slessor



with one thousand aircraft — the whole sky filled with airplanes — if you shot down two or three of your own, it was no big deal. If you lose five percent or under, you're winning the air war; if you lose five percent or more, you're losing the air war. Five percent actually is a huge loss. If you lose five percent in a constant formation, in twenty missions you will have lost half the formation. Again, when you're dealing with eight hundred aircraft and you lose two of

them because they shot each other down, that's more than acceptable — as long as it's added to a small group that the Germans have shot down.

Lucasfilm: At what point did the Luftwaffe fighter pilots realize that they could do some real damage to the B-17 formations?

Murray: When they discovered that their cannons could damage at ranges beyond the U.S. machine guns. They also discovered that head-on attacks were possible, something that nobody thought was possible in any air force. The Luftwaffe guys who were really good could come in and, in one-and-a-half seconds, put a whole bunch of 30-mm. shells into an engine, and that was the end of the B-17. The head-on attack was terrifying to the B-17 crews, and was probably pretty frightening to the Bf 109 and FW 190 drivers who were doing it. And the really good German pilots were aiming

to come so close that they would break up the B-17 formation; make a B-17 pilot actually take evasive action, which might lead to a couple of B-17s running into each other or falling out of the formation, where they're sitting ducks. But at closure rates of 600 miles per hour, a good portion of the Luftwaffe pilots couldn't hit anything.

Lucasfilm: And when the Me 262s and other faster aircraft came along, the closure rates were even faster.

Murray: Again, of course, the faster the closure rate, the more skilled a pilot you had to be to put shells on a target. And some guys in the Luftwaffe in 1943 and 1944 — the only thing they could try to do was to fly their airplane.

Lucasfilm: How did the availability and the quality of German pilots change during the war?

Murray: The Luftwaffe in the summer of 1942 was spending as many hours to train a new pilot, in terms of flight time, as the British and Americans. In fact, I think it was slightly more for brand-new Bf 109 drivers in summer 1942, and twenty-five more hours in Bf 109 fighter transition school than a Spitfire or a P-38 pilot. The problem for the Germans is that starting in 1942, attrition begins to pick up speed. They're fighting on every front, outnumbered;



While another black cross is painted on a P-47, two outstanding U.S. fighter pilots, Captain Robert Johnson and Captain Walker Mahurin, congratulate each other.

and while they may shoot down two airplanes for every one they lose in North Africa, and, while they may shoot down two for every one they lose in Russia, it's clear that the countries they're fighting against can afford to lose those two airplanes and pilots more than the Germans can afford to lose their one. By 1943, the Germans are forced to cut back on the number of flying hours because they need more and more pilots to fill the cockpits. And this becomes a major factor in the 1943 fighting. By then, the experienced guys are getting worn down, tired, weary, and they know they're going to get killed. Maybe not today, maybe not tomorrow. But somewhere along the line they're going to make a mistake or somewhere along the line they're going to come up against the guy on the other side who is as good as they are. And they'll lose. Meanwhile, the younger Luftwaffe guys were beginning to come in with considerably less overall flying time than their opponents. By 1944, for example, the average American pilot coming over to Europe to fly the P-51 had, I think, 125 hours in the P-51 plus some 150 to 200 hours in training aircraft. The typical Luftwaffe fighter pilot had just 25 hours in a Bf 109.

A P-51 pilot told me that, once, he shot down a 109 that was actually flying along crabwise. On the 109, the torque on the engine would make the airplane fly sideways unless you trimmed the rudder. And, obviously, if you fly sideways, you lose a lot of the capability. The guy flying this airplane didn't know enough to trim his rudder to get the airplane to fly straight! By the summer of 1944, the Luftwaffe was putting kids in the aircraft, and they just didn't have the capabilities to stay in the arena. In early March 1944, thirteen rocket-armed Bf 110s from this one squadron went up, and only one came back.

Generally, by June 1944, the Luftwaffe flight commanders each had about thirty days of flying time, and the average fighter pilot had about eight days of combat. So the U.S. was dealing with a few extraordinarily good pilots, along with a bunch of people who were killing themselves in huge numbers just taking off and landing! And the American pilots, by 1944–1945, were all experienced twenty- to twenty-one-year-old kids — the Chuck Yeagers of the world — twenty-year-old killers!

Lucasfilm: With that lack of training, the Me 262 wouldn't have made much of a difference.

Murray: By the point of the war when the Me 262 was introduced, the few jet squadrons they were able to put up in the air did wonderfully, because they were in the hands of the flight commanders, people who were incredible flyers. The question is, did the Germans, in early 1944 or even in the summer of 1943 have enough good pilots to take advantage of the capabilities of the aircraft? Because the capabilities of the aircraft depended on having a guy who was really a first-



Luftwaffe General Adolf Galland first made his mark as one of the leading German aces in the Battle of Britain while commanding Jagdgeschwader 26. Later, he became general of the Luftwaffe's fighter arm at age 30, and used the knowledge gained in combat to direct the fighter defense against Allied bombers. Wrongly blamed by Göring for the declining Luftwaffe fortunes, Galland was removed from his post but was later allowed to form his own Me 262 jet fighter squadron, Jagdverband 44, and finished the war as he began it—as a fighter pilot. An outstanding flier, leader, and tactician, Galland tallied 104 aerial victories.

rate pilot. And you can't put a guy into a 262 in the fall of 1943 with 175 hours' flying and expect him to do anything with the aircraft.

From their own point of view, the Germans had another problem. Pilot morale was not helped by Göring's attitude that, somehow, the failure to shoot down or stop B-17 formations was due to cowardice. There were incredible conferences where Göring talked to a large group of fighter pilots and called them all base cowards. This fat, dumpy, corrupt guy with forty-seven rings on each hand, calling them cowards! I asked Johannes Steinhoff, "How could you guys take that?" And he said, "You have to understand that the sensibilities of many people in the Third Reich weren't particularly high." I think his answer also would have been to the effect that they were all twenty-one, twenty-two years old, and had that German respect for authority.

A few U.S. bombers and fighters that had crash-landed in German-occupied Europe were repaired and made airworthy again by Luftwaffe ground crews. This group of aircraft, known as the *Wanderzirkus*, or "traveling circus," toured Luftwaffe bases, giving German fighter pilots invaluable knowledge of the aircraft they were fighting against. Some of these patched-up B-17s, still retaining their U.S. markings, would infiltrate American bomber formations and even open fire on the startled bomber crews.

Lucasfilm: Did it really take a better pilot to fly an Me 262, on average? Was it a more difficult plane than the Bf 109 or FW 190?

Murray: My guess is if you're a less experienced pilot, speed kills. The faster you go, the more unforgiving the aircraft is. In addition, the great weakness of the 262 was that its takeoff and landing patterns were too long and slow — it needed a 10,000-foot concrete runway. Fires in the jet engines were also common. But the real issue here is: If a guy can't hit anything with a 109, how can he hit anything with a 262? Without the pilot, it doesn't matter what aircraft you have. It's not a question of whether a

guy can take it off and land; it's whether a guy can fly through a B-17 formation, shoot two B-17s down, swing over, shoot down two P-51s, and then go home. If all five hundred of your guys flying 262s could do that, in a couple of days you could put some real holes in the U.S. bombing offensive. But if only twenty of the five hundred guys can do that, then it doesn't do you much good.

Lucasfilm: How was it that the Luftwaffe had so many high-scoring aces in World War II?

Murray: There are certain extraordinary pilots who can develop, in the right arena, even more extraordinary capabilities the more they fly. And some really good examples of this are the top Luftwaffe fighter pilots, the guys who fly from 1939 or 1940 through to 1945: some of them ended their careers in 1943 as smashed-up wrecks, but the guys who flew over one hundred missions showed from that point on a quantitative leap in the number of airplanes shot down per fifteen missions. And, clearly, guys like Adolf Galland and Hannes Trautloft had sort of a computer template in their mind that allowed them to look at a situation in-

instinctively, with no conscious evaluation. One time, Galland and Trautloft took off to evaluate the air war, I think in March or April of 1944, and they took a look around and understood instantly that if they stayed up there, they could maybe have shot down ten U.S. aircraft, but they would die in the process. They both headed for home. No conscious thought, no discussion, just an instantaneous decision. Johannes Steinhoff talks about a mission that he was on, where he looked at a situation and instinctively went into the formation and took out a B-17. It's a skill honed by combat, and these guys were clearly the best fighter pilots in the Second World War. The problem is that there was one of them and two hundred of the other guys who were flying through the skies without their rudder trimmed!

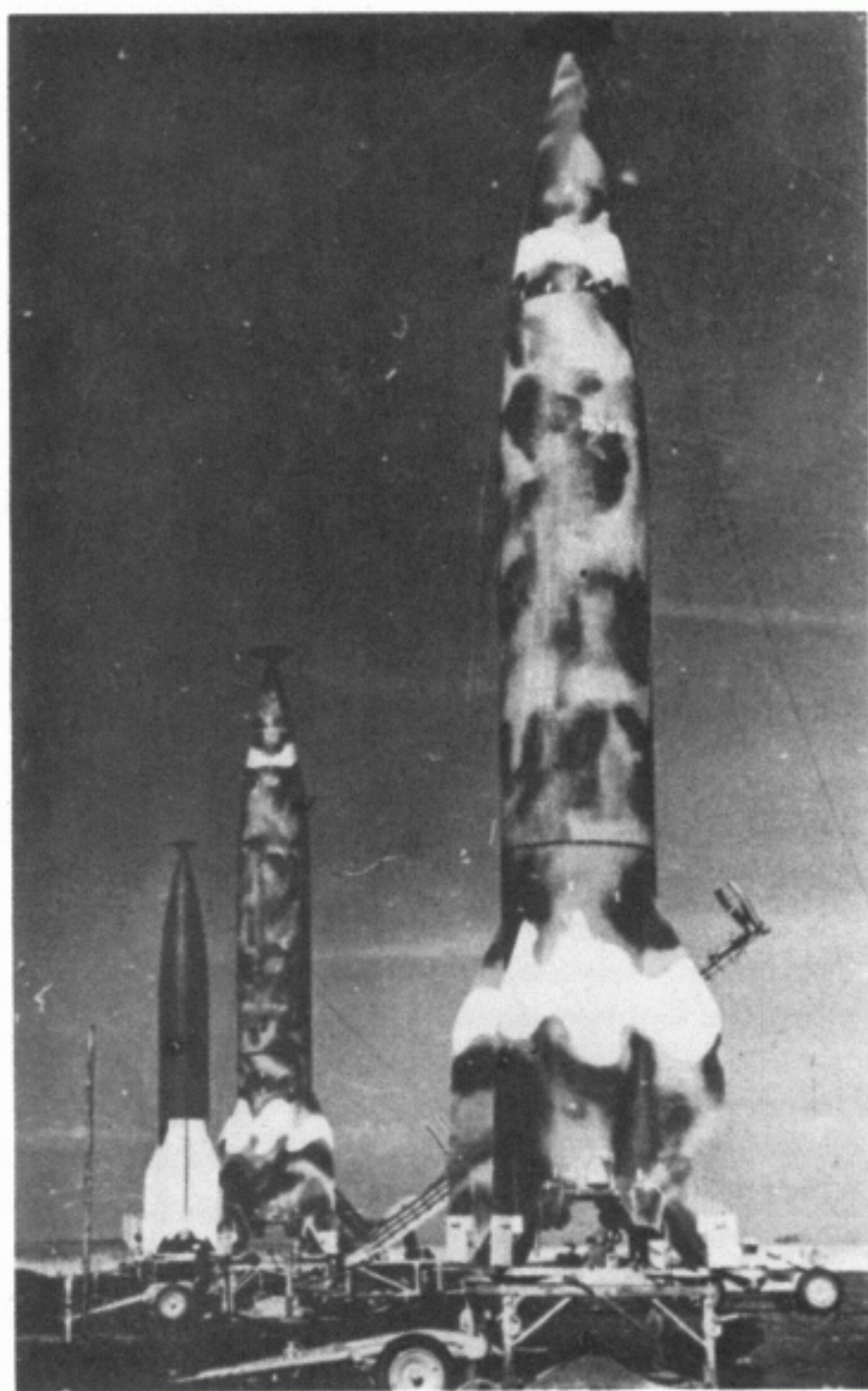
On the other hand, the Americans and British generally pulled their fighter pilots out after a hundred missions, and sent them back to train other pilots. As a resource to pass along to the training establishment, a guy who'd flown a hundred missions over Germany was so valuable that it was worth putting up guys with three hundred hours to replace him. The Germans never thought in that fashion. They were so hard-pressed for pilots from 1941 on that they couldn't afford the luxury of taking out their best guys to grow better pilots down the road.

Lucasfilm: Was the U.S. even aware of the fact that there were just a few guys that had these incredible victory totals?

Murray: Yes. We knew that because of German propaganda. We just made a very different choice in terms of the long-range, which was that when a guy reached a certain skill level — no matter how good he was — it was far more effective to use that skill level to work on the new guys coming through. Again, I think it reflects our approach to war. We understood something by 1941 and 1942, and the British did, too, that the war was going to be a long war, because the Germans were going to win the short war if anybody was going to win a short war! So if we were going to win, we were going to have to win a long war, and think in those terms; whereas the Germans, with a few very minor exceptions, were always thinking in terms of what they could do that would help them tomorrow, rather than a year or two years from now.

Lucasfilm: Was there a pattern with any of these top fighter pilots? Would it be possible to pick them out early in a training program?

V-2 rockets about to be deployed sometime in late 1944.





U.S. Army Air Force Major General Carl Spaatz, the commanding general of the U.S. Eighth Air Force in 1942, was temporarily assigned to oversee air operations for the North African theater, and then commanded the Allied air forces for the invasion of Sicily and the Italian peninsula. Brought back to England in early 1944, Spaatz coordinated the overall bombing of Germany by the Eighth Air Force and the Fifteenth Air Force in Italy. On March 5, 1944, Spaatz issued the Oil Plan, which called for the bombing of Germany's vital oil installations before D-Day as a way to draw the Luftwaffe away from the invasion beaches. His Oil Plan was rejected in favor of the Transportation Plan, but he nevertheless ordered strikes on oil targets after D-Day, and these proved extremely successful in stifling the German war effort. Later, Spaatz directed the bombing of Japan by B-29 bombers, including the two that dropped atomic bombs on Hiroshima and Nagasaki. Courtesy of the United States Air Force

Murray: If you could figure out today who the top fighter pilots would be, you could go to the United States Air Force and they'd make you a millionaire tomorrow. Because you really can't tell. Some of these guys were religious, decent family men. Others were complete wastrels, women chasers, drank huge amounts of liquor, that sort of thing. One of the top Luftwaffe night fighter pilots was one of the leading conspirators against Hitler. There's no pattern because there's just something undefinable about what it takes to be an ace fighter pilot.

Lucasfilm: How did the Luftwaffe organize their day forces?

Murray: It's an interesting question. Their day interception approach is a defense that looks relatively similar to what the RAF did in the Battle of Britain, giving the course and speed of enemy bomber formations when they crossed the Channel. In the daylight, the other side wasn't going to try to spoof your radar because they were in visible range once they crossed the Channel. What the Luftwaffe aimed to do from 1943 on was to make the U.S. escort fighters drop their tanks early, and then intercept attacking bomber formations after the escort fighters dropped off. They put sustained pressure on B-17 formations from the beginning of their run into Germany until they went home. And the longer they could attack them, the better! Now, it's clear that the system became more and more complex as more fighters were brought back to defend Germany's airspace in the summer and fall of 1943. They also added Bf 110s and Me 410s and a variety of other aircraft to go up there and fire rockets. The crucial thing they understood right from the first was that the best way to attack the formations was to break them up. Because a small group, or preferably even a single B-17 by itself, was a much easier target than a whole group of them. So they ended up firing rockets into the B-17 formations, or dropping fragmentation bombs from above. Dropping bombs wasn't terribly effective, except that seeing an enemy airplane above dropping bombs scared the hell out of B-17 crews. In one case of a B-17 group of twelve aircraft, one aircraft was hit by a bomb and a number of the others scattered, and then were shot down.

Lucasfilm: Were the air-to-air rockets really that effective at breaking up formations?

Murray: Not really. But that brings up an interesting point: If the Germans had really put a major effort into air defense, and regarded air superiority over the central continent as their first priority in terms of air fighting, they could have done a much better job. For example, they actually had a glider bomb that looked like a tiny V-2, except it was much tubbier. This bomb had a little TV camera in the front, and the resolution from it was primitive, but you could at least make out the shape of the target you were attacking. In the Mediterranean, they dropped a radio-

controlled glide bomb right down the smokestack of the battleship *Roma*, and sank it. You can't get much more accurate than that! I'm not a technologist, so I don't know if the TV camera would have worked on a rocket that was fired off instead of a bomb that was gliding down. But think about the damage one of these would have created if it were guided into a B-17 formation!

Lucasfilm: Why did it take so long for the Allies to develop a long-range escort fighter?

Murray: Because they didn't think they needed it. If you don't believe you need a weapons system, or can develop such a weapons system, you're not going to develop it. Churchill asked the RAF experts, "Why don't we develop long-range escort fighters?" And their response was, "That's technologically impossible." And Churchill's reply



A formation of P-51 Mustangs from the 375th Fighter Group. The lowest P-51 is a B-model, while the rest are D-models.

to that was, "Well, that closes a great many doors!" Now some of the guys in charge of the air forces may have had engineering backgrounds, but generally they were not technological experts. So the RAF leadership felt, on the basis of what they knew, that it was impossible to develop a long-range escort fighter. They excluded it — they didn't feel it was necessary to go and ask the engineers and scientists or the aircraft manufacturers if it could be developed.

The second part of the problem was the "not developed here" syndrome. For example, the U.S. Navy developed the F4U Corsair, first flown on May 29, 1940, as a high-speed air superiority fighter for use at long ranges. The Corsair very clearly could have been developed as an air superiority fighter for the U.S. Army Air Force in Europe. But the army never went for it, because it's the army, and the army, like the air force today, is simply not going to buy what the navy has built! The "not developed here" syndrome almost killed the Mustang.

Lucasfilm: Given its neglect by the U.S. Army Air Force,

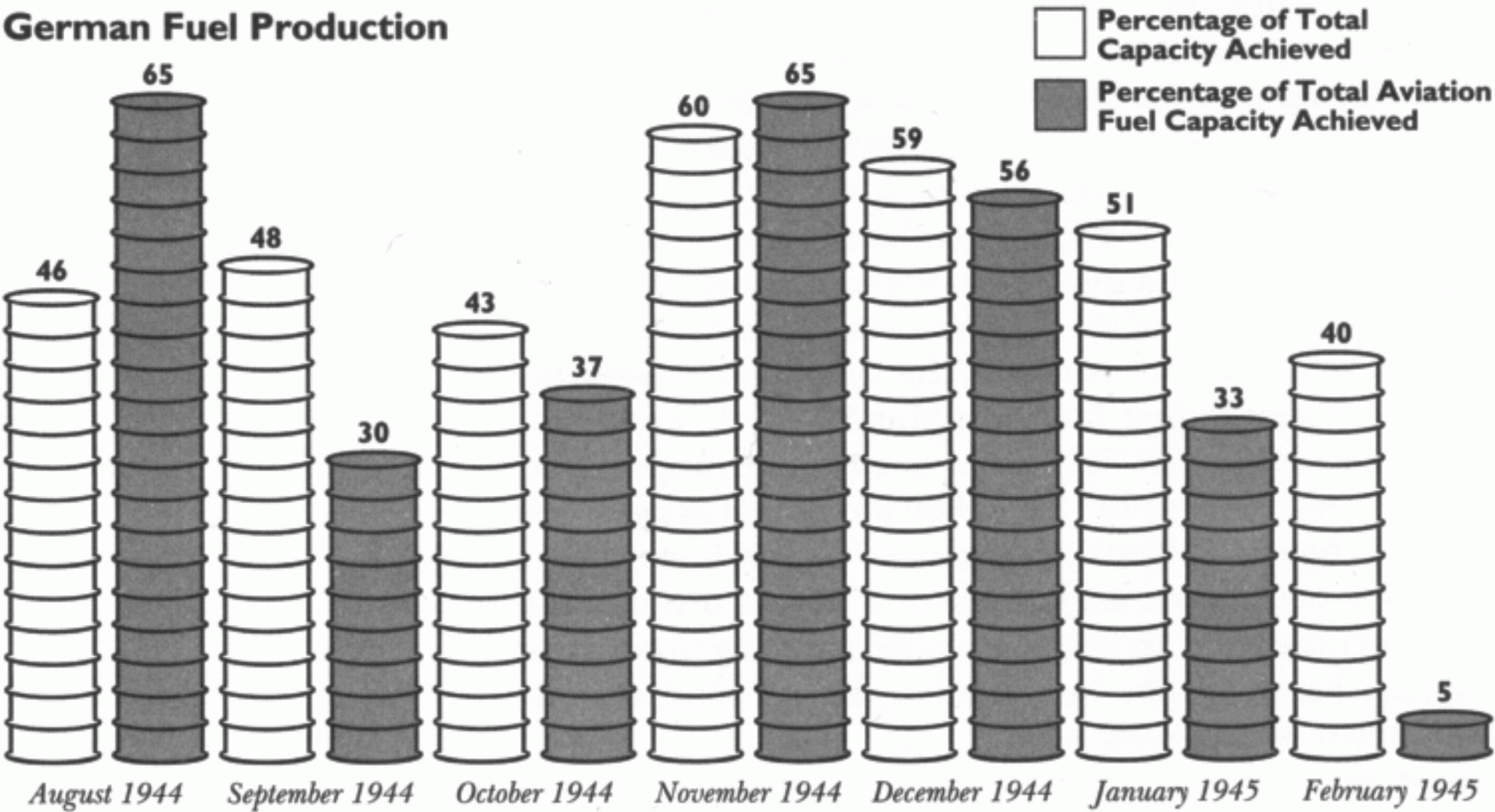
“There is one thing that will bring Hitler down, and that is an absolutely devastating attack by very heavy bombers from this country upon the Nazi homeland.”

Prime Minister Winston Churchill, in 1940

how did the Mustang program ever get off the ground?
Murray: The story of the Mustang development is a fascinating piece of greed, capitalism, incompetence, and desperate need. The British showed up in the U.S. in 1940, and they went to North American Aviation and said, “We’d like you guys to build the P-40 under contract from Curtis.” And the engineers at North American thought to themselves, “If we build the P-40, we’ll have to give Curtis all this money. No, No, No!” And they told the British, “We’ve got this great design we’re working on, and we could have the design to you in final form in one hundred days and we’ll be able to go into production shortly thereafter.” Desperate, the British said, “Oh, OK, do it!” And the engineers came up in one hundred days with a design for the P-51. They put an Allison engine in it — which was a dog — but it took off. And the RAF bought it and the guys at North American were happy to have it, but they didn’t think about developing it into something else. They didn’t say, “Ah, what a great design we’ve got!” But then in 1942, the RAF’s R & D guys at Farmborough are looking at the flight characteristics and profiles of all the various fighters that they’re buying. And they put the Mustang in the wind tunnel, and they discover that it’s a wonderfully aerodynamic airframe! They try a few more tests with it, and it still comes out as an extraordinarily good design. And then, one of them gets the bright idea, “What’s the matter with it? It’s got a terrible engine. Let’s put a Merlin on it.” They install the Merlin engine and create the hottest piston engine fighter of World War II.

What’s interesting is that the U.S. Army Air Force still did not want to buy it because it was ordered under RAF specifications and then further developed by the RAF establishment. They wouldn’t buy it even though its airframe was

German Fuel Production



the only one, I believe, which had a center-line fuel tank behind the pilot, and gave fighter pilots the capacity to go to Berlin. They changed their minds only after they got the hell kicked out of them over Germany.

Lucasfilm: How much did the Allies fall prey to bombing a target, thinking it was destroyed, crossing it off the map, and figuring that they didn't have to return?

Murray: It took until 1944 for airmen to begin to realize that hitting a target once may not have removed the target. There were some real problems with post-raid analysis of damage done. One was the poor weather conditions over central Europe. When the RAF dropped the kitchen sink on Berlin during the fall and winter of 1943–1944, they didn't get their first photographs of damage until February of 1944. And the second part of the problem was estimating damage when you did have good photographs. Schweinfurt is a good example of that. In the first Schweinfurt raid, they knocked the roofs out, and knocked a whole bunch of the walls down. When reconnaissance flew over the city the next day, it looked like one ravaged, smashed-up landscape. But the nature of the target was such that knocking the roofs and exterior walls down and having some of the interior walls and exterior walls collapse inward didn't guarantee that the target was destroyed. In fact, the collapsing walls provided sort of an insulation so that the succeeding bombs then did even less damage. And when you think it through, what makes ball bearings? Large machine tools. What are large machine tools made out of? Tons of high-alloyed steel. You've got to put a 500-pound bomb on each one of those things to destroy it. But the collapsing walls actually protected these machines. While post-raid reconnaissance flying over the target were crossing Schweinfurt off, what were the Germans doing? Pulling all of the bricks off the damaged machine tools, which, for the most part, they were able to put back into service relatively easily.

By 1944, I think, our airmen had begun to realize the sort of intractable nature of destroying targets. Here, *Ultra* really played a major role in World War II. When the U.S. began to bomb oil targets, *Ultra* indicated that we were really hurting the Germans, and also indicated how fast the Germans were rebuilding these targets and putting them back into operation. And the benchmark was that when they got back up to thirty percent, we would hit them again, and do a substantial amount of damage to the repair work and waste



Germany's largest oil refinery, Rhenania-Ossag, goes up in flames after an attack by U.S. bombers on August 6, 1944.

A formation of B-17s from the 452d Bomb Group unloads its deadly cargo. Courtesy of the United States Air Force



the huge amount of German effort that had gone into putting synthetic oil production back on line. This underscores the fact that throughout the war, Allied intelligence was far superior to German intelligence. The Germans didn't have a clue as to what we were doing, and we had a very good picture of what the Germans were doing from a variety of sources, such as prisoner interrogation. But *Ultra* radio intercepts were by far the most important source of information.

Lucasfilm: What effect did Allied attacks on oil production have on the Third Reich?

Murray: The oil attack by itself was not decisive, but it had a crucial effect on many areas. First of all, it was the death knell of the Luftwaffe, because when you substantially reduce the amount of oil available, you end the capability of the Luftwaffe to ever recreate a pilot force that can fly with any kind of effectiveness, and end any pilot training programs. Second, it clearly had a major impact on German ground mobility. One of the best examples of that is that Silesia on the eastern front fell to Soviet armored formations in only a few days in February 1945. The Germans had 1,300 tanks, Panthers, Tigers, Mark IVs, which were highly capable weapons systems, but with no oil or petroleum. So the mobility of the German army to fight was simply not there, and the Soviet capture of Silesia was made much easier. It clearly had an impact on the Battle of the Bulge, the fact that the Germans planned to get halfway to Antwerp by using their own fuel and hoped to capture the rest on the way. The idea never had any possibility to succeed because it doesn't take much more than a lighter to set a fuel dump on fire.

Lucasfilm: How important was the Transportation Plan in terms of its effect on Germany?

Murray: The Transportation Plan not only led to the complete collapse of German industry but created a situation in which the Germans were literally incapable of moving supplies anywhere in the Reich from the factories. It meant that the German armies that surrendered in 1945 were out of ammunition and weapons. The Germans had all the discipline in the world, but guys don't fight when they don't have any weapons and ammunition. It's the main reason why there was no last climactic battle over the ruins of the Third Reich.

Lucasfilm: Are there other strategic or important resources that the U.S. should have gone after?

Murray: Yes. The target that was initially on the list and then got dropped for the wrong reasons was the German electric supply. In retrospect, it could have been as damaging earlier to the Germans as oil. When the Germans in 1943 began to think, "How can we damage the Russian economy?" the one thing the Germans went to, because they were looking at the Russian economy in terms of their own vulnerabilities, was the electric supply. But the U.S. looked at the German economy and said, "Well, electric, that's nice, but Britain and America have all this excess capacity, so hitting the German electric would not do any appreciable damage." We were analyzing German targets in terms of our own strengths and weaknesses, and the electric industry was something we clearly missed. In fact, one of the reasons why oil was a relatively low priority for so long was that we had an excess of oil in Texas and the Caribbean that virtually nobody else had — enough surplus oil so that the American population, while on rationing, still got a huge quantity of oil products to keep their cars running.

Attacking the ball bearing industry could have also had a far more severe impact on the German economy had the U.S. been willing to make a more sustained effort. In the summer of 1943, when the U.S. was attacking too many different targets, the major priority target really was the Luftwaffe, because the Luftwaffe was capable of inflicting grievous harm on American bombing operations. That didn't leave a great deal of excess capacity to go after anything else. So the ball bearing industry, while it was hit and hurt, didn't suffer the permanent damage that would have really put the Germans in a hard place. The Germans also had some options we didn't really think through — namely the Swiss and the Swedes, who were more than happy to produce ball bearings in huge numbers twenty-four hours a day, and sell them to the Third Reich. Only in late 1944 were we able to force the Swedes to substantially decrease their ball bearing sales to the Third Reich. (I believe there was an American Air Force colonel on a negotiating team who implied to the Swedes that American B-17 formations could get lost over Europe and might hit the major Swedish



Reichsmarschall Hermann Göring, a World War I fighter ace and hero, rose in the Nazi ranks to become head of the Luftwaffe and the number two man in Germany. The Luftwaffe he had organized enjoyed a succession of victories at the start of the war, but setbacks in the Battle of Britain, in the Mediterranean, and on the Eastern front undermined his position. Blaming his pilots for his own failures, he gradually fell out of favor with Hitler and became increasingly unwilling to stand up to the Führer. He was also blind to the threat posed by Allied bombing until it was too late. Sentenced to death by hanging at the Nuremberg Trials, Göring committed suicide with a concealed poison pill just before his scheduled execution.

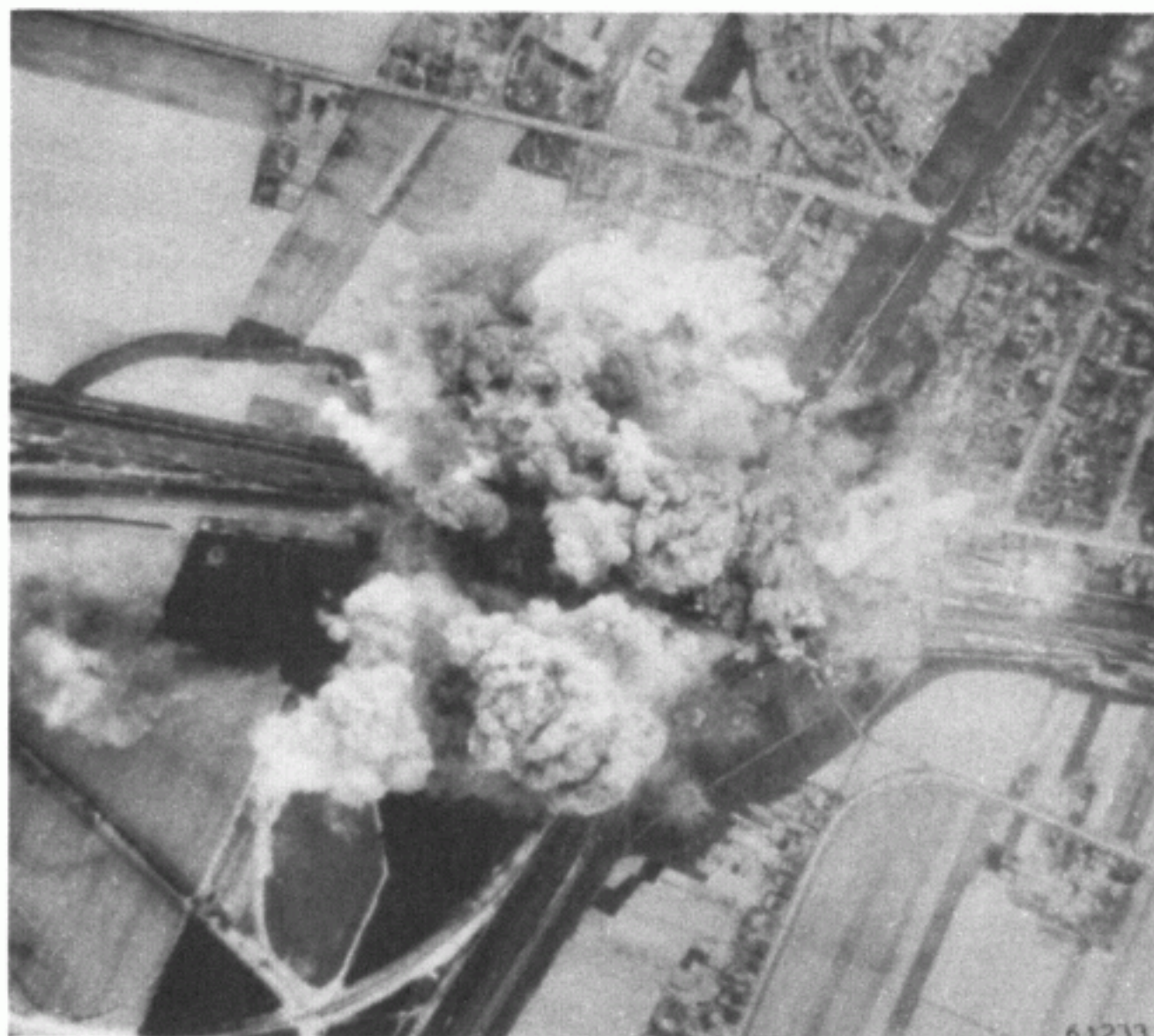
ball bearing factory by mistake, which he was severely reprimanded for, because that was really undiplomatic behavior.) We also miscalculated the fact that the Germans had some options on the low end of the spectrum. For example, Tiger tanks and Panther tanks were changed to roller bearings rather than ball bearings, since roller bearings were much easier to manufacture. The resulting tanks were harder for the crew to turn, but the Tiger and Panther were still fairly efficient weapon systems in 1944 and 1945.

Lucasfilm: Why didn't the U.S. and the RAF cooperate more fully by bombing more of the same targets day and night, and how did this lack of cooperation hamper the Combined Bomber Offensive?

Murray: I believe we cooperated with the British more than they cooperated with us. And I think that reflects Harris, who was an ideologue, a true believer, the man who saved the British strategic bombing campaign. The problem is

that Harris was worn out by his success, and the very qualities that made him an extraordinary commander in 1942 and 1943 made him a disaster at the end of 1943 and into 1944. One of the few quarrels I have with the British official history is that they claim that the Americans hit Schweinfurt during a full moon period and, therefore, Bomber Command couldn't come over that night. That's ridiculous, because that same night the RAF hit Peenemünde, a much deeper target. They spoofed the night defenses so the Germans put up a huge number of fighters over Berlin, and the RAF got away with minimal losses over Peenemünde. They could have done the same thing over Schweinfurt. If the raids had been combined so that after the Eighth Air Force started a large number of fires at Schweinfurt, the RAF Pathfinders could have dropped marker flares on these fires and 600 Lancasters and Halifaxes could have destroyed fifty-seven percent of the German ball bearing industry. Unfortunately, Harris obdurately refused to believe in what he called "panacea targets"; he was not going to bomb precision targets. The irony is that, by the summer of 1944, the RAF had better capabilities of hitting targets with precision bombing than the U.S. did. In the Transportation Plan attacks on France, Bomber Command did a better job than the Eighth Air Force, because each RAF bomber bombed its target individually, so

During a fifty-plane raid on a German airfield near Brussels, the lead bombardier decided to practice for the bombing run by aiming for a large rectangular park in a residential section of the Belgian capital. With their bombers' bay doors open, all the bombardiers adjusted their bombsights. Suddenly, the lead bombardier accidentally released his own bombs over the park. Following his lead, the other bombardiers also dropped their bombloads, hitting many houses alongside the park. The pilots, navigators, and bombardiers of the lead crews were later called to a meeting with the commander of their bombardment wing. Fearing that hundreds of innocent and sympathetic civilians had been killed, the lead bombardier took full responsibility for the accident. After noting how bombardiers had been warned repeatedly about such accidents, the commander informed the crews that through intelligence sources it had been learned that the houses around the park were occupied not by Belgians but by German troops, some 1,200 of whom had been killed in the recent bombing. "Across the Channel," the commander stated, "this accident is being called a remarkable exhibition of American precision bombing. Such are the fortunes of war, gentlemen. This meeting and the incident are now closed."



A key railway junction at Falkenberg, fifty-five miles south of Berlin, pulverized by U.S. bombers.

that once the markers had gone down accurately, then the target was dead. But Harris was such an ideologue that it reached the point where he was ordered by the chief of air staff at the end of 1944 to hit more oil targets and he basically said, "Not only no, but if you don't like it, fire me!" And the air staff didn't fire him.

Lucasfilm: It seems like early on, the U.S. took the high moral road as far as bombing. The RAF bombed cities to kill workers, whereas the U.S. tried to knock out industries. Why did the U.S. position deteriorate as the war went on?

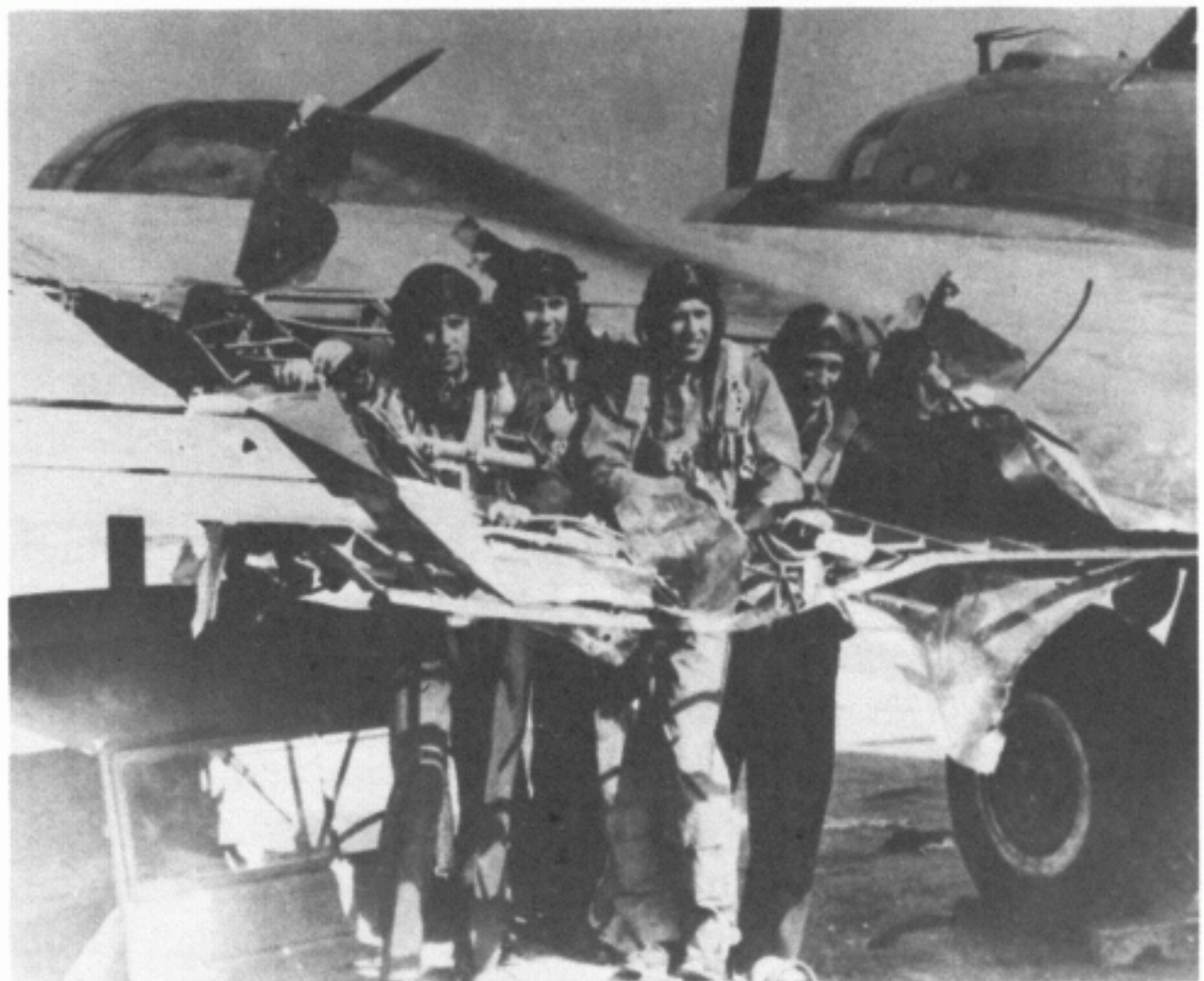
Murray: Well, the British position deteriorated as the war went on, too. During the RAF Wilhelmshaven raid in December 1939, they didn't drop their bombs, even though they saw German cruisers and maybe even a pocket battleship tied up on docks, because bombing policy at that time was that you could not drop a bomb onto a warship tied up on a dock because you might kill a dockworker. Under the pressures of war, all that changed. In 1941 and 1942, the British are forced to go to area bombing because of the capabilities of the weapons and air crews — the cities are the only target they can hit. So they're driven to it. And I think they are also pushed to that by their own prewar doctrine and proclivities. The two go hand-in-glove. But I think the reason the U.S. went in that direction is because we discovered that, while we could do precision bombing, there were large numbers of days when there was a cloud cover over Germany and we weren't going to do any precision bombing. So what did they do, seven out of ten days, do nothing with their air force? This was one reason why the Eighth Air Force gave far more support to the Transportation Plan, because when it couldn't hit oil targets or precision targets,

then it could hit cities, because the railroad station is located at the middle of every major German city. I think it was unrealistic to believe that you could drop bombs on enemy countries and not kill civilians. But in 1937 and 1938, the U.S. Army Air Force could not advertise that to Congress because the idea of killing civilians was anathema to the American people.

Lucasfilm: Was part of this policy based on the fear that the Germans would also let loose?

Murray: No, I think everybody understood in World War II — they've forgotten since — that the Germans let loose from the beginning. First in Rotterdam, then in London in September of 1940, the Germans clearly tried to do what the British were finally able to do to Hamburg; and, actually, the Germans created the first fire storm, at Belgrade, which killed near 17,000 people — that's up there with

Flak over Ludwigshafen punched this huge hole in the wing of "Rum Runner," a B-17 which nevertheless returned to its base safely.



Hamburg and Dresden. And the difference is that Belgrade was declared an open city and had virtually no industry. When the war was over, the Germans said, "Oh, we never did any strategic bombing, because we never thought of doing it" — which, in fact, is completely wrong. The Germans thought very long and hard about doing strategic bombing. The thing was that the Germans never really developed the capabilities or a large enough air force to do it. And that was partially driven by two things. First, before the war, nobody realized how large an air force you needed to do strategic bombing; and second, once the war started, only Britain and the United States, who were not involved in massive continental fighting, had the luxury to spend the kinds of resources necessary to turn out thousands of four-engined bombers a month. Again, look at the huge numbers of B-17s shot down in the summer of 1943, into the fall, and yet,

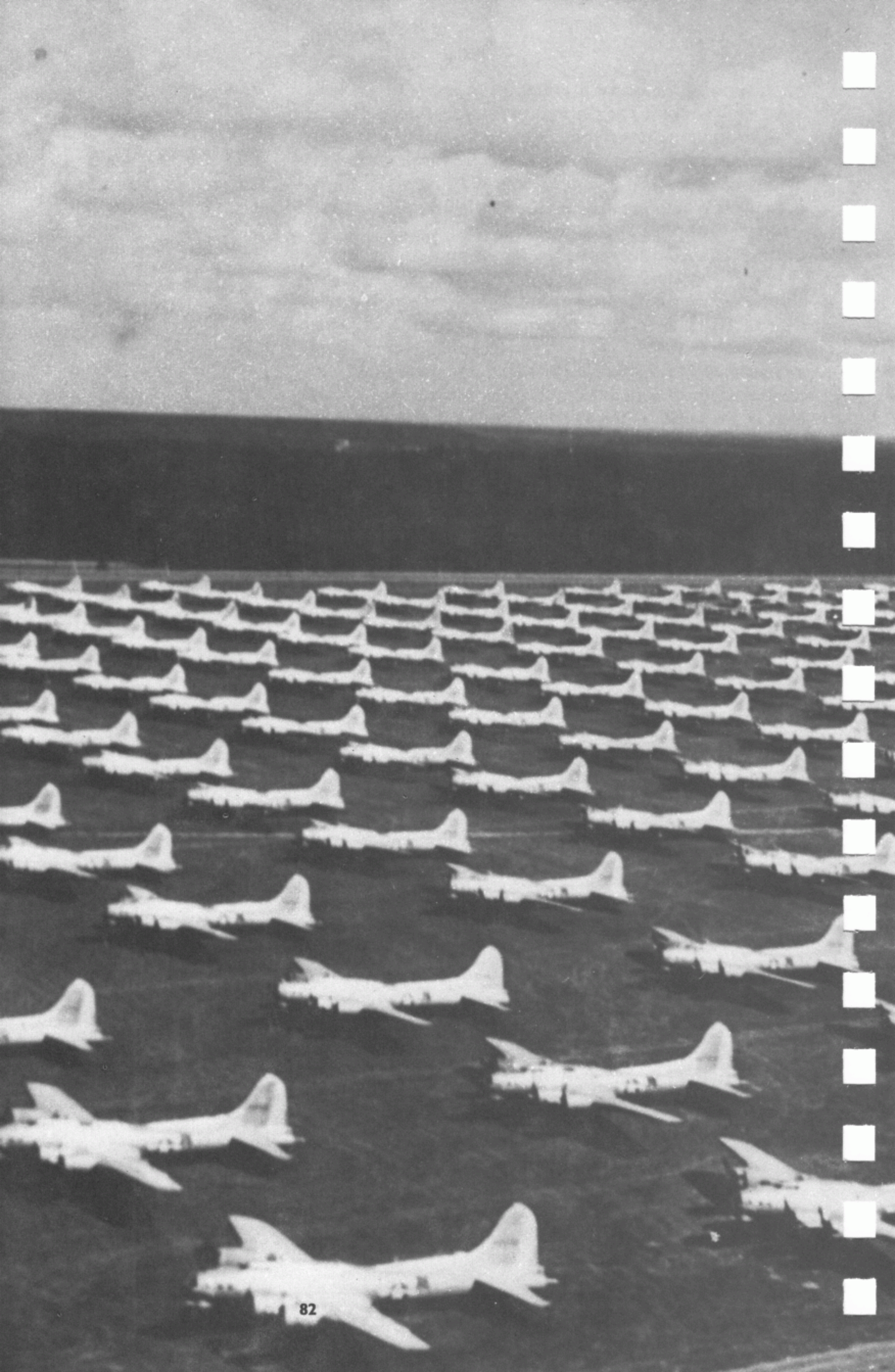
every month, the curve is going up in terms of available number of aircraft. The Germans are trying to stop the tide. They're shooting down the American and British bombers in huge numbers, but, in fact, there are more and more. The force structure grew every month!

Lucasfilm: What were the great lessons learned from the air war over Europe?

Murray: In the larger sense, the air war underlined lessons of World War I and the American Civil War: that there is no short, decisive solution to war in the modern age. Industrialized societies are capable of ginning out armies and navies and air forces and men to fight and fly and sail ships, almost ad nauseam. Massive war between industrialized states ends up in attrition of national wealth and humanity. So in World War II, the results of the air war were exactly the same as on the ground — attrition.

"We must never allow the record of this war to convict us of throwing the strategic bomber at the man in the street."

U.S. Army Air Force Brigadier General Ira Eaker





MISSION INSTRUCTIONS: PRE-FLIGHT

LOADING INSTRUCTIONS

Inside the box that this manual came in, you'll find an envelope with several floppy disks labeled *Secret Weapons of the Luftwaffe*. You'll also find a Code Wheel, along with a Reference Card. Turn to the *Loading Instructions* section of the Reference Card, which tells you how to start up the program from the floppy disks, plus how to install it on a hard disk drive. When you've finished loading the program, see the *Game Controllers* section below.

Game Controllers (Mouse/Joystick/Keyboard)

Your mouse, joystick, or keyboard cursor (arrow) keys will be referred to as the *controller* in this manual. *Controller buttons* will refer to the buttons on the mouse or joystick, as well as several keys on the keyboard.

To find out which controllers you can use with your computer, see your Reference Card.

If your computer doesn't support a mouse or a joystick, you can use the keyboard to control all of the game functions. However, flying an aircraft is easier and more enjoyable with a joystick or mouse. The joystick allows you to pilot the U.S. and German planes much the way you would in actual flight. The mouse gives you very precise control, which is helpful for positioning a fighter to attack and for aiming your guns.

Using the Controller to Select from Menus and Directories

After you've loaded *Secret Weapons of the Luftwaffe*, you'll need to make selections from several menus, often by choosing icons from those screens. You'll also need to make selections from a number of directories consisting of long lists of names, not all of which are displayed at once.

Whenever you're at a menu or screen that has a list of choices or icons, look for a floating arrow. Use your controller to move the arrow over the desired choice or icon, and then click your controller button. This procedure will be referred to as "clicking on" in the manual.

To select an item from a directory, click on its name. Sometimes, the list of names will be longer than what is displayed. To look down all the names in the directory, move the floating arrow over the down arrow icon at the bottom of the vertical bar that is located on the lefthand side of the list, and press and hold the controller button. To look back up the list, pass the floating arrow over the up arrow icon, and press and hold the controller button. There is also a small slider box inside the vertical bar, and you can use it to scan the directory: Position the floating arrow over the box, press and hold your controller button, and move the controller up or down. Release the controller button when

Preceding page: With its massive industrial strength, the United States turned out tens of thousands of heavy bombers during World War II. Courtesy of the United States Air Force

you're at the desired location in the directory. You can also click on the space in the bar above or below the box to move the directory list up and down.

This procedure for clicking on the arrow icons will be used on many screens, including the Flight Briefing Map and the In-Flight Map (see below), both of which have a horizontal as well as a vertical bar.

Choosing Sides

After you start up the game, you'll go to a menu which will allow you to choose between flying as an American and flying as a German. Make your choice by clicking on either "United States Eighth Air Force" or "German Luftwaffe." This decision is critical, since it restricts all of your selections and options to the side you've chosen. (In the manual, any notations which have a U.S. insignia next to them will be more relevant if you're fighting on the American side. Likewise, any selections which have a German insignia will be more useful if you're fighting on the German side.)

If you choose the U.S. side, your missions will largely involve strategic daylight bombing of various ground targets in western Europe, and providing fighter escort for these bombing raids. Other missions will involve trying to destroy Luftwaffe fighters in air-to-air combat, as well as utilizing fighter-bombers in the ground attack role.

As an American, you'll be flying for the U.S. Army Air Force. This was a branch of the U.S. Army at the time of World War II, and was divided into separate *air forces*, which commanded certain geographic areas. The Eighth Air Force was responsible for air operations against targets in western Europe from bases in England. (The chart below

"Do not needlessly endanger your lives until I give you the signal."

General Dwight D. Eisenhower



Luftwaffe crew prepares a Bf 109G for the day's mission.

details the organization of the Eighth Air Force, and how it compared to the Luftwaffe.)

If you choose the German side, your missions will largely involve defending German-occupied western Europe from American bomber attacks, and preventing these bombers from pulverizing key German factories, airfields, and other installations. As a fighter pilot you'll be trying to destroy the U.S. bombers, along with any fighter escort or fighter-bombers, in air-to-air combat.

The German Luftwaffe was organized into self-contained *Luftflotten*, or "air fleets," each of which covered the air operations for a given geographic area. The following chart shows how aircraft of the Luftwaffe and its Luftflotten were organized, as compared to the way the U.S. Army Air Force organized its aircraft:

U.S.A.A.F.	Number of Aircraft	LUFTWAFFE	Number of Aircraft
Air Force	1,000–3,000	Luftflotte	1,000
Wing	140–180	Geschwader	80–120
Group	48	Gruppe	36
Squadron	16	Staffel	12
Flight	4	Schwarm	4
Element	2	Rotte	2

Whether you're fighting on the U.S. or on the German side, these terms will be used frequently to describe the units you're flying with.

MAIN MENU

After you've chosen which side you want to fly on, you'll go to the Main Menu. There you'll see a large list of choices you can make:

FLIGHT SCHOOL Lets you learn and practice your aerial skills, including flying, takeoffs, landings, and firing weapons. The results of these practice missions will not count on any Combat Records.

HISTORICAL MISSIONS Allows you to fly a historically based mission, the results of which will count on your Combat Record.

CUSTOM MISSIONS Lets you create and fly customized missions. (See your Reference Card for information on how to use the Mission Builder.)

TOURS OF DUTY Challenges you to survive a given number of missions under the same circumstances that World War II pilots were required to serve.

CAMPAIGN BATTLES Allows you to command various large-scale campaign

The Allied bombing offensive so infuriated German civilians that U.S. airmen who were forced to bail out of their stricken aircraft were sometimes beaten and killed. Even Luftwaffe pilots who bailed out over their own country would be rudely treated if they were mistaken for Americans. On one occasion, a German fighter pilot was hanging from a tree in his parachute when a civilian approached him with a shotgun. "Help me down, you fool," the pilot yelled. But the civilian stood his ground, raised his shotgun, and replied, "So! The pig even speaks German!"

battles on either the U.S. or the German side, so that you may alter the historical outcome of the air war over Europe.

COMBAT RECORDS Lets you look over the records of the pilots and crews who have flown on your missions.

FILM VIEWING ROOM From here you can watch the combat action you've recorded with the gun camera.

SWITCHING SIDES Allows you to switch between the German side and the U.S. side.

EXIT FROM PROGRAM Lets you leave the simulation and return to your computer's operating system.

FLIGHT SCHOOL

Going to Flight School is the best way to learn and practice the skills that will make you more successful in air combat. The mistakes you make in Flight School won't count on any Combat Records, so use it to practice aerial maneuvers and sharpen flying skills.

When you choose FLIGHT SCHOOL from the Main Menu, you'll be presented with an Aircraft Selection menu. There you'll see a list of either U.S. or German aircraft that you can choose from. Click on the name of the aircraft you wish to fly.

Next, you'll be shown a Flight School Selection menu. This is a list of training flights to help you master particular air combat skills. After you've selected a training flight, you'll go to Flight Briefing.

HISTORICAL MISSIONS

These missions duplicate historically authentic flights that took place at different times during the air war over Europe (see the *Historical Overview* chapter for more information). As an American pilot or crew, you'll be flying B-17s, P-47s, and P-51s in an attempt to seize control of the sky from the Luftwaffe. As a German pilot, you'll be flying the "secret weapons," including the Me 262 and the Me 163 Komet, against large formations of U.S. aircraft, as well as flying the formidable piston-engined Bf 109 and FW 190. The Go 229 is the only aircraft in the simulation that did not see any combat action during the war, although its prototypes were flight-tested in late 1944 and 1945. We've created several speculative missions for this innovative "flying wing," so that you can experience how it might have performed in combat.

To fly any of these missions, you can select from a roster of pilots you've created for the side you're flying on. Each of your pilots and crew will have a Combat Record, which keeps track of their successes, failures, medals, and promotions.

Click on HISTORICAL MISSIONS to select this type of mission. You'll then move to an Aircraft Selection menu, with a list of either German or U.S. aircraft. Click on the

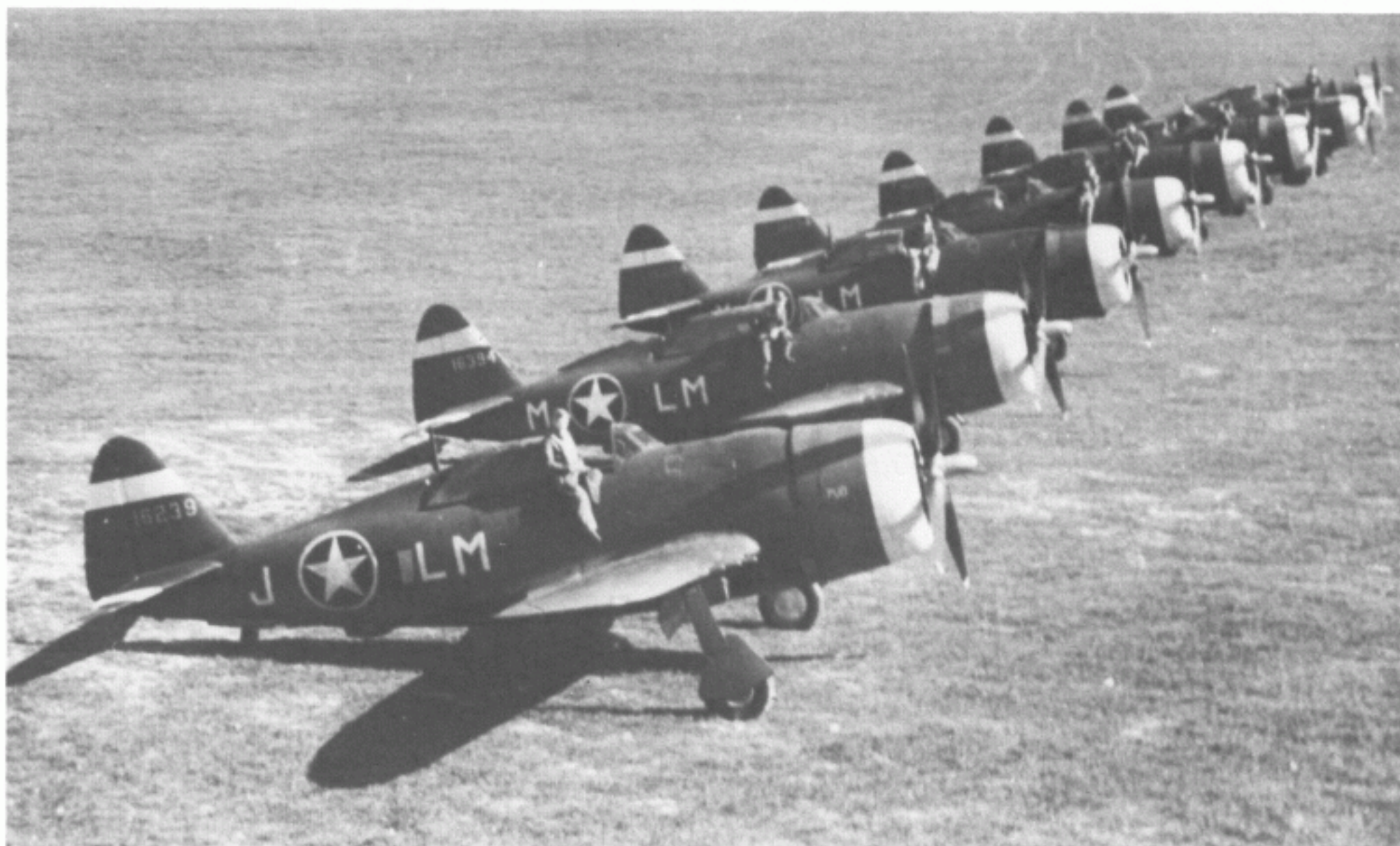
"The [Bf] 109G and the P-51D were fairly evenly matched in level maneuvering flight, but the '51 could climb and dive faster, although the 109 had an advantage in initial acceleration in a dive—which was often sufficient to allow the 109 to get away."

**U.S. Army Air Force Colonel
Jesse Thompson**

name of the plane you want to fly. This will send you to a Historical Mission Selection menu, where you can choose from several missions appropriate for the type of aircraft you've selected. These choices are ranked in increasing order of difficulty, with the first choices being the easiest. To select a mission, click on its name.

If you're flying on the U.S. side, the terms listed below, commonly used during the war, will be used to describe the general types of missions you'll be flying:

Circus A mission in which a small group of up to six bombers was used to lure the Luftwaffe into the air, where the heavy U.S. fighter protection could pounce on them.



The P-47C Thunderbolts of the 56th Fighter Group, the "Wolfpack."

Rodeo A fighter sweep without bombers. The U.S. fighters would simply fly over enemy territory looking for Luftwaffe fighters to engage. Often they were ignored by the Luftwaffe, since they posed no threat to their fighters, until the U.S. fighters began strafing airfields and other targets.

Ramrod A bombing mission in which U.S. bombers, with heavy fighter escort, would try to knock out a specific ground target. The Germans, not knowing the difference between a Circus and a Ramrod, would usually attack the bombers in either case.

Sweep Differed from a Rodeo in that the U.S. fighters would be flying ahead of a bomber formation, where they could "sweep" the sky of Luftwaffe fighters before a target was bombed.

After you've selected a mission, you'll go to the Flight Briefing Map. Or, to leave the Historical Mission Selection menu altogether, click on EXIT.

CUSTOM MISSIONS

This is where you can create and fly in those missions that you've built yourself with the Mission Builder. Choosing this brings up three menu choices:

CREATE OR CHANGE CUSTOM MISSION FLY CUSTOM MISSION EXIT

CREATE OR CHANGE CUSTOM MISSION Sends you to the Mission Builder, where you can build or modify a mission (see your Reference Card for more information about using the Mission Builder to create your own missions).

FLY CUSTOM MISSION Displays a directory of all the missions you've previously created with the Mission Builder, along with a menu that contains the following choices:

FLY MISSION Use to select and fly a mission you've already created. To do this, click on a selection in the directory, then click on this button.

RETRY Use to search a new floppy disk for custom missions if you aren't using a hard drive.

EXIT Sends you to the main Custom Missions menu.

EXIT Returns you to the Main Menu.

Click on any of these menu items to make your selection. Once you've chosen a custom mission from the directory, you'll go to Flight Briefing.

TOUR OF DUTY

In World War II, pilots and crew had to fly a set number of missions before they could be taken off of active combat duty. This was known as a **tour of duty**. The number of missions an airman had to fly to complete a tour of duty varied, depending on the side he flew on, the circumstances of the war, and the type of aircraft he flew. When the U.S. first began bombing western Europe, a B-17 crew had to fly twenty-five bombing missions to complete their tour of duty. The crew of the *Memphis Belle*, a B-17F, became the first Eighth Air Force bombing crew to reach this mark, in June 1943. Later, the minimum number of missions in a tour of duty for bomber crews was raised to thirty, then to thirty-five. U.S. fighter pilots generally had to fly a hundred missions to complete their tour of duty, since the majority of their missions did not involve contact with the enemy. On the other hand, Luftwaffe pilots did not have a fixed number of missions to fly during their careers; however, they were sometimes taken off active duty for outstanding air

"I knew some of them would that day die. Still, I was certain I would survive..., but only if I followed my private ritual. Only if I went out and found a poppy to put in my buttonhole. I had worn poppies before. I am a reasonable man, but in matters of life and death, I do not exclude talismans.

U.S. Army Air
Force navigator
Elmer Bendiner

"Our one hope is that the other side has an air force General Staff as scatterbrained as ours."

**German Minister of Armaments
Albert Speer, in 1944**

combat achievements, such as downing large numbers of enemy aircraft.

With the Tour of Duty option, your pilot or crew can fly a series of connected missions that make up a tour of duty. You'll be able to select the general type of mission for your pilot or crew to fly, but during their tour of duty the individual missions will vary tremendously, and will have a sense of the unexpected as random factors come into play. Just as in World War II, if your pilot or crew is killed in action or captured, their tour of duty will not be completed.

Starting, Continuing, and Viewing Records of a Tour of Duty

When you select TOUR OF DUTY from the Main Menu, a Tour of Duty menu will appear, with the following choices listed at the center of the screen:

**START NEW TOUR OF DUTY
CONTINUE TOUR OF DUTY
VIEW TOUR OF DUTY RECORD
EXIT**

START NEW TOUR OF DUTY Displays a series of menus that allow you to decide what kind of Tour of Duty you'll serve. The first asks you to choose the combat unit you're going to be a member of. This will determine the type of airplane you'll be flying, and the kinds of missions you'll be taking part in. After you've selected your combat unit, you'll see a directory of available pilots and crews, plus another menu with four choices:

**SELECT PILOT/CREW FOR TOD
CREATE PILOT/CREW FOR TOD
RETRY
EXIT**

SELECT PILOT/CREW FOR TOD Allows you to select an existing pilot or crew to fly a Tour of Duty. First, click on the name of the pilot or crew from the directory, then click on this button.

CREATE PILOT/CREW FOR TOD Click on this to bring up a cursor. Type in the name of a pilot or crew you want to create to fly a Tour of Duty, then press RETURN.

RETRY Use to search a new floppy disk for Tours of Duty if you aren't using a hard drive.

EXIT Returns you to the main Tour of Duty menu.

Once you've chosen a pilot or crew to fly a Tour of Duty, you'll be asked to select the time period that you want them to fly in, along with the mission emphasis. These choices are listed in order of difficulty.

CONTINUE TOUR OF DUTY Brings up a directory of the names of pilots and crew currently serving tours of duty, plus three menu choices:

CONTINUE TOD
RETRY
EXIT

CONTINUE TOD Use to select a Tour of Duty pilot or crew that you want to continue flying with. First, click on the name of a pilot or crew from the directory, then click on this button.

RETRY Use to search a new floppy disk for pilots/crews serving Tours of Duty if you aren't using a hard drive.

EXIT Returns you to the main Tour of Duty menu.

VIEW TOUR OF DUTY RECORD Brings up a list of pilots or crews who have served or are currently serving a Tour of Duty, so you can examine how the Tours are progressing. You'll also see three menu choices:

VIEW TOD
RETRY
EXIT

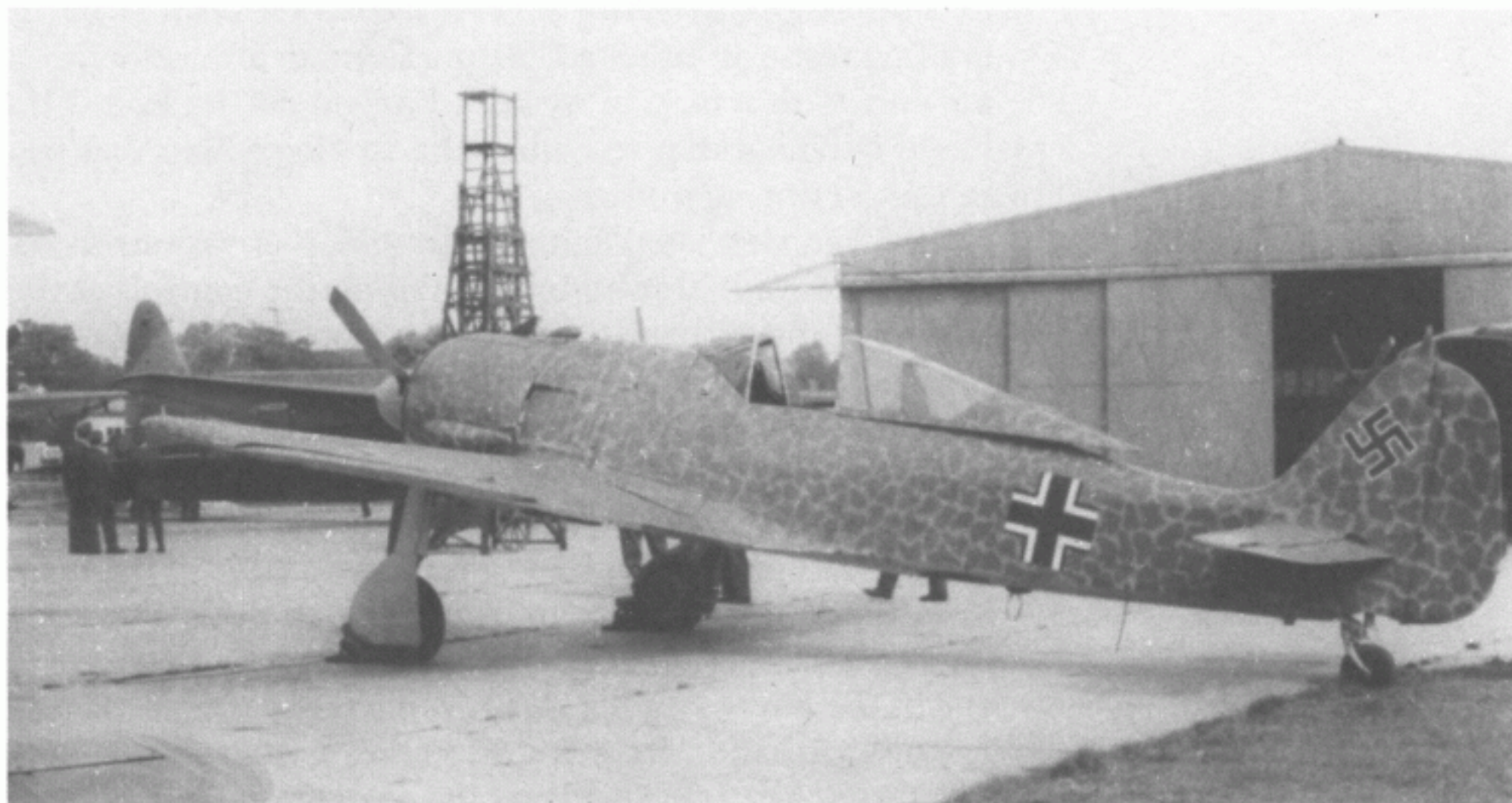
VIEW TOD Use to view the progress of a Tour of Duty. First, click on the name of a Tour of Duty pilot or crew, then click on this button.

RETRY Use to search a new floppy disk for Tours of Duty if you aren't using a hard drive.

EXIT Returns you to the main Tour of Duty menu.

EXIT Sends you to the Main Menu.

The FW 190, equally effective against U.S. bombers and fighters.



"On the days you flew, they'd let you go back through the kitchen, and you could tell the cook how you wanted your eggs fixed for breakfast. It was a 'last meal' kind of thing."

**U.S. Army Air Force Pilot
Officer Robert Davila**

Tour of Duty Length

If you're flying on the U.S. side, you can choose between flying as a fighter pilot, as a bomber pilot, or as a bomber crew. Your Tour of Duty as a fighter pilot will be from twenty-five to thirty-five combat missions, and you'll engage the enemy in all of these missions. This is roughly equivalent to a historical tour of duty, since fighter pilots, who had to fly a hundred missions on a tour of duty, usually only engaged the enemy in about a third of their missions. As a bomber pilot or crew, your Tour of Duty will be either twenty-five, thirty, or thirty-five missions, depending on the time of war and the level of difficulty you select.

If you're flying on the German side, your Tour of Duty will be longer and more difficult, and you'll need to complete at least fifty missions or shoot down at least two hundred aircraft.

Each of your pilots or crew on either side can fly a maximum of five Tours of Duty. However, a pilot or crew can only fly one Tour of Duty at a time. A Combat Record will be kept for each pilot or crew that takes part in a Tour of Duty. Flying a Tour of Duty accelerates the process by which a pilot or crew earns medals and promotions, and will help them to move to the top ten list faster.

Before flying each mission in a Tour of Duty, you'll go to Flight Briefing.

FLIGHT BRIEFING

After you've selected a training flight from Flight School, a Historical Mission, a Custom Mission, or a mission in a Tour of Duty, you'll go to Flight Briefing. This is where you'll learn about your mission in greater detail and make any last-minute modifications to it. You'll also be able to select pilots or crews to fly in your mission.

The Flight Briefing screen depicts a typical flight briefing scene on either a U.S. or a German airbase before a mission, with a map of western Europe on the wall. This Flight Briefing Map resembles the In-Flight Map that you can access during a mission.

You can view the Flight Briefing Map at various scales, and can move it around by clicking on the controls at the bottom and righthand edges of the map. These map scale controls are: **ZOOM IN**, which enlarges the map size, and **ZOOM OUT**, which reduces the map size. You can also move the map up, down, left, and right by clicking on the up, down, left, or right arrows inside the horizontal and vertical bars at the bottom and righthand edge of the map, by moving the slider box, or by clicking on the space inside the two bars.

On the Flight Briefing Map, you'll find many icons representing airfields, factories, and other installations. There will also be icons representing the aircraft on your side. To

get information about any of the installations or aircraft, click on an icon. A window will open over the map and display the relevant facts.

The course you'll fly during your mission will also be indicated on the map. If you're flying on the U.S. side, your bombing target will be highlighted.

On the bottom of the screen you'll find a horizontal menu, with these choices listed from left to right:

MAP Brings the Flight Briefing Map back after you've made another choice from this menu.

BRIEFING Brings up a detailed text description of your mission which will replace the Flight Briefing Map. This description may be larger than what is displayed in the window, so click on the up or down arrows, move the slider box, or click on the space inside the vertical bar to scroll the text up and down.

WEAPONS Lets you modify the armament of your aircraft. (See the *Weapons Load Options* section below.)

ROSTER Lets you create pilots and crew, and assign them to fly in your mission. (See the *Flight Roster* section below.)

ABORT "Scrubs" your mission and sends you back to the Main Menu, where you can choose a different mission if you want.

START Lets you begin your mission.

Weapons Load Options

When you choose WEAPONS from the Flight Briefing Map screen, the map will be replaced by a display headed by the name of the aircraft you're flying, along with a list of its standard armament. You'll also see up to three lists that indicate the various locations at which specific weapons and equipment — including a variety of guns, cannons, bombs, rockets, and fuel tanks — can be attached to your aircraft. These locations include:

BOMB BAY/CENTER RACK Lists all the armament and equipment that can be carried in the bomb bay or attached to the fuselage rack. You'll only be able to add one from the list.

INNER WING RACKS Lists all the armament and equipment that can be attached to the wing racks near the fuselage.

OUTER WING RACKS Lists all the armament and equipment that can be attached to the wing racks near the wing tips.

From each of these lists you can also choose NO ATTACHMENT, which removes any weapons or equipment you want from their location on the aircraft.

Click on any armament and equipment from these lists. Your choice will then ap-

His formation under attack by Me 109s, Colonel Beirne Lay noticed a bright metal object, which he recognized as the main exit door of a B-17, tumble past the wing of his bomber. Then, he saw a "black lump" fly through the bomber formation, nearly striking several propellers. When the lump got closer to his plane, Lay saw that it was a man, who had grabbed both of his knees and tucked them under his chin. The man came so close to Lay's bomber that he saw a piece of paper fly out of his jacket.

“Aeronautics opened up to men a new field of action, the field of the air. In so doing, it of necessity created a new battlefield; for wherever two men meet, conflict is inevitable.”

Italian General Giulio Douhet

pear next to the headings for these three lists.

While it may be tempting to load up your aircraft with every type of gun, cannon, bomb, rocket, or fuel tank it can carry, keep in mind that the more items you add to your aircraft, the less maneuverable it will be in flight, which will affect its performance in combat.

Below the weapons load options are three choices you can make to modify your aircraft settings for these missions. If you change any of these settings, however, the results of your mission will not count in any Combat Record. (If you add armament and equipment from the weapons load options, the results of your mission will still count.) Whenever you select a mission to fly, the aircraft settings you'll see will reflect the values for that particular mission.

The aircraft settings you can alter are:

DAMAGE Use to toggle between STANDARD and UNLIMITED amounts of damage your aircraft can sustain in combat. In the STANDARD mode, your aircraft can be damaged and even shot down. In the UNLIMITED mode, your aircraft can't be damaged or shot down, and it can't even crash.

AMMO Use to toggle between STANDARD and UNLIMITED amounts of ammunition. In the STANDARD mode, your aircraft will carry the same number of machine gun rounds, cannon rounds, rockets, and bombs that World War II aircraft carried. In the UNLIMITED mode, you'll have an endless supply of ammunition.

FUEL Use to change between STANDARD and UNLIMITED fuel capacity. In the STANDARD mode, your plane will carry a finite supply of fuel, and use it up at the same rate as World War II aircraft. In the UNLIMITED mode, you'll never run out of fuel.

FLIGHT ROSTER

The ROSTER button below the Flight Briefing Map allows you to create pilots and crews, and assign them to fly in your missions. If you don't create or select a pilot or crew to fly your mission, you can still fly it, but the results won't be kept in any Combat Records and you won't earn any medals or promotions.

You can also create pilots and crews to fly in any other aircraft that are taking part in a mission. As you create a roster of pilots and crew, and as they gain mission experience, they will become more proficient in battle, and you can select these experienced personnel to help you achieve more successful mission results.

When you click on the ROSTER button, a Flight Roster appears in place of the map. On the right will be a list of either U.S. or German aircraft, under the heading AIRCRAFT FOR MISSION. The aircraft that you're going to fly will be highlighted. Next to each aircraft will be the name

of the pilot or crew assigned to it, or a blank if no assignment has been made. If you've flown a previous mission with a certain pilot or crew, they will be automatically reassigned to your aircraft if they have survived. This way, you won't have to create or select a new pilot every time you fly a new mission. If you're serving a Tour of Duty, your pilot or crew will be automatically scheduled to fly your aircraft. On the left will be a directory of all the pilots and crews you've already created, under the heading AVAILABLE PILOTS. This list will give their names and their status (whether they're alive, dead, captured, or retired). For U.S. pilots, the list will note if they are fighter or bomber pilots. If this list is long, click on the up or down arrow keys, move the slider box, or click on the space inside the vertical bar to scroll the list up or down.

Creating and Deleting Pilots and Crews

Below the Available Pilots menu, you'll see three menu choices which allow you to manage your roster:

CREATE Lets you create a new pilot or crew. When you click on this button, a text cursor will appear. Type in the name of a pilot or crew, then press RETURN. If you're on the U.S. side, you'll be asked if you want that person to be a fighter pilot or a bomber pilot.

DELETE Lets you remove a pilot or crew from the directory. To do this, first click on this button, then use the text cursor to type in the name of the pilot or crew you want removed from the list, and press RETURN.

RETRY Use to search a new floppy disk for pilots or crews if you aren't using a hard drive.

Assigning Pilots and Crews

To assign a pilot or crew to a particular plane, first click on their name from the directory of available pilots or crews. Then, click on the slot next to the name of the aircraft

The adaptable Bf 109G.



“When I saw Mustangs over Berlin, I knew the war was lost.”

**Reichsmarschall
Hermann Göring**

that you want to assign that pilot or crew to fly. The pilot's or crew's name should appear next to the aircraft name. If you're flying on the U.S. side, you won't be able to assign a fighter pilot to fly a bomber, or assign a bomber pilot to fly a fighter.

To replace a pilot or crew with another pilot or crew, first click on the name of the new pilot or crew from the directory. Then, click on the name of the old pilot or crew, which will be next to the name of their assigned aircraft. This will remove their name. Clicking on a second time will put the new pilot or crew in that airplane. (Note: The pilot or crew serving a Tour of Duty cannot be replaced.)

To deactivate a pilot or crew, click on their name when it appears next to the name of their assigned aircraft.

How to Have More Successful Missions

Whenever you complete a mission, the Combat Records for all pilots and crews that fly in that mission will be updated. The more experience that each pilot or crew assigned to fly in your mission gains, the better they'll perform in future missions. When you select proven, experienced pilots or crews for your missions, they'll usually repeat their successes while flying with you. This will help you to achieve the goals of your missions more often, and earn more medals and promotions as a result.

To see the Flight Briefing Map again, click on the MAP button at the bottom of the screen.

CAMPAIGN BATTLES

If you'd like to control the “big picture” of World War II, you can choose to direct a Campaign Battle, and have a chance to change the historical outcome for either the U.S. or the German side. You'll fly a sequence of Eighth Air Force or Luftwaffe missions, starting from the summer of 1943. The outcome of your side's entire campaign rests to a large extent on what you accomplish, or fail to accomplish, in each mission you fly. Moreover, the gains and losses of each mission affect your ability to fly and direct future missions. For example, if you're playing the German side and you fail to defend German aircraft factories that are then destroyed by U.S. bombing, you may later find that you won't have enough aircraft left to mount an effective defense. After you've finished each mission, a scoring screen will let you know how your side is doing in the campaign. (See the *Post-Flight* chapter.)

The conditions for winning a campaign will vary, depending on which side you choose. For example, if you're flying a U.S. campaign, your winning conditions can include bombing key German industries until production drops below levels necessary to continue supplying the war effort. If you're directing the German side, you'll win by

protecting vital installations such as oil refineries and factories, and by making critical decisions regarding the German war economy. (For more information about the actual U.S. and German campaign strategies used in the war, see the *Historical Overview* chapter.)

Starting a Campaign

Choose CAMPAIGN BATTLES from the Main Menu to begin your campaign. You'll then see a menu with the following choices:

START NEW CAMPAIGN
CONTINUE CAMPAIGN IN PROGRESS
EXIT

START NEW CAMPAIGN Creates a new campaign, to begin in the summer of 1943. Type in the name of your campaign at the text cursor, and press RETURN.

CONTINUE CAMPAIGN IN PROGRESS Displays a new menu. On the right will be a directory of the names of the ongoing campaigns of either the U.S. or the German side. On the left will be three buttons:

CONTINUE CAMPAIGN Click on after you've selected a current campaign from the directory.

RETRY Use to search a new floppy disk for Campaign Battles in progress if you aren't using a hard drive.

EXIT Click on to go back to the main Campaign Battle menu.

EXIT Returns you to the Main Menu

The Campaign Map

Once you've started a new campaign or chosen an existing one, you'll go to a special Campaign Map. At the top of this map will be displayed the name of your campaign, plus the historical date on which you'll direct your forces into combat. After organizing your aircraft into flight groups, moving them around to different airfields, and giving them orders, you'll begin that day's mission by taking the controls of one of the planes. If you're on the German side, you can also control portions of the German economy to affect production of war materials.

The Campaign Map displays icons representing the locations of different German ground installations, such as factories, refineries, railroad yards, and Luftwaffe airfields around western Europe. It also

"In the briefing room, which was just a big old room with chairs, there was a curtain, and when they'd pull that curtain back, there was a map, with a tape pointing to where you were going. When everybody saw that tape, they would moan. If that tape had gone around the corner to London and back, you would have heard the same moan."

**U.S. Army Air Force
Pilot Officer Robert Davila**

shows U.S. airbases in England. Clicking on any of the icons on the map will open a pop-up window containing information relevant to your side. The Campaign Map also displays aircraft icons for the flight groups you've created (see *Creating and Modifying Flight Groups* below). You may see aircraft icons that represent enemy aircraft positions, as well.

At certain times in the campaign, this map may have a line through it, which represents the battle line between the Allied and German forces. This line may fluctuate, depending on whether the campaign decisions you make are beneficial to your side.

"You had to wear so much junk you'd hope you didn't have to go use the tube. You'd have your longjohns on, pants on, electric suit on, then you'd have your summer flying coveralls or your winter flying stuff on top of that, and then you had your Mae West and your parachute harness."

U.S. Army Air Force
Pilot Officer Robert Davila

At the bottom of the screen, you'll see several choices:

MAP Will bring the Campaign Map back after you have made a different choice from this menu.

STATUS Will bring up a text description of how well or how poorly your campaign is faring.

WEAPONS Lets you modify the armament of the plane you will be flying in this campaign (see *Weapons Load Options* in the

Flight Briefing section above for more information).

ROSTER Lets you create pilots and crew, and assign them to fly in your campaign (see the *Flight Roster* section above for more information).

ABORT Cancels this mission of your campaign and sends you back to the Main Menu.

START Lets you begin the day's mission of your campaign.

Directing the German Fighter Defense

If you're directing a German campaign, you'll be marshaling Luftwaffe fighters from various airfields to mount a defense against U.S. bombers and fighters. You'll be in charge of:

(1) Launching interceptions: creating flight plans and deciding which U.S. aircraft you're going to intercept in an incoming raid.

(2) Assigning the alert status to those Luftwaffe airfields within range of a U.S. attack, so that additional fighters can intercept.

(3) Moving air units between different airfields. You'll use the Campaign Map to do all this.

On each day of your campaign battle, the Campaign Map for the German side will highlight the ground targets that are most likely to be attacked that day by the Eighth Air Force (This does not necessarily mean that the U.S. will actually bomb all those targets, but German intelligence believes that some or all will be hit.) Icons representing the Luftwaffe airfields that are near these targets will also be

highlighted, designating that they have automatically been put on alert. Finally, any incoming U.S. bombers that have been spotted will be displayed, to show which direction the attack is coming from.

At the bottom of the Campaign Map screen will be the same choices discussed above: MAP, STATUS, WEAPONS, ROSTER, ABORT, and START, plus a new one, UNIT TRANSFERS. This shows all the transfer orders you've given to move various Luftwaffe air units to new airfields so that they can be used to defend particular installations. The process of moving these air units will require a certain number of days (see *Making Aircraft Unit Transfers* below).

To set up flight groups and flight plans, as part of your fighter defense, click on any airfield icon that is near incoming U.S. bomber forces (see *Creating and Modifying Flight Groups* below). To cover other targets, as well as to set up another line of defense, you can also change the alert status for each airfield (see below). These additional forces may defeat the incoming raid if none of your flight groups succeed in intercepting it.

Clicking on the desired airfield icon to set up a flight group or to change an airfield's alert status will open a pop-up window, whose selections include:

AIRCRAFT Shows the type of aircraft stationed at that airfield.

CREATE FLIGHT GROUP Allows you to build a flight group to intercept U.S. raids, and to create a flight plan that you yourself will fly. (See *Creating and Modifying Flight Groups* below.)

ALERT STATUS Sets the number of flight groups that will automatically take off from that airfield to intercept incoming U.S. aircraft (in addition to the flight groups you create). Toggles through the different alert status settings, so that either all, some, or none of the aircraft will respond.

MAKE AIRCRAFT TRANSFER Allows you to move your aircraft between different fighter bases. (See *Making Aircraft Unit Transfers* below.)

EXIT Closes the airfield window.

Changing Production in the German Economy

On the German side, in addition to directing the fighter defense, you control those sectors of the economy that provide war material for the Luftwaffe. You'll be able to choose exactly what is produced at aircraft assembly plants, aircraft engine factories, oil refineries, and even research and development facilities, where "secret weapons" are emerging. These decisions can affect what kind of aircraft will be available to fly later on in the campaign.

To command German war production, click on any factory icon on the Campaign Map. This opens up a window, which tells you the type of factory it is. If it is an aircraft factory, an aircraft engine factory, an oil refinery, or an R & D facility, you can convert it to the production of other products.

Below the factory heading is a list of production figures:

% CAP Displays the percentage of total capacity that the factory is currently operating at.

% OF INDUSTRY TOT Indicates the amount of production that this factory is contributing to the industry as a whole.

PRODUCTION Clicking on this cycles through and selects the different types of war material that this factory can produce. If you're examining an aircraft factory at the beginning of the campaign, it will be able to produce only Bf 109s or FW 190s, but will later be able to produce Me 262s, Me 163s, or Go 229s. Aircraft engine factories can produce standard piston engines, jet engines, or rocket engines. Oil refineries can produce regular fuel, jet fuel, or rocket fuel. The R & D facilities can research and produce the V-1 flying bomb, the V-2 rocket, the Me 262, the Me 163, or the Go 229.

DISPERSE Allows you to scatter production for certain industries into hidden facilities that are impossible for the Eighth Air Force to locate and bomb effectively. This option has the side effect of lowering production. Click on a second time to reconsolidate production in one centralized location.

There will be other sectors of the economy whose production you will not be able to control, such as power plants, munitions factories, and railroad marshaling yards. However, you may still need to provide fighter protection for these installations.

Directing the U.S. Bombing Campaign

On the U.S. side, your main concern will be to select strategic targets to bomb, so that you can cripple German war production. To do this, you'll command a main raid by creating and selecting flight groups and making a flight plan for that raid, which you yourself will fly in (see *Creating and Assigning Flight Groups* below).

You'll also create a series of secondary raids against as many German targets as you want. The more effective your main raid, the more likely the secondary raids are to succeed. To create a series of secondary raids, click on a German ground installation icon on the Campaign Map. A window will display information about the target, plus the following list of choices:

Flying at altitudes of 20,000 feet and higher, where temperatures often dropped to -40 degrees, U.S. bomber crews had to wear many layers of clothing to avoid freezing. When Luftwaffe planes attacked, the gunners removed their gloves to fire their machine guns, and some lost their fingers to frostbite as a result.

OF BG Lets you choose how many bombardment groups are going to bomb the target.

OF FG ESCORT Lets you choose how many fighter escort groups are going to protect the bombers en route to the target.

OF GROUND ATTACK Lets you choose how many fighter-bomber groups are going to attack the target.

To choose how many of each type of group to send against a target, click on one of these selections. Pressing the left controller button increases and pressing the right controller button decreases the number.

Creating and Modifying Flight Groups

Before you begin any German or U.S. Campaign Battle, you'll need to assign the aircraft under your command to various flight groups. A flight group is a given number of aircraft that fly together as a unit. Using the Flight Group menu (see below), you'll determine the number and type of aircraft in each flight group and then assign mission objectives by creating a flight plan. Flight groups are created from airfields, so you'll need to open an airfield window and select the CREATE FLIGHT GROUP button, to bring up the Flight Group menu.

The Flight Group Menu

Following the words PLANES AVAILABLE on the screen is a number which indicates how many total aircraft are available to be placed in all of the flight groups that you wish to create. Below the words PLANES AVAILABLE are five buttons which you'll use to determine the composition of each group:

YOU Allows you to select whether or not you are going to fly as a member of this flight group.

PLANE TYPE Click on to cycle through the different types of aircraft you can allocate to a particular flight group from the airfield. Each flight group must be made up of the same type of aircraft.

OF PLANES Lets you determine the number of aircraft in the flight group you're creating. A flight group must have at least one plane before it can fly in your mission. Press the left controller button to increase the number, and the right controller button to decrease it.

FORMATION Click on to cycle through and set the flight formation for the current flight group you're creating.

ORDERS Click on to cycle through and set the mission orders for your current flight group. If you're directing the Luftwaffe, you can choose to have your fighters attack either bombers or fighters. If you're directing the Eighth Air

"The Americans are good at making fancy cars and refrigerators, but that doesn't mean that they are any good at making aircraft. They are bluffing. They are excellent at bluffing."

**Reichsmarschall Hermann
Göring, in early 1942**

“The fighter is simply a flying gun, and its basic qualities of speed and surprise should always be used to the greatest advantage.”

RAF Group Captain Johnnie Johnson

Force, the choices vary depending upon the type of plane you choose. American fighters can fly in a bomber escort role, a free-ranging role, or a fighter-bomber role, but American bombers can fly only bombing missions.

Creating a Flight Plan

After you’ve created a flight group, you must implement a flight plan for it. To do this, you’ll plot a course on the map identifying a series of navigational points that this group will follow. A flight plan is composed of up to six locations, including its starting point (BEGIN), four rendezvous points (WAY POINTS 1–4), and an airfield to return to (LAND).

Below the flight group buttons, you’ll see a chart which looks like this:

FLIGHT PLAN	ALT	ATK
BEGIN		
WAYPT 1		
WAYPT 2		
WAYPT 3		
WAYPT 4		
LAND	DELETE	

To choose the starting point of your flight group’s mission, click on BEGIN. The word BEGIN will be highlighted, and a large circle will be drawn around the airfield. Click on a location inside the circle where you want the flight group to start its mission. A starting point icon will appear on the Campaign Map. To change the starting point, click on a different location inside the circle.

Now, look for the ALT heading on the chart. The first number in this column indicates the current cruising altitude for this flight group in thousands of feet. Click the left controller button to increase and the right controller button to decrease the altitude at which the flight group begins your mission.

To set the locations of the four Way Points, first click on WAYPT 1, and click on the desired location. An icon will appear on the map to represent the location of that Way Point. Click on the second number in the ALT column to adjust the altitude for the flight group flying toward Way Point 1. Repeat this procedure for Way Points 2, 3, and 4 if you want. You can use these different Way Points to plot a course that may confuse or divert the enemy.

In fighter sweeps, fighter patrols, and fighter escort, the flight group repeats the flight plan until it runs low on fuel and returns to base. In fighter-bomber and bomber missions, the flight group follows the flight plan only once.

If you’re flying a U.S. campaign, the bomber or fighter/bomber flight groups will automatically bomb a tar-

get if it is located where you've placed a Way Point icon. If you don't want to attack this target, locate the ATK (attack) column on the chart. The word YES will appear if an attack is to occur. Click on YES to call off the attack.

To assign each flight group to a landing area after you have assigned them different Way Points, click on LAND, then click on the desired airfield.

To remove one or more of the Way Points after you've created a flight plan, click on the Way Point you'd like to remove, then click the DELETE button, which is located to the right of the LAND button.

To cancel the creation of a flight group, click on CANCEL. When you're finished creating all of the elements of a flight group and its flight plan, click on EXIT.

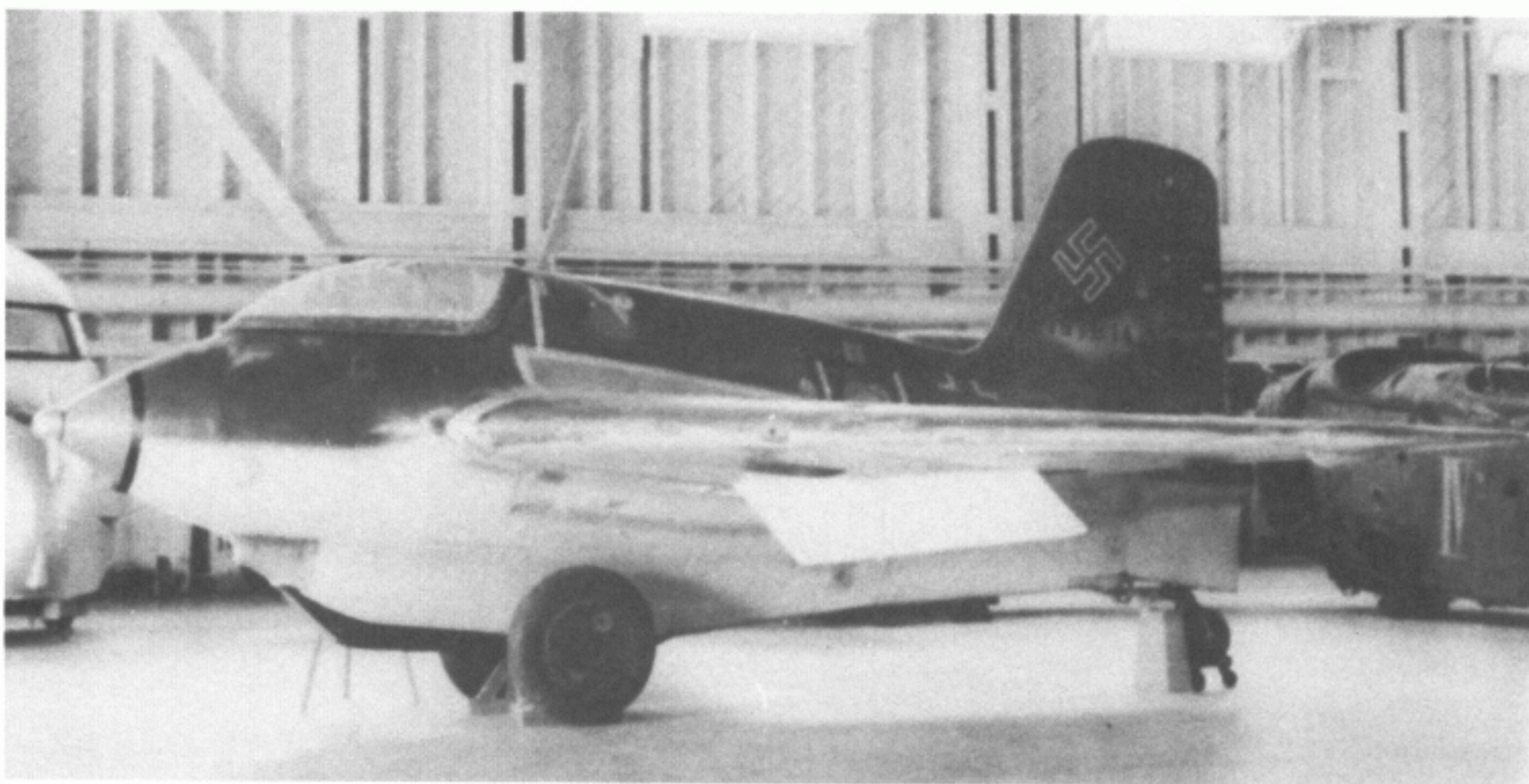
As you create flight plans for all of your flight groups, their starting points will be marked by icons on the Campaign Map. To modify a flight group that you have already created, click on its icon on the Campaign Map and repeat the above-outlined procedures.

Making Aircraft Unit Transfers

In both the German and the U.S. campaigns, you can transfer air units to different airfields. On the German side, this is vital for defending factories, airfields, and other installations from U.S. bombing raids. On the U.S. side, you may not find it as critical to move your forces around, except after D-Day, when you may want to move them from England to the Continent.

To transfer air units, click on an airfield on your side that you want to transfer aircraft from. A window will appear with the airfield name on the top. On the lower part of the window will be a button labeled MAKE AIRCRAFT TRANSFER. Clicking on this button will open a window labeled TRANSFER ORDER.

The volatile Me 163 Komet.



Beneath the name of the airfield, the following choices will be displayed:

TYPE Cycles through the kinds of aircraft that you may want to transfer.

Cycles through the number of Gruppen or Groups that you may want to transfer.

TO Sends the Gruppen or Groups to a different airfield. First click this button, then click the desired airfield icon on the map. Below **TO** will be a heading, **# OF DAYS**, showing how many days it will take to transfer that unit.

EXIT Click on when you've finished issuing your transfer order. The lengthy process of transferring will then begin. To see the status of the transfer, use the **UNIT TRANSFERS** option on the Campaign Map screen.

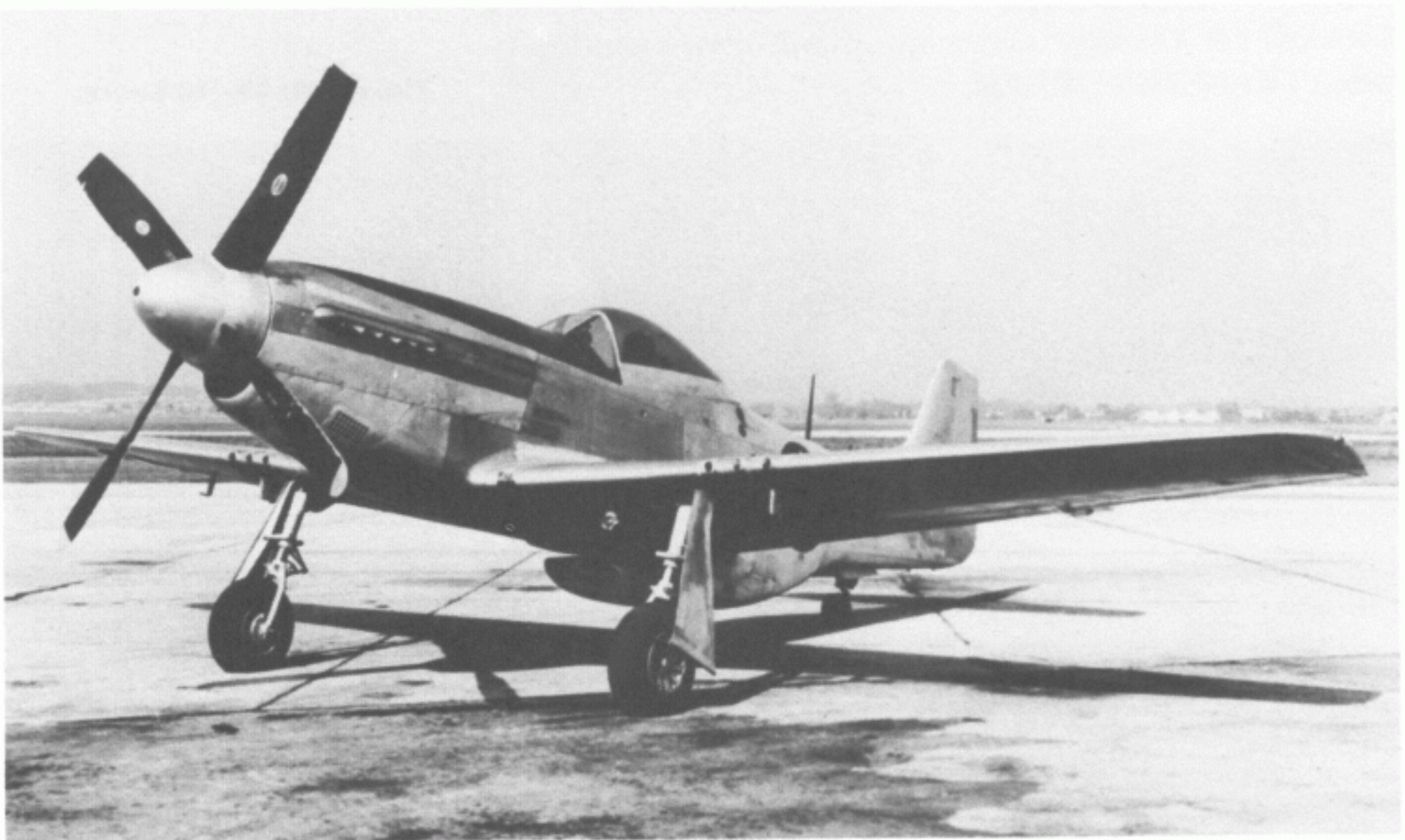
CANCEL Stops the transfer order from being issued.

In addition to moving units between airfields, you can also move units from the reserves to the airfields. A window labeled **RESERVES**, in the upper righthand corner of the Campaign Map screen, will display all the different aircraft units produced by aircraft factories and waiting to be delivered to the airfields. Click on the button labeled **MAKE AIRCRAFT TRANSFER**, which will open a window just like the Transfer Order window you accessed from the airfield icons, with all the same transfer choices.

Campaign Results

Even though your mission involves flying just a few aircraft, the success of those few aircraft will be used to gauge the success of the secondary raids that you set up for

Perhaps the best piston-engined fighter of the war: the P-51D Mustang.



that day. Whichever side you command, the decisions you make will have a direct influence on the outcome of your campaign as well. On the U.S. side, choosing key targets to bomb is vital to success. On the German side, your decisions about fighter defense and wartime production will determine whether or not your side can come out on top.

At the end of each mission, the Campaign Map will appear and display various icons representing targets that may have been hit. Click on any of these icons to learn the status of these installations, including whether they have been destroyed or damaged. If you open a factory icon, you'll also see at what percentage of capacity that factory is now operating. The map will show icons representing downed aircraft, as well. Click on any of these icons to learn the type of aircraft, and who downed it.

COMBAT RECORDS

To look over the records of various pilots and crew on the particular side you've chosen, click on COMBAT RECORDS from the Main Menu.

In the middle of the Combat Records screen, a list of all the pilots and crew you've created will be displayed. On the right will be a list of the top ten pilots and crew, based on their mission performance. On the left will be four menu choices:

VIEW Brings up the Combat Record for a particular pilot or crew. To view, first click on the name of a pilot or crew, then click on this button. You'll then see detailed information about the pilot or crew you've chosen, including rank, status, number of missions flown, number of aerial victories, and various bombing statistics.

DELETE Lets you remove a pilot or crew from the list by first clicking on this button, then typing in the name of the pilot or crew you wish to remove.

RETRY Use to search a new floppy disk for Combat Records if you aren't using a hard drive.

EXIT Returns you to the Main Menu.

Choosing COMBAT RECORDS only lets you look at pilot and crew records, and doesn't allow you to create additional pilots and crews. To do this, select the ROSTER option, which you can access from Flight Briefing after you've chosen a mission (see the *Roster* section above for more information).

*"Things don't look rosy
for our big cities."*

Feldmarschall Erhard Milch,
in March 1943





MISSION INSTRUCTIONS: IN-FLIGHT

This chapter details the different controls and instruments you'll use while you're flying *Secret Weapons of the Luftwaffe*. Except where noted, these instruments and controls have the same function in all the aircraft. For an instrument panel screen shot, with call-outs indicating the exact instruments and controls for the particular aircraft you're flying, look up your airplane in the *German and U.S. Aircraft and Weapons* chapter.

The midsection of this chapter, titled *Aircraft Operating Instructions*, will give you an overview of how aircraft are flown. And at the end of the chapter, you'll find instructions on how to use the Film Viewing Room and the In-Flight Map.

When flying an airplane from the pilot's position, you'll always see a cockpit interior, with various instruments and gauges displayed on the bottom. You'll also survey the view from the cockpit window, which you can change with the Pilot View Controls. And on the bottom of the screen a message line will flash important information throughout your mission.

The controls and instruments discussed in this chapter are grouped in the following order:

Simulation Controls Let you stop, adjust, and exit the program.

Pilot View Controls Give you the different views available from your cockpit.



Captain Robert Johnson, one of the leading U.S. fighter aces of World War II, with twenty-eight "kills."

Maneuvering Controls (including advanced mode) Allow you to move your airplane up, down, left, and right while in flight.

Airplane Controls and Equipment Many of the critical functions you'll need to use while flying a mission.

Engine Controls Determine the power of your aircraft's engine or engines.

Weapons Controls Allow you to drop bombs and fire machine guns, cannons, or rockets, depending on how the airplane you're flying is equipped.

Preceding page: B-17s of the 92d Bomb Group leave trails in the sky as they head out on a bombing raid.

Crew Position Controls (bomber only) Allow you to move to different crew positions in a bomber such as the B-17.

Gunner Position Controls (bomber only) Let you move and fire the different machine guns you can man in a bomber.

Bombardier Controls (bomber only) Allow you to use your Norden bombsight to drop a bombload accurately.









Cockpit Instruments The various gauges and levers you'll see in the cockpit of the aircraft you're flying.

"I learned firsthand that a man can resign himself to the certainty of death without becoming panicky."

Unidentified U.S. airman who survived the raid on Schweinfurt on August 17, 1943

SIMULATION CONTROLS

These controls can be used at any time during flight to stop, adjust, and exit the simulation:

Keys	Function
	Pauses flight; press any key to continue
	Turns all sounds off and on
	Turns only the engine sound off and on
	Displays version number of program
	Changes amount of ground detail, to smooth out your flight if program is running slow
	Turns accelerated time mode on and off
	Toggles between advanced and standard flight control modes
	Exits the program; returns you to your computer's operating system

PILOT VIEW CONTROLS

You can look completely around your airplane in any of seventeen different directions by using either the numeric keypad or the number keys on the top of your keyboard. For a lateral, or "wing-level," view in any direction around your aircraft, press one of the eight view keys displayed below. To look up at a 45-degree angle from your aircraft, you can switch to the "high" view mode by pressing the **0** key; while in this mode, as well, you can use the eight view keys to look in any direction around your airplane. Pressing **0** again switches you back to the "wing-level" view. From either view mode you can look straight up at a 90-degree angle from your aircraft by pressing the **5** key.

You can look around your aircraft in any direction by pressing the **S** key for the scan mode and moving your controller (this will not affect your flight path). To find out your

“When caught by the enemy in large force, the best policy is to fight like hell until you can decide what to do.”

U.S. Army Air Force Colonel Hubert Zemke, P-47 pilot and leader of the “Wolfpack”

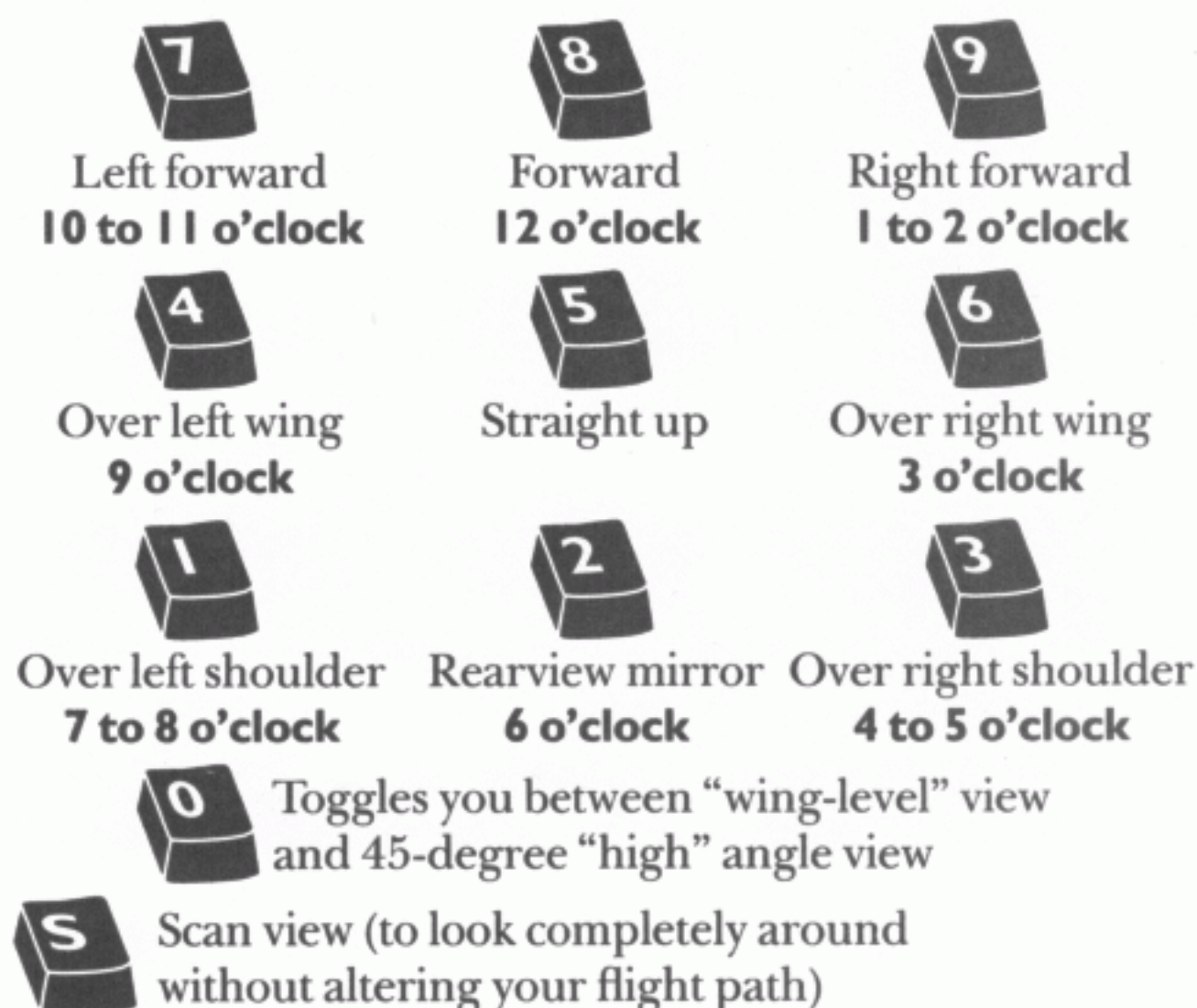
view angle coordinates, refer to the two numbers that appear in the cockpit panel. The first number shows where you are looking in vertical terms, starting at 0 degrees (level flight), and ranging from -90 degrees (straight down) to +90 degrees (straight up). The second number gauges your view from side to side. If you’re looking to the right, the number ranges from 0 degrees (straight ahead, your flight path) to +90 degrees (directly right) to 180 degrees (behind you). If you’re looking to the left, the number ranges from 0 degrees to -90 degrees (directly left) to -179 degrees (nearly straight behind you).

To help you orient yourself when in the “high” view mode — and in certain aircraft at other times — the cockpit view panel at the top of your screen will indicate what direction you’re looking in **clock face** terms. U.S. fighter and bomber crews used the clock face system during World War II to note the direction from which enemy aircraft were approaching or attacking. To understand this system, imagine that a giant clock face is superimposed on your airplane from above, with the 12 at the nose, the 3 on the right wing, the 6 on the tail, and the 9 on the left wing. Therefore, if a fighter were to attack your airplane at “12 o’clock high,” it would be diving on your nose at a 45-degree angle. On the

An FW 190 dodges a stick of bombs during a U.S. raid on German railroad yards.



numeric keypad, each of the following eight view keys occupies the clock face position to which it corresponds. (For more information, see *View Indicators* in the *Cockpit Instruments* section below.)



If you're piloting a bomber, you'll only be able to use the five forward view keys, to look over each of your wings, straight ahead, ahead left, and ahead right, respectively. To command any other view from your bomber, you'll need to move to the gunner positions, by pressing the **G** key. To find the gun position you want, consult the *Gunner Position Controls* section below.

MANEUVERING CONTROLS

An aircraft can be maneuvered in three different directions. A pilot can make the aircraft **pitch**, or move its nose up and down, by controlling the **elevators**; **yaw**, or swivel left and right, by controlling the **rudder**; and **roll**, or tilt left or right, by controlling the **ailerons**. (For a more detailed discussion of flight fundamentals, see the *Aircraft Operating Instructions* section below.)

There are two flight control modes you can choose from in *Secret Weapons of the Luftwaffe*. In the **standard** mode, the rudder is automatically coordinated with the ailerons and is not controlled separately. To maneuver your airplane in this mode, simply move your controller up or down to control pitch, and right and left to control roll. In the **advanced** mode, however, you can control the rudder separately in order to make the airplane yaw, so that you can perform

"We had a completely different system from the American pilots. They normally went home after one hundred missions. If I would have been sent home after one hundred missions, I wouldn't have had any victories at all. There were some of us who had a second tour of two hundred missions and some who had three hundred missions. As long as you were able to fly and as long as you were willing to fly, you could fly. But on the other hand, you saw them die — all of them, slowly they disappeared and that was very difficult. So you also had the feeling — It's just the time, to die very, very young."

— Luftwaffe General Walter Krupinski



Luftwaffe Major Walter Nowotny piloting an experimental night fighter with Kurt Tank, the designer of the FW 190. Courtesy of the Galland Collection

different kinds of maneuvers that require more sophisticated flying skills. To select this advanced mode, press **Alt-X**. Then, to maneuver in this mode, press the function keys and move the controller right and left to control yaw and roll, and move the controller up and down, as in the standard mode, to control pitch. (For more information, see *Flight Instruments* in the *Cockpit Instruments* section below.)











Controller Direction	Function
Forward (away from you)	Pushes down the nose of the plane
Backward (toward you)	Pulls up the nose of the plane
Right	Banks the plane to the right
Left	Banks the plane to the left

Advanced mode only

Key	Function
F5	Moves rudder hard left
F6	Moves rudder partially left
F7	Moves rudder partially right
F8	Moves rudder hard right

AIRPLANE CONTROLS AND EQUIPMENT

These keys control many of the important functions of your aircraft during a mission. (For more information, see *Airplane Control Indicators* in the *Cockpit Instruments* section below.)




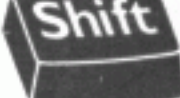


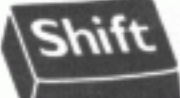


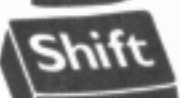


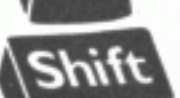


Key	Function
	Lowers and raises landing gear or skid
	Cycles through the three settings for your flaps: up, partially down, and down
	Turns automatic pilot on and off
	Cycles through the different fuel tank settings on your aircraft (the status of the active tank will be displayed on the fuel gauges)
	Releases drop tanks (fighters only)
	Turns gun camera on and off
	Sends you to Film Viewing Room to watch your gun camera movie
	Sends you to the In-Flight Map
	Lets you jump from your aircraft and parachute to safety
	Ends mission; sends you to post-flight evaluation

ENGINE CONTROLS

All of the aircraft in *Secret Weapons of the Luftwaffe* are powered by either jet, rocket, or propeller-driven engines. The following keys control the throttle or power settings of the engines of all aircraft, with the function keys applying only to multi-engined aircraft. On twin-engined aircraft, if you're facing forward in the cockpit, the left engine is numbered 1, and the right engine is numbered 2. On four-engined aircraft, when you're facing forward in the cockpit, the engines from left to right are numbered 1, 2, 3, and 4. If you're flying a four-engined aircraft, pressing the **E** key will let you view a set of engine instruments for two engines only, on either the left or the right wing. To turn off an engine, decrease its throttle until its RPM indicator reads 0. (For

Crews of the two main U.S. Eighth Air Force heavy bombers, the B-17 Flying Fortress and the B-24 Liberator, developed a less-than-serious rivalry. B-24 crews touted their plane's superior bombload capacity and speed. B-17 crews, on the other hand, bragged that the Fortress could fly at higher altitudes and was better able to withstand battle damage. Noting the B-24's large, ungainly fuselage, they cracked that the Liberator was really the crate that the B-17 was shipped in. Since the B-24s were forced to fly several thousand feet below the Fortresses, where they were easier targets for German fighters, the B-17 crews also joked that the Liberator was the best fighter escort they could ask for.

more information, see *Engine Indicators* in the *Cockpit Instruments* section below.)

Key	Function
	Increases throttle for all engines (shift key not needed)
	Decreases throttle for all engines
	Decreases the throttle for Engine #1
 	Increases the throttle for Engine #1
	Decreases the throttle for Engine #2
 	Increases the throttle for Engine #2
	Decreases the throttle for Engine #3
 	Increases the throttle for Engine #3
	Decreases the throttle for Engine #4
 	Increases the throttle for Engine #4
	Toggles between left and right set of engine instruments (four-engined aircraft — instruments for only two engines displayed)



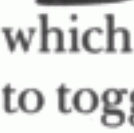

Even after being rammed by a Bf 109, this B-17 still managed to drop its bombload on the oil storage tanks at Buchen and return to its base. The vertical gashes on the left were ripped by the spinning propeller of the German fighter. Surprisingly, the tail gunner did not know that the collision had occurred until after the bomber had landed.



WEAPONS CONTROLS

All the aircraft in *Secret Weapons of the Luftwaffe* can carry and deploy a wide variety of weapons, including fuselage- and wing-mounted machine guns, cannons, and bombs, plus wing-mounted rockets. The following keys and controller buttons allow you to select, aim, adjust, and fire these formidable weapons. (For more information, see *Weapons Indicators* in the *Cockpit Instruments* section below.)

Key Function





-  Lets you choose which controller buttons will fire machine guns or cannons
-  Cycles through the different bombload configurations, and arms and selects those bombs which are to be dropped. (On bombers, this key allows you to toggle between dropping only one bomb at a time and automatically dropping them consecutively when you press **RETURN**)
-  Cycles through the different rocket configurations, and arms and selects those rockets which are to be fired
-  Turns automatic shoot mode on and off if you're manning a machine gun position on a bomber

Controller Button	Function
Left controller button or SPACE BAR	Fires primary guns or cannons
Right controller button or CTRL key	Fires secondary guns or cannons
RETURN	Drops armed bombload and/or rockets

CREW POSITION CONTROLS (Bomber Only)

In a bomber, you can fly as a pilot, a bombardier, or in a variety of gun positions. These keys allow you to move to all the different crew stations.

Key Function





-  Sends you to a gun position
(see *Gunner Position Controls* below)
-  **(Period)** Switches you between pilot's position and last gun position manned
-  Sends you to bombardier's position
-  Sends you to pilot's position

"I stay with the enemy until he is destroyed, I'm out of ammunition, he evades into the clouds, or I'm too low on gas... to continue."


**U.S. Army Air Force Colonel
Hubert Zemke**

GUNNER POSITION CONTROLS (Bomber Only)

When you're flying a bombing mission and you're in the pilot's position, you can move to any gun position by first pressing **G**, then pressing one of the keys in the chart below. The bomber will continue to fly with the controls left where you set them, unless you press **A** to turn on the autopilot before you leave the cockpit; press **P** to return to the pilot's position, or press **B** to move to the bombardier's position. If you go back to the pilot's position and then press **G** again, you'll be returned to the last gunner position you manned. To move from any gun position to a different gun position, press one of the appropriate number keys, as follows:

		
Right cheek gun	Chin turret or nose gunner	Left cheek gun
		
Left waist gunner	Top turret gunner	Right waist gunner
		
	Tail turret or tail gunner	
		
Ball turret gunner		Toggles between pilot and last gun position manned

Key Function

	Switches automatic shooting mode in machine gun position on and off
---	---

To position your machine gun when you're manning any of these gun stations, move your controller up, down, left, and right. Press your controller button to fire. The number displayed on the machine gun indicates how many rounds of ammunition remain. To set the machine gun so that it automatically aims and shoots for you, press **A**. A red light will turn on to indicate that the gun is in the auto-shoot mode. You won't be able to manually aim and shoot the gun until you turn off the auto-shoot mode by pressing **A** again. In all gun positions you'll also see Gunner Indicator Lights, similar to those in the cockpit, which indicate the status of every gun position.

BOMBARDIER CONTROLS (Bomber Only)

When you press **B** from the pilot position of a bomber, you'll find yourself in the bombardier's position looking straight down through the Norden bombsight. Your bombsight is hooked up to the automatic pilot of the bomber, so you'll actually fly the bomber and maneuver it into the ideal position for precision bombing. To do this, simply move the controller as though you were piloting the bomber from the pilot's position. From the bombardier's position, you'll still be able to use the Maneuvering Controls, Engine Controls, and, of course, those Weapons Controls that relate to dropping bombs.

In the bombardier's position, you'll find four instruments to help you position your aircraft for your bombing run: an Altimeter, an Airspeed Indicator, a Compass, and a Bank Indicator. These instruments function identically to their counterparts in the cockpit. You'll also find the same set of Gunner Indicator Lights that you have in the cockpit and at each gun position, so you can be aware of enemy fighter attacks and the status of all of your machine gun positions. See the *Cockpit Instruments* section below for more information about these instruments and lights.

When you want to learn the status of your bombload, check your Bomb Indicator Panel for the number of bombs remaining in your bomb bay. The two lights correspond to the two different settings for dropping your bombs. If the green light on the left is lit, only one bomb will drop every time you press **RETURN**. If the red light on the right is lit, all of your bombs will drop consecutively when you press **RETURN**. Press **W** to alternate between these two settings.

Using the Norden Bombsight

Your Norden bombsight can pinpoint any ground target along the flight path of your bomber, and can calculate the precise instant a bombload needs to be dropped in order to hit this target. The bombsight is used during the final phase of the bombing run when the bomber is being flown level at a constant speed directly at the target. It's important that you position your bomber correctly during the bombing run before activating, or "synchronizing," the bombsight.

When your bomber is flying a steady course, and is approaching the target area, press the **8** (up arrow) key to move the sighting mechanism of the bombsight forward and bring the center of the crosshair directly on the target. Press the **2** (down arrow) key to move back in the opposite direction. Press **5** to reposition the sighting crosshairs of the bombsight directly below your bomber. When the center of the crosshair on the bombsight is lined up on the desired target, press the **S** key. The Norden bombsight will then calculate when your bombload should be dropped to hit the

"The bombing attacks on German oil production, begun in 1944, were the largest factor of all in reducing German war potential."

**Generalmajor
Albrecht von Massow**

target. The green indicator light in the control box labeled “NORDEN” will illuminate to show that a calculation has been made, and the digital timer below will begin counting down the number of seconds until your bombload needs to be dropped to hit the target. When this timer reaches 0, press the **RETURN** key to drop your bombload. Between the time of synchronization and the release of your bombload, any speed, altitude, or heading changes will cause bombing inaccuracies.

COCKPIT INSTRUMENTS

The following is a description of all the instruments you’ll find in the cockpits of the aircraft you’ll fly in *Secret Weapons of the Luftwaffe*. All the aircraft have these instruments except where noted. For a cockpit screen shot with call-outs for the exact instruments of a specific aircraft, see the *German and U.S. Aircraft and Weapons* chapter.

VIEW INDICATORS (See the *Pilot View Controls* section above for more information.)

1 View Panel At certain times when you’re using the Pilot View Controls — and always when you’re in the “high” view mode — this panel will indicate the direction in which you’re looking from the cockpit of your aircraft, based on the clock face system of direction. When you press the **S** key to change to the scan mode, this panel will display two numbers. The first number shows how many degrees you’re looking up or down, while the second number shows how many degrees you’re looking to either side.

FLIGHT INSTRUMENTS (See the *Maneuvering Controls* section above for additional information.)

2 Airspeed Indicator Shows how fast your aircraft is flying, in tens of miles per hour. For example, if the hand on the gauge is pointing to “30,” you’re flying at 300 miles per hour.

3 Altimeter Displays the number of feet your aircraft is flying above sea level. The digital number in the center of the dial indicates thousands of feet, the small hand on the dial indicates hundreds of feet, and the big hand tens of feet. For example, if the digital display reads “8,” the big hand is on the “2,” and the small hand on the “7,” your altitude is 8,720 feet.

4 Rate of Climb Indicator Shows the rate your airplane is climbing (+) or diving (–), in thousands of feet per minute.

5 Banking Indicator Shows the roll of your aircraft as you bank (see the *Aircraft Operating Instructions* section below for a de-

Several older-model B-17s were used in Project Aphrodite, which was an attempt to knock out the V-weapons launching sites on the coast of France. These “Fortresses” were filled with explosives and flown toward the target by the crew, who then bailed out. As the unmanned drone flew on, it was guided by remote control by another B-17 and put into a steep dive to crash on the target. This project proved to be a disaster, as the drones sometimes blew up before the crew could get out. Since the B-17 was very stable in flight, it would resist going into a dive and usually missed the target altogether. One crewless B-17 that had flown past the target actually made a wheels-up landing in Germany. It was surrounded by German soldiers, who ordered the crew to surrender. When they got no response, the soldiers opened fire on the bomber, which exploded, leaving a crater twenty feet deep.



Cockpit of an FW 190A-5 and FW 190A-8

scription of roll and banking). The large horizontal bar indicates the attitude, or the position of the wings of your aircraft relative to the ground, while the small vertical bar shows the direction your tail is pointing. As you bank left or right, the horizontal bar will rotate in the same direction.

6 Rudder Indicator Shows the position of your rudder: left, center, or right. If you're flying in the advanced mode, you'll need this information to steer your plane properly, since the rudder will be controlled separately from the ailerons. (See the advanced mode controls under *Maneuvering Controls* above.)

7 Compass Gives you the direction your aircraft is headed: north, south, east, or west.

AIRPLANE CONTROL INDICATORS (See the *Airplane Controls and Equipment* section above for additional information.)

8 Landing Gear Lever Shows the position of your landing gear. If the lever is up, your landing gear is up; if the lever is down, your landing gear is down. You'll always need to lower your landing gear by pressing **L** when landing, and raise it by pressing **L** after takeoff. If you're flying a fighter and are engaged in a dogfight, it may be useful to lower your landing gear to slow your airspeed, but always check the performance data beforehand for the maximum speed you can safely fly with the landing gear lowered. (See the *German and U.S. Aircraft and Weapons* chapter for aircraft performance data.)

9 Flaps Lever Indicates the position of your aircraft's flaps, which you can change by pressing **F**. If the lever is in the up position, the flaps are up; if it is in the middle position, the flaps are partially lowered; if it is in the down posi-

"The [enemy] fighters had much more speed than we did, and you had to try to follow the plane, and between the speed and the evasive action and the rolling of the airplane and everything, it was awfully hard to get what you'd call a decent shot."

B-17 waist gunner John Doherty

tion, your flaps are down. You should keep your flaps up during normal flight, but lower them partially or fully for takeoffs and landings, to increase lift and lower the stalling speed. Lowering your flaps partially will slow your airplane and give you greater maneuverability in combat. However, your flaps can be damaged when lowered at high speeds, so be sure to check the performance data for the aircraft you're flying first. (See the *German and U.S. Aircraft and Weapons* chapter for aircraft performance data.)

10 Automatic Pilot Light (bombers only) Will be illuminated if you've turned on your automatic pilot by pressing the **A** key. If you're flying a bomber, be sure to turn on the automatic pilot before moving to the bombardier position or any gunner positions, or else the bomber will fly with the controls set where you left them.

11 Fuel Gauges Are found on the upper and lower sections of a circular dial, and give you two readings. The top gauge indicates the amount of fuel pressure remaining in the tank your aircraft is currently drawing fuel from, while the bottom gauge shows the amount of fuel remaining. The needle will point to the right when the tank is full and to the left when the tank is empty. A group of lights next to this gauge indicate which fuel tanks are currently in use on your airplane, including drop tanks. If a given light is **black**, there is either no tank attached or no fuel remaining in the tank. If a light is **red**, a tank of fuel is available but you're not using it at the moment. If a light is **green**, you're currently drawing fuel from that tank.

On the fuel pressure gauge, if the needle moves into the red zone, the tank has low fuel pressure. This indicates that you are losing fuel, which is a highly dangerous condition, since a leaky fuel tank that is still attached to your airplane could explode.

12 Gun Camera Indicator Shows the percentage of film remaining in your gun camera after you have switched it on. The number displayed will steadily decrease until the camera is out of film. The light above the indicator will go on when you press **C**, and will stay on until you have turned your camera off, or have used up all the film.

13 Hydraulic Pressure Gauge Indicates the amount of pressure in your airplane's hydraulic pressure system, which is needed to raise and lower landing gear, flaps, and other controls. If you have no hydraulic pressure, you may not be able to use these controls.

14 Clock Displays the time of day of the mission.

ENGINE INDICATORS (See the *Engine Controls* section above for additional information.)

15 RPM Indicator (one per engine) Gives you two readings. The dial shows the number of revolutions per minute (RPMs) the engine is delivering, in units of one hundred. The dial will move farther to the right as you increase your

RPMs; if it moves into the red area, you're using up fuel at a high rate and causing wear and tear on the engine. Extended usage at this level may damage the engine. The white number at the bottom of the gauge displays the throttle or power setting of the engine. For example, if it reads "90," the engine is set to operate at 90 percent of its capacity. If the number is in gray, it means that the engine has either been shut off or destroyed.

16 Manifold Pressure and Temperature Gauges (one per engine) A circular instrument divided into two gauges by a horizontal bar. The gauge on the top shows the amount of pressure in the manifold of a given engine, and the gauge on the bottom indicates the temperature of the manifold. The needles of these gauges will be in the black when you begin your mission, but will move to red if the manifold pressure drops and the manifold temperature increases. If either needle moves into the red, that engine may catch fire and explode, and you may have to reduce power or shut it off by using the function keys.

17 Oil Pressure and Temperature Gauges (one per engine) A circular instrument divided into two gauges by a vertical bar. The gauge on the right shows the amount of oil pressure remaining in a given engine, and the gauge on the left indicates the oil temperature. At first, the needles of these gauges will be in the black, but if the engines are damaged, the needles will move into the red as the oil pressure decreases and the oil temperature increases. If either needle moves into the red, the engine is in the danger zone and could start smoking, burst into flames, and explode. You may need to reduce power or shut it off by using the function keys.

18 Engine View Selector Allows you to view either the left-wing or the right-wing set of engine instruments on any four-engined aircraft by pressing the **E** key. These instruments are the RPM indicator, the manifold temperature and pressure gauge, and the oil temperature and pressure gauge.

WEAPONS INDICATORS (See the *Weapons Controls* section above for additional information.)

19 Cockpit Gunsight (fighters only) Used to aim forward-firing machine guns and cannons at enemy aircraft. The small dot in the center shows where the bullets will hit enemy aircraft if you're flying straight and level. (See the *Combat Tactics* chapter for a discussion of how to use the gunsight.)

20 Cockpit Ammunition Round Indicator (fighters only) Displays up to three numbers. The top number indicates the number of rounds remaining in the gun you're firing with the left controller button, which is normally a machine gun. The bottom right number shows how many rounds you have remaining in the gun you're firing with



Cockpit of a B-17F

the right controller button, which is normally either a second set of machine guns or a cannon. On some aircraft there will be a third number, on the bottom left, which shows the number of rounds in a second set of cannons that will fire simultaneously with the first.

21 Bomb Indicator Panel This shows the status of your bombload, if you're carrying one. On a bomber, there will be a number on the panel showing how many bombs you have left to drop. Next to this number, you'll see two lights, one marked "1," the other marked "A." If the light next to the "1" is on, one bomb will drop every time you press **RETURN**. If the light next to the "A" is on, your entire bombload will drop consecutively when you press **RETURN**. To toggle between these two lights, press the **W** key.

On a fighter, as many as three lights will be illuminated on the panel. The two outer lights indicate the status of wing-mounted bombs, and the inner light refers to the fuselage-mounted bomb. These lights will be **black** if you have no bombs to drop, or have already dropped them. When any or all of these lights are illuminated **red**, bombs are being carried but are not armed to be dropped, which you can do by pressing **W**. When any of the lights are illuminated **green**, they are armed to be dropped. Pressing **W** cycles you through all the possible configurations for dropping the bombs you carry. (Note: wing-mounted bombs are always carried in pairs.) When you press **RETURN**, all bombs symbolized by the illuminated green lights on the panel will be dropped.

22 Rocket Release Indicator (fighters only) Certain fighters can be optionally fitted to carry rockets. The Rocket Release Indicator shows the status of the rockets that are

mounted under each wing. Two lights will be displayed on the instrument panel, one for the rocket pack under each wing. If a light is **black**, there is no rocket pack on that wing, which indicates that you're either not carrying rockets or have already fired them. If a light is **red**, a rocket pack is available but has not yet been armed to fire. You can arm it by pressing the **R** key. If a light is **green**, a rocket pack is armed and is ready to be fired. All active rockets can be fired by pressing the **RETURN** key.

23 Gunner Indicator Lights (bomber only) Give you the status of each of your bomber's machine gun positions. From the top light down, these eight lights represent the nose gun or turret, the two cheek guns, the top turret, the ball turret, the left and right waist guns, and the tail gun or turret. The location of each light corresponds to the actual machine gun position on the bomber. At each gun position, and in the bombardier's position, you'll find the same group of lights. The chart below tells you how to read these lights while you're flying your bomber, so that you can switch to those threatened gun positions and mount a defense.

Color of Light	Gun Status
Gray	Gun idle
Yellow	Enemy fighters approaching the field of fire of that gun; an attack from that direction could occur
Black	Gun is either out of ammunition or has been destroyed.
Red	Gun has been switched on to automatic shoot mode
Green	Gun is firing at enemy fighters in automatic shoot mode

These colors may be different on some computers. Consult your Reference Card to see which colors your computer uses.

No guns will shoot at enemy aircraft automatically when your bombing mission begins. To ward off first attacks by enemy fighters, you must move to each individual gun position and either fire the machine guns manually or set each gun to fire automatically. To put the guns into this auto-shoot mode, press **G**, then press the number of the gun position you want to move to (see the *Gunner Position Controls* section above to choose a particular gun position). When you've moved to that position, press the **A** key. A **red** light on the machine gun barrel will illuminate, indicating that the gun has been set for the auto-shoot mode. As long as the machine gun is in this mode, you won't be able to manually

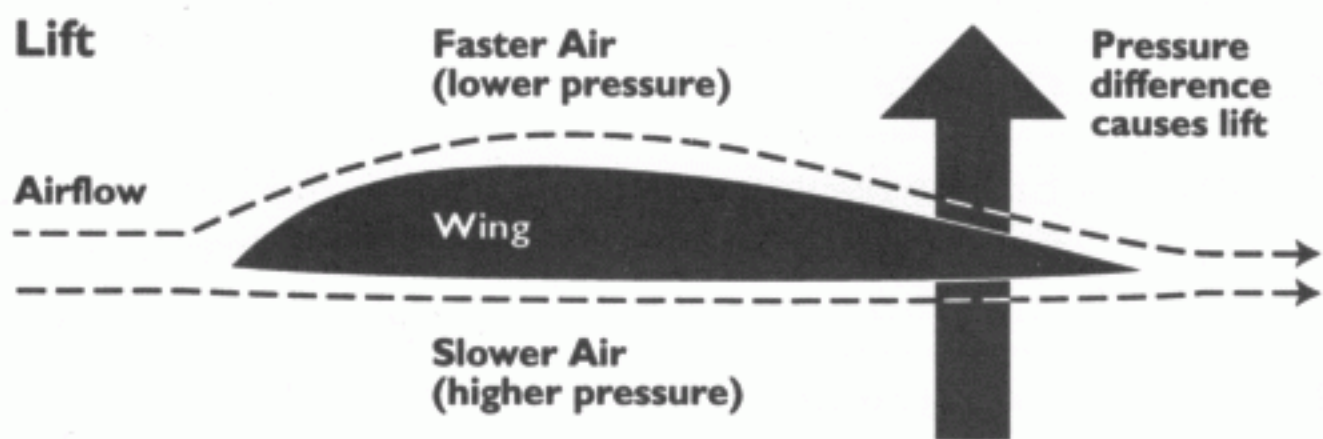
move and shoot the gun. Pressing A again will turn off the auto-shoot. Return to your pilot's seat by pressing **P**, or move to the bombardier's position by pressing **B**. The Gunner Indicator Lights in the cockpit, in the bombardier's position, and in each gun position will be red for every gun position that you've switched to the auto-shoot mode. When enemy fighters attack, these lights will flash green as your machine guns fire back.

AIRCRAFT OPERATING INSTRUCTIONS

The following discussion covers the dynamics of flight and how they pertain to operating and maneuvering your aircraft. Those sections that will be useful to you in the simulation are in italics.

Flight Fundamentals

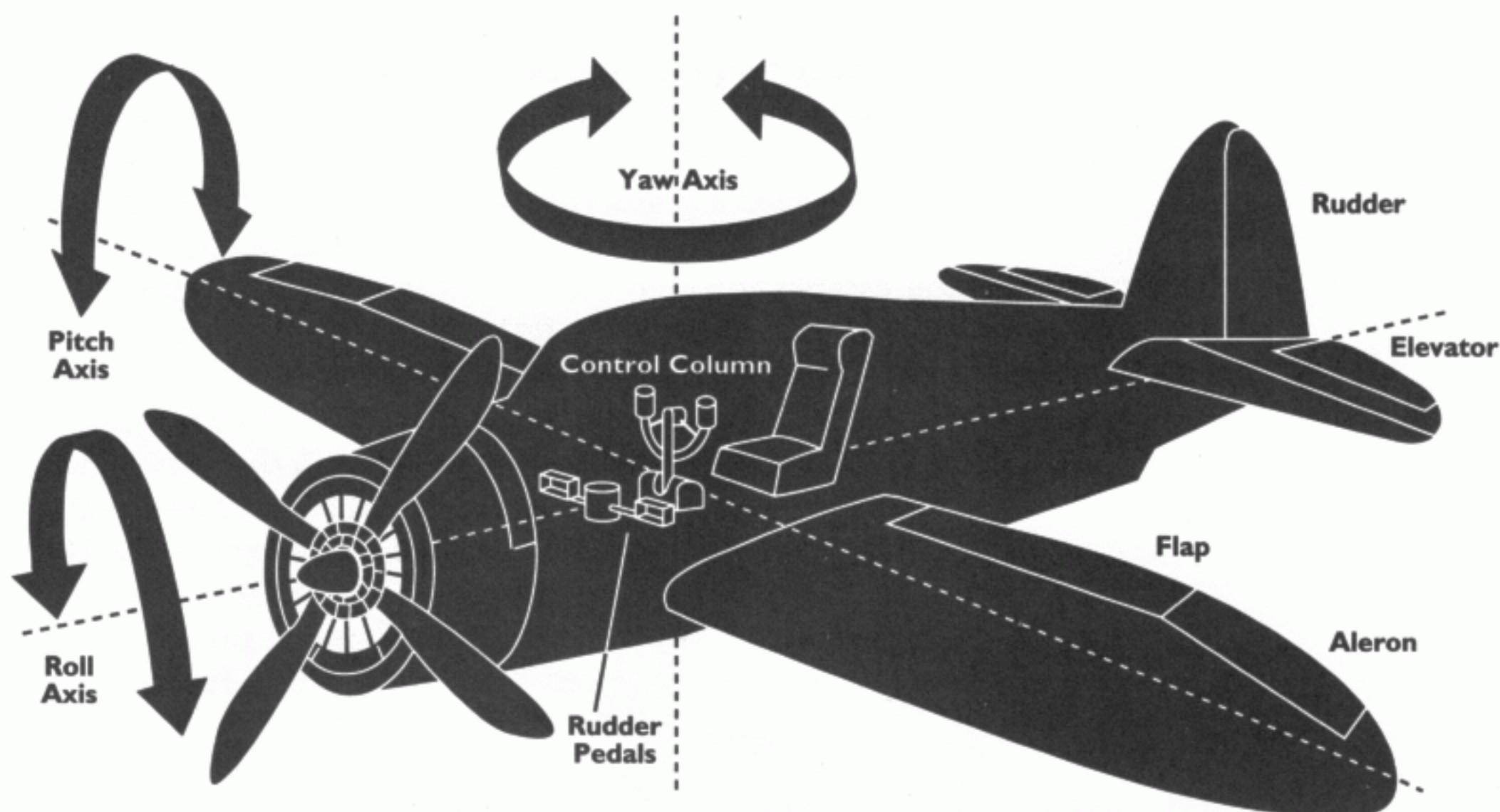
An airplane is affected by four fundamental forces: **Gravity**, **lift**, **drag**, and **thrust**. **Gravity** is the force that normally keeps the plane on the ground or pulls it toward the earth while it is in flight. **Lift** is the force which acts against



gravity and pushes the aircraft upward. As air flows around an airplane's wing, high- and low-pressure zones form around it to create lift. The amount of lift an airplane's wing creates must be more powerful than the opposing force of gravity, or the plane will not fly. The wing needs to have a streamlined shape, so that there's always a smooth flow of air around it. Otherwise, it will produce too much wind resistance, or **drag**, and the amount of lift will be reduced. Drag is the force which acts against the forward movement of the airplane. To create a smooth flow of air around the wing of an airplane so it can remain in the air, an engine is used to push the aircraft through the air by providing forward **thrust**, or movement. Thrust is the force that opposes drag, and the greater the forward thrust, the more lift is created. As a result, even a large and heavy airplane will fly as long as it is equipped with a powerful engine.

Aircraft Engines

There are three main types of engines used to provide the power that allows an airplane to fly: **reciprocating engines**, **jet engines**, and **rocket engines**. Of these, the recip-



reciprocating engine is the most widely used. This is the engine used by propeller-driven aircraft, and is similar to an automobile engine. The reciprocating engine burns a mixture of gasoline and air, which forms a fine spray and then explodes inside cylinders, causing pistons inside the cylinders to move up and down. The motion of the pistons rotates a crankshaft, which in turn spins the propeller, creating forward movement. Reciprocating engines are heavier, slower, and less powerful than jet and rocket engines, but they operate better at low speeds. Their power is measured in horsepower.

For higher-speed aircraft, jet engines are used. The first successful jet engine was developed by the Germans in the 1930s and is known as a **turbojet**. A jet engine is shaped roughly like a cylinder and operates by taking in air through a large opening in the front. The oxygen in the air is then burned with fuel in a combustion chamber, and the exhaust formed by this combustion escapes out the rear of the engine with tremendous force. This escaping exhaust causes the engine to move in the opposite direction, thus providing forward thrust. Most jet engines today are **turbofan** engines, which differ from turbojets in that they have a large fan at the opening, which draws in large amounts of air, part of which is burned with the fuel while the remainder is added to the exhaust to create even greater thrust. The power of a jet engine, as well as that of a rocket engine, is measured in pounds of thrust.

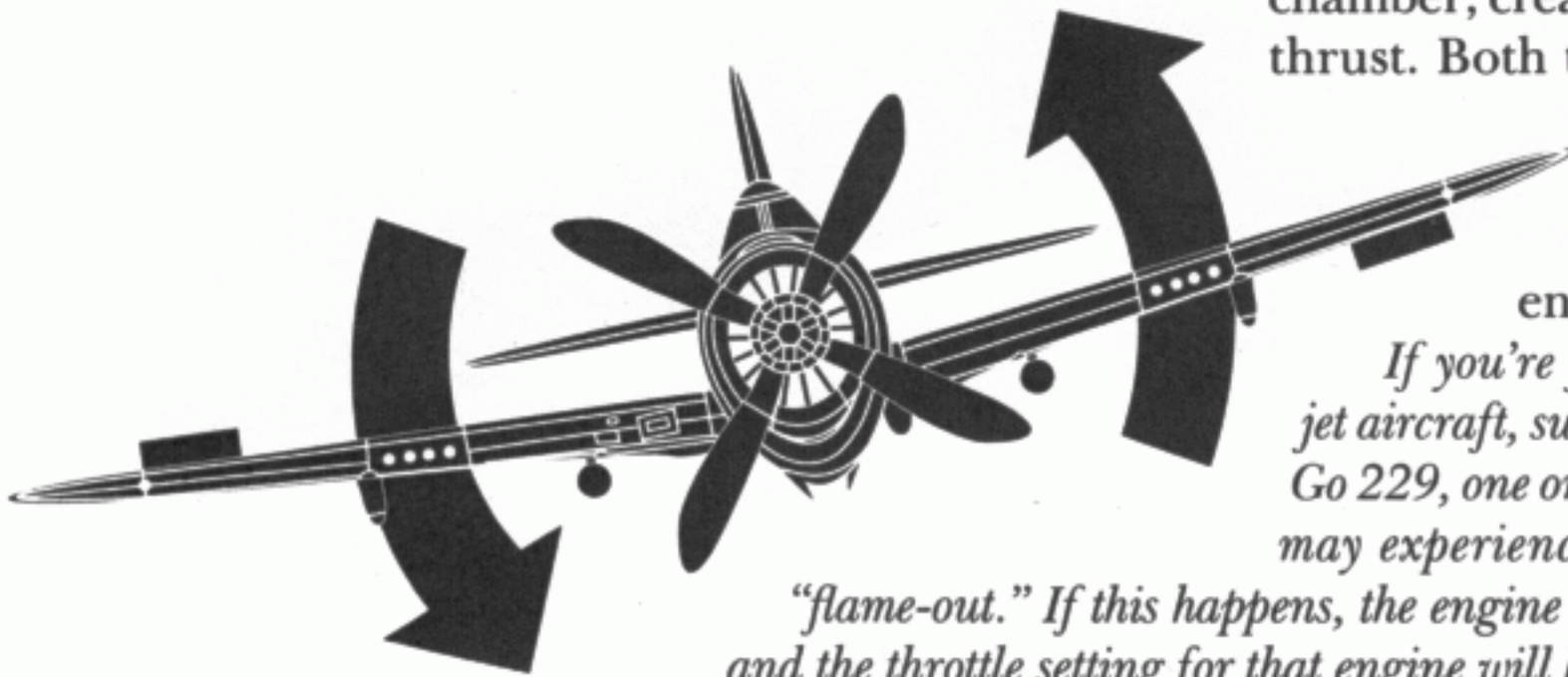
The most powerful of the three engines is the rocket engine, which utilizes many of the same principles as the jet engine. However, unlike a jet engine, which burns oxygen in the atmosphere, a rocket engine carries its own supply of oxygen and therefore has no opening in the front to draw in

air. Rocket engines are much more dangerous than jet engines, since they can, and do, explode. The two main types of rockets used in World War II were solid-fuel rockets and liquid-fuel rockets. A solid-fuel rocket burns a plasticlike material called a **grain**, consisting of a fuel and an oxidizer, in a combustion chamber. The gas created by this combustion escapes through the rear of the rocket, creating forward thrust. The German R4M air-to-air missile was a solid-fuel rocket. A liquid-fuel rocket burns liquid fuel and liquid oxygen, which are stored in separate tanks. The fuel is first cooled and then ignited with the oxygen in the combustion

chamber, creating exhaust gas and thrust. Both the German Me 163 and the V-2 rocket were powered by liquid-fuel rocket engines.

If you're flying a multi-engined jet aircraft, such as the Me 262 or the Go 229, one or both of your jet engines may experience what is known as a

"flame-out." If this happens, the engine will not be operational, and the throttle setting for that engine will be at 0. To restart it, increase the throttle setting for that engine by using the function keys when your aircraft is below 13,000 feet and your airspeed is below 186 miles per hour. At altitudes and speeds greater than these, you may have difficulty restarting the engine and it may even catch fire. (See the Engine Controls section above for more information.) Regardless of the type of engine that powers your aircraft, you should always monitor your RPM indicators and your manifold temperature and pressure and oil temperature and pressure gauges to prevent engine damage. Operating an engine frequently at maximum RPMs, a condition U.S. pilots referred to as "war emergency power," is a major cause of engine overheating and damage, so try to avoid leaving your engines set for maximum RPMs. If the needles for any of your engine gauges begin to move into the red, look out the window to see if the corresponding engine is smoking or flaming, and decrease the power to that engine. If the condition of the engine is severe, turn it off altogether by using the function keys to set the throttle for that engine at 0. If you switch off a propeller-driven engine, it will automatically disconnect itself from the propeller and will be "feathered." Your fuel supply should be constantly monitored, too. Watch for any drops in fuel pressure, which could indicate a leaky fuel tank that could soon explode, and keep an eye on your fuel consumption. If you're flying a fighter and are carrying drop tanks, your fighter won't be as maneuverable, so you should always jettison your tanks before engaging enemy aircraft. Also, if you fail to jettison your drop tanks and are hit by enemy gunfire, your tanks could explode. If you're flying an Me 163, your fuel supply is extremely volatile, so you should make an extremely smooth landing. Otherwise, your remaining fuel could explode as you touch down.



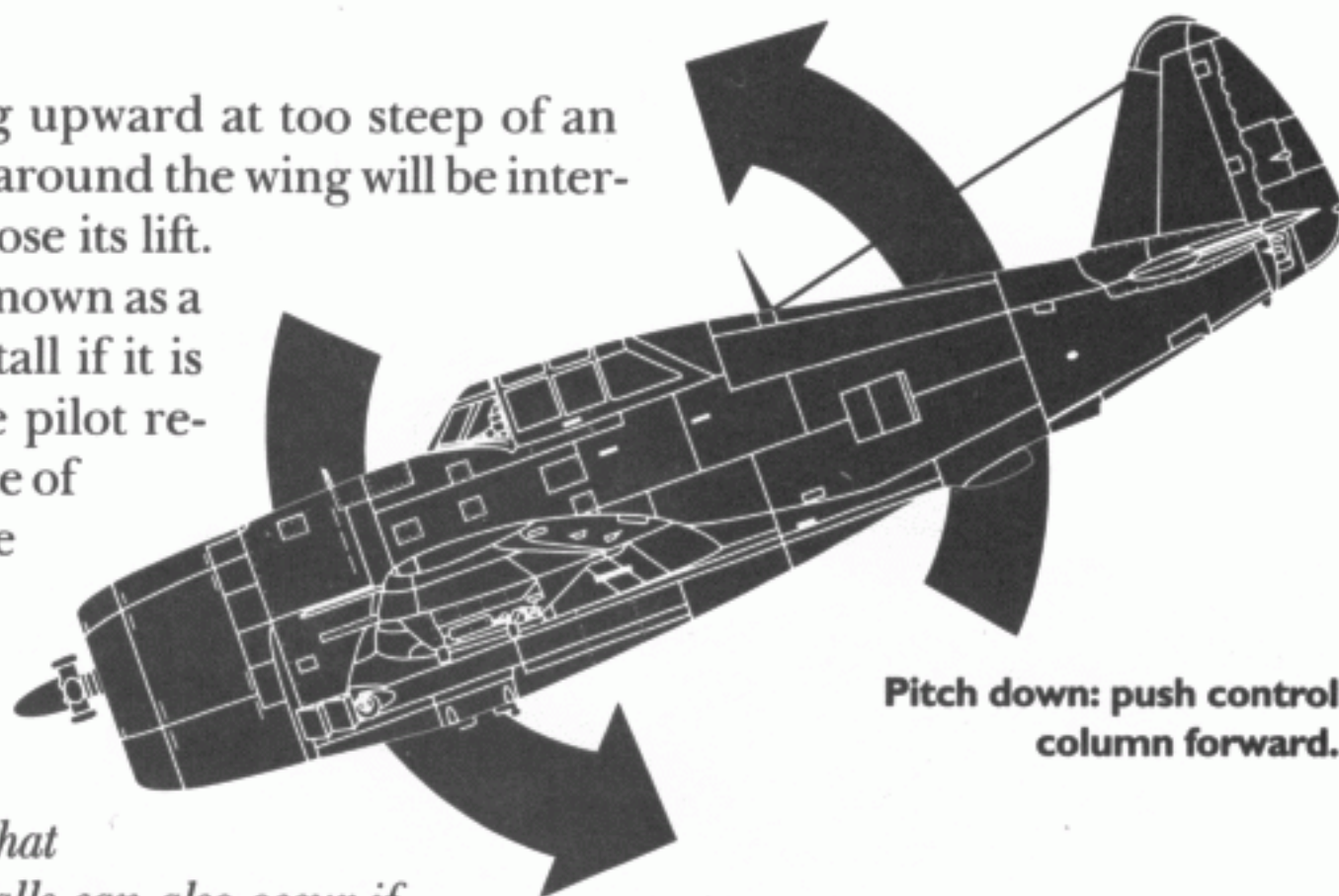
Roll right: push control column right.

Stalling

If an airplane is climbing upward at too steep of an angle, the smooth flow of air around the wing will be interrupted and the aircraft will lose its lift.

This dangerous situation is known as a **stall**. An airplane can also stall if it is flying too slowly. Unless the pilot regains lift by dropping the nose of the aircraft and allowing the aircraft to build up enough speed, the plane will go out of control and crash.

*Your aircraft may stall if you let its airspeed drop below what is called the "stalling speed." Stalls can also occur if you pull your nose up at too sharp an angle. If you stall, push the nose of your aircraft down by moving the controller forward, until the message **STALL RECOVERED** appears on the screen. Then, quickly pull back on the controller until your aircraft is flying level again. Beware of stalling when you're trying to engage an aircraft that's at a much higher altitude, and always gain altitude gradually. Also, keep an eye on your airspeed indicator, and listen for the distinctive sound that your aircraft makes when it is about to stall.*

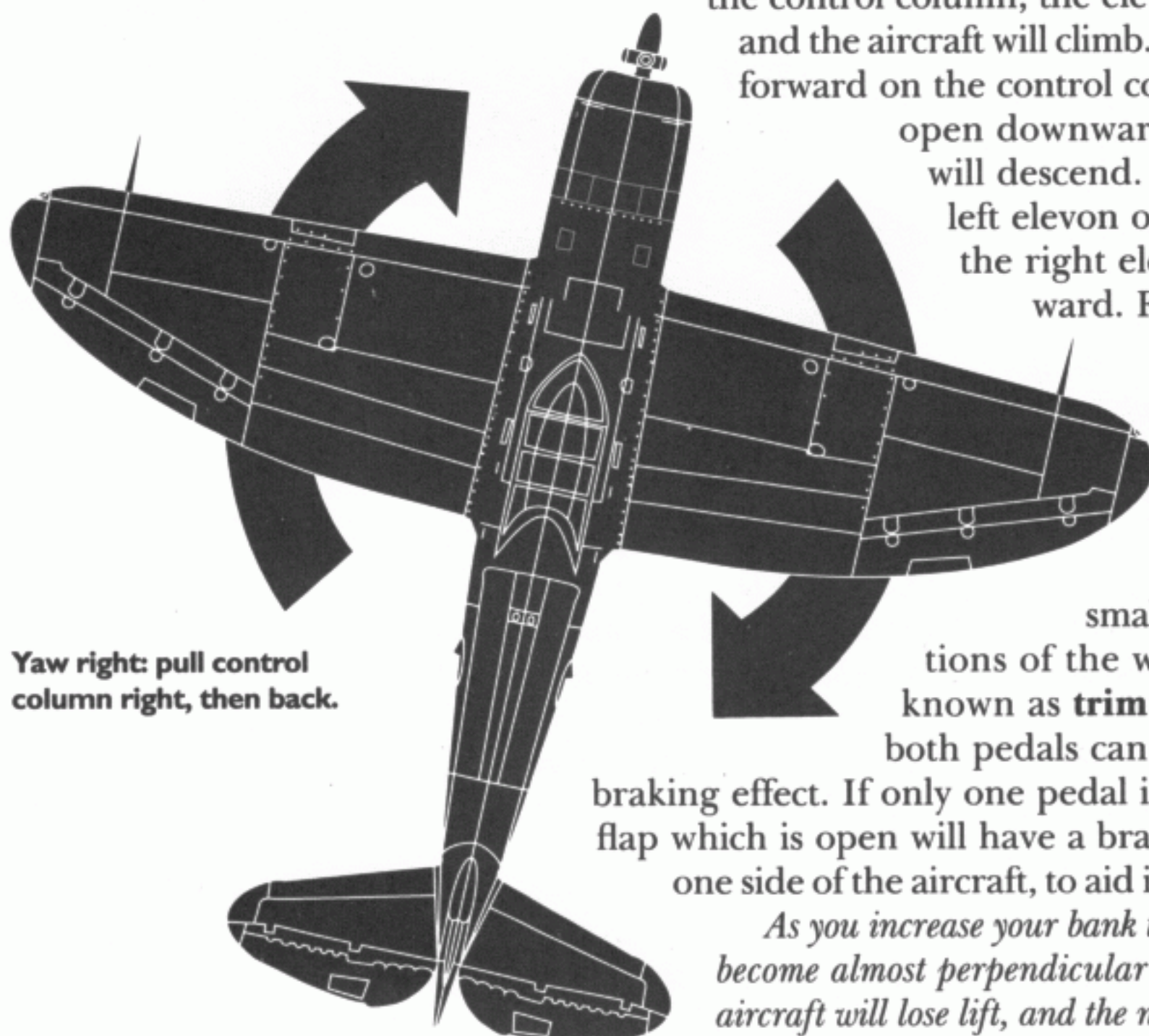


Pitch down: push control column forward.

Maneuvering

As discussed earlier, a conventional aircraft can **pitch**, or move up and down; **yaw**, or swivel left and right; and **roll**, or tilt left or right. A **control stick** or **column** is used to control pitch and roll, and the pilot steps on **rudder pedals** to control yaw. To make an aircraft dive, or pitch down, the pilot pushes forward on the control stick. This moves the trailing-edge (or rear), horizontal portions of the tail, called **elevators**, down. To climb, the pilot makes the plane pitch up by pulling back on the stick, which moves the elevators up. To turn, the pilot moves the control stick either left or right, which creates roll by raising and lowering the small, trailing-edge sections of the wing near the wing tips, called **ailerons**. At this time, the pilot will also step on either the left or right rudder pedal, which creates yaw by moving the trailing-edge vertical segment of the tail, called the **rudder**. This will swing the nose of the plane either left or right. As a plane rolls, its wings will tilt more and more to the side it is turning toward. This is called a **bank**, and the more steeply the plane banks, the sharper the turn will be, up to a full ninety degrees, when the wings will be pointing straight up and down. The more a plane banks, the more lift is lost, so a pilot will usually increase the throttle setting while making a turn. The German Go 229 and the Me 163 were both tailless aircraft that relied on **elevons** to maneuver. As its name suggests, an elevon is a control surface that combines the

functions of the elevator and the ailerons of a conventional aircraft. It is a large, trailing-edge (or rear) section of the wing which opens upward or downward whenever the control column is moved. If the pilot pulls back on the control column, the elevons open upward and the aircraft will climb. If the pilot presses forward on the control column, the elevons open downward and the aircraft will descend. For left turns, the left elevon opens upward, and the right elevon opens downward. For right turns, the left elevon opens downward and the right elevon opens upward. Also, two rudder pedals open



Yaw right: pull control column right, then back.

small trailing-edge sections of the wing near the tips, known as **trim flaps**. Depressing both pedals can give the aircraft a braking effect. If only one pedal is pushed, the trim flap which is open will have a braking effect on that one side of the aircraft, to aid in turning.

*As you increase your bank turn, your wings will become almost perpendicular to the ground, your aircraft will lose lift, and the nose will start to drop. To counter this, pull back on the controller slightly or increase your throttle setting when you bank. To come out of a bank turn and return to level flight, move your controller in the opposite direction of your bank. In the standard flight control mode, the rudder is coupled with the ailerons, and turns are accomplished easily without any sideslipping (when your airplane flies in a different direction from where it's pointed). In the advanced flight control mode, however, the rudder is moved independently by the function keys. Therefore, when banking for a turn in the advanced mode, you must move the rudder in the direction of the turn in order to prevent sideslipping. Having independent control of the rudder can allow you to pull off many difficult maneuvers. For example, if you're attacking an aircraft that is making a tight turn, you can yaw, or pivot your aircraft on its vertical axis, to adjust your aim. An extremely sharp turn that you can pull off only with the rudder is called the **hammerhead turn**. To execute this, make a steep climb at full throttle until your airspeed is less than 100 miles per hour and you're close to stalling speed. Then, give the airplane full left or right rudder. When the airplane has yawed around a full 180 degrees, center the rudder, ease back on the throttle, and recover to level flight.*

Takeoffs and Landings

Flaps are the large, trailing-edge sections of the wings that allow an aircraft to gain lift for takeoffs, and slow it down for landings. When they are extended downward, the added lift lowers the stalling speed of the airplane; when they are partially extended, they can slow an airplane down in flight. The wheels of the aircraft and their supports, called **landing gear**, are retracted and extended during takeoffs and landings. When taking off, a pilot brings the airplane to its maximum speed, in order to create lift. As the plane moves down the runway at ever-increasing speed, the pilot will move the elevator up, to pitch the nose up, and will also lower the flaps, to create even more lift. When the plane gains enough lift to counter the force of gravity, the plane will take off and fly. Once the plane is airborne, the pilot will raise the flaps and move the elevator to a neutral position. When landing, the pilot will make what is known as an **approach glide** by pushing the nose of the plane down and reducing the power of the plane during its descent so that it is nearly gliding toward the runway. However, reducing power too much will decrease the amount of lift, so the pilot must lower the flaps, to increase lift and reduce the stalling speed. At this time, the pilot will also extend the landing gear. As the plane nears the runway, the power will be nearly off, and the pilot will level the plane out. When the plane touches down, the pilot will turn the power off.

To take off from an airfield, partially lower your flaps and increase your throttle until the white digital number at the bottom of the RPM indicator reads "100%." As your aircraft moves down the runway, wait until the airspeed exceeds 100 miles per hour for propeller-driven aircraft, 135 miles per hour for jet aircraft, and 180 miles per hour for the rocket-powered Me 163. Then, pull back on your controller to become airborne. Retract or jettison your landing gear, raise your flaps, and decrease your throttle setting to conserve fuel. When approaching an airfield to land, slow your airspeed by decreasing the throttle setting as you begin your descent. Gradually flatten your descent, then line up your aircraft with the airstrip. As you continue to descend, lower your flaps and your landing gear, and decrease the throttle setting until it is just above the stalling speed of your aircraft. (If you're flying an Me 163, you must land very gently on its landing skid, or the airplane will explode.) When you touch down, decrease the throttle setting to 0 and let your aircraft taxi until it has come to a complete stop.

"When they peeled off to attack, they came in so close together that by the time one ship had shot us up and banked away, the next one in line had his sights on us."

U.S. Army Air Force pilot Charles W. Paine, describing Luftwaffe fighter tactics

"A B-17 turned gradually out of the formation to the right, maintaining altitude. In a split second, the B-17 completely disappeared in a brilliant explosion from which the only remains were four balls of fire, the fuel tanks, which were quickly consumed as they fell earthward."

U.S. Army Air Force Lieutenant Colonel Beirne Lay, Jr., who flew in the August 17, 1943, bombing mission on Regensburg

FILM VIEWING ROOM

You can use the gun camera to record your aerial action on film, and then watch this film in the Film Viewing Room anytime during a mission. You can also save these film clips and view them in the Film Viewing Room at any future time, except during a mission.

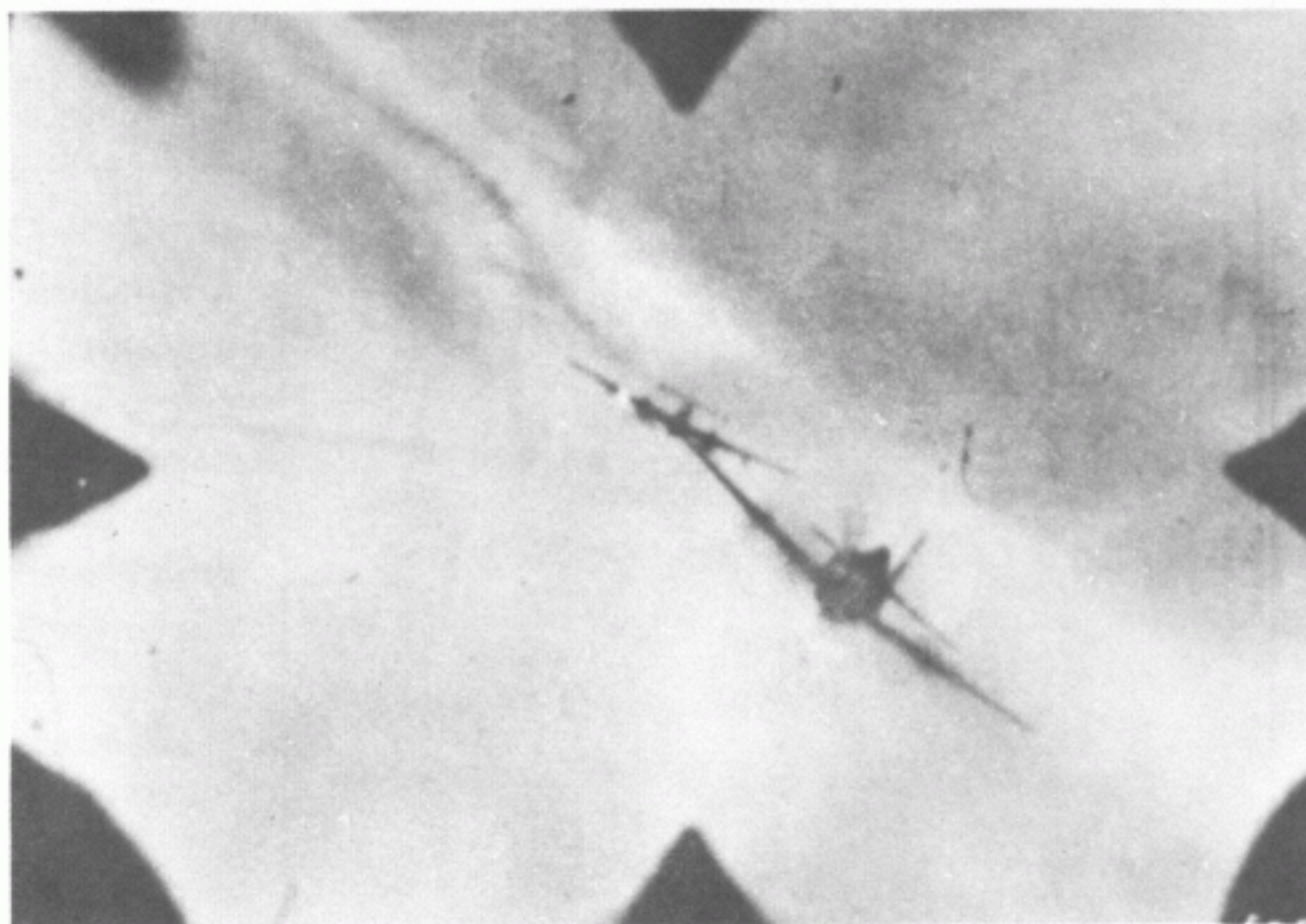
To turn on the gun camera, press the **C** key. The Gun Camera Indicator light in your cockpit will illuminate, and the number beside the camera, which indicates the percentage of film remaining to be shot, will begin to decrease. To turn off the gun camera, either press **C** again or wait until the film runs out. To view the film you've just recorded, press **V**, which will send you to the Film Viewing Room screen. To view a film clip you've already recorded and saved, choose FILM VIEWING ROOM from the Main Menu. The name of the previously recorded film will appear after the heading FILM.

Film Controls

In the upper righthand corner of the Film Viewing Room screen, under the heading FILM CONTROLS, you'll see several buttons — similar to those on a VCR — which control the playback of your film. The first letter of the name on each button indicates the keyboard key you must press to activate that button. When you press the appropriate key, the corresponding button on the screen will be illuminated.

If you've interrupted a mission to watch your latest footage, your film will automatically be loaded and ready when you arrive in the Film Viewing Room. If you want to watch a film you've already recorded and saved, you'll need to load it first (see below). Press the **P** key to play, and press it again to pause the film. Press the **A** key to advance, and press it again to stop the film. Rewind the film to its beginning by pressing the **R** key. To leave the Film Viewing

A P-47 Thunderbolt shoots at a twin-engined Bf 110 fighter, striking it on the left wing. Major Everett Stewart, the pilot whose gun camera recorded this picture, was forced to cease fire for fear of hitting Lieutenant John Coleman's P-47 ahead of him. Moments later, the Bf 110 went down in flames.



Room, press the **E** key. Pressing **E** will return you to your aircraft if you were flying a mission; otherwise, you'll go to the Main Menu.

Key	Name	Function
	PLAY	Starts and stops playback of film
	ADVANCE	Turns film advance on and off
	REWIND	Rewinds film to start
	DISK	Moves you to Disk Menu (see below)
	EXIT	Returns you to mission or to Main Menu

Disk Menu

Pressing the **D** key will bring up the Disk Menu, which allows you to save a film clip, load or delete a film clip you've already saved, and allocate disk space so that you can record longer films. On the righthand side of the screen will be a directory listing all the film clips you've previously saved, and on the lefthand side of the screen will be a menu displaying the following disk menu selections:

LOAD Lets you load a film clip. To do this, first click on a film clip name from the film clip directory, then click on the LOAD button. (The LOAD selection is not available during flight.)

SAVE Brings up a text cursor. Type the name of the film clip you're currently viewing, then press RETURN to save it.

DELETE Brings up a text cursor. Type the name of the film clip you want to erase, then press RETURN to delete it.

RETRY Lets you search a new floppy disk for film clips if you aren't using a hard drive.

DISK CACHE Toggles between on and off settings. When the disk cache is turned off, the film is saved to system memory, and the length of the film clip is limited to the amount of memory available. When the disk cache is turned on, the film is periodically saved to disk and the length of the film clip is determined by the film disk cache size.

SET FILM DISK CACHE SIZE Limits the amount of disk space to be allocated for the film disk cache, allowing you to record as long a film as you'd like. Click on this selection, then type in the maximum number of bytes you want to set aside on your disk drive.

View Modes

Below the Film Controls buttons are three View Modes buttons. The CHASE view mode, selected by pressing the **C** key, is the one you'll always start out in. In the CHASE

"Those poor bomber pilots had it the toughest, they had to just sit there and sweat through it. And when your bomber went down, that was you and nine other guys."

**U.S. Army Air Force Captain
James Finnegan**




“The enemy knows that he must wipe out our fighters. Once he has done that, he will be able to play football with the German people.”

Feldmarschall Erhard Milch, in 1943

mode, the camera looks at an object from directly behind it and moves along with it. To zoom in on the object the camera is chasing, press the left controller button. To draw back from the object, press the right controller button. You can “chase” different objects by repositioning the camera with the **F1** through **F4** keys (see below).

In the **FREE** view mode, selected by pressing the **F** key, the camera is free-floating and suspended in space. To pan this “eye-in-the-sky” left, right, up, or down, just move your controller. To move the camera forward, press the left controller button. To move the camera back, press the right controller button.

The **TRACK** mode, selected by pressing the **T** key, works in conjunction with either the **CHASE** or the **FREE** mode. In the **TRACK** mode, the camera follows an object that is moving independently within your camera’s view, automatically panning to keep it in the center of the screen. For example, if you’re watching a film in the **CHASE** mode from behind your fighter and you see an enemy fighter fly by, you can select the **TRACK** mode to have the camera lock onto the enemy fighter, and it will automatically follow the enemy fighter from your fighter’s vantage point. Keys **F5** through **F8** allow you to track different objects. (Note: you cannot track an object you’re currently “chasing.”) If you’re tracking an object in the **FREE** mode, you can press the left and right controller buttons to zoom the camera in on the tracked object or away from it.

Key	Function
	CHASE mode; positions camera directly behind an object
	FREE mode; allows camera to be free-floating
	TRACK mode; automatically pans camera to follow an object in either CHASE or FREE mode

Controller Button	Function
Left controller button	Moves camera forward
Right controller button	Moves camera back

Selecting Camera Positions and Tracked Objects

Of the eight buttons below the View Mode buttons, the first four, **CAMERA POS**, allow you to select different camera positions, and the latter four, **TRACK OBJ**, allow you select different objects to be tracked.

To position the camera behind your aircraft when in **CHASE** mode, or at your aircraft when in **FREE** mode, press **F1**. To position the camera behind or at any other air-

craft that was flying when your film was taken, press **F2**. If you press **F2** repeatedly, it will cycle through all the different aircraft in your film. If any aircraft dropped bombs or fired rockets while your film was being made, press **F3** to have the camera positioned at or behind these bombs or rockets, and press it repeatedly to cycle through all the different warheads. To position the camera at ground installations attacked or used in your mission, press **F4**.

Press **F5** to have the camera track your aircraft. To track any other aircraft, press **F6**, and press it repeatedly to cycle through all the aircraft. To track a warhead, press **F7**. Press **F8** to track any of the ground installations attacked or used in your mission.

Key	Function
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F1	Positions camera at or behind your aircraft
F2	Positions camera at or behind other aircraft
F3	Positions camera at or behind any active warheads
F4	Positions camera at or behind any ground installations
F5	Tracks your aircraft
F6	Tracks other aircraft
F7	Tracks active warheads
F8	Tracks ground installations



This gun-camera photo was taken by a P-51 Mustang as it opened fire on an Me 262 that had just slipped into an excellent attack position behind another P-51. The dogfight took place during a U.S bombing raid on an oil refinery.

The View Window

The action recorded by your gun camera will be shown in the large view window in the center of the screen. As you view your film, you'll see two lists running horizontally across the bottom of the screen. In the list marked CHASE will be displayed the name of the aircraft that the camera is positioned behind while in the CHASE mode. The CHASE list will also display flight information for that aircraft, including its current speed in miles per hour, its heading in degrees, and its altitude in feet. When you're in the TRACK mode, the TRACK list will display the name of the aircraft that is currently being tracked, plus its ongoing speed, heading, and altitude, as well as the camera's distance from the object being chased.

IN-FLIGHT MAP

To acquire information about the location of various enemy and friendly aircraft and ground installations during your mission, examine the In-Flight Map by pressing **M**.

This map also allows you to change the orders for different groups of fighters on your side. The In-Flight Map depicts continental Europe and the eastern part of England, and has controls that let you move the map around and examine different portions of it. These controls are much the same as those for the Flight Briefing Map.

To the upper right of the map, you'll see two buttons: **ZOOM IN** enlarges the map size, and **ZOOM OUT** reduces it. To zoom the map in or out, either click on these controls or use the keyboard keys: the **Z** key to zoom the map in, and the **X** key to zoom it out. To move the map up, down, left, and right, click on the up, down, left, or right ar-

rows inside the horizontal and vertical bars at the bottom and on the righthand side of the map window, or move the slider box, or click on the space inside the two bars.

Getting Information from the In-Flight Map

On the map, you'll see various aircraft icons and ground target icons located throughout western Europe. To get information about any aircraft or ground target, click on an icon. A pop-up information window will display a text description of the aircraft or ground target. If you select an aircraft icon, the description will include the name of the aircraft, its altitude in feet, its heading in compass points, its speed in miles per hour, its bearing (relative to you and your aircraft), and its distance from your aircraft. Ground targets include aircraft factories, ball bearing factories, oil refineries, railroad marshaling yards, electric plants, munitions

"So far as the German jets were concerned, you'd got to be above them, by at least three thousand feet, because all we could do was open up everything and dive. But as soon as they knew you were there they were off..., so we just had that moment when you could catch that chap, when he couldn't see you, when you came down, going like the clappers hoping to get close enough to get in a burst before he saw you. He just had to open his throttle and he was gone! And that really was the name of the game."

RAF Wing Commander John Wray

plants, airfields, and secret weapons sites. If you click on an icon for an industrial target, the window will display what the target is producing and what kind of condition it is in (whether it has been damaged or destroyed). If you select an icon for an airfield or secret weapons site, the window will display what kind of aircraft or secret weapons are located there, as well as the condition of the airfield or site. If you're flying on the U.S. side, information on ground installations may not be accurate or precise, owing to poor weather, lack of reconnaissance flights, or inaccurate intelligence. The more U.S. missions are flown over a certain target in good weather, however, the more accurate subsequent information will be. If you're flying on the German side, the information will always be accurate and up-to-date.

If you have selected a fighter or a fighter-bomber on your side, the bottom of the information window will display, beside the EXIT button, a small button marked CHANGE ORDERS. Click on CHANGE ORDERS to reassign the selected fighters on your side to attack a different aerial target (see below). Click on EXIT to close the window altogether.

Changing Orders

When you click on CHANGING ORDERS, the Orders Window opens, displaying a menu that allows you to control which targets are attacked in air-to-air combat by selected fighters or fighter-bombers on your side.

When the Orders Window is opened, various air icons on the In-Flight Map will be lit in different colors. If an icon is lit **green**, that icon is the primary air target that your selected fighter is either trying to attack or will be attacking. Icons lit **red** represent any other air targets that your selected fighter could go after. (Your selected fighter can only be reassigned to go after alternative air targets, and cannot be reassigned to attack ground targets.)

Inside the Orders Window, you'll see four choices:

SET AIR TARGET Click on this, then click on any of the red secondary air target icons to change the primary air target for the selected fighter. The red icon you click on will turn green, designating the new primary air target.

IGNORE CURRENT TARGET Click on this to order the selected fighter not to attack its current target.

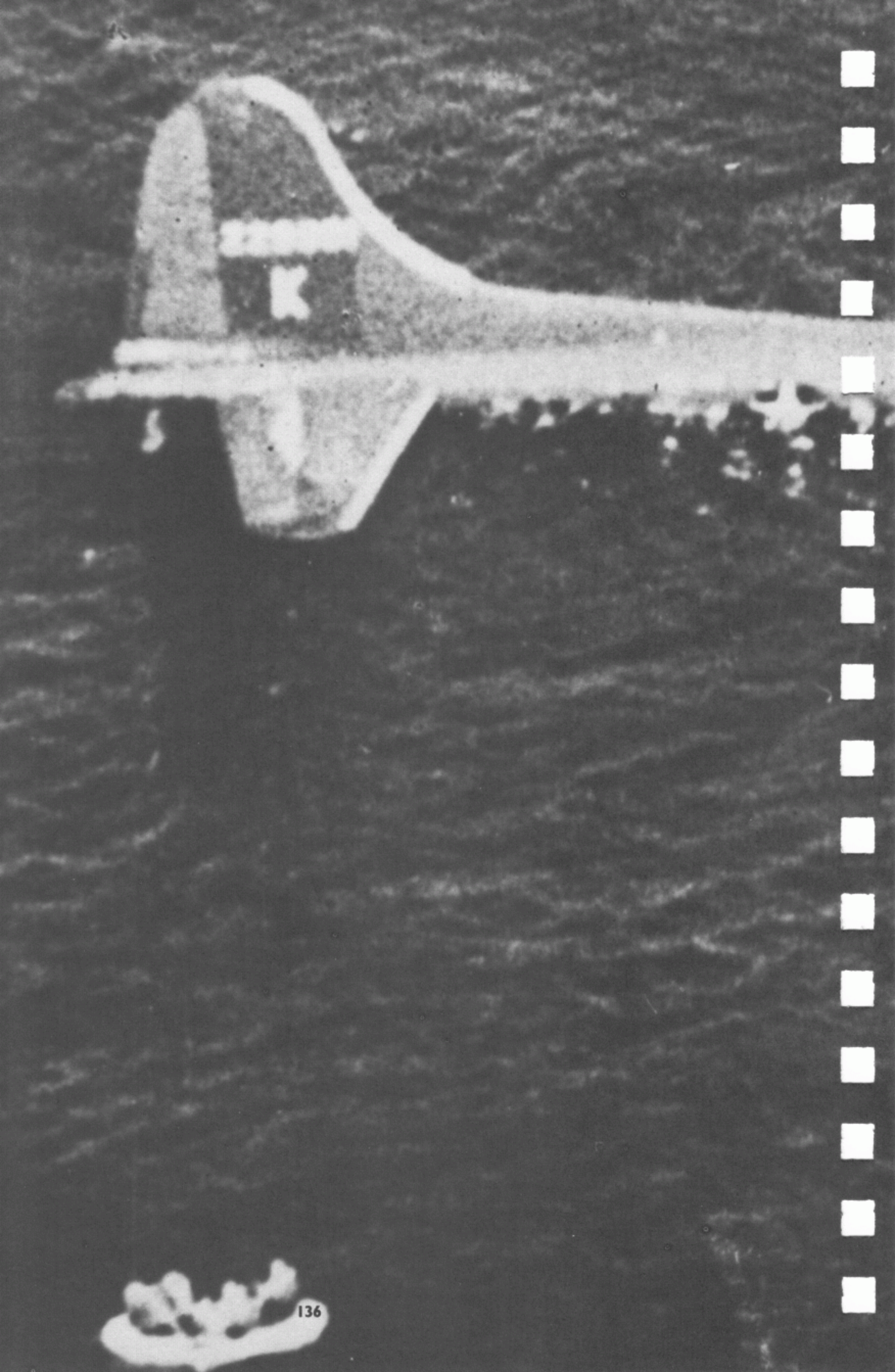
MISSION ABORT Click on this to order the selected fighter to go home. Beware: orders to abort a mission cannot be reversed.

EXIT Click on this to close the Orders Window.

To leave the In-Flight Map and return to your flight, either click on the EXIT button below the map or press **M** or **E** on your keyboard to exit.

"Men who walked through the rain to their aircraft; who slept in heated suits; who played sweaty games in their flying clothes, were wet when they took off. They were casualties when they came back."

Unidentified U.S. Army Air Force flight surgeon, on why so many bomber crewmen contracted frostbite in the below-freezing flying conditions



A black and white photograph of a snowy mountain peak, possibly Mount Everest, with a film strip overlay on the left side. The film strip has white rectangular sprocket holes. The text is overlaid on the right side of the image.

MISSION INSTRUCTIONS: POST-FLIGHT

ENDING YOUR MISSION

Your mission can end several different ways:

Crashing If your plane impacts into the ground or into a body of water at a steep angle before the pilot or crew can bail out, they are considered killed in action.

Crash Landing If your plane comes down to earth at a shallow angle, lands with the landing gear up, or lands poorly, it will be completely demolished, but the pilot or crew will survive. If this crash landing occurs on enemy territory, however, the pilot or crew will be captured and will be lost for the war, unable to fly any more missions. (If you're flying on the U.S. side, there's a slight chance that your pilot or crew will avoid capture, return to England, and will be able to fly another mission.)

Ditching If your plane lands at a shallow angle in a large body of water, such as the English Channel, it will be lost. However, the pilot or crew will be picked up by a passing ship or a rescue seaplane from their own side, and can fly a new mission.

Bailing Out over Land If your plane is uncontrollable and cannot be flown back to your base, and you press **J** before it crashes, the pilot or crew will parachute to safety. Be sure to bail out before your aircraft reaches too low of an altitude. If the pilot or crew bail out over enemy territory, they will most likely be captured, and will be unable to take part in any more missions. If they bail out over friendly territory, they will be taken to their home airfield and can fly another mission.

(Keep in mind that the boundaries for friendly territory and enemy territory may change, depending on what time period of the war you fly in.)

Bailing Out over Water If the pilot or crew parachute from their plane over a major body of water, such as the English Channel, they will be rescued and can fly again.

Landing at Your Home Airfield When you fly back to your home airfield, land safely, and press **Q**, your mission will end.

Pressing Q in Midflight If you'd rather not make a landing, you can press **Q** to end your mission at any time while your plane is in the air. Doing this will not affect the Combat Record score for your pilot or crew unless you lose your plane, which can happen if you:

- Press **Q** while flying over enemy territory. This will cause the pilot or crew to be captured, and the plane will be lost. (On the U.S. side, there's a slight possibility that the pilot or crew can escape capture.)



A Bf 109 pilot bails out of his fighter over France.

Preceding page: This B-17 was forced to ditch in the English Channel. Some of the crew wait for rescue in the life raft.
Courtesy of the National Film Board

- Press **Q** while flying over water. This will cause the plane to be lost, but the pilot or crew will be rescued.

If you're a U.S. Pilot, try to make it back to the airspace over England or any Allied-held territory in western Europe before pressing **Q**, to avoid being penalized on your Combat Record score for losing your plane. If you're a Luftwaffe pilot, try to reach the airspace over Germany or German-held territory in western Europe before pressing **Q**.

MISSION AND CAMPAIGN RESULTS

After your mission has ended, a Post-Flight Debriefing Map will appear, displaying icons representing various airfields and industrial targets in western Europe. Click on any of these icons to learn if the targets have been damaged or destroyed. You'll also see icons representing aircraft that have crashed at various locations. Click on any of these icons to learn what kind of aircraft crashed and who shot it down. At the bottom of the screen are three menu choices — MAP, STATUS, and CONTINUE. Click on STATUS to view a chart displaying the total number of victories and losses both for your side in the mission and for the airplane you were flying. If you're directing a Campaign Battle, this chart will display additional information summarizing the impact of your last mission on the air war over Europe, and will let you know how both sides are faring, and which side is closer to victory.

UPDATING COMBAT RECORDS

From the Post-Flight Debriefing Map, click on CONTINUE to view a screen displaying the updated Combat Records for the pilot or crew you've chosen, based on the results of this latest mission. The Combat Records of any additional pilots or crews that you selected from the Flight Roster to fly the mission will also be updated. The numeric score displayed on the screen ranks how well the pilot and crew performed during the mission. This cumulative score will be updated after every mission, and you can use it to compare different pilots and crews.

Your pilots and crews will achieve higher scores if they accomplish the main objectives of their missions. If you're a Luftwaffe pilot, your main mission objective is to prevent industrial targets, Luftwaffe airfields, and other German fighters from being destroyed by U.S. bombers and fighters. If you're flying a U.S. bomber, your main mission objective is to bomb your assigned target accurately. Knocking out a target is a group effort, so if other bomber crews also score direct hits on a target, your individual score will improve. If you're flying a U.S. fighter on an escort mission, your main mission objective is to protect the bombers from enemy fighter attack so they can drop their bombloads over the target. The more bombs that hit the target, and the

"On missions when everybody came home OK, we'd fly tight, wingtip-to-wingtip on the way back. I'd come up on my wingman and I'd say, 'Hey, Palmer, we were successful,' and get my wing under his, and tip him. He'd yell, 'You son of a bitch, knock it off,' and we were just laughing like hell all the way home. Those were the joyous times."

**U.S. Army Air Force
Captain James Finnegan**

*"We were fighter boys.
Fighter boys fight."*

**Luftwaffe General Walter
Krupinski**

more bombers that survive, the higher your score will be. If you're flying a U.S. fighter in a free-ranging role, your main mission objective is to shoot down as many Luftwaffe fighters as you can. The lower the ratio of U.S. fighter losses to Luftwaffe fighter losses, the higher your score will be.

No matter which mission you choose to fly, the more you help your fellow pilots and crews to survive and complete their missions, the better your score will be.

MEDALS AND PROMOTIONS

Whether you're flying on the American or the German side, medals and promotions in rank will be awarded if you and your fellow pilots or crews successfully fulfill your main mission objectives. The medals listed below were awarded to courageous U.S. Army Air Force and Luftwaffe airmen throughout the Second World War.

U.S. Army Air Force Medals (in order of rank)

Congressional Medal of Honor

This medal is the highest award in the U.S. military, and was originally established by the Congress of the United States in December 1861 and signed into law by President



Major General Carl Spaatz, the commander of the U.S. Eighth Air Force, pins a medal on Brigadier General Ira Eaker, the leader of the Eighth's bombing offensive against Germany.

Abraham Lincoln. The Medal of Honor is the only medal awarded in the name of Congress by the president, and is given to officers and enlisted men for an individual act of heroism that involves extraordinary bravery in combat "above and beyond the call of duty." Only an individual who conspicuously distinguishes himself in action against an armed enemy at the risk of his own life without harm to his mission can be eligible to win the Medal of Honor, and it is only awarded after thorough investigation. This medal may only be given once; if a second medal for valor is warranted, a gold star is awarded instead, and is worn on the ribbon of the Medal of Honor.

Distinguished Service Cross

This decoration was first instituted in January 1918 and is given in the name of the president. It is awarded for extraordinary heroism against an armed enemy when the circumstances do not warrant awarding the Medal of Honor, making it the second-highest award for valor in the U.S. military. A bronze oak cluster is awarded if the individual performs a second such act of bravery, and it is worn on the ribbon.

Distinguished Service Medal

Instituted on the same day in 1918 as the Distinguished Service Cross, the Distinguished Service Medal is given in the name of the president for "exceptionally meritorious

service to the government in a duty of great responsibility in time of war, or in connection with the military operations against an armed enemy of the United States." It is the highest medal for achievement in the U.S. military, and can be awarded for service in either combat or noncombat positions of duty. If a person has already received the Distinguished Service Medal, they are awarded a bronze oak leaf.

Silver Star

Based on a World War I badge of honor, the Silver Star is awarded for "gallantry in action" when the circumstances do not warrant awarding the Medal of Honor or Distinguished Service Cross.

Distinguished Flying Cross

Established by Congress in July 1926, the Distinguished Flying Cross is awarded for an act of heroism or extraordinary achievement performed while in flight. This medal of valor can be awarded for both combat and noncombat situations, and if a second medal is warranted, a gold star is given.

Air Medal

Created to award "meritorious achievement while participating in an aerial flight," the Air Medal is given for actions that do not justify the awarding of the Distinguished Flying Cross. Generally, it is awarded for missions that do not involve contact with an armed enemy, although a pilot or crewman can earn one for destroying an enemy plane. Bomber crews were awarded this medal after flying five missions of at least two-and-a-half hours' length, while fighter crews were awarded it after ten missions of under two-and-a-half hours, except for escort missions.

Purple Heart

Originally instituted by George Washington when he was Commander in Chief of the Continental Army during the Revolutionary War, the Purple Heart is awarded to those who are wounded in action against an enemy of the United States, and require medical attention. It is given to wounded personnel before or immediately after they arrive at the hospital. An oak leaf cluster is awarded to previous Purple Heart recipients.

Luftwaffe Medals (in order of rank)

Grand Cross

This was the highest class of the Knight's Cross of the Iron Cross, and was truly the most elite award ever given in the German military. The Grand Cross was awarded for

On his first mission, ball turret gunner Sergeant Maynard "Snuffy" Smith was busy firing at FW 190s as his B-17 bombed the submarine pens at Saint-Nazaire. When he heard no other gun positions firing, he crawled out of his ball turret to find out why. What he saw was a badly wounded tail gunner, two empty waist gun positions, and a radio compartment engulfed in flames. After giving first aid to the gunner, he tried to put out the fire by stomping on it and, in desperation, even urinating on the flames. When FW 190s began firing at the damaged bomber, Smith manned both waist guns and fired back. When the fighters broke off their attacks, he managed to put out the flames with his bare hands. Because of his efforts, his B-17 was able to make it back across the English Channel to Britain, and Smith was later awarded the Congressional Medal of Honor. His actions were confirmed by the crew of another bomber, who could actually see him through the numerous bullet holes torn in the B-17's fuselage.

actions that decisively influenced the course of the war, and only one person, Reichsmarschall Hermann Göring, was ever given this medal. He received it after France surrendered to Germany in 1940.

Knight's Cross of the Iron Cross

Instituted by Adolf Hitler on September 1, 1939, the Knight's Cross of the Iron Cross was established to take the place of the order "Pour le Merite," which had been abolished after World War I. The Knight's Cross was given for gallantry in action, and was awarded to those in the Luftwaffe and the Wehrmacht, as well as in civilian branches such as the police and fire departments. Luftwaffe fighter pilots could be awarded this medal for shooting down a set number of enemy planes, although this number changed as the war progressed. One pilot was awarded the Knight's Cross for shooting down 20 planes in 1941, while by 1943 another pilot had to shoot down 123 planes to receive this award.

Several upgraded classes of the Knight's Cross appeared during the war (listed in increasing order of importance):

Knight's Cross with Oak Leaves This was created on June 3, 1940, and was first awarded to Luftwaffe fighter pilots Werner Molders and Adolf Galland for recording forty aerial victories each.

Knight's Cross with Oak Leaves and Swords Instituted by Hitler on July 15, 1941, this award was first given to Adolf Galland for reaching the sixty-nine-victory mark.

Knight's Cross with Oak Leaves, Swords, and Diamonds Also instituted on July 15, 1941, this was first given to Werner Molders for downing twenty-eight Russian aircraft in twenty-four days. There were only twenty-six other recipients of this award, which was commonly referred to as "the Diamonds."

Knight's Cross with Golden Swords, Oak Leaves, and Diamonds This award, intended to be the highest award for gallantry, was established on December 29, 1944, and was to be given only to the twelve bravest soldiers of the Third Reich. However, it was only awarded once, to Luftwaffe pilot Hans-Ulrich Rudel, for flying 2,530 sorties and destroying some 500 Russian tanks in a Ju 87 Stuka dive bomber. The Golden Swords, Oak Leaves, and Diamonds award differed from the other Knight's Cross awards in that it was made of gold, instead of silver.

"One time I got a bullet in the cooling system, and I saw the temperature was going up, so I turned my Bf 109 around and made a belly landing. At the moment when I was on the ground I heard an explosion and I thought that soldiers were shooting at my crippled aircraft. I thought, 'You have to get out fast.' I was opening the canopy and was just trying to pull out, when I saw two German soldiers ten or fifteen meters in front of me who were crying and waving with their arms. I looked around at my aircraft and saw that it didn't have a tail anymore. Then I looked around and saw that there were a lot of black boxes. I had come down in a minefield! And to cross the ten or fifteen meters to get me out, the minesweepers needed two hours to reach me! They were lying on the ground and feeling with their fingers and pulling the mines away, and then they came to my aircraft and got me out. Two hours I was left in a minefield!

Luftwaffe General Walter Krupinski

German Cross in Gold

Created by Hitler on September 28, 1941, as a bridge between the Knight's Cross of the Iron Cross and the Iron Cross First Class, this medal was awarded for "continuous military achievement." A recipient needed to have already been awarded the Iron Cross First Class; however, it was not necessary to win the German Cross in Gold before being awarded the Knight's Cross.

Iron Cross First Class

This award was first established by Friedrich Wilhelm III in 1813, and reinstated for the Franco-German War in 1870 and the First World War in 1914. It was the only major award given by the Nazis during World War II that they themselves did not create. The Iron Cross First Class was awarded for outstanding heroism, and a Luftwaffe pilot was usually awarded one after shooting down four or five enemy aircraft.

Iron Cross Second Class

This medal was given for acts of bravery or distinguished service, and over two million Germans were awarded it during World War II.

Wound Badge

Given to an individual who was wounded in action, this medal had three different colors, or classes. A person receiving one or two wounds earned a black badge. For three or four wounds, or the loss of an eye, a hand, a foot, or his hearing, he was given a silver badge. For five or more wounds, or blindness, brain damage, or total disability, he was awarded a gold badge.

Ranks and Promotions

For both the U.S. Army Air Force and the Luftwaffe, promotions in rank were awarded to those pilots who demonstrated success in battle and exhibited qualities of leadership. New Luftwaffe pilots began their careers with the rank of Leutnant, while new U.S. pilots started out with the rank of Pilot Officer.

World War II Commissioned Officer's Ranks

Luftwaffe

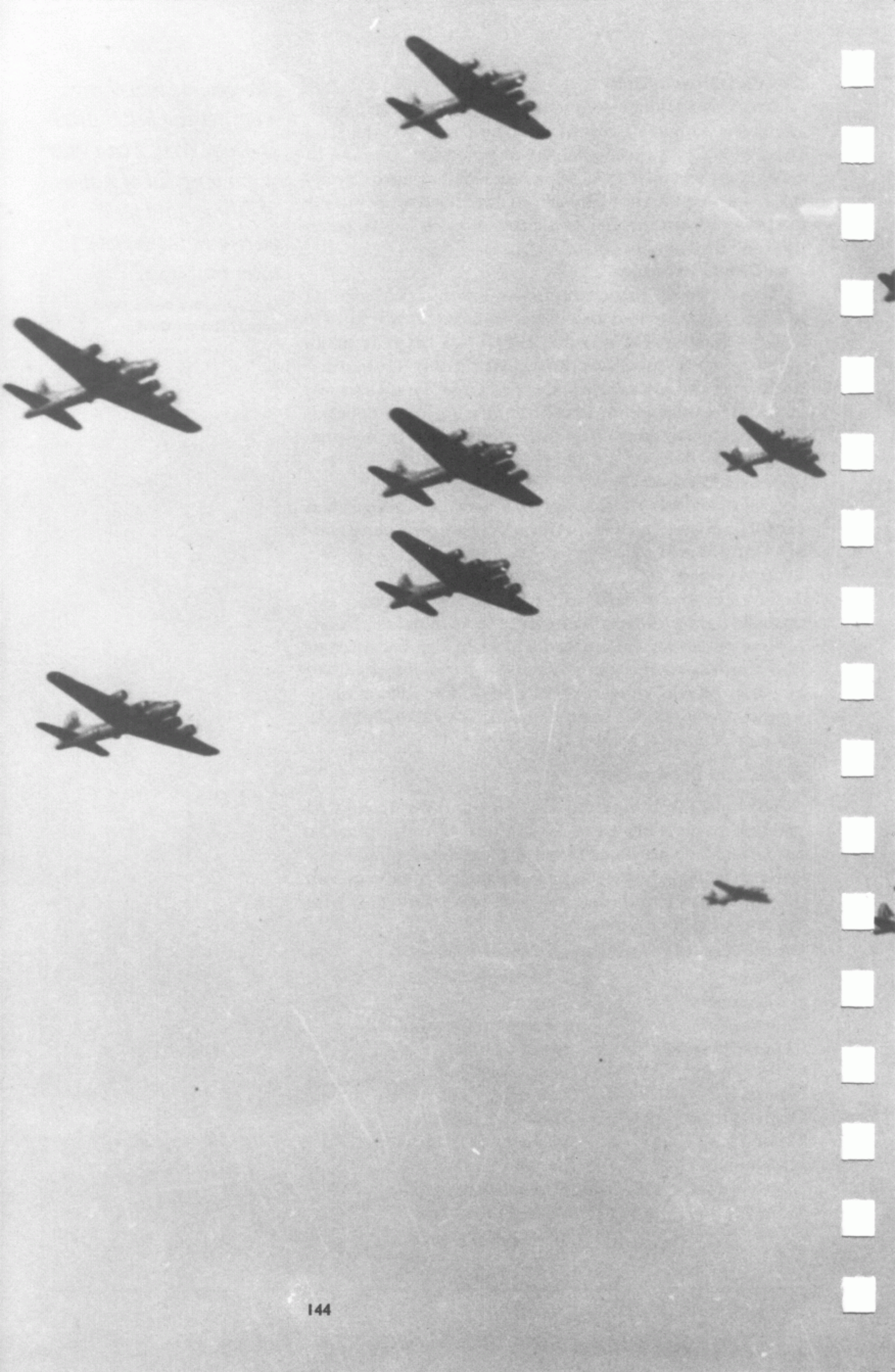
Generaloberst
General
Generalleutnant
Generalmajor
Oberst
Oberstleutnant
Major
Hauptmann
Oberleutnant
Leutnant
—

U.S. Army Air Force

General
Lieutenant General
Major General
Brigadier General
Colonel
Lieutenant Colonel
Major
Captain
First Lieutenant
Second Lieutenant
Pilot Officer

"People say that things were getting better after D-Day. Well, I can give you a long list of names of fellows that were buried in the cemetery after that time."

**U.S. Army Air Force Pilot
Officer Robert Davila**



An aerial photograph showing a large formation of aircraft, likely B-29 Superfortresses, flying in a staggered pattern. The aircraft are silhouetted against a light sky. The title text is overlaid in the upper right portion of the image.

GERMAN AND U.S. AIRCRAFT AND WEAPONS

GERMAN SECRET WEAPONS PROJECTS

Both before and during the war, German scientists and engineers developed an awesome array of advanced weapons to be used against the Allies. These weapons included the V-2 liquid-fuel rocket, whose development can be traced to research performed by an American, Robert Goddard, who fired his first liquid-fuel rocket in 1926. Goddard's work inspired two Germans, Hermann Oberth and, later, Wernher von Braun, who developed the first V-2 rocket in 1942 (von Braun went on to develop the Saturn 5 rocket for the U.S. space program). There was no defense against this enormous supersonic missile, which was 46 feet 6 inches tall and weighed 27,000

pounds. It also had no launching sites that the Allies could destroy, as it had a mobile launching system and could be carried on special trucks and launched from any cleared space. However, the V-2 had several problems: its warhead would sometimes explode when the rocket reentered the earth's atmosphere; it consumed many valuable German resources; and it was squandered in a futile terror-bombing campaign against London and Antwerp. Albert Speer considered his support of the V-2 program to be one of the biggest mistakes he made during his tenure as minister of armaments.

The alternative program that Speer, in hindsight, would have backed fully was Project *Wasserfall*, or "waterfall." This was a 25-foot-long anti-aircraft missile whose development, in 1942, had paralleled that of the V-2. The Wasserfall rocket could be guided

to its aerial target by a directional beam that was not affected by weather or darkness. The rocket could carry 660 pounds of explosives up to altitudes of 50,000 feet, and was extremely accurate. Speer reasoned after-the-fact that producing several thousand a month of these smaller, less expensive rockets in 1944, instead of hundreds of V-2 rockets, might have prevented the devastating Allied air strikes on German industry.

One of the more successful German weapons programs was the V-1 flying bomb. Powered by an early-model jet engine, the 27-foot-long V-1 weighed about 4,800 pounds and had a range of 250 miles. It was less expensive to produce than the V-2, and could be manufactured in a much shorter time. It also used cheaper, lower-grade fuel than the alcohol-and-liquid-oxygen-propelled V-2, and carried a 2,000-pound payload, the same as the V-2. Its disadvantages were

"They're still trying to pump 'soup' into the superman. Becoming more frequent are the appearances of these hopped-up go-buggies, and they're one of the last-ditch hopes of the Nazi overlords.

Suffice it to say if they become prominent, we'll have adequate countermeasures for them. Tests already show they'll walk away from conventional aircraft. Which from the bomber's point of view means only one thing: You have less time to hit him, and he has less time to shoot at you."

U.S. Air Force newsletter article, titled, "Warm Your Guns for Jerry's Final Brainstorm," warning crews about the Me 262 and the Me 163

Preceding page: A close formation of B-17s during a bombing raid on March 12, 1945.

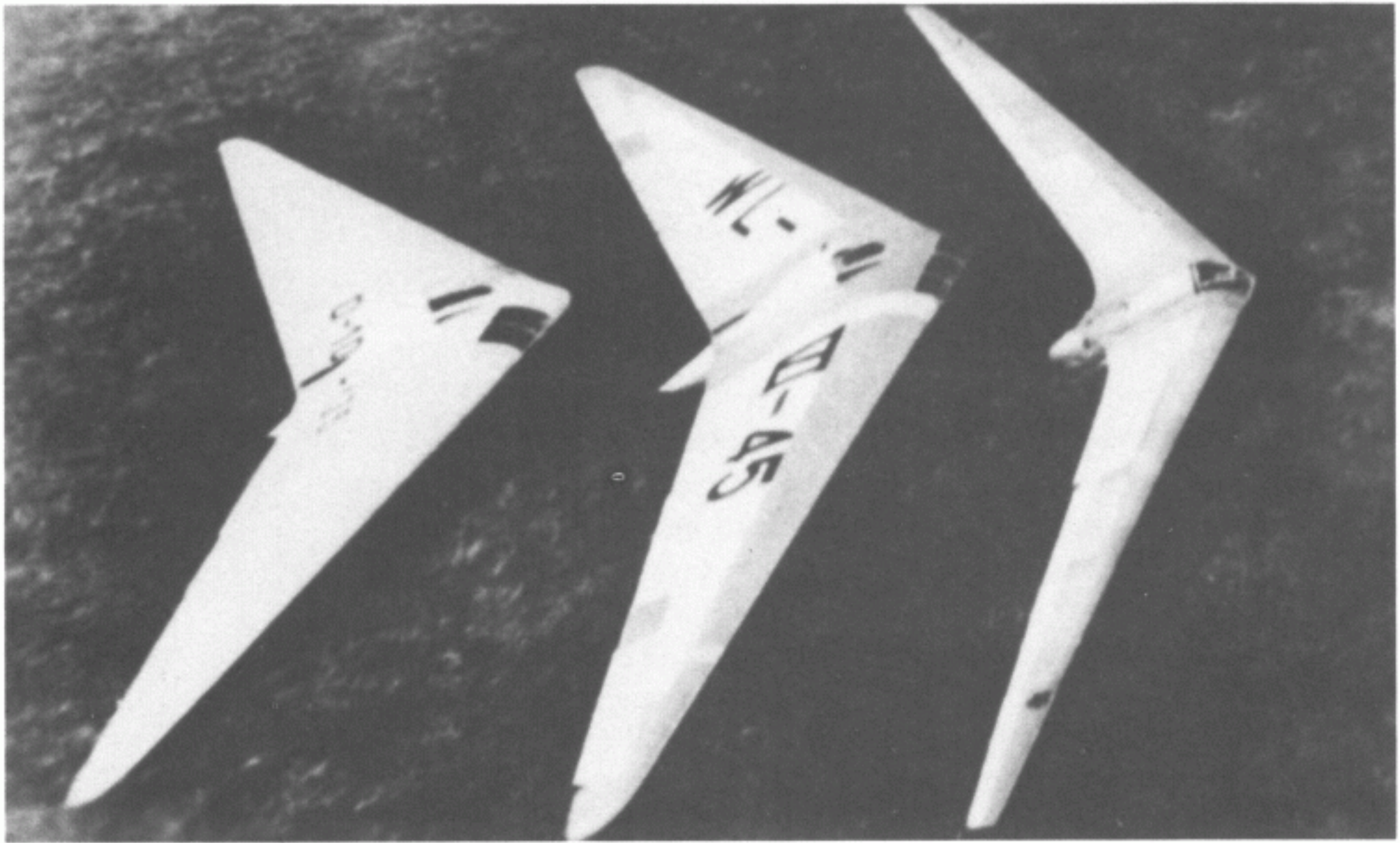
that it was much slower than the V-2, and could be shot out of the skies or even tipped over by Allied fighters. These flying bombs were also unreliable: nearly a quarter of the V-1s launched failed en route to their targets. Finally, the V-1s needed elaborate launching ramps, which were not mobile, and many that were located on the French coast were captured by the Allies after D-Day.

One weapon which arose out of German desperation was the Bachem *Natter*, or "Adder." This was a manned rocket interceptor which was to be launched straight up and then guided to the Allied bomber formations by the pilot. When the Natter was a few hundred yards from the bombers, the pilot was to fire twenty-four 73-mm rockets at the aircraft, and then speed away. The pilot would then jettison the forward part of the Natter and pull a lever which would open a parachute attached to the rear. This action would catapult the pilot out of the compartment, and he would parachute to safety while the rear part of the Natter and its Walther rocket engine would be recovered and reused again. Several unmanned versions of the Natter were tested, but the only pilot who ever went up in the rocket was killed when the Natter crashed before he could eject himself. Additional tests were canceled as the Allied armies neared the test site, and the Natter never saw action against Allied bombers.

Many other "secret weapons" were designed, tested, and in some cases deployed against the Allies. One which sank several Allied ships was an air-to-ground glide bomb that was launched from German aircraft and then radio-guided to the target using a joystick. Another weapon, the *Hochdruckpumpe*, or "high-pressure pump," was partially completed before the Allies captured it in 1944. It had a

A V-2 rocket ready to be launched from its mobile launching platform. Courtesy of Aeroplane Photo Supply





The development of these three gliders, the Horten Ho II, III, and IV, led to the “flying wing” design of the Go 229. Courtesy of Peter Bowens

barrel 150 feet long and was to fire 150-mm shells from Calais across the English Channel to London. Other missiles were developed, including an unmanned version of the Me 163, a two-stage antiaircraft rocket, and a rocket that was fired underwater by a U-boat. A wide array of delta-winged, swept-wing, and tailless aircraft were designed, and as part of designer Rudolf Schriever’s “Project Saucer,” several “flying disk” prototypes were actually built. In fact, the wealth of ideas generated by German scientists and engineers during this period actually hurt the overall war effort, as German resources were spread thin over a vast array of projects, and few could be evaluated correctly as to their worthiness in combat.

“Sometimes, when we were flying across the Channel to Europe in the morning, we could see the contrails of V-2s flying across the other way, and we’d report them. They left streaks, contrails, just like a jet plane does today. There was a warning, but there wasn’t anything anybody could do about it, because they didn’t know where it was going to land. It would take out a whole block. I was in a hotel in London once when a V-2 hit, and I forget how far away it was, but it flushed all the toilets. V-1s used to come over our base all the time, at three or three-thirty in the morning, coming practically down the runway, about 2,500 to 3,000 feet off the ground, going toward London. It sounded like a model A automobile engine until it would cut out, which was when it would explode.”

U.S. Army Air Force Pilot Officer Robert Davila

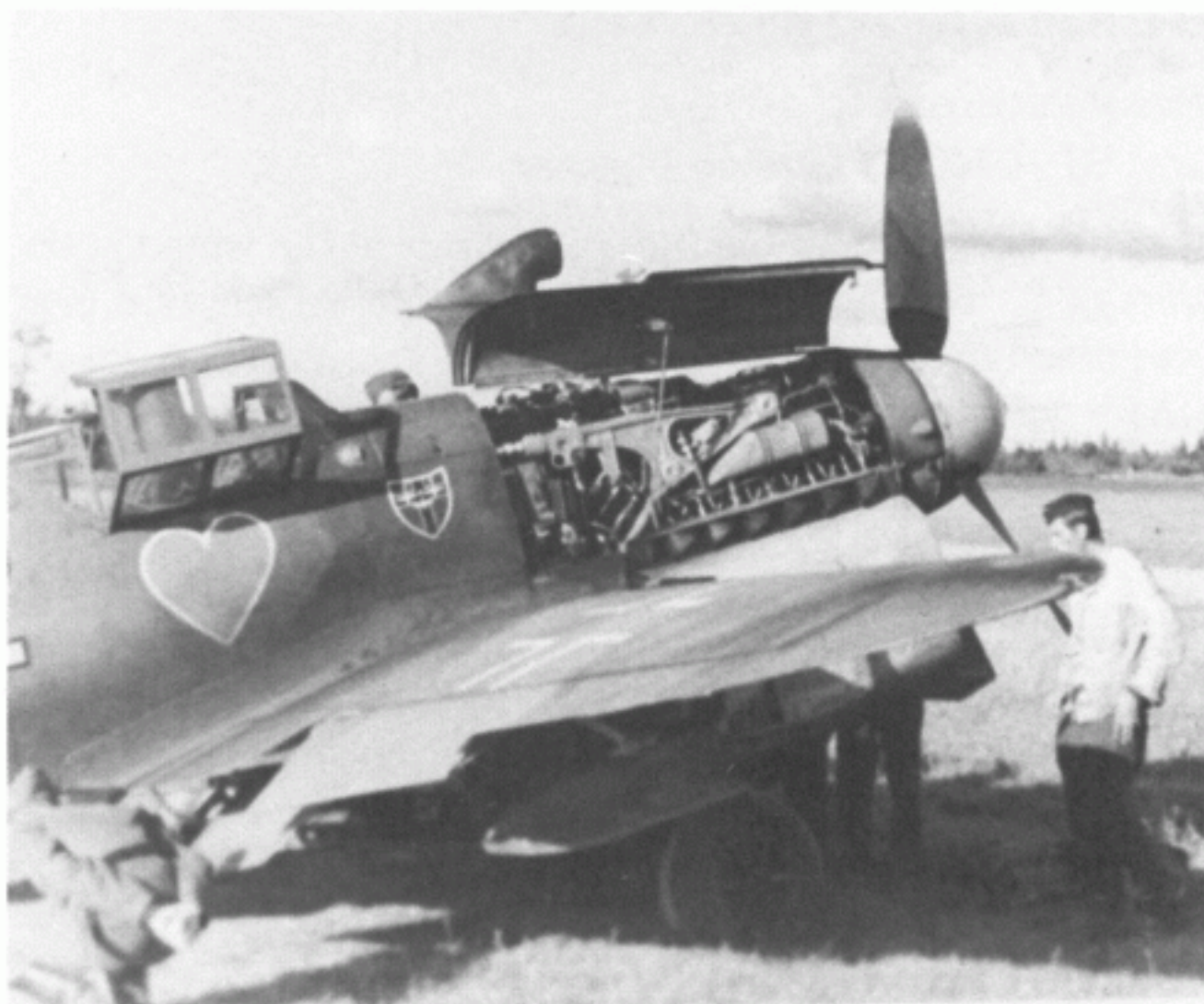
GERMAN AIRCRAFT

Messerschmitt Bf 109G-6 and Bf 109G-10 Gustav Fighter

The most formidable fighter aircraft in the world at the start of World War II, the Messerschmitt Bf 109 had been surpassed by the Focke-Wulf 190 and later versions of the RAF's Spitfire by the time the United States entered the war. Its planned successors, the Me 209 and the Me 309, were plagued by development problems, and as a result, the Bf 109 was kept in production at a time when it perhaps should have been phased out. Later models were fitted with larger, more powerful engines, which increased its speed. However, extra speed came at the expense of maneuverability, since the added weight of these engines reduced its handling ability, and made it more difficult to fly, especially during takeoffs and landings.



The Bf 109G was built in larger numbers than any other 109. It was the first 109 to be fitted with the more powerful Daimler Benz DB 605A engine, and later versions featured a supercharger for better high-altitude performance. One of these versions, the Bf 109G-6, was designed to accept various field conversion sets, or *Rüstsätze*, which meant that it could be modified with a variety of fuel tanks, bomb racks, and armament to suit different tactical situations. The Bf 109G-6 could also accept the MW 50 methanol-water injection system, which boosted the engine horsepower by about



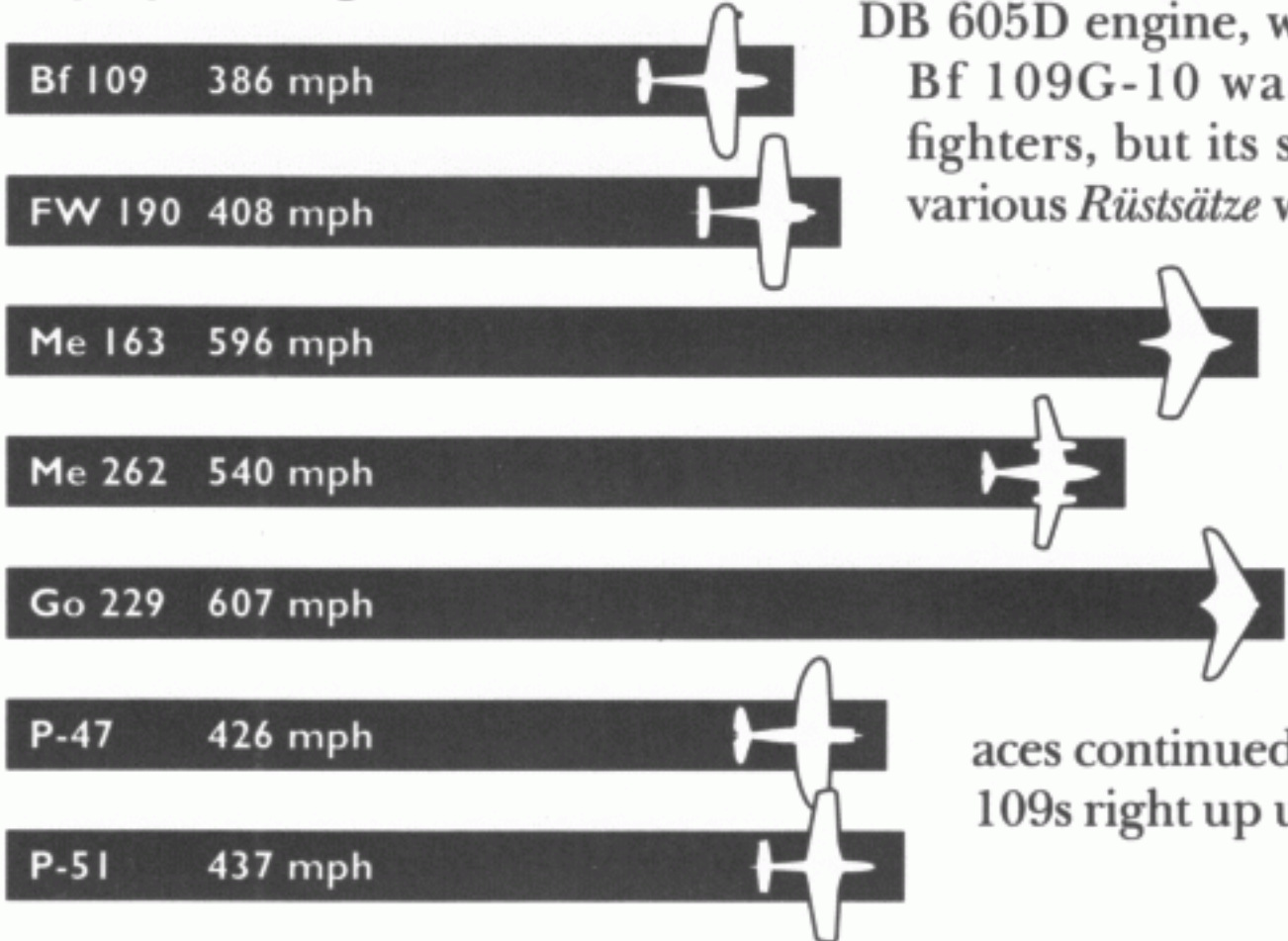
four percent for some ten minutes. This system was activated by a cockpit switch that forced the methanol-water mixture to flow from a tank behind the pilot's seat through a tube leading into the supercharger. Once the cycle was completed, the pilot had to wait at least five minutes before the next activation. Though the MW 50 system gave the Bf 109G-6 a quick burst of speed, it used up fuel rapidly, and thus cut back on the fighter's endurance. Another new feature of the Bf 109G-6 was the MK 108 cannon, which was fired through the propeller spinner in the nose, but the short supply of this formidable weapon meant that the G-6 models were usually fitted with the MG 151 cannon. This extra armament gave the 109G-6 a deadly punch for attacking bombers, but the added weight hampered it during dogfights with Allied Mustangs and Thunderbolts.

In the spring of 1944, the Bf 109G-6 was replaced by the Bf 109G-10. This featured the even more powerful DB 605D engine, with a larger supercharger. The Bf 109G-10 was the fastest of the G-series fighters, but its speed was degraded when the various *Rüstsätze* were added to it.

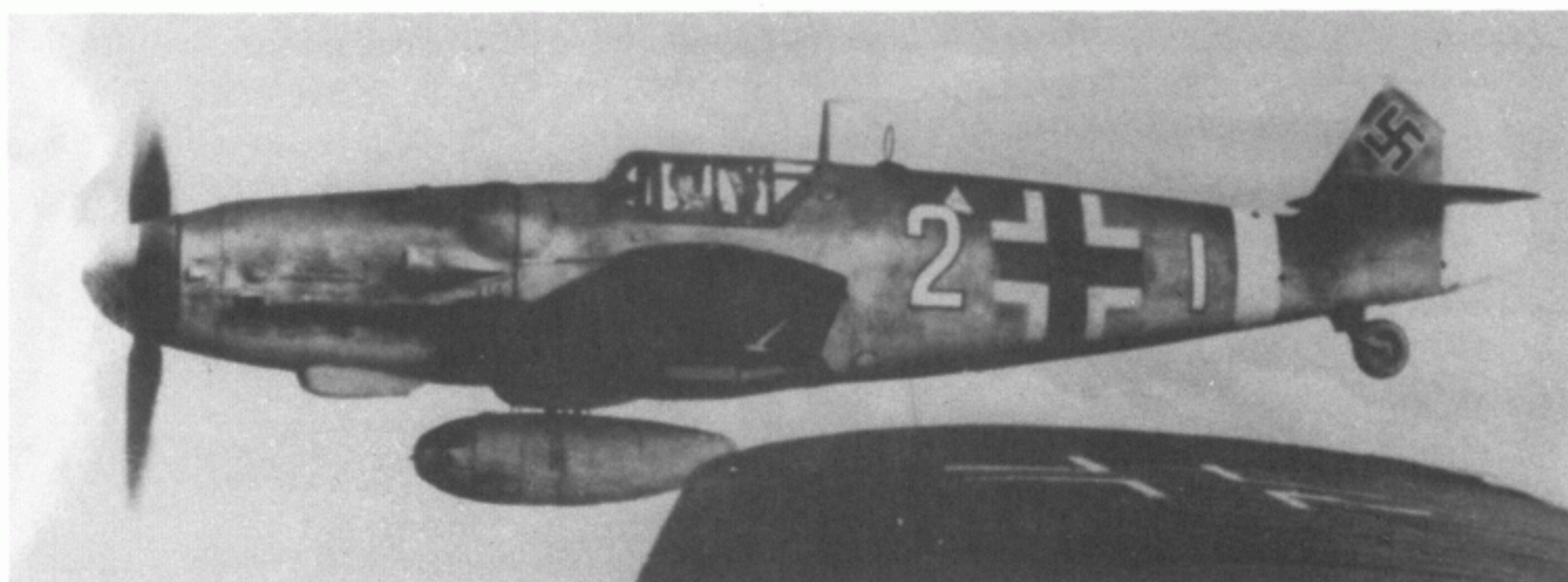
Despite the fact that it was overmatched by the time of the U.S. bombing offensive, the Bf 109 was still the most widely used Luftwaffe fighter aircraft of the war, with over 35,000 produced.

Many of the Luftwaffe's top aces continued to rack up high kill totals in Bf 109s right up until the defeat of Germany.

Top Speed, Fighters



"I flew every model we had of the Bf 109, from the B-model to the K-14. The 109 was a very bad aircraft as far as takeoff and landing was concerned if you were not familiar with it. In the air, it was much better, but I'd have to say the Spitfire was a superior fighter aircraft to the 109. For a fighter aircraft there are three parameters which are absolutely the 'ne plus ultra,' as we say, and they are: speed, climbing speed, and turning rate. And there was no doubt that the Spitfire was the best one in these three parameters. I had the chance in 1944 to fly a recovered Spitfire and also to fly both the P-47 and the P-51 and the German types. So, I can absolutely state that the Spitfire was the best one.

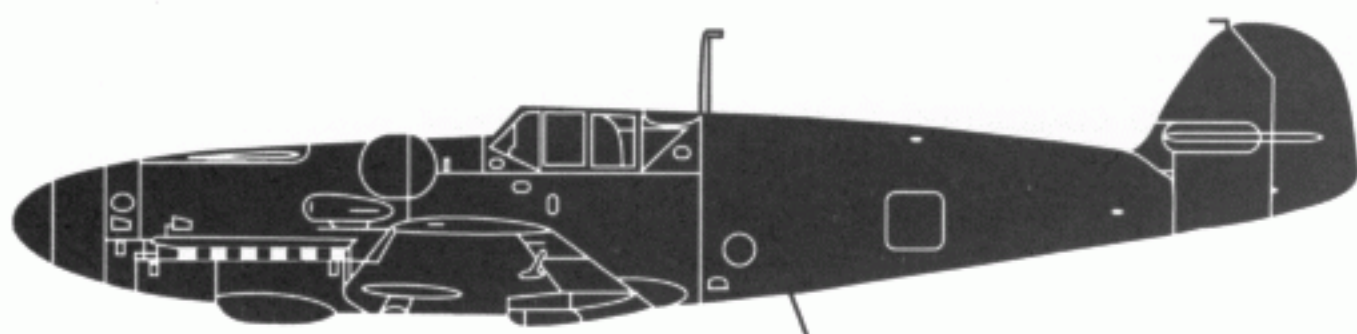


"The 109 was not bad at diving, but the Thunderbolt was much better at diving. In climbing, if you compared it with the Mustang and with the Spitfire, it depended on what height you started to climb. In the altitude between 5,000 and 10,000 meters, I think the 109 was much better at climbing than all the other types. The version of the 109 that I flew in 1944 and 1945 as a commander of a high-cover fighter group for our FW 190s was a very good one at 8,000 to 10,000 meters, as it had a special engine for high altitude, but it was very bad at low levels. Of course, it had a special tank for injections in the fuselage and so at a lower altitude your turning radius was not so good as that of a normal 109 and not even as good as that of an FW 190. So we normally didn't attack Mustangs or Thunderbolts at low altitudes because it was bad for our type of aircraft."

Luftwaffe General Walter Krupinski

"I always thought that the 109 could go faster on the initial dive than a P-47, I guess because we didn't throw everything to the wall. But overall, the 109 was not as fast as the P-47."

U.S. Army Air Force Captain James Finnegan



**Bf 109G-6 and Bf 109G-10
Performance Data (figures
identical for two versions
except where noted)**

Powerplant: (G-6): one Daimler Benz DB 605A 12-cylinder liquid-cooled engine; (G-10): one Daimler Benz DB 605D 12-cylinder liquid-cooled engine

Horsepower (G-6): 1,475 at takeoff, 1,800 with MW 50 methanol-water system; 1,355 at 18,700 feet, 1,700 at 13,500 feet with MW 50 methanol-water system; (G-10): 2,000 at takeoff with MW 50 methanol-water system; 1,800 at 16,730 feet

Top speed (G-6): 340 miles per hour at sea level with MW 50 methanol-water system, 386 miles per hour at 22,640 feet; (G-10): 342 miles per hour at sea level with MW 50 methanol-water system, 426 miles per hour at 24,280 feet

Maximum diving speed: 500 miles per hour

Maximum speed with landing gear extended: 225 miles per hour

Maximum speed with flaps partially lowered: 325 miles per hour

Maximum speed with flaps fully lowered: 200 miles per hour

Rate of climb (G-6): 3,346 feet per minute, 6 minutes to 18,799 feet; (G-10): 3,500 feet per minute, 5.8 minutes to 19,685 feet

Ceiling: 37,890 feet

Range: 350 miles; 620 miles with drop tank

Crew: one

Dimensions

Wingspan: 32 feet 6 1/2 inches

Wing area: 172.75 square feet

Length: 29 feet 7 inches

Height: 11 feet 2 inches

Weights

Empty: 5,953 pounds

Loaded: 6,945 pounds

Standard Armament

- Two 13-mm MG 131 machine guns, with 300 rounds per gun, mounted on the upper cowling

- (G-6 only): one 20-mm MG 151 cannon, with 200 rounds per gun, mounted through the propeller spinner in the nose

- (G-10 only): one 30-mm MK 108 cannon, with 60 rounds per gun, mounted through the propeller spinner in the nose

Optional Field Conversions (Rüstsätze)

- One 551-pound bomb, with delayed time fuse, mounted under the fuselage
- Four 110-pound bombs, mounted in pairs under each wing
- One 79-gallon auxiliary drop tank, mounted under the fuselage
- Two 20-mm MG 151 machine guns, with 120 rounds per gun, mounted under the wings
- Two 30-mm MK 108 cannons, with 60 rounds per gun, mounted under the wings
- Two 21-cm Wfr. Gr. rocket-fired mortars, mounted under the wings



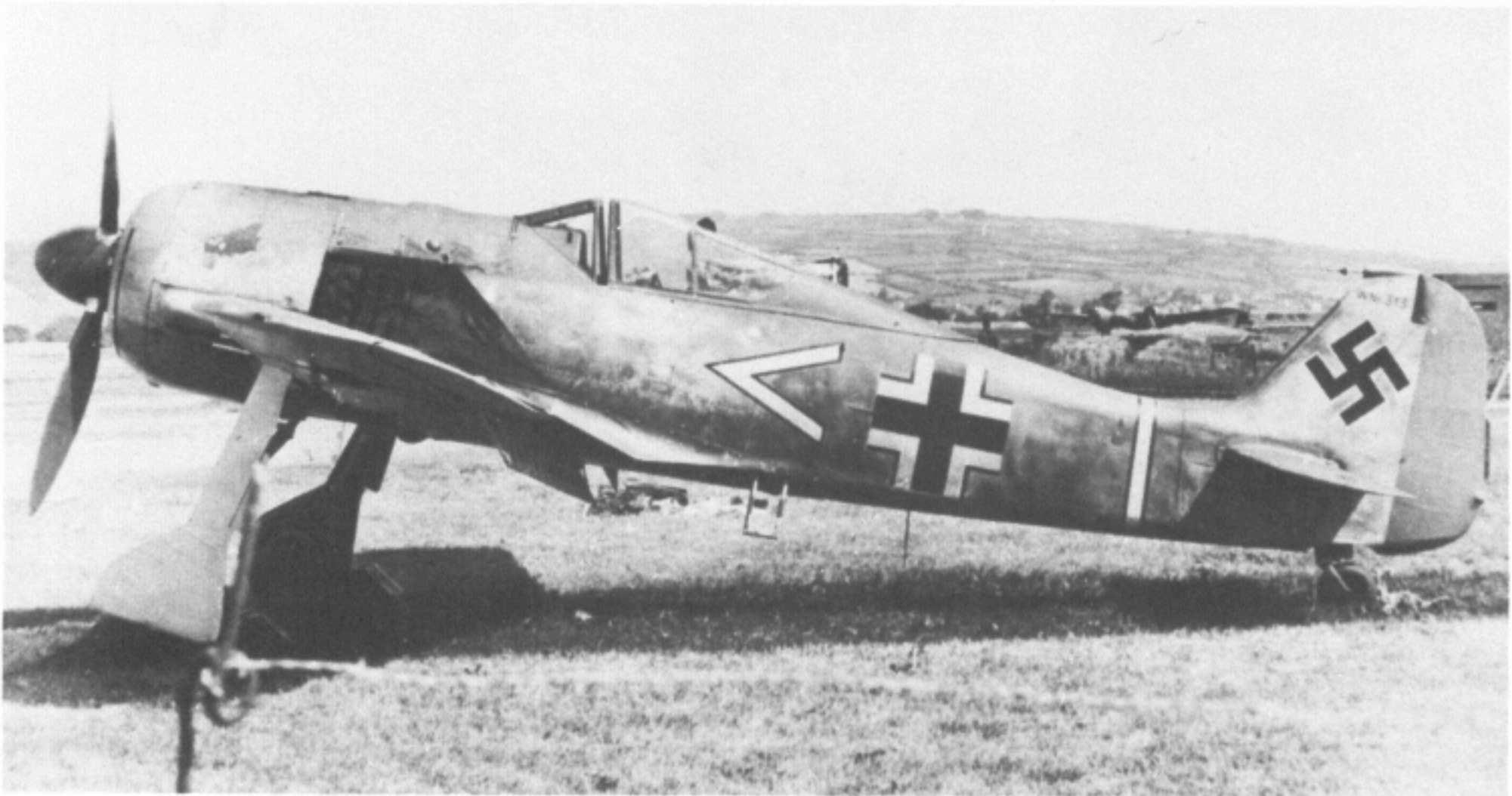
- 1 Cockpit Gunsight**
- 2 View Panel**
- 3 Cockpit Ammunition Round Indicator**
- 4 Compass**
- 5 Airspeed Indicator**
- 6 Banking Indicator**
- 7 Rate of Climb Indicator**
- 8 Flaps Lever**
- 9 Bomb Indicator Panel**
- 10 Altimeter**
- 11 Landing Gear Lever**
- 12 Manifold Pressure and Temperature Gauge**

- 13 Oil Pressure and Temperature Gauge**
- 14 Hydraulic Pressure Gauge**
- 15 RPM Indicator**
- 16 Clock**
- 17 Fuel Gauges and Fuel Tank Indicator Lights**
- 18 Rudder Indicator**
- 19 Gun Camera Indicator**
- 20 Rocket Release Indicator**

Cockpit of a Bf 109G-6 and Bf 109G-10

Focke-Wulf FW 190A-5 and FW 190A-8 Fighter

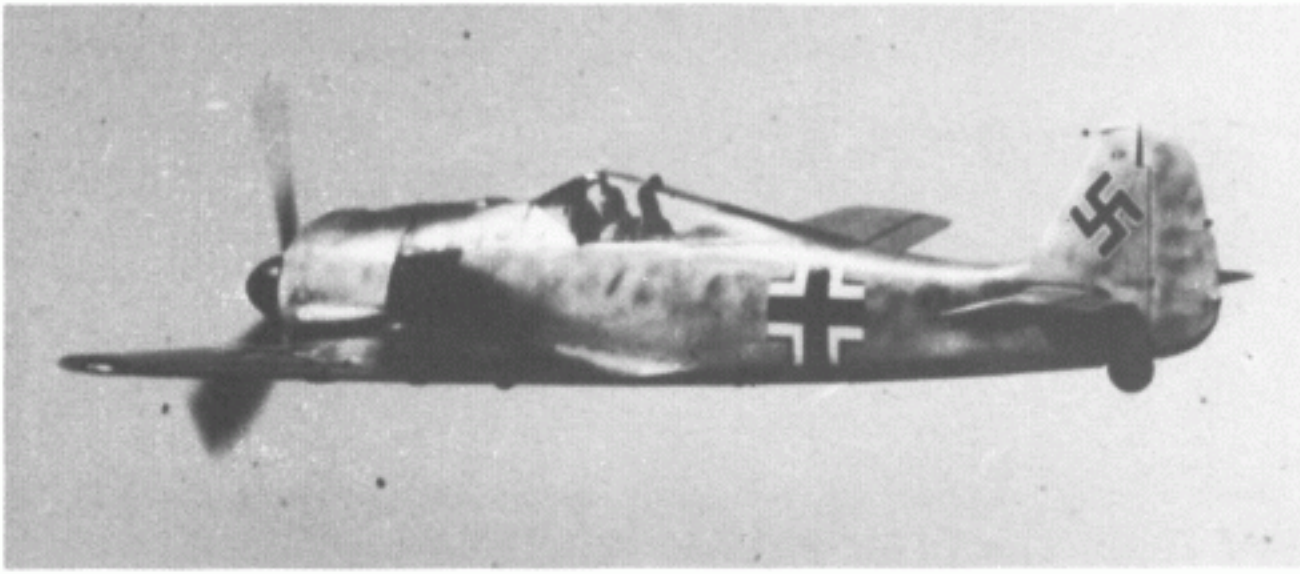
The best mass-produced German piston-engined fighter of the war, the FW 190 was a masterpiece of innovative design. It was powered by an air-cooled radial engine, which many designers predicted would not match the performance of liquid-cooled inline engines, since this engine created drag. Yet at the time it first saw action in mid-1941, the FW 190 proved to be superior to all inline-engined fighters of the day, including the Spitfire V and the Bf 109F,



The pilot of this FW 190 accidentally landed his fighter in England, giving the Allies a valuable prize. Courtesy of the United States Air Force

while using an engine that was in far less demand from the German aircraft industry. Lightweight, extremely maneuverable, and formidably armed, the FW 190 quickly replaced the Bf 109 as the Luftwaffe's deadliest fighter, although it never supplanted the 109 in production totals. Its wide-track landing gear proved to be far superior to the notoriously weak, narrow landing gear of the Bf 109. And since the FW 190 was smaller than the Bf 109 and most other fighters of its day, it had the added advantage of being a smaller target for Allied fighters and gunners. A superb daylight fighter, the FW 190 also saw service as a night fighter, fighter-bomber, dive bomber, ground attack, and photo reconnaissance aircraft.

The FW 190A-5 began to roll off the assembly lines in April 1943. This model could accept a wider variety of bombs, armament, and fuel tanks than earlier versions. The FW 190A-8, which began to appear in late 1943 and early 1944, was the last and most numerous A-model to be produced, and offered improved performance over earlier models, along with a larger fuel tank. Like the Bf 109G-6, the FW 190A-8 could accept the MW 50 methanol-water injection system, which gave it ten minutes of increased speed and climbing power. Heavy armament, including a 20-mm



Courtesy of the Boeing Aircraft Company

cannon, was standard on the A-8, and other versions featured different types of 30-mm cannons, for attacking tanks and bombers. One version, the *Rammjäger*, was designed especially for ramming U.S. bombers, and had an increased amount of frontal and cockpit armor.

"I only flew the late model of the FW 190, what we called the 'long nose,' for about a month, in February 1945. It was a marvelous aircraft, I must say, but if you had over 1,000 missions in a 109, you didn't like the 190 too much. There were a lot of German pilots who flew the 190 from the very beginning who very much favored it over the 109, but personally I didn't like it too much. In 1944, the 190s normally attacked the American bombers, and were much better at it than the 109s because they had a radial engine that was very good protection against the rear gunners of the bombers." *Luftwaffe General Walter Krupinski*

"In my opinion, the Focke-Wulf and the Thunderbolt were equal in terms of maneuverability and speed."

U.S. Army Air Force Captain James Finnegan

Courtesy of the United States Air Force





FW 190A-5 and FW 190A-8 Performance Data (figures identical for two versions except where noted)

Powerplant: one BMW 801D 14-cylinder radial air-cooled engine

Horsepower: 1,700 at takeoff with MW 50 methanol-water system

Top speed: 355 miles per hour at sea level; (A-5): 407 miles per hour at 19,685 feet; (A-8): 408 miles per hour at 20,670 feet

Maximum diving speed: 525 miles per hour

Maximum speed with landing gear extended: 230 miles per hour

Maximum speed with flaps partially lowered: 350 miles per hour

Maximum speed with flaps fully lowered: 210 miles per hour

Rate of climb: (A-5): 2,830 feet per minute, 12 minutes to 26,250 feet; (A-8): 2,450 feet per minute, 9.1 minutes to 19,685 feet

Ceiling (A-5): 34,400 feet; (A-8): 37,400 feet

Range: 497 miles at 298 miles per hour at 23,000 feet

Crew: one

Dimensions

Wingspan: 34 feet 5 1/2 inches

Wing area: 196.98 square feet

Length: 29 feet

Height: 13 feet

Weights

Empty: 7,000 pounds

Loaded: 9,750 pounds

Standard Armament (A-5)

- Two 7.9-mm MG 17 machine guns, with 1,000 rounds per gun, mounted on the upper cowling

- Two 20-mm MG 151 cannons, with 200 rounds per gun, mounted in the wing roots

- Two 20-mm MG FF cannons, with 55 rounds per gun, mounted in the outer wings

Standard Armament (A-8)

- Two 13-mm MG 131 machine guns, with 400 rounds per gun, mounted on the upper cowling

- Two 20-mm MG 151 cannons, with 250 rounds per gun, mounted in the wing roots

- Two 20-mm MG 151 cannons, with 125 rounds per gun, mounted in the outer wings

Optional Field Conversions (A-5)

- Two Wfr. Gr. 21 mortars beneath wings

Optional Field Conversions (A-8)

- One 551-pound bomb, with delayed time fuse, mounted under the fuselage

- Four 110-pound bombs, mounted in pairs under each wing

- Two 79-gallon auxiliary drop tanks, mounted under the wings

- Two 30-mm MK 108 cannons, with 60 rounds per gun, mounted under the wings

- Two 30-mm MK 103 cannons, with 60 rounds per gun, mounted under the wings

- Two 21-cm Wfr. Gr. rocket-fired mortars, mounted under the wings



- 1 Cockpit Gunsight**
- 2 View Panel**
- 3 Cockpit Ammunition Round Indicator**
- 4 Compass**
- 5 Airspeed Indicator**
- 6 Banking Indicator**
- 7 Rate of Climb Indicator**
- 8 Flaps Lever**
- 9 Bomb Indicator Panel**
- 10 Altimeter**
- 11 Landing Gear Lever**
- 12 Manifold Pressure and Temperature Gauge**

- 13 Oil Pressure and Temperature Gauge**
- 14 Hydraulic Pressure Gauge**
- 15 RPM Indicator**
- 16 Clock**
- 17 Fuel Gauges and Fuel Tank Indicator Lights**
- 18 Rudder Indicator**
- 19 Gun Camera Indicator**
- 20 Rocket Release Indicator**

Cockpit of an FW 190A-5 and FW 190A-8

Messerschmitt Me 163B-1a Komet Fighter

The most radical aircraft to see action in World War II, the Me 163 coupled innovative design features with a futuristic powerplant to produce a bold new type of short-range interceptor. The rocket-powered Komet featured a short fuselage and a tail with no horizontal section. After takeoff, the landing gear assembly, which was mounted on a trolley, was jettisoned at an altitude of twenty to thirty feet. Once it



was airborne, the Komet was put into a very steep climb to intercept enemy aircraft. It could climb extremely fast, but since it had only about eight minutes' worth of fuel, it could only make a few passes at enemy aircraft. The high speed of the Me 163 was often a detriment to Luftwaffe pi-

lots trying to score hits on U.S. bombers, since it left them with only about three seconds to get off shots with its slow-firing cannon. The Me 163 had evolved from a glider design and handled extremely well as a glider after its fuel was used up, although this was when it was most vulnerable to Allied fighter attack. The Komet would land on an extendable skid with a shock-absorbing leg.

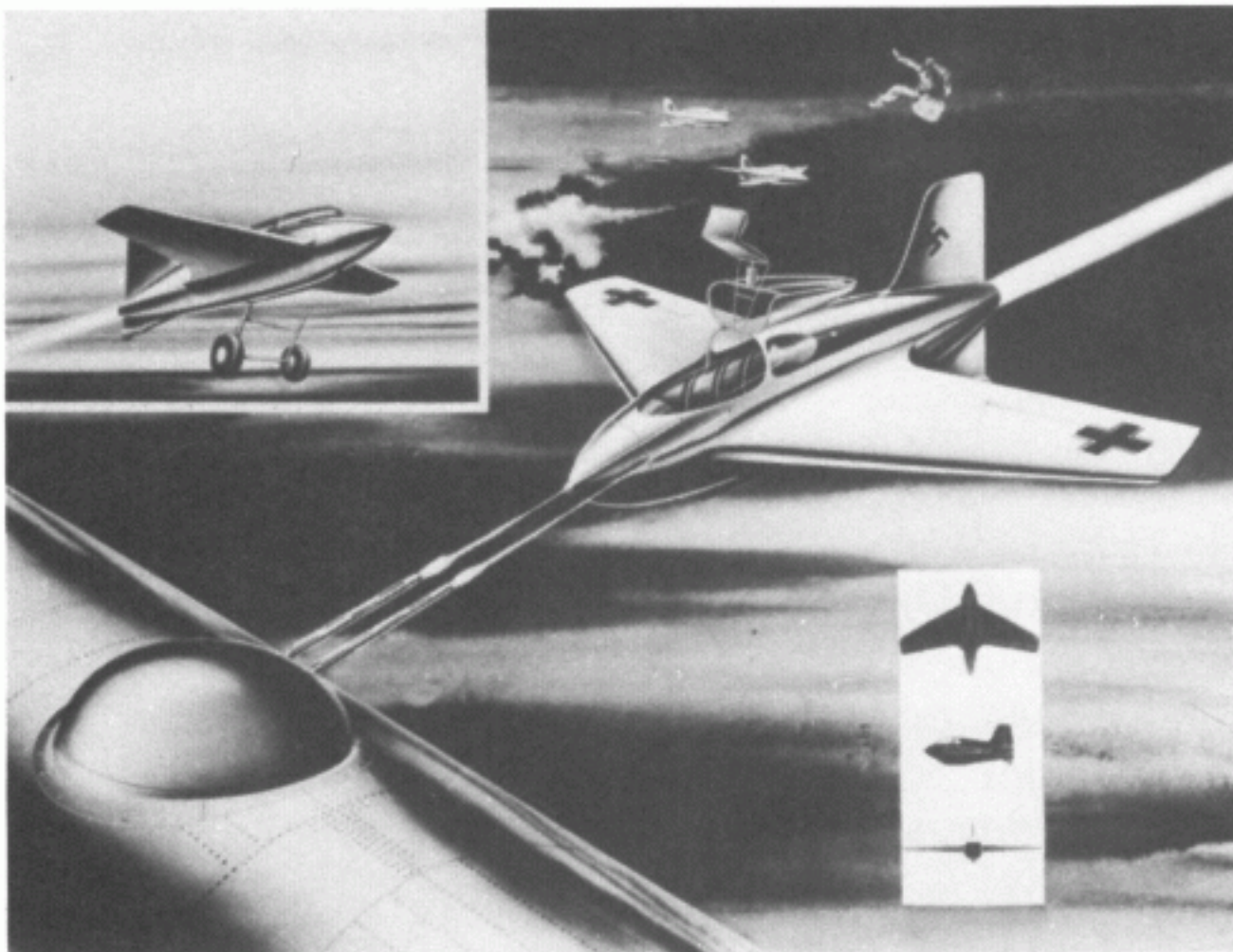
The chief drawback of the Me 163 was the volatility caused by its two rocket propellants, called "T-Stoff" (hydrogen peroxide and water) and "C-Stoff" (hydrazine hydrate, methyl alcohol, and water). These two propellants reacted violently when mixed, and if a Komet had any residual amounts of propellant in its tanks when landing, it would often explode if the touchdown was too rough. Sometimes a Komet would explode while merely sitting on

a runway! Pilots wore acid-resistant suits to prevent being dissolved by the two corrosive rocket fuels in the event of a leak. Another disadvantage was the landing skid, which made landings extremely rough, causing several pilots to break their backs. A pilot had to be extremely proficient at precise, high-speed landings, for if he overshot the runway and landed on rough ground, the Me 163 would flip over and explode. Many pilots died while test-flying this rocket fighter, and although the Komet was occasionally successful at downing Allied aircraft, its high speed made this difficult.

The Me 163A was the prototype version of the Komet, and the Me 163B was the model that saw the most service. An improved model, the

Ceiling, Fighters





Taken from an issue of *Mechanics Illustrated*, this drawing depicts the Me 163, including its proposed ejector seat and detachable landing gear. Actually, few Komet pilots would ever get nearer to a U.S. bomber than 500 yards, since the tremendous speed of the Me 163 left little time to avoid a collision at short distances. *Courtesy of Mechanics Illustrated*

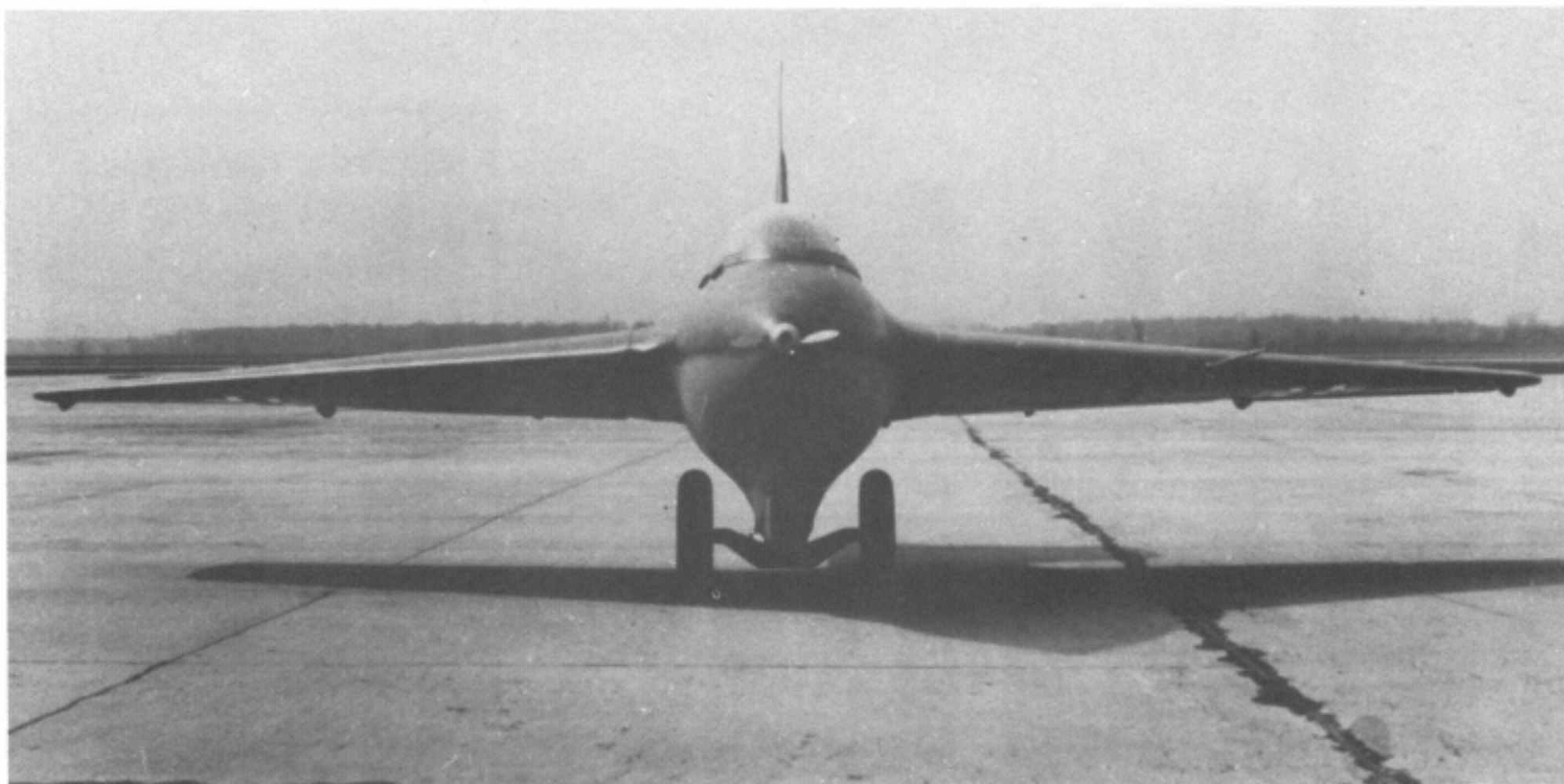
Me 263, with retractable landing gear and a longer fuselage, was tested but never saw action.

"A good friend, Wolfgang Späte, flew the Me 163. I heard that the problem was that it would explode if the two types of fuel came together. They had a lot of losses out of this one. It was only used as what we called an 'object fighter.' You could only let it take off when you saw the enemy bombers, and it went up very fast over them. The main tactic I know about was attacking from above, without any fuel in the tanks, if possible.

"I don't know anyone who liked flying it, since it was a very dangerous thing to fly. I would say it was a crazy idea — that's my opinion. If you have a fighter and you have to burn out your fuel first, attack, and then make a glider landing, it doesn't seem to make much sense."

Luftwaffe General Walter Krupinski

Frontal view of an Me 163. As its sleek design indicates, it had excellent handling characteristics as a glider once it ran out of fuel. *Courtesy of the United States Air Force*





Me 163B-1a Komet Performance Data

Powerplant: one Walther HWK 509A-1 or A-2 bi-fuel rocket motor

Thrust: 3,750 pounds

Top speed: 515 miles per hour at sea level, 596 miles per hour at 20,000 feet

Maximum diving speed: 615 miles per hour

Maximum speed with landing skid extended: 300 miles per hour

Maximum speed with flaps partially lowered: 375 miles per hour

Maximum speed with flaps fully lowered: 250 miles per hour

Rate of climb: 16,000 feet per minute, 2.6 minutes to 30,000 feet

Ceiling: 39,500 feet

Range: 50 miles

Crew: one

Dimensions

Wingspan: 30 feet 7 inches

Wing area: 211 square feet

Length: 18 feet 8 inches

Height: 9 feet $\frac{2}{3}$ inch

Weights

Empty: 4,191 pounds

Loaded: 9,042 pounds

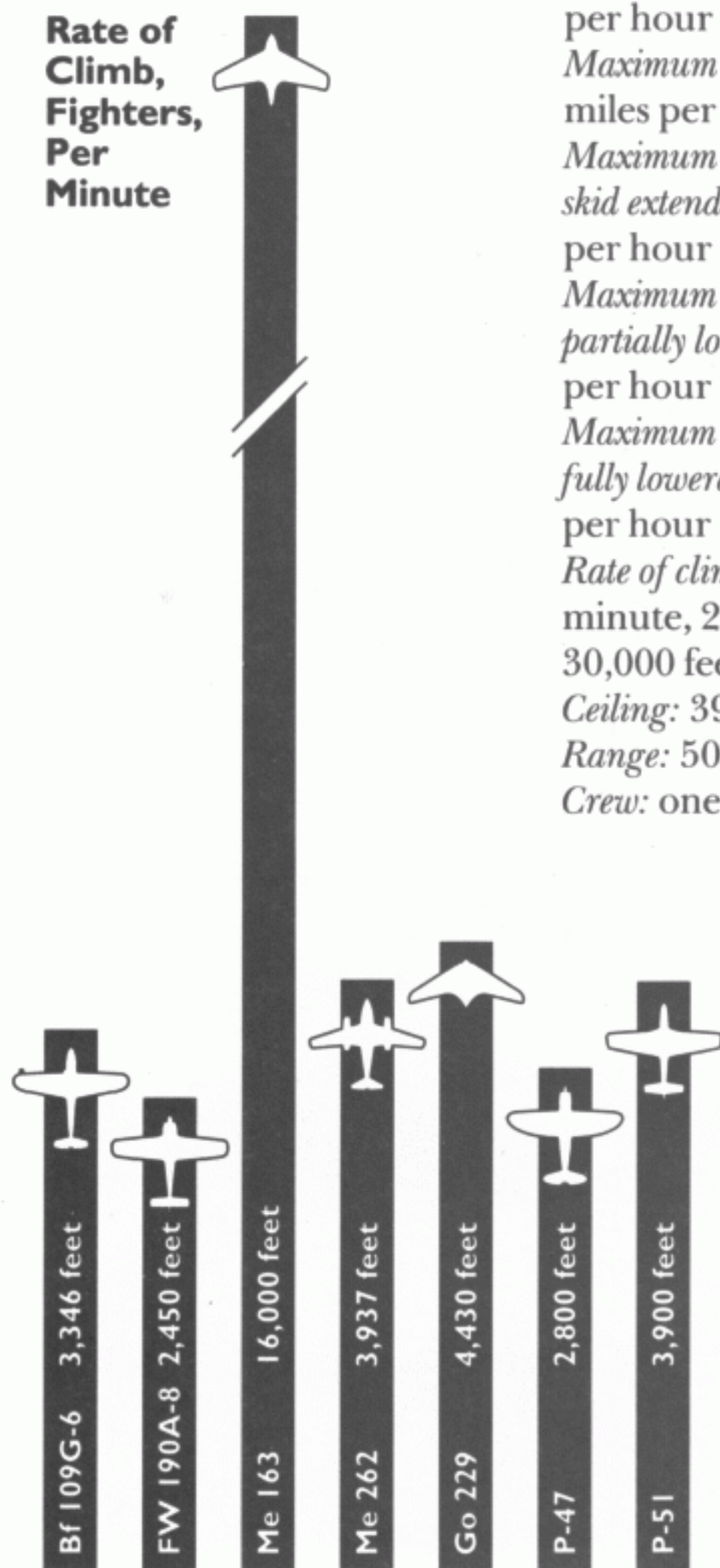
Standard Armament

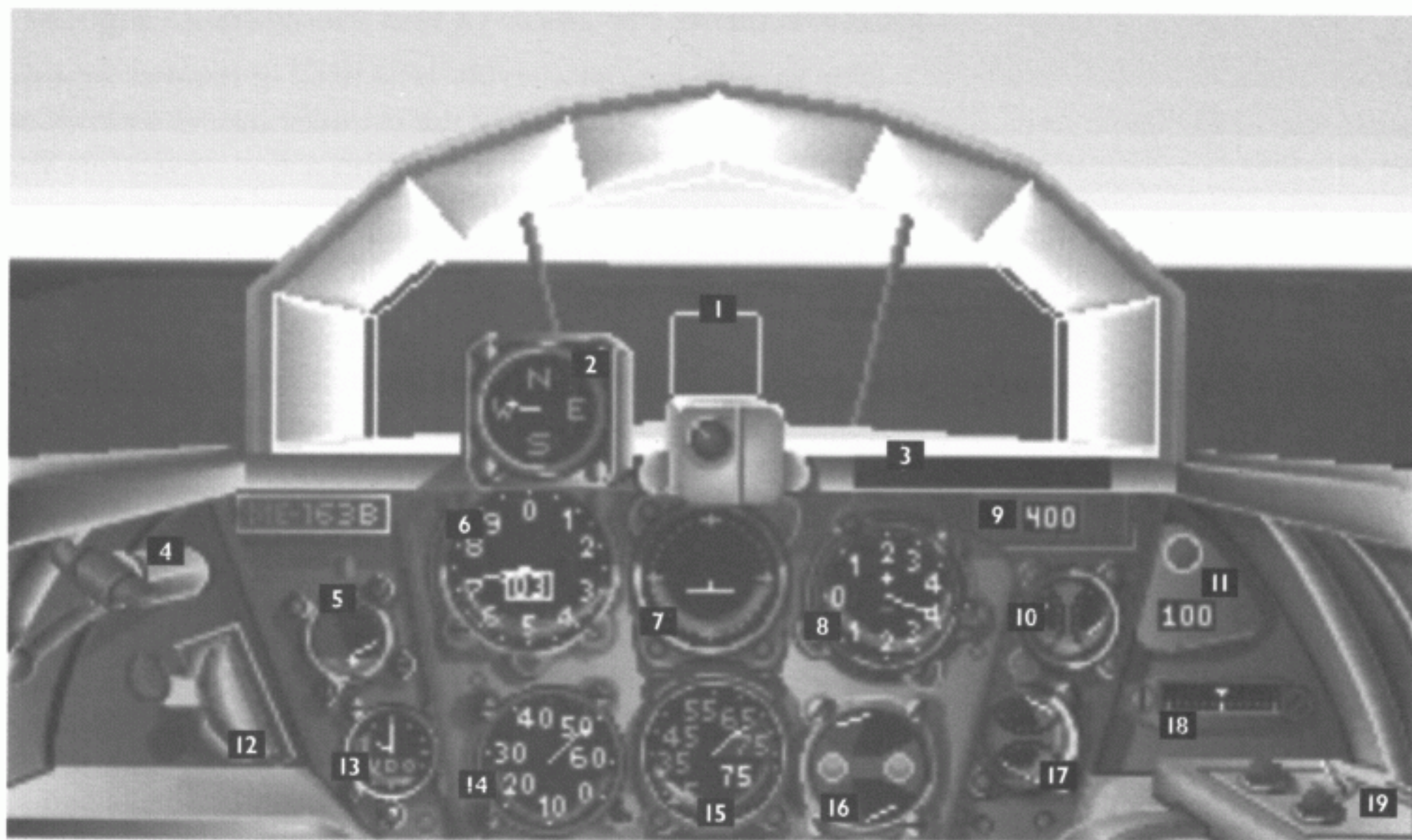
- Two 30-mm Rheinmetall Borsig MK 108 cannon, with 60 rounds each, mounted in the wing roots

Optional Armament

- Two 20-mm MG 151 cannons, with 100 rounds per gun, mounted in the wing roots
- Ten vertically launched SG 500 Jagdfaust 50-mm high-explosive rocket-propelled shells, mounted in vertical tubes in the wings

Rate of
Climb,
Fighters,
Per
Minute





- 1 Cockpit Gunsight**
- 2 Compass**
- 3 View Panel**
- 4 Landing Skid Lever**
- 5 Hydraulic Pressure Gauge**
- 6 Altimeter**
- 7 Banking Indicator**
- 8 Rate of Climb Indicator**
- 9 Cockpit Ammunition Round Indicator**
- 10 Oil Pressure and Temperature Gauge**

- 11 Gun Camera Indicator**
- 12 Flaps Lever**
- 13 Clock**
- 14 Airspeed Indicator**
- 15 RPM Indicator**
- 16 Fuel Gauges and Fuel Tank Indicator Lights**
- 17 Manifold Pressure and Temperature Gauge**
- 18 Rudder Indicator**
- 19 Jagdfaust Vertically Launched Rocket Release Indicator**

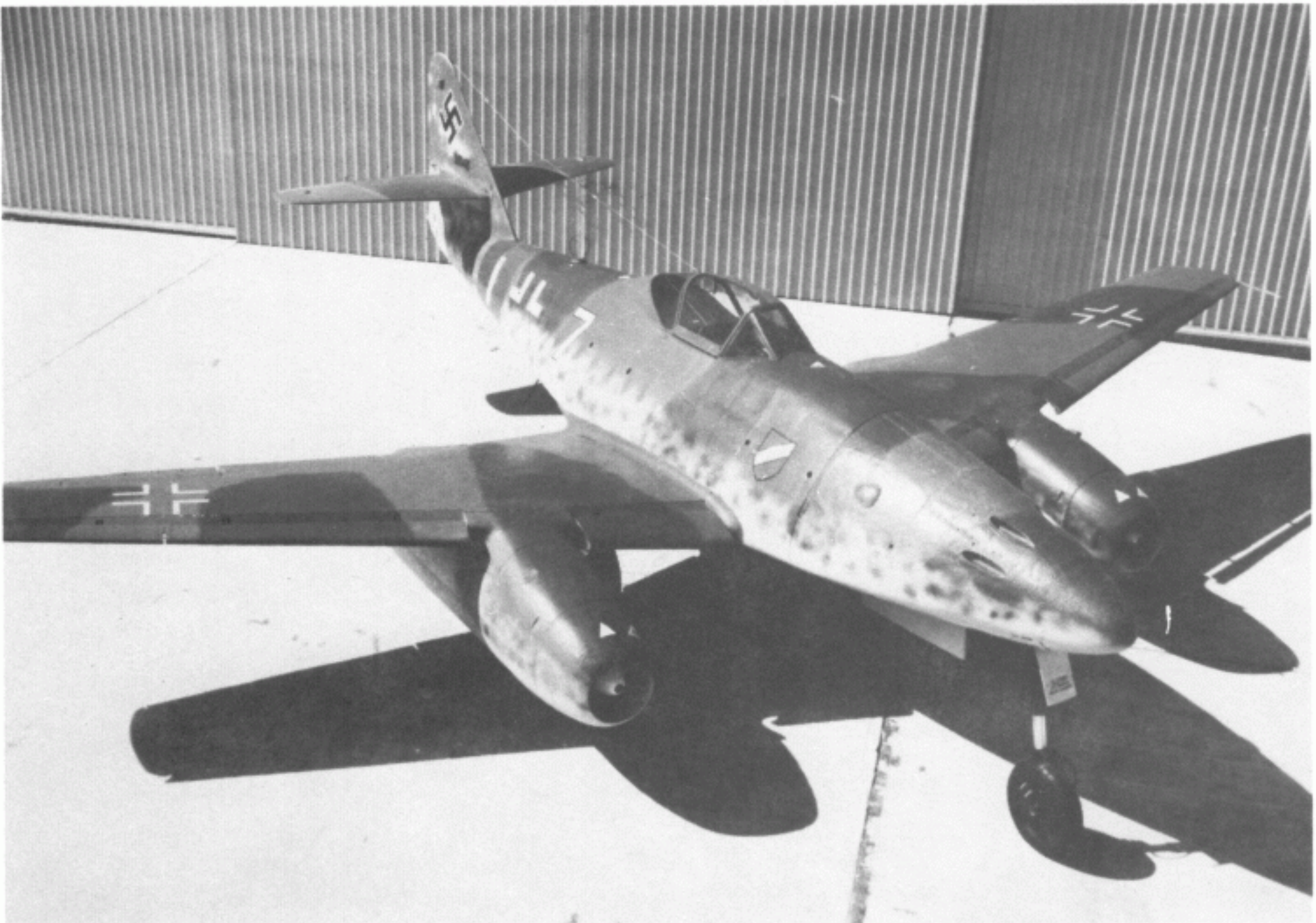
Cockpit of an Me 163B-1a

Messerschmitt Me 262A-1a and Me 262A-2a Fighter

The world's first jet aircraft to be used in combat against other aircraft, the Me 262 was the premier fighter aircraft of World War II. (It saw its first action a few days after the British introduced the world's first operational jet fighter, the Gloster Meteor, which was used only against V-1 flying bombs.) With its revolutionary swept-wing design, the Me 262 was much faster than any aircraft the Allies could counter with. Though not as maneuverable as piston-engined fighters, the Me 262 more than made up for this limitation with its superior speed, as it could sweep through enemy formations faster than pursuing aircraft. It could also hold its speed in tight turns for longer periods of time than piston-engined fighters. But by the time it saw its first action in 1944, the Me 262 was hampered by a lack of trained pilots, a fuel shortage, Allied attacks on airfields, and the general collapse of the Third Reich. Despite these overwhelming handicaps, the Me 262 dominated all other aircraft at a time when the Allies ruled the sky above Germany, and signaled the beginning of a new era in aviation.

While German bureaucratic bungling at the highest levels kept the Me 262 from entering service as a fighter at an earlier date, the jet also suffered from rushed development. Its Jumo engines were "frozen" at an early stage, and the resulting mass-produced engines required constant servicing. Still, the first prototype, fitted with a nose-mounted piston engine, was flying a full six months before the jet engines

This restored Me 262 is on display at the National Air and Space Museum in Washington, D.C.



were ready. The first jet-powered Me 262 made its trial flight on July 18, 1942, but production was delayed until General Adolf Galland flew another one nine months later. The early prototypes were fitted with a tailwheel, but this meant that while taxiing down the runway the pilot had to lightly tap the brakes to bring the tail up and allow the plane to take off. Later prototypes were fitted with a tricycle landing gear, which, like other Messerschmitt landing gear, was prone to collapse. Tested as a fighter, it proved superior in flight and excelled at the interceptor role. However, production was held up again while completed Me 262 fighters were converted to Sturmvogel bombers, at Hitler's insistence. Not until October of 1944 did the first Me 262 jet fighter unit become operational. But for the next seven



months, until the end of the war, the Me 262 proved to be outstanding in combat; it was simply too fast for Allied fighters and bomber gunners. However, its superior speed was sometimes a liability to its pilots, who found it difficult to hit targets at high speeds, and Me 262s were sometimes shot down after the pilot had slowed to attack. In fact, most of the losses occurred when the pilot had to slow down to land.

The Me 262A-1a was the main fighter version produced during the war, and was dubbed the *Schwalbe*, or "Swallow." It was heavily armed, with four cannons in the nose, and later, as the Me 262A-1B, with twenty-four R4M air-to-air rockets mounted under the wings. Other versions included the infamous Me 262A-2a Sturmvogel fighter-bomber, with bomb racks mounted under the fuselage for carrying one or two bombs, and various two-seater night fighters and trainers. Although some 1,430 Me 262s were produced, only about 300 were ever used against the Allies.

An Me 262 Sturmvogel fighter-bomber. Although Hitler hampered the development of the Me 262 by ordering that it be equipped with bomb racks, technical problems with the Junkers Jumo 004 jet engine also kept this remarkable aircraft from mass production until 1944. Courtesy of the U.S. Air Force Museum, Wright-Patterson Air Force Base, Dayton, Ohio

“It felt as though angels were pushing.”

Luftwaffe General Adolf Galland,
describing his first test flight of
the Me 262 on May 22, 1943

“I received absolutely zero training in the Me 262. I was pulled out of our fighter recreation center in March of 1945 by General Galland and Colonel Steinhoff who came at that time with their squadron. Steinhoff asked me, ‘What are you doing here?’ and I said I had finished the war. He asked me if I would like to fly the 262. I said, ‘Immediately’ and the next morning Steinhoff gave me the introduction to the aircraft. I was sitting in the cockpit and he was explaining something to me and he said, ‘The most difficult thing about this aircraft is starting the engine. So I will do it for you.’

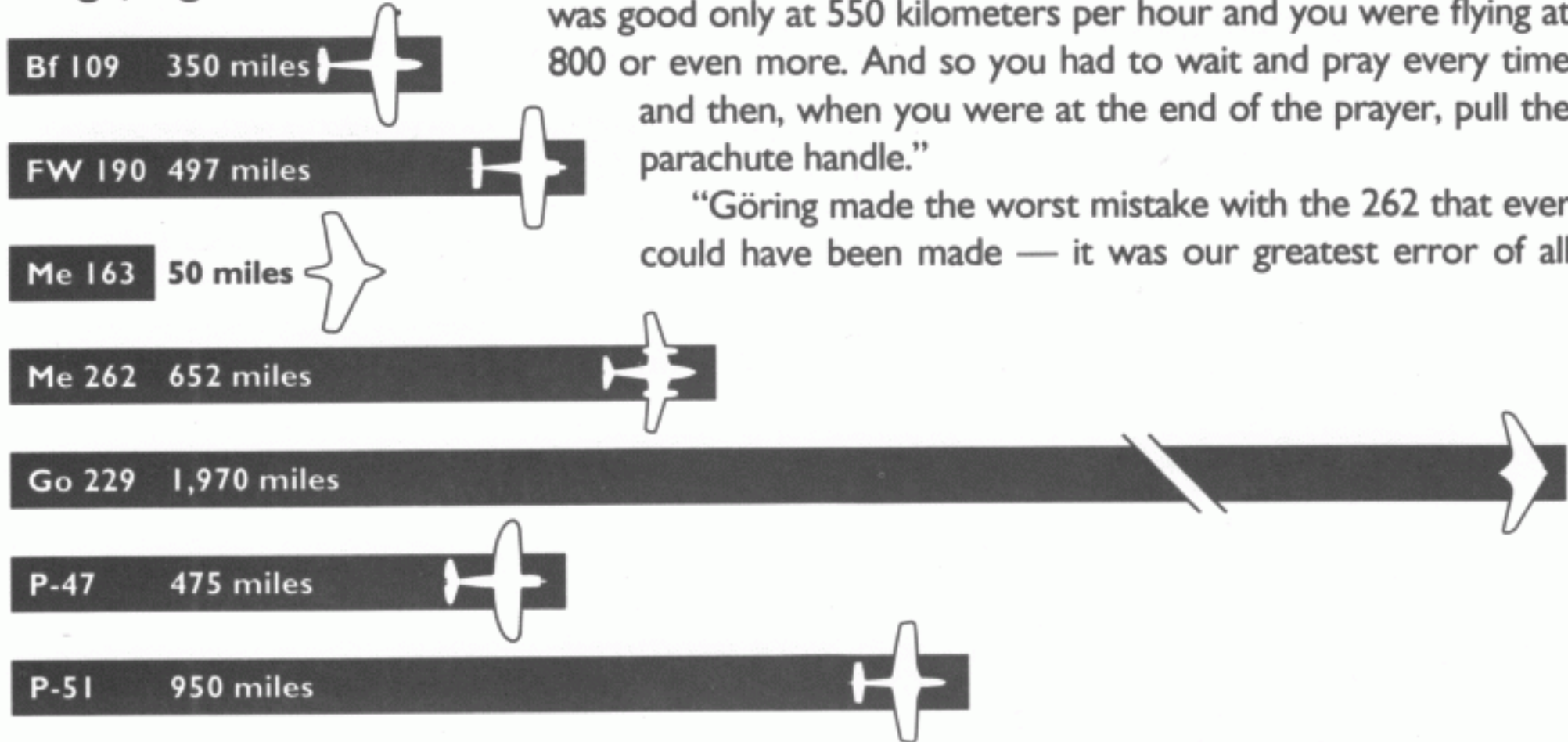
“It was easy to take off in the 262 because the nose gear was running real nicely and properly. The problem was that the engine didn’t bring the speed up very fast. You needed the whole base before you came to a takeoff speed. For example, at Munich, that strip where we took off was about eleven hundred meters long, and only after about a thousand meters did you have the lifting speed to come off the field. Landing was easy, but you had to kill the speed at the right time and then make what you call a glider landing. That means never touching the throttle again and coming in at the right angle. The problem was, if you wanted to give a little more power to the engine, you had to do it very carefully and use the throttle millimeter by millimeter.

“I flew a lot of fighters in the air force, and flameout was the biggest problem that you normally could have in a jet aircraft. But I never experienced a flameout in a 262, and I never heard about one. The reason may be that the fuel control system was so simple that you immediately could ignite the engine again.

“The main danger in flying the 262 was that there were a lot of problems with the engine. After four or five years of war, the material used in the engine was not the best. So after each flight, you listened to the turbine blades to hear whether they were scraping, which they normally did after ten or fifteen hours; they told us that the engines should be good for twenty-five hours. The other problem was that you didn’t have an ejection seat, so if you had to bail out, you had to first kill the speed. The parachute was good only at 550 kilometers per hour and you were flying at 800 or even more. And so you had to wait and pray every time and then, when you were at the end of the prayer, pull the parachute handle.”

“Göring made the worst mistake with the 262 that ever could have been made — it was our greatest error of all

Range, Fighters



times. They saw it — while it was still an experimental aircraft — in 1943 and decided to make a bomber out of it. There were nearly four air corps bomber wings that were changed to the 262, and they were to bomb the U.K. with 500-kilo bombs, which was all they could carry. The fighter service had only one 262 wing, Number 7 Wing, and only the 262 squadron General Galland commanded after they kicked him out of his position as a fighter general.

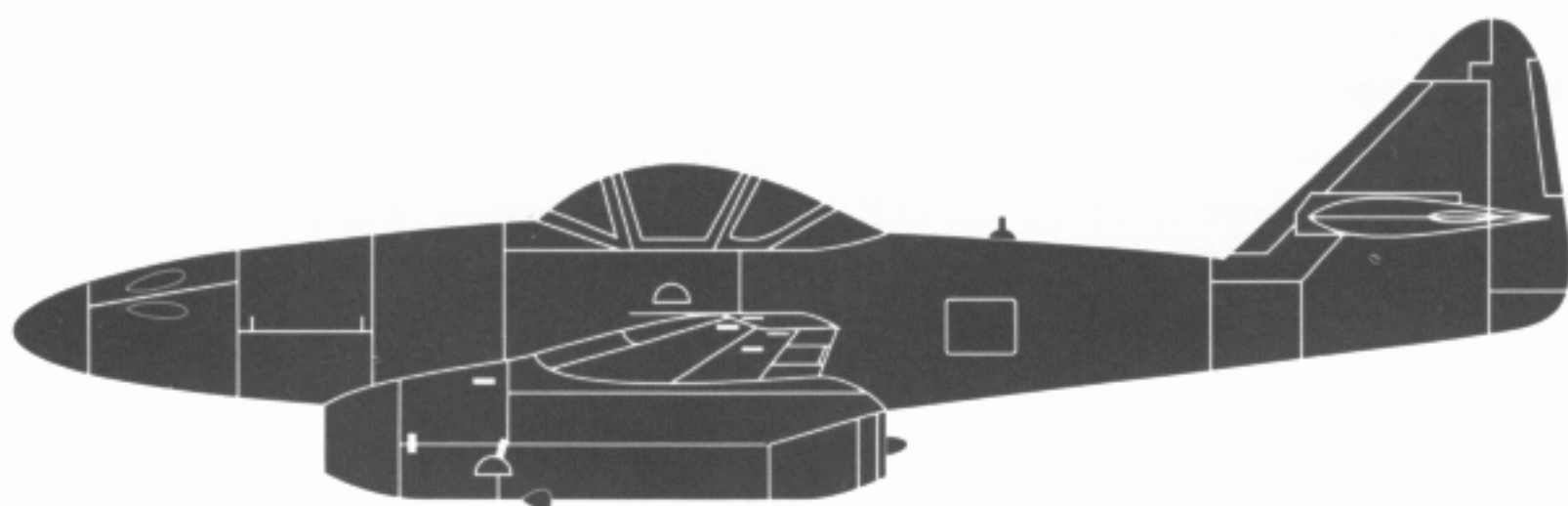
“Every time the discussion comes up, I say the same thing — that the Germans didn’t have a chance to win the war with the 262. But if the 262 had come up, say at the end of 1943, or even 1944, the air war over Germany would have been a different picture. The Americans wouldn’t have had a chance to fly in daylight



on every target, because the 262 would have given the American bomber force so many losses; their fighters at that time were not fast enough to fight against the 262. So the Americans would have concentrated much more on special military targets and not destroyed all of Germany, or all the towns wherever they were flying.”
Luftwaffe General Walter Krupinski

“We first got news of the 262 in October of ‘44. They said that it was a jet and was the fastest one around. We weren’t afraid that if we hit it we were going to die. We knew we had won the war by this time, and the pilots that we were running up against were just kids, with the exception of this one squadron led by Galland, who had all the aces on the western front. And yet, the first time I saw the 262, I just couldn’t believe it, I couldn’t figure out what the hell it was. I just saw the 262s as specks, until we finally got closer to them; then I recognized them as jets. We never got any instructions on how to go after the 262, other than, ‘Watch out for these things.’

“Had the Germans done what Galland had continuously harped on them to do, to use the 262s as defensive weapons instead of offensive weapons, before the massive air raids that started knocking out their manufacturing, their oil, their fuel, we would have still won the war, but it would have been one hell of a bitter time.”
U.S. Army Air Force Captain James Finnegan



Me 262A-1a and Me 262A-2a Performance Data (figures identical for two versions except where noted)

Powerplant: two Junkers Jumo 004B-1 or B-4 turbojets

Thrust: 1,980 pounds per engine

Top speed: 515 miles per hour at sea level, 540 miles per hour at 19,685 feet

Maximum diving speed: 620 miles per hour

Maximum speed with landing gear extended: 250 miles per hour

Maximum speed with flaps partially lowered: 400 miles per hour

Maximum speed with flaps fully lowered: 300 miles per hour

Rate of climb: 3,937 feet per minute, 6.8 minutes to 19,685 feet

Ceiling: 36,080 feet

Range: 526 miles at 19,685 feet, 652 miles at 29,560 feet

Crew: one

Dimensions

Wingspan: 41 feet $\frac{1}{8}$ inch

Wing area: 233.3 square feet

Length: 34 feet 9 $\frac{1}{2}$ inches

Height: 12 feet 6 $\frac{3}{4}$ inches

Weights

Empty: 8,820 pounds

Loaded: 14,938 pounds

Standard Armament

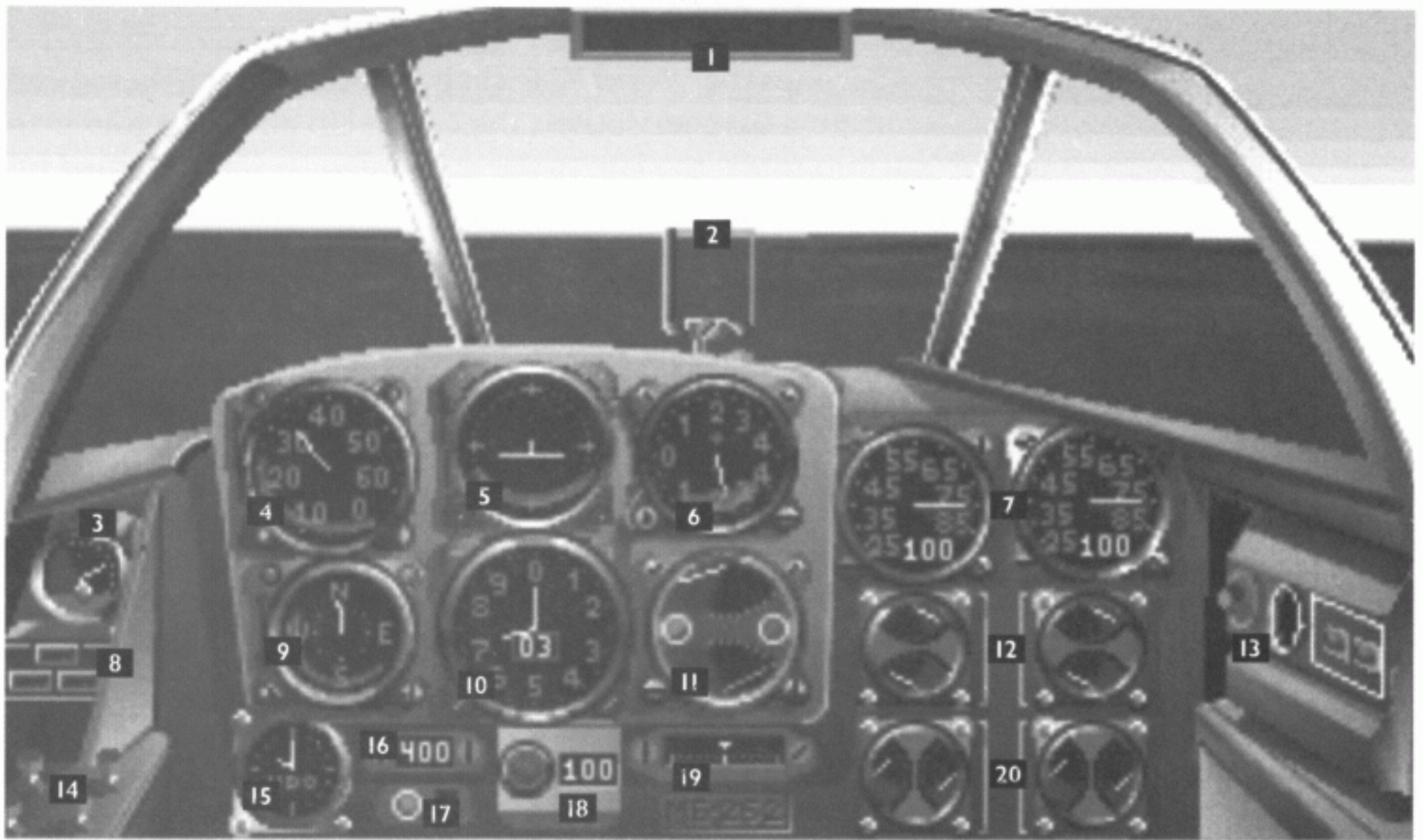
- Four 30-mm Rheinmetall Borsig MK 108 cannons, two with 100 rounds each and two with 80 rounds each, mounted in the upper and lower nose

Optional Armament (1a)

- Twenty-four 5cm R4M rockets, twelve clustered in each wing

Optional Armament (2a)

- Two 551-pound bombs, mounted under the fuselage
- One 1,102-pound bomb, mounted under the fuselage



1 View Panel

2 Cockpit Gunsight

3 Hydraulic Pressure Gauge

4 Airspeed Indicator

5 Banking Indicator

6 Rate of Climb Indicator

7 RPM Indicators (one per engine)

8 Landing Gear Lever

9 Compass

10 Altimeter

11 Fuel Gauges and Fuel Tank Indicator Lights

12 Manifold Pressure and Temperature Gauges (one per engine)

13 Rocket Release Indicator

14 Flaps Lever

15 Clock

16 Cockpit Ammunition Round Indicator

17 Bomb Indicator Panel

18 Gun Camera Indicator

19 Rudder Indicator

20 Oil Pressure and Temperature Gauges (one per engine)

Cockpit of an Me 262A-1a and Me 262A-2a

Gotha Go 229A-0 Fighter-Bomber

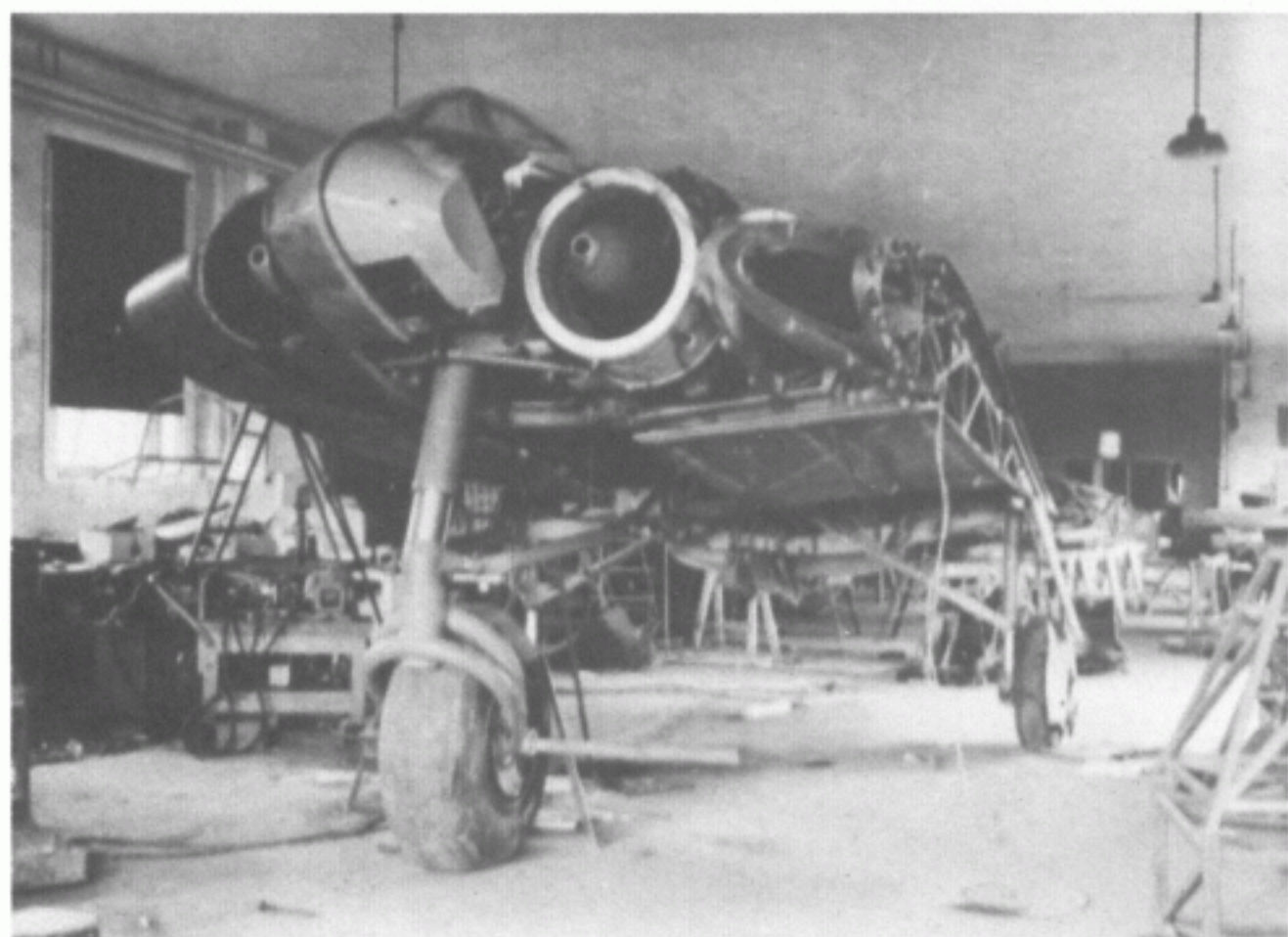
Perhaps the World War II aircraft that was farther ahead of its time than any other, the Gotha Go 229 went into production much too late to see any action. It was designed by Luftwaffe Major Walter Horten and Oberleutnant Reimar Horten, two brothers who had been experimenting with tailless gliders since 1931. The Hortens were convinced that such a “flying wing” was an outstanding aircraft design, since it caused the least amount of drag. They discovered that if the wing had a bell-shaped curve, it would be both stable and controllable. Their first powered prototypes were built in the late 1930s and were equipped with two rear-facing prop engines. During the early 1940s, they found it difficult to generate much official financial support for their projects until intelligence reports from the United States revealed that the Northrop Corporation was developing its own “flying wing.”

In 1943, the Hortens began working on a twin-jet-powered “flying wing” prototype, the Horten Ho IX V2. This fighter-bomber was made to Göring’s general specification that all new aircraft should carry 1,000 kilograms of bombs, fly 1,000 kilometers per hour, and have a “penetration depth” (one-third the total range) of 1,000 kilometers. This

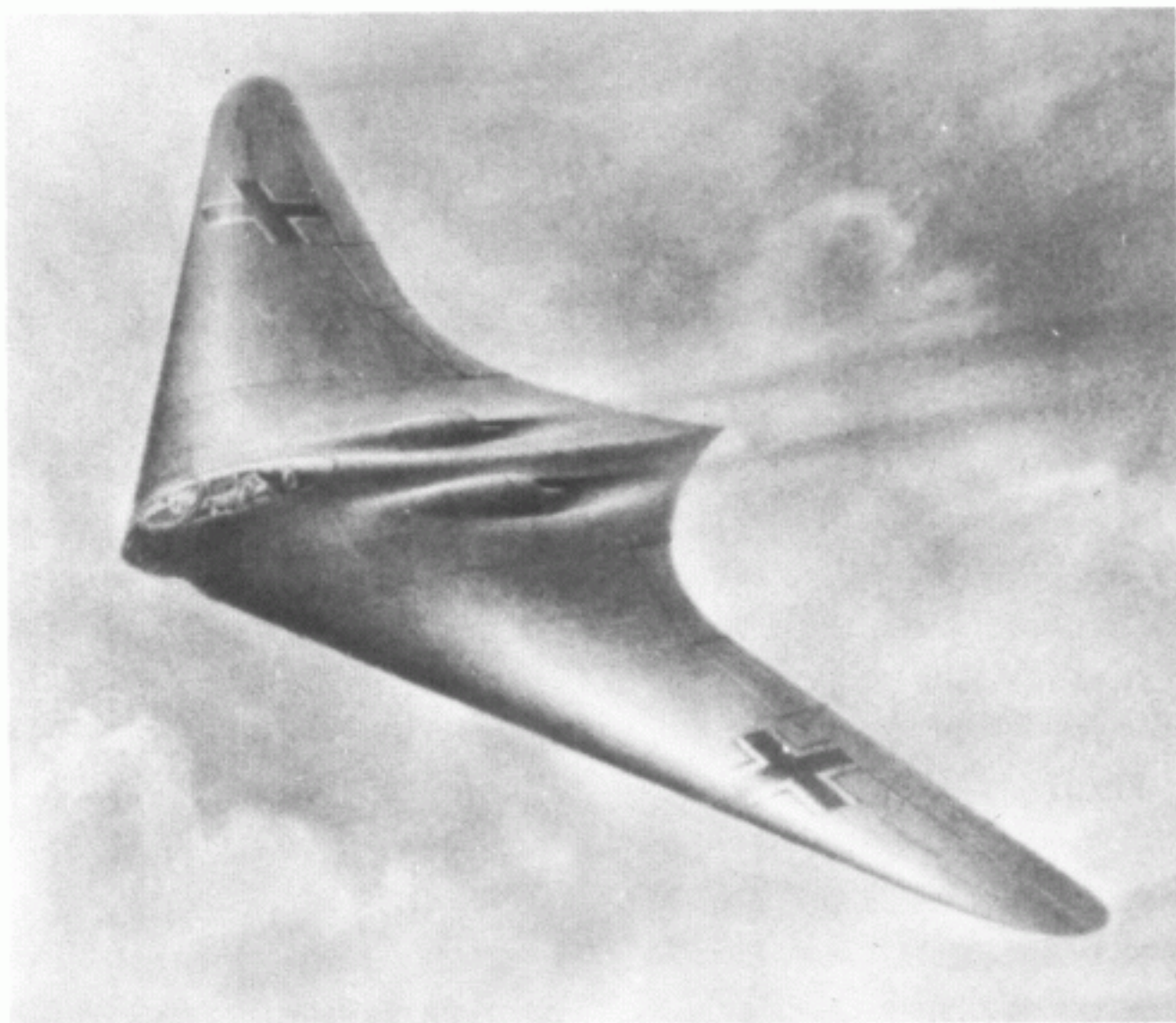
“1,000/1,000/1,000” plane was made of wood, since it was lightweight and metal was in short supply. The Hortens also believed that a wooden wing hit by a cannon shell would sustain less damage than a metal one. The wood construction, covered with a special radar-absorbing paint, made this “flying wing” virtually undetectable by radar. Since the Ho IX V2 was tailless, two drag brake flaps above and below each wingtip provided direction-

al control. The pilot achieved lateral and longitudinal control by moving outer and center-mounted surfaces on the trailing edge of the wing. For better visibility, the pilot’s compartment was located as far forward as possible.

After its first flight, in February 1945, the Ho IX V2 pilot reported that it had excellent flying characteristics; however, on its second flight, it crashed when its starboard engine flamed out. Although the Ho IX V2 prototype had only logged two hours of flying time, the design was put into production at the Gotha factory for Luftwaffe evaluation, and was designated the Gotha Go 229. Several production ver-



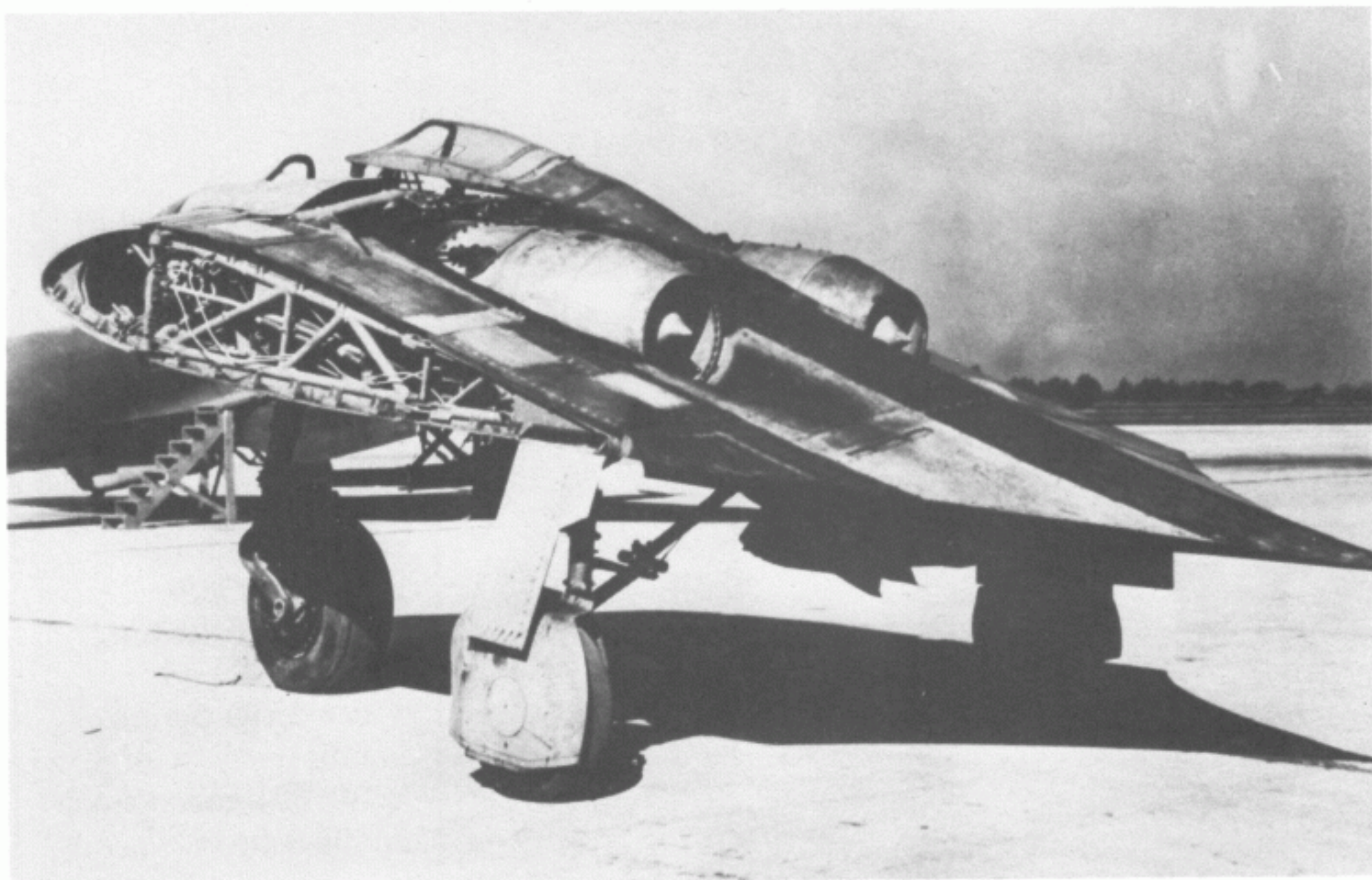
Courtesy of the United States Air Force

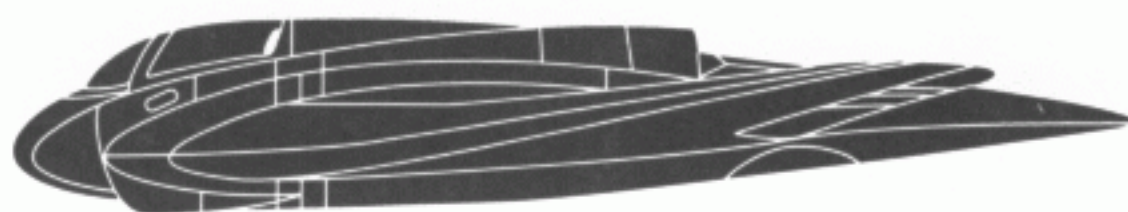


Artist's conception of a Go 229 in flight. Had Germany been able to prolong the war for a few more months, this fighter-bomber could have seen action against Allied aircraft.

sions, including two-seat all-weather fighters and trainers, as well as single-seat A-0 fighter-bombers, were nearing completion when the Gotha factory was captured by the U.S. Army in April 1945. The Hortens had also been contracted to develop a six-engine jet bomber with a range of 4,000 miles, and were working on a supersonic "flying wing," and even a large passenger-carrying version. If Germany had prolonged the war, the Go 229A-0 would probably have entered Luftwaffe service in late 1945 or early 1946.

A nearly completed Go 229 captured by the U.S. Army at the Gotha factory.





Go 229A-0 Performance Data (Estimated)

Powerplant: two Junkers

Jumo 004B-1 turbojets

Thrust: 1,962 pounds at takeoff

Top speed: 590 miles per hour at sea level, 607 miles per hour at 39,370 feet

Maximum diving speed: 640 miles per hour

Maximum speed with landing gear extended: 175 miles per hour

Maximum speed with flaps partially lowered: 500 miles per hour

Maximum speed with flaps fully lowered: 275 miles per hour

Rate of climb: 4,430 feet per minute, 6.1 minutes to 19,685 feet

Ceiling: 52,500 feet

Range: 1,180 miles at 393 miles per hour, 1,970 miles with drop tanks

Crew: one

Dimensions

Wingspan: 45 feet 11 1/8 inches

Wing area: 376.6 square feet

Length: 24 feet 6 1/8 inches

Height: 9 feet 2 1/4 inches

Weights

Empty: 10,140 pounds

Loaded: 16,550 pounds

Standard Armament

- Four 30-mm MK 108 cannons, with 120 rounds per gun, mounted in the wing roots

Optional Armament and Attachments

- Four 30-mm MK 103 cannons, with 120 rounds per gun, mounted in the wing roots
- Two 2,205-pound bombs
- Two 331-gallon auxiliary fuel tanks



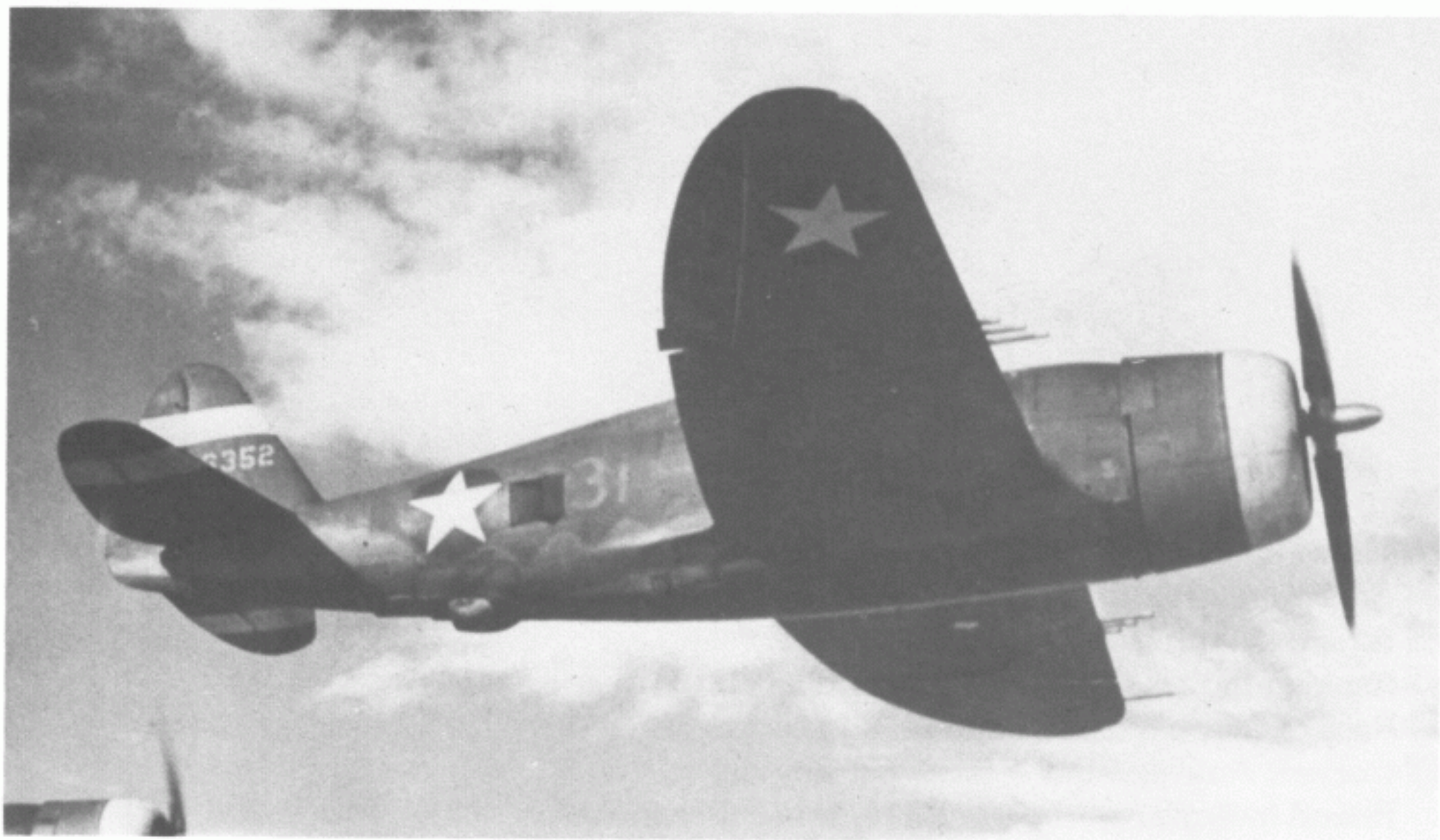
Cockpit of a Go 229A-0

- | | |
|---|---|
| 1 View Panel | 12 Flaps Lever |
| 2 Cockpit Gunsight | 13 Gun Camera Indicator |
| 3 Airspeed Indicator | 14 Clock |
| 4 Banking Indicator | 15 Landing Gear Lever |
| 5 Rate of Climb Indicator | 16 RPM Indicators (one per engine) |
| 6 Cockpit Ammunition Round Indicator | 17 Hydraulic Pressure Gauge |
| 7 Rocket Release Indicator | 18 Manifold Pressure and Temperature Gauges (one per engine) |
| 8 Bomb Indicator Panel | 19 Oil Pressure and Temperature Gauges (one per engine) |
| 9 Fuel Gauges and Fuel Tank Indicator Lights | |
| 10 Compass | |
| 11 Altimeter | |

UNITED STATES AIRCRAFT

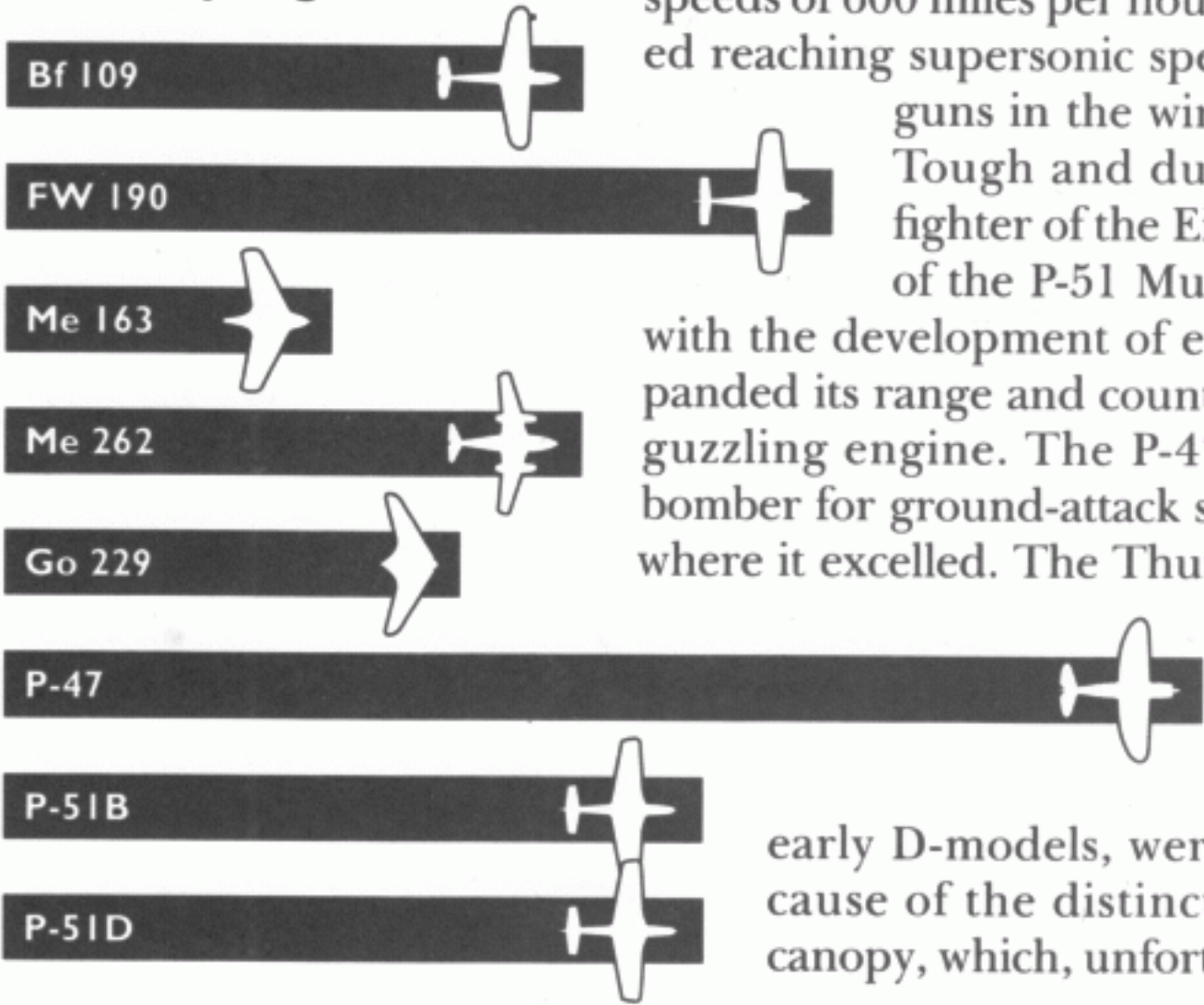
Republic P-47C Thunderbolt Fighter ("Razorback")

The largest, heaviest single-engine, single-seat fighter of World War II, the P-47 Thunderbolt was nicknamed "the Jug," and was indeed a juggernaut. It was designed around an enormous new air-cooled radial engine which, at 2,000 horsepower, was the most powerful available at the time and



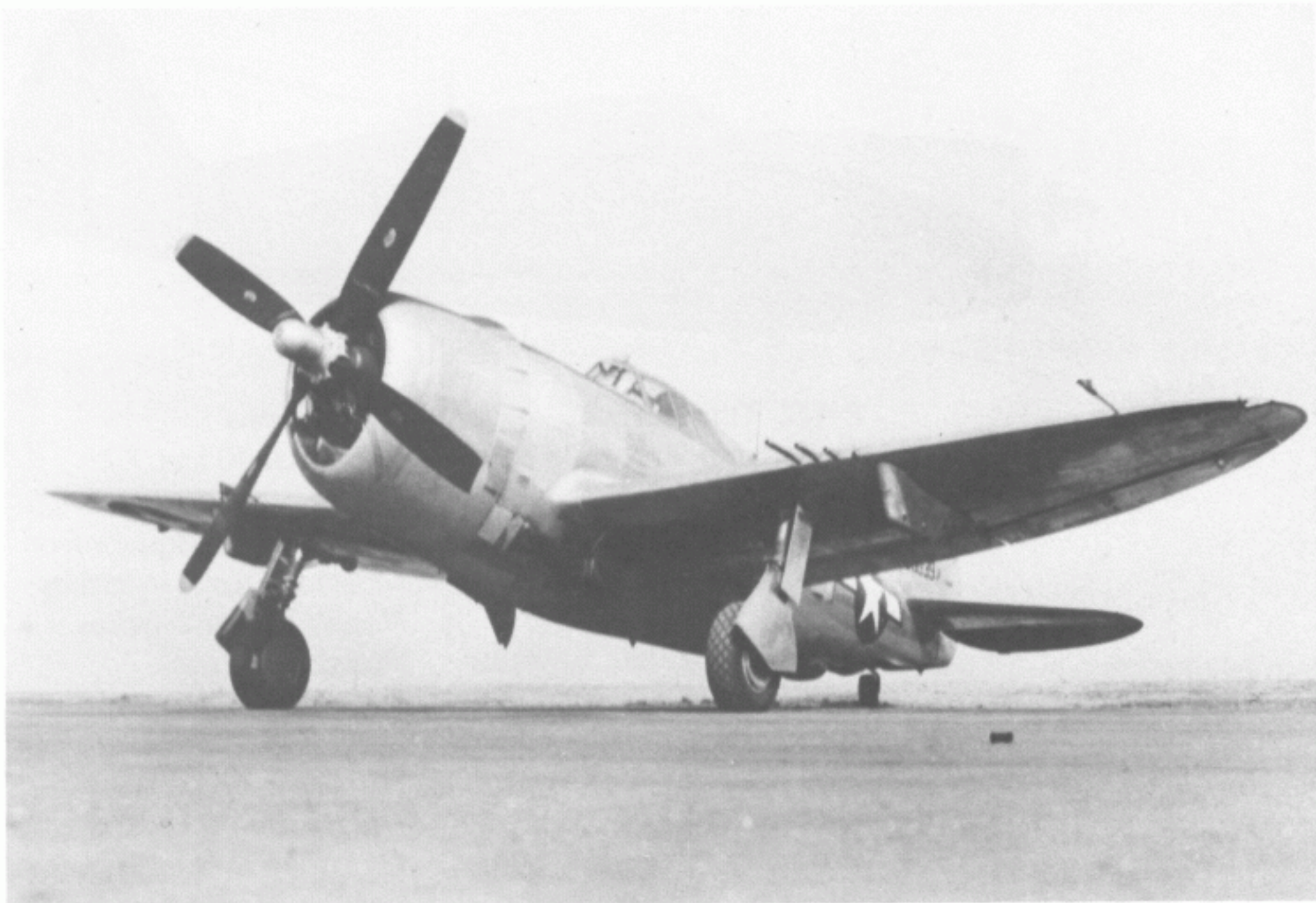
Courtesy of Temple Press, Ltd.

Durability, Fighters



could withstand damage better than liquid-cooled engines. The P-47 also had a huge propeller that measured twelve feet in diameter. Despite its huge size and seven-ton weight, the P-47 was fast and maneuverable; since it weighed so much, it could dive faster than any other fighter, reaching speeds of 600 miles per hour (several pilots actually reported reaching supersonic speeds). And with eight machine guns in the wings, it packed a deadly punch. Tough and durable, the P-47 was the main fighter of the Eighth Air Force until the arrival of the P-51 Mustang. Its worthiness increased with the development of external drop tanks, which expanded its range and countered the limitations of its fuel-guzzling engine. The P-47 was later used as a fighter-bomber for ground-attack strafing and bombing missions, where it excelled. The Thunderbolt had the distinction of being built in larger numbers than any other U.S. fighter.

The P-47C, as well as the early D-models, were known as "razorbacks," because of the distinctive raised shape of the rear canopy, which, unfortunately, obscured the pilot's vi-



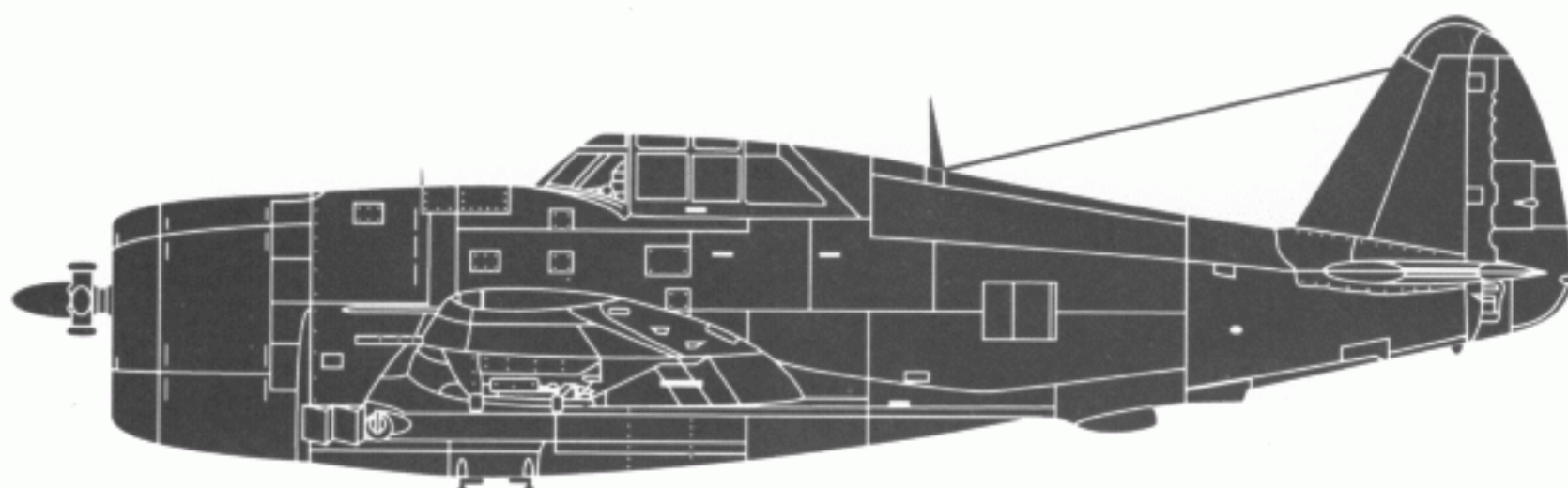
sion to the rear. The C also featured a longer fuselage than the previous models, plus racks for bombs or fuel tanks. This model was the first to see service in Europe, and arrived in England at the beginning of 1943, as the Eighth Air Force was being established.

"The P-47 was designed for high-altitude fighting, period. The Mustang was a derivative of the A-36, and the A-36 was built as a dive bomber: it had dive brakes, the whole works. But the Mustang was getting the hell kicked out of it in low-level attacks because of its inline engine. If you got in a nick in it, it was goodbye. With a P-47, I came back one time with two cylinders shot out, and you'd never be able to do that with a Mustang. Somebody finally decided that, hey, this P-47 can really take a beating and still stay in the air, and can do some fighting. Let's use that as a fighter-bomber, and let's take the Mustang and put it up above, where it does better at air-to-air."

U.S. Army Air Force Captain James Finnegan

"The P-47 shot down a lot more 190s and 109s than they shot down P-47s. As a matter of fact, it was hard to shoot a P-47 down because it could come home with half the engine gone and it would still run. It was a great plane, the safest one of all. For combat, for ground support, air-to-air, anything, I'd take it anytime over the P-51. I flew P-80s and F-86s after the war, and I'd still take the P-47 anytime."

U.S. Army Air Force Second Lieutenant Thomas Marsters



P-47C Thunderbolt Performance Data

Powerplant: One Pratt & Whitney R-2800-21 Double Wasp 18-cylinder radial engine

Horsepower: 2,000; 2,300 at war emergency power

Top speed: 255 miles per hour at sea level, 433 miles per hour at 30,000 feet

Maximum diving speed: 600 miles per hour

Maximum speed with landing gear extended: 250 miles per hour

Maximum speed with flaps partially lowered: 300 miles per hour

Maximum speed with flaps fully lowered: 195 miles per hour

Rate of climb: 2,800 feet per minute, 14 minutes to 20,000 feet

Ceiling: 42,000 feet

Range: 475 miles; 800 miles with 200-gallon belly tank

Crew: one

Dimensions

Wingspan: 40 feet 9 1/4 inches

Wing area: 300 square feet

Length: 36 feet 1 1/4 inches

Height: 14 feet 2 inches

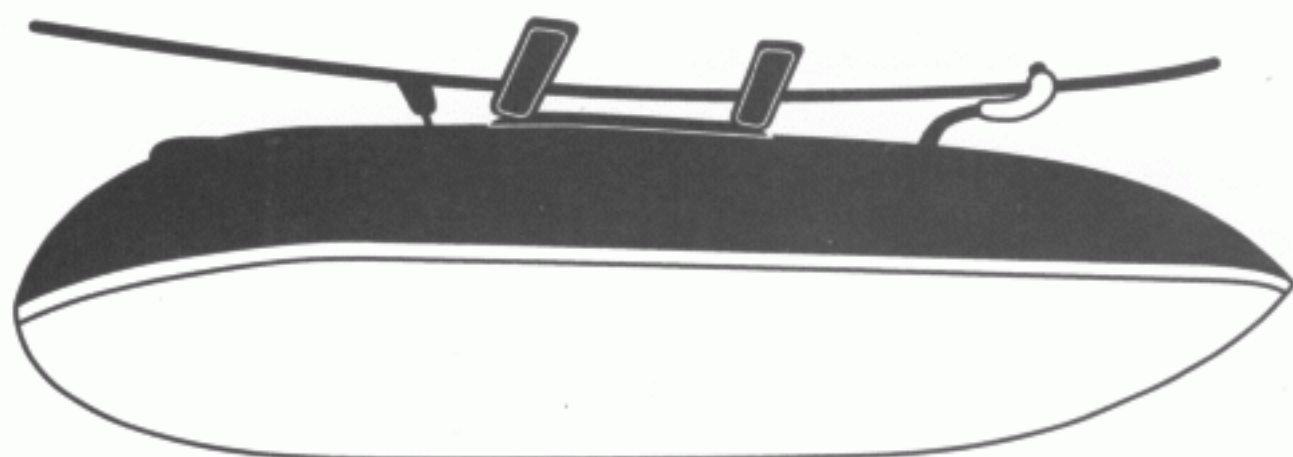
Weights

Empty: 9,010 pounds

Loaded: 14,925 pounds

Standard Armament

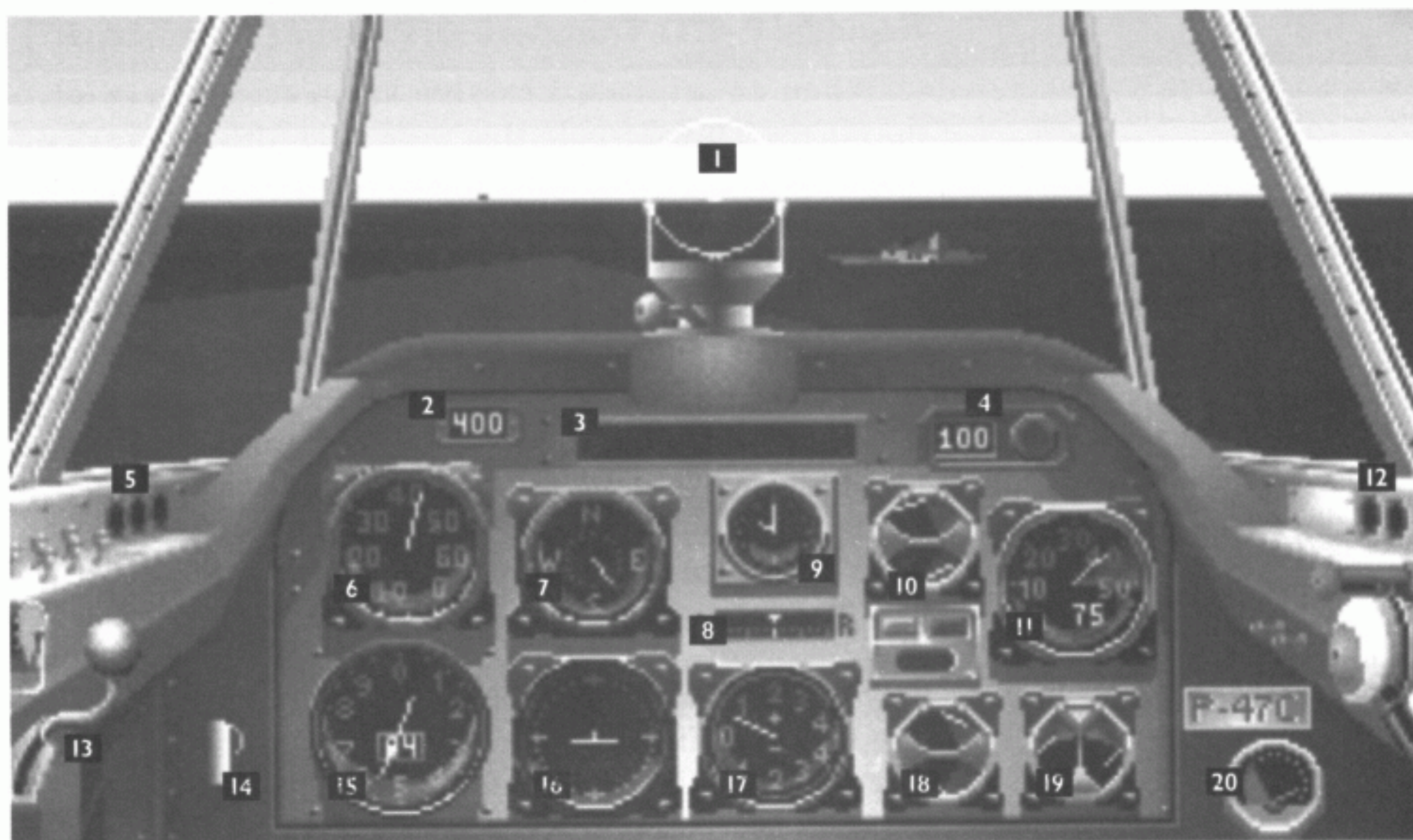
- Eight .50-caliber Colt-Browning M-2 machine guns, with a maximum of 425 rounds each, mounted in the wings



200-gallon "flat" belly tank.

Optional Equipment

- One 200-gallon belly tank
- Two 75-gallon wing tanks
- Two-thousand-pound bombload



- 1 Cockpit Gunsight**
- 2 Cockpit Ammunition Round Indicator**
- 3 View Panel**
- 4 Gun Camera Indicator**
- 5 Bomb Indicator Panel**
- 6 Airspeed Indicator**
- 7 Compass**
- 8 Rudder Indicator**
- 9 Clock**
- 10 Fuel Gauges and Fuel Tank Indicator Lights**
- 11 RPM Indicator**

- 12 Rocket Release Indicator**
- 13 Flaps Lever**
- 14 Landing Gear Lever**
- 15 Altimeter**
- 16 Banking Indicator**
- 17 Rate of Climb Indicator**
- 18 Manifold Pressure and Temperature Gauge**
- 19 Oil Pressure and Temperature Gauge**
- 20 Hydraulic Pressure Gauge**

Cockpit of a P-47C

Republic P-47D Thunderbolt Fighter ("Razorback")

When an improved Double Wasp engine was introduced, the Thunderbolts that were built with it were designated the P-47D. This faster model saw its first action in late 1943, and featured improved armor plating and a better engine cooling system. Later D-models also had a bubble canopy, which gave the pilot 360-degree visibility, along with a water injection system for extra power, and external bomb racks and fuel tanks, plus greater internal fuel capacity. The P-47D was the most widely produced subtype of fighter aircraft ever, with 12,602 D-model Thunderbolts rolling off the assembly lines.

Despite the fact that the P-51 Mustang eventually usurped the P-47's role as the main air-to-air combat aircraft, many of the leading U.S. aces in Europe, including the top two, Lieutenant Colonel Francis Gabreski and Captain Robert Johnson, scored the majority of their kills in Thunderbolts. They took advantage of the P-47's ability to dive and climb fast, as well as of the fact that the P-47 was faster than the Bf 109 or FW 190 at high altitudes, although it did not have as tight a turning radius as these Luftwaffe fighters.

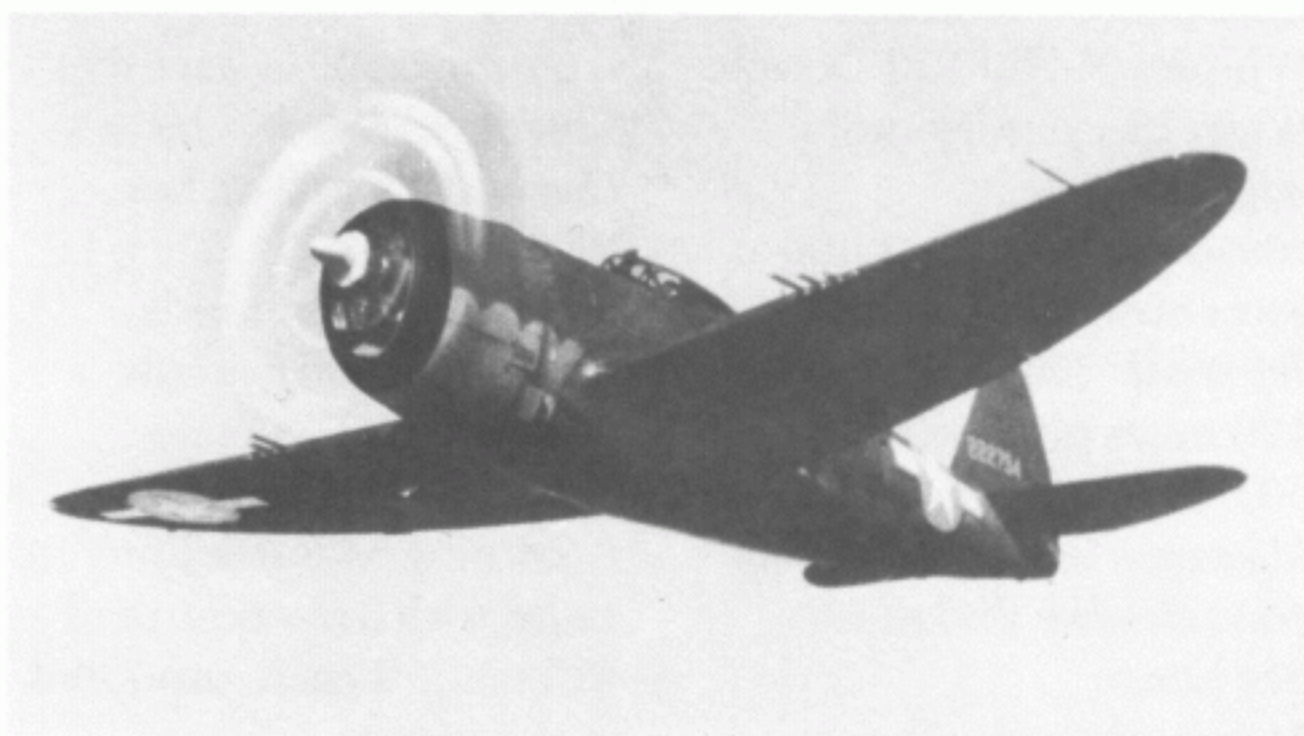
When the P-47 began to be used in the ground attack role in late 1943, many pilots who had survived months of high-altitude warfare fell victim to the dangers of low-level combat, with heavy ground fire and numerous obstacles to maneuver around at 400 miles per hour. Nevertheless, the durability of the P-47 made it an outstanding fighter-bomber, and it provided invaluable support for Allied ground forces from D-Day up until the end of the war. The



Thunderbolt would go down in history as the one aircraft that excelled at both roles it was assigned: air-to-air and ground support.

"The P-47, from takeoff, was a bitch for torque. All propeller-engined planes have torque, if they're single-engined. When those big paddle props went around, you had that right leg on that right rudder the whole way down the runway until you got up in the air. Because of the weight, we always took off with flaps to get up quicker.

"A directive came out that when we'd go into a dive, we were to try not to use all the power. Because the nose was so heavy, you'd go so fast that the controls couldn't hold it; they were inef-



fective. So as a result, if you were going down, you'd just keep going down, there was no way to pull it out.

"The P-47 flew like it looked, although maybe that's wrong, because it was a good-flying airplane. When you got into trouble, you could shove that left rudder and shove that stick over, and make that thing turn. I'm not saying you couldn't do that with a Mustang, but you could treat the P-47 rougher. When it was running slow, you had to do a lot of work at it, unlike a 51. But the P-47 was a great ship to fly. It didn't look good, but Germans will tell you, as Galland told me, that it was one ship they did not like to take on, particularly one-on-one, because of the firepower more than anything else. It couldn't outmaneuver a 109 in a dogfight close to the ground, but at high altitude you could always go down faster than whatever was on your back. Nothing could outdive a P-47."

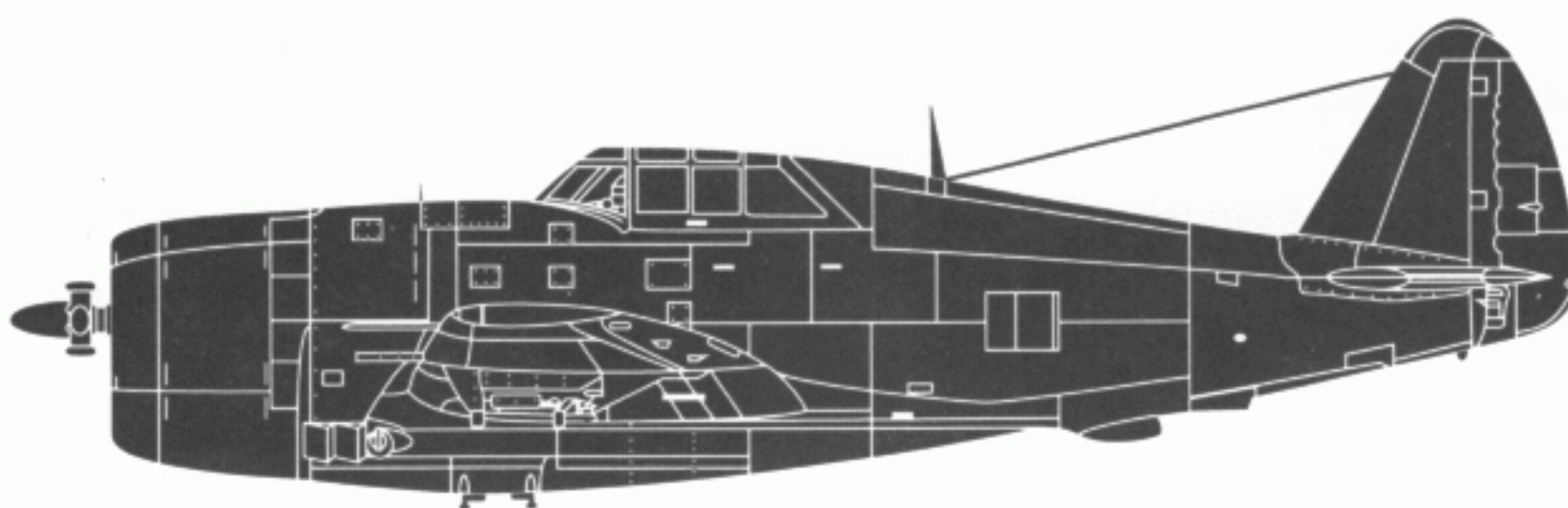
U.S. Army Air Force Captain James Finnegan

"The weaknesses of the P-47 were that they were low on speed and low on climbing. But they were excellent on a dive, so if they realized they were being attacked by German fighters and they were diving, you couldn't catch them. You'd say, 'Come again another day, and let's find out who is the better one.'"

Luftwaffe General Walter Krupinski

"The real importance of the air war consisted in the fact that it opened a second front before the invasion of Europe. That front was the skies over Germany."

**German Minister of Armaments
Albert Speer**



P-47D Thunderbolt

Performance

Powerplant: one Pratt & Whitney R-2800-21 Double Wasp 18-cylinder radial engine

Horsepower: 2,000; 2,300 at war emergency power

Top speed: 255 at sea level, 426 miles per hour at 30,000 feet

Maximum speed with landing gear extended: 250 miles per hour

Maximum speed with flaps partially lowered: 300 miles per hour

Maximum speed with flaps fully lowered: 195 miles per hour

Rate of climb: 2,800 feet per minute, 14 minutes to 20,000 feet

Ceiling: 42,000 feet

Range: 475 miles; 800 miles with external drop tanks

Crew: one

Dimensions

Wingspan: 40 feet 9 1/4 inches

Wing area: 300 square feet

Length: 36 feet 1 1/4 inches

Height: 14 feet 2 inches

Weights

Empty: 10,700 pounds

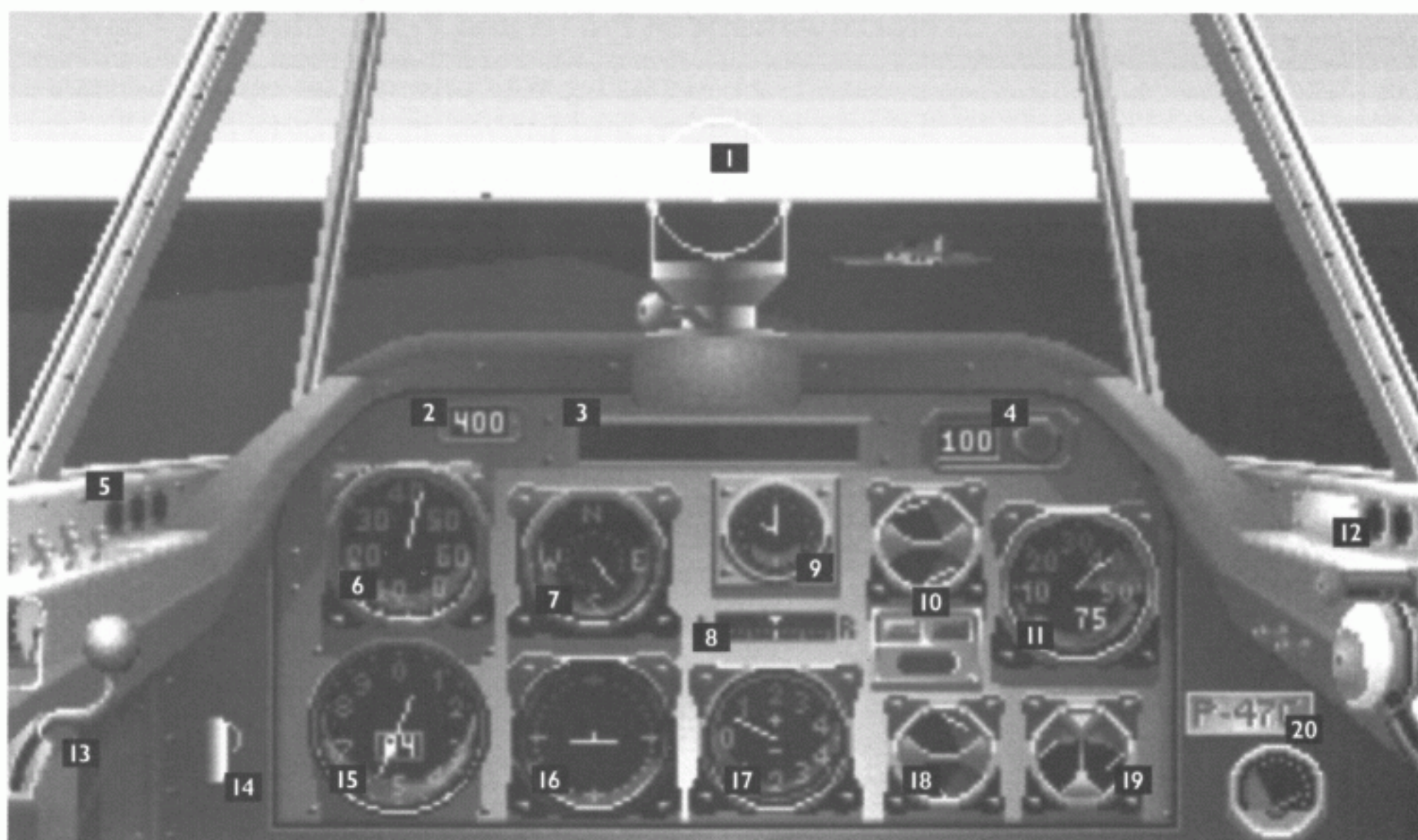
Loaded: 19,400 pounds

Armament

- Eight .50-caliber Colt-Browning M-2 machine guns, with a maximum of 425 rounds each, mounted in the wings

Optional Equipment

- One 200-gallon belly tank
- Two 75-gallon wing tanks
- Two-thousand-pound bombload



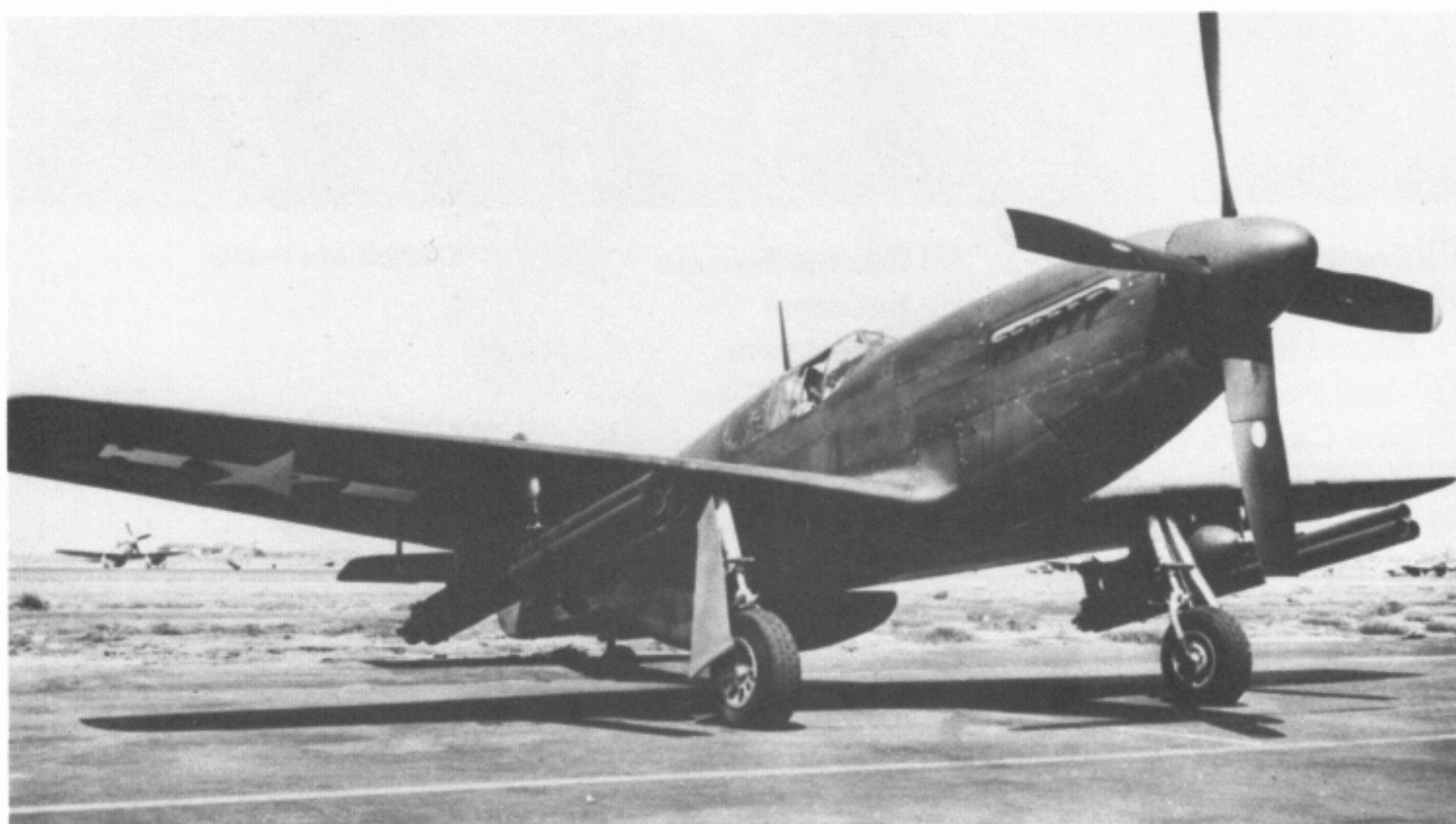
- 1 Cockpit Gunsight**
- 2 Cockpit Ammunition Round Indicator**
- 3 View Panel**
- 4 Gun Camera Indicator**
- 5 Bomb Indicator Panel**
- 6 Airspeed Indicator**
- 7 Compass**
- 8 Rudder Indicator**
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- 13 Flaps Lever**
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- 15 Altimeter**
- 16 Banking Indicator**
- 17 Rate of Climb Indicator**
- 18 Manifold Pressure and Temperature Gauge**
- 19 Oil Pressure and Temperature Gauge**
- 20 Hydraulic Pressure Gauge**

Cockpit of a P-47D

North American P-51B and P-51C Mustang Fighter

The P-51 Mustang was one of the most successful fighters in history, and proved its worth to the U.S. Army Air Force as the aircraft that provided the badly needed long-range fighter escort that permitted U.S. heavy bombers to continue operations. Originally designed for the RAF in 1940 as a reliable, inexpensive fighter, the Mustang went from the drawing board to test flight in an unheard-of 117 days. Its development was headed and speeded along by James "Dutch" Kindelberger of North American Aviation, who utilized some ideas he had picked up during a trip to the Messerschmitt and Heinkel factories in 1938. However, at the time it was first developed, the U.S. Army Air Force had no interest in the new fighter, although



they later ordered a dive bomber version of this aircraft, the A-36 Invader. The airframe and design of the Mustang were clean and highly advanced, and the P-51 featured a unique laminar-flow wing design, with a thin leading edge, a thick trailing edge, and similar curvature on the upper and lower sections of the wing. This laminar-flow wing greatly reduced drag and contributed to the Mustang's ability to fly long distances. The British initially used the Mustang for reconnaissance and ground attack, since its performance at medium and high altitudes was less than satisfactory due to its underpowered Allison engine, the same powerplant that gave the P-38 Lightning so many problems in Europe. But when the British installed the Rolls-Royce Merlin engine in October 1942, the potential of the P-51's airframe was unleashed, and the faster Mustang II proved to be outstanding at high altitudes. Unfortunately, the U.S. Army Air Force was slow to become interested in

the Mustang, since it had already committed itself to mass-producing other fighters. When the need for a long-range escort fighter became critical after the disastrous U.S. raids on Schweinfurt, P-51 production was stepped up, and the first Mustangs arrived in Europe in late 1943. The P-51 quickly made an impact against the German fighters as a fast escort with unsurpassed maneuverability and excellent range.

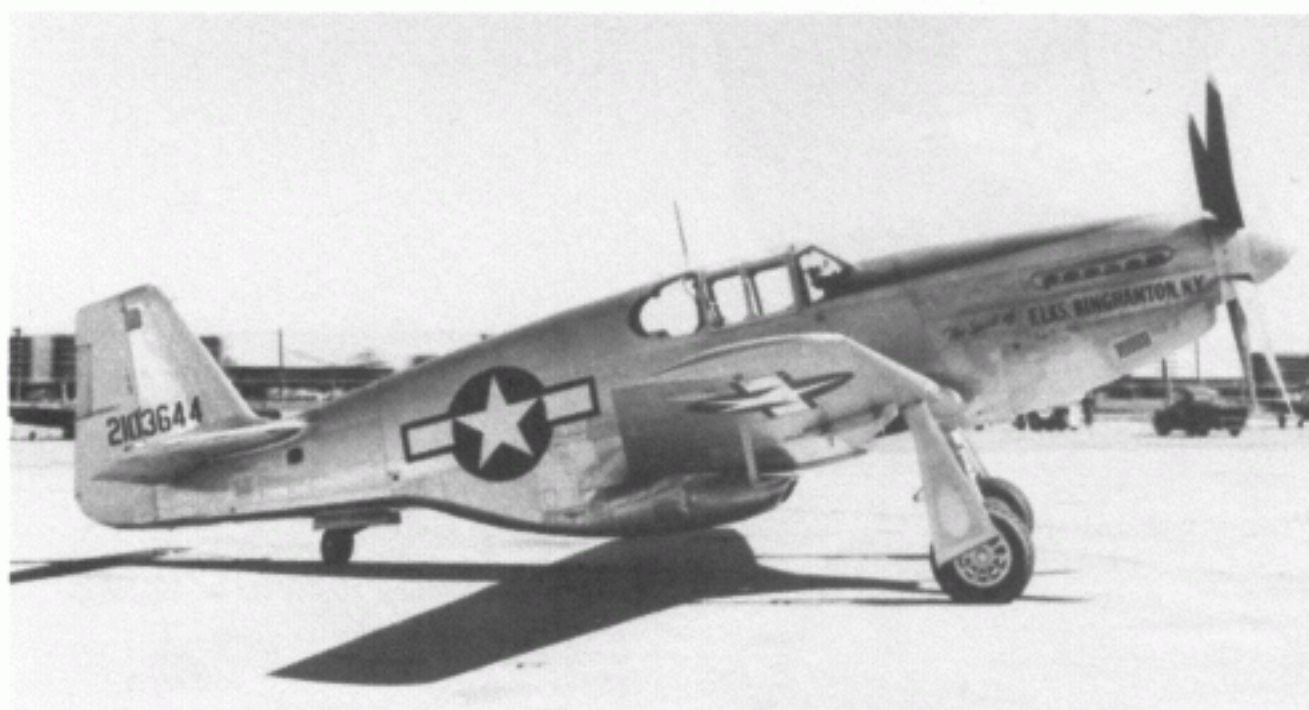
The first U.S. mass-produced, Merlin-powered Mustang was the B-series. It featured a large, four-bladed propeller, to maximize the performance of the Merlin. The P-51B also had wing racks for carrying up to 2,000 pounds of bombs, plus a bulged Malcolm canopy that the RAF had used on the Spitfire, for increased visibility and headroom. The P-51C Mustang was identical in every way to the P-51B, except that it was built at North American's newer plant in Dallas, Texas.

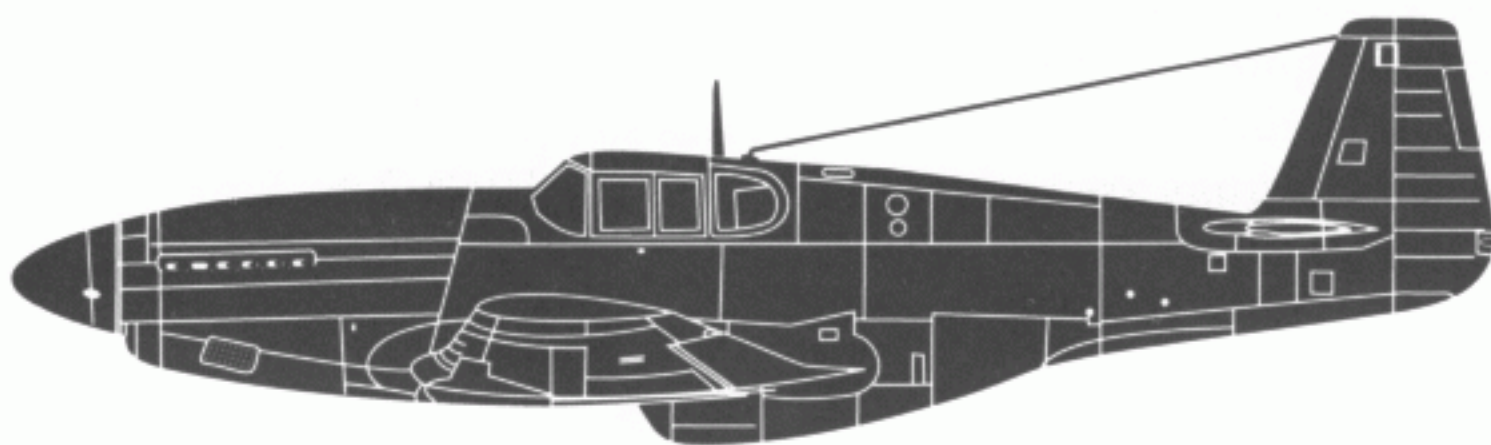


Courtesy of North American Aviation

"Flying the P-51 was very, very exciting; it was a really great aircraft. I could do anything I wanted with it in flight. You could make quick turns, things like that, although it wouldn't go any faster than the P-47 once you got the old Jug going. The P-51 had a Rolls-Royce Merlin engine in it that sounded just like a kitty purring; it really ran smooth. There was only one problem with the airplane itself in combat, which was if you got one bullet hole in the coolant system, you had to abandon it right away because the engine would freeze up because of the lost coolant. Also, like all rear-wheeled aircraft, it was a little tough to taxi because you couldn't see out the front, you had to do an S-curve when you taxied. But it handled real nicely; we really didn't fly it, we wore it."

U.S. Army Air Force Second Lieutenant Thomas Marsters





P-51B and P-51C Mustang Performance Data

Powerplant: one Packard V-1650 (Rolls-Royce Merlin 61) 12-cylinder liquid-cooled engine

Horsepower: 1,490 at take-off, 1,720 at war emergency power

Top speed: 375 miles per hour at sea level, 437 miles per hour at 25,000 feet

Maximum diving speed: 505 miles per hour

Maximum speed with landing gear extended: 170 miles per hour

Maximum speed with flaps partially lowered: 380 miles per hour

Maximum speed with flaps fully lowered: 200 miles per hour

Rate of climb: 3,900 feet per minute, 7 minutes to 20,000 feet

Ceiling: 42,111 feet

Range: 1,300 miles with external drop tanks

Crew: one

Dimensions

Wingspan: 37 feet

Wing area: 233 square feet

Length: 32 feet 3 inches

Height: 13 feet 8 inches

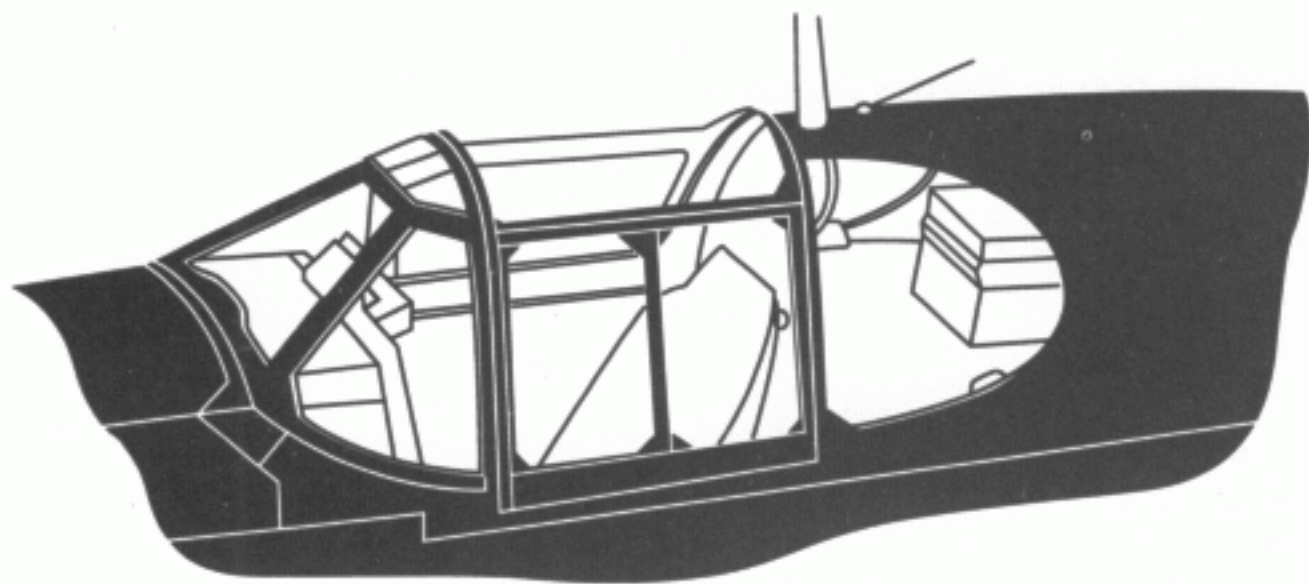
Weights

Empty: 9,800 pounds

Loaded: 11,200 pounds

Standard Armament

- Four .50-caliber Colt-Browning M-2 machine guns, with a maximum of 350 rounds for each in-board gun and 280 rounds for each outboard gun, mounted in the wings



Canopy of a P-51B

Optional Equipment

- Two 75-gallon wing tanks
- Two-thousand-pound bombload



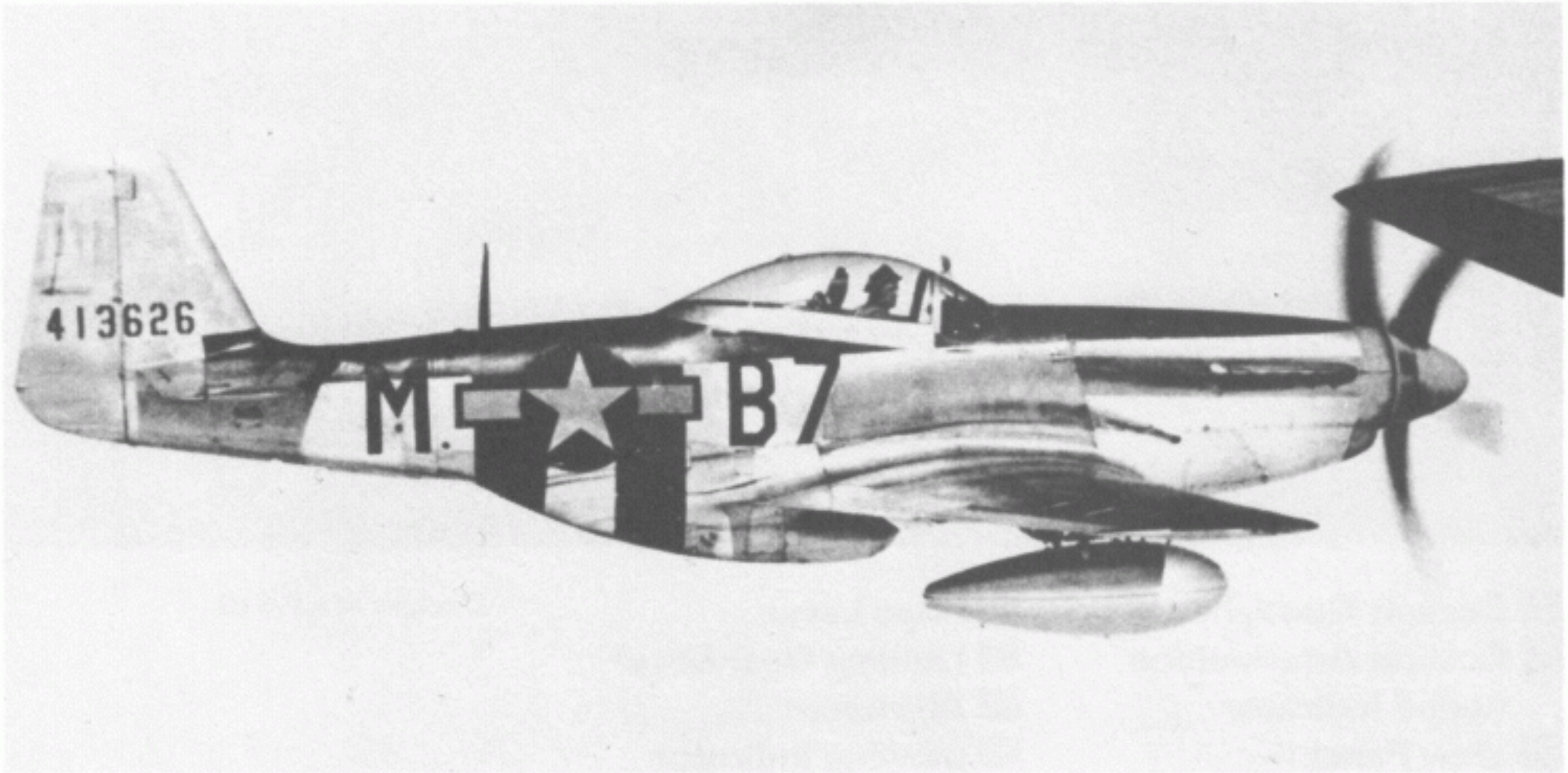
- 1** Cockpit Gunsight
- 2** Cockpit Ammunition Round Indicator
- 3** View Panel
- 4** Gun Camera Indicator
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- 10** RPM Indicator
- 11** Rocket Release Indicator

- 12** Flaps Lever
- 13** Landing Gear Lever
- 14** Altimeter
- 15** Banking Indicator
- 16** Rudder Indicator
- 17** Rate of Climb Indicator
- 18** Manifold Pressure and Temperature Gauge
- 19** Oil Pressure and Temperature Gauge
- 20** Hydraulic Pressure Gauge

Cockpit of a P-51B

North American P-51D Mustang Fighter

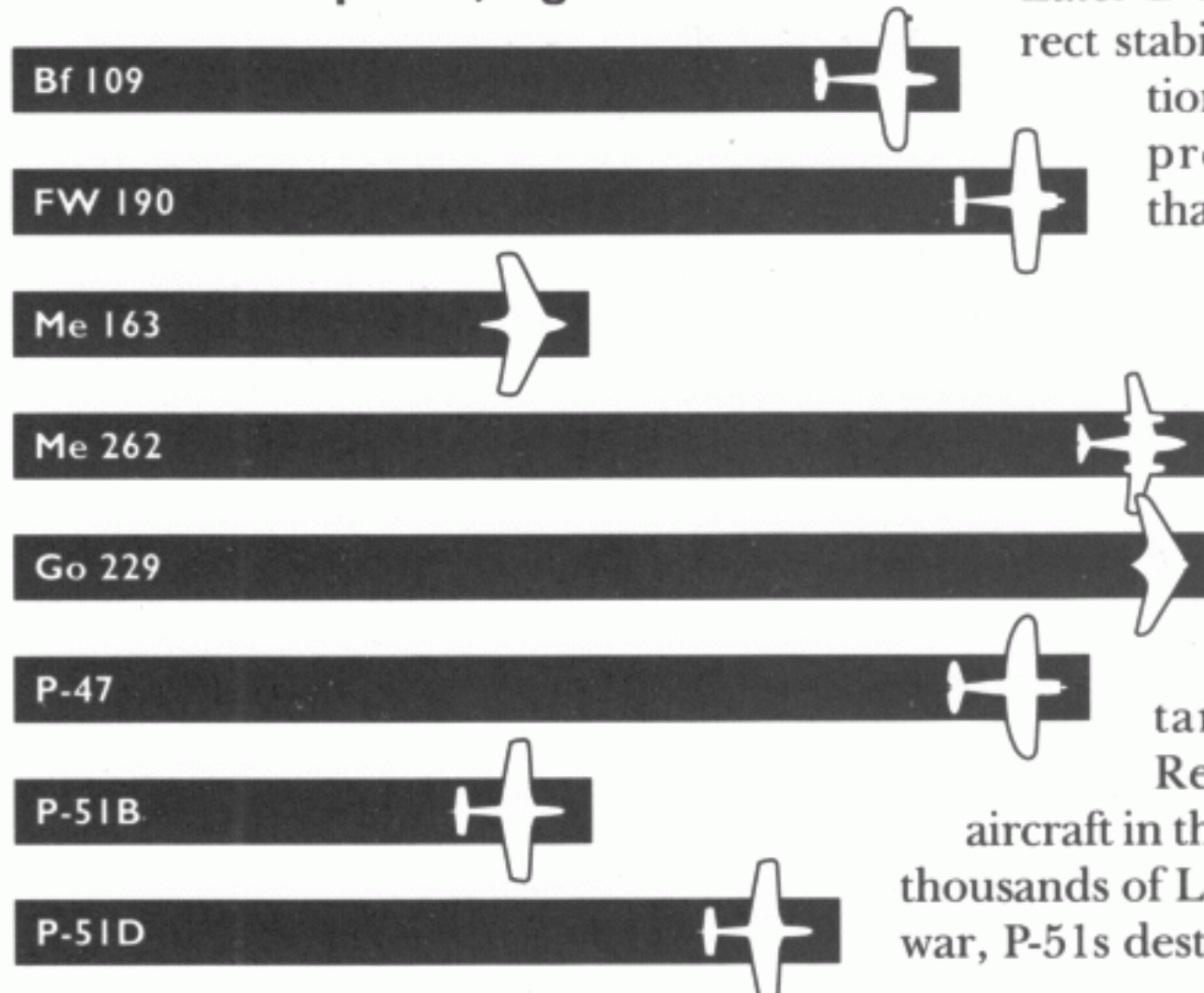
As the P-51B and P-51C models were being flown in combat, the first pilot evaluation reports began coming in to North American. Although pilots unanimously loved the Mustang, they complained that rear visibility was hampered by the cockpit and rear fuselage arrangement, and the Malcolm hood was proving to be less than satisfactory.



Courtesy of the United States Air Force

To solve this problem, North American decided to fit a teardrop canopy onto the Mustang. This canopy, already in use by the RAF, offered the pilot total 360-degree visibility, and North American engineers redesigned the rear part of the fuselage to incorporate it onto the Mustang. This model was known as the P-51D, and also featured an improved engine, reinforced wings, and two additional wing-mounted machine guns with extra ammunition.

Maximum Firepower, Fighters



Later D-models had a dorsal fin, to correct stability problems. With a production total of 7,956, the P-51D was produced in greater numbers than any other Mustang.

The importance of the P-51 in the U.S. aerial offensive in Europe cannot be overstated. From late 1943 on, it was a feared presence at both high and low altitudes, escorting larger and larger bomber formations to their targets deep within the Third Reich, and destroying German aircraft in the air and on the ground. Of the thousands of Luftwaffe aircraft lost during the war, P-51s destroyed some 4,950, or nearly 49

percent. After World War II, the Mustang was utilized for ground support during the Korean War, and was also used by fifty air forces around the world.

"The Mustang was delicate to the touch, a sweet airplane. There are guys who fly jets today who say that the Mustang was the purest airplane to fly."

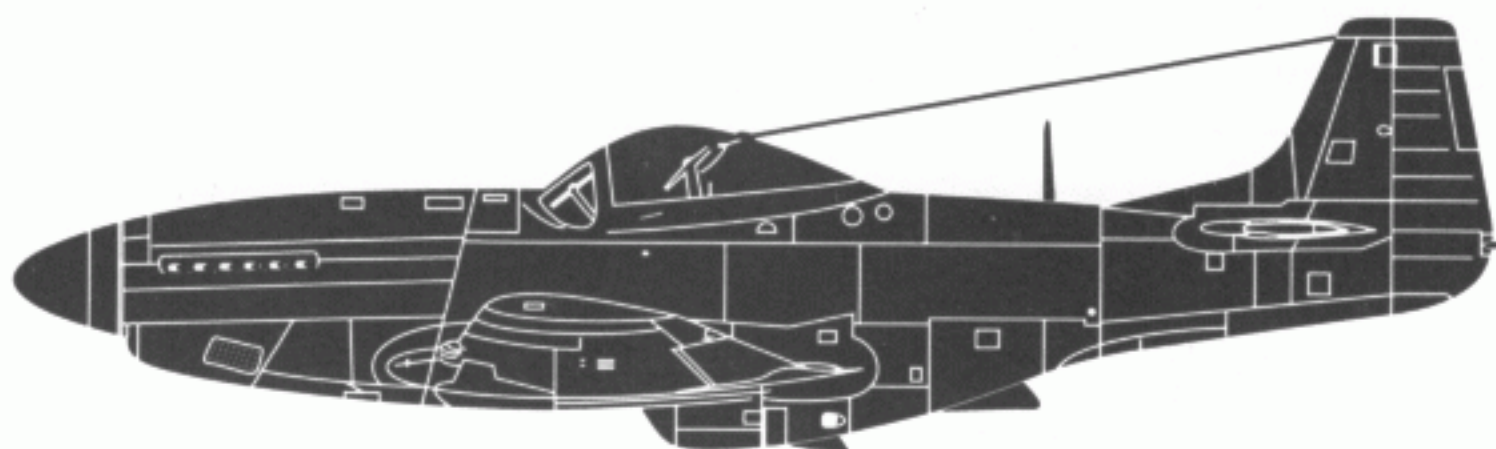
U.S. Army Air Force Captain James Finnegan

"The Mustangs were excellent in the altitude of 7,000 to 8,000 meters. That was also the altitude where they flew normally over the bombers, but above that nearly every piston engine had a lot of trouble. Only we in our 109s with our special engines were a little bit better than the Mustang engines at higher altitudes, so we'd try to attack them when we were higher than they were.



But we had to protect our fighters who were attacking bombers, and normally the Mustangs were attacking us and that was very bad if you were not an experienced pilot. Even I was shot down once by a Mustang. I thought that I had my whole group of thirty aircraft behind me, and I didn't realize that they were all gone. The Mustang hit me and I bailed out at 8,000 or 9,000 meters."

Luftwaffe General Walter Krupinski



**P-51D Mustang
Performance Data**

Powerplant: one Packard V-1650-7 (Rolls-Royce Merlin 61) 12-cylinder engine

Horsepower: 1,490 at takeoff, 1,720 at war emergency power

Top speed: 375 miles per hour at sea level, 437 miles per hour at 25,000 feet

Maximum diving speed: 505 miles per hour

Maximum speed with landing gear extended: 170 miles per hour

Maximum speed with flaps partially lowered: 380 miles per hour

Maximum speed with flaps fully lowered: 200 miles per hour

Rate of climb: 3,275 feet per minute, 7 minutes 18 seconds to 20,000 feet

Ceiling: 42,000 feet

Range: 950 miles, 1,650 with external drop tanks

Crew: one

Dimensions

Wingspan: 37 feet

Wing area: 233 square feet

Length: 32 feet 3 inches

Height: 13 feet 8 inches

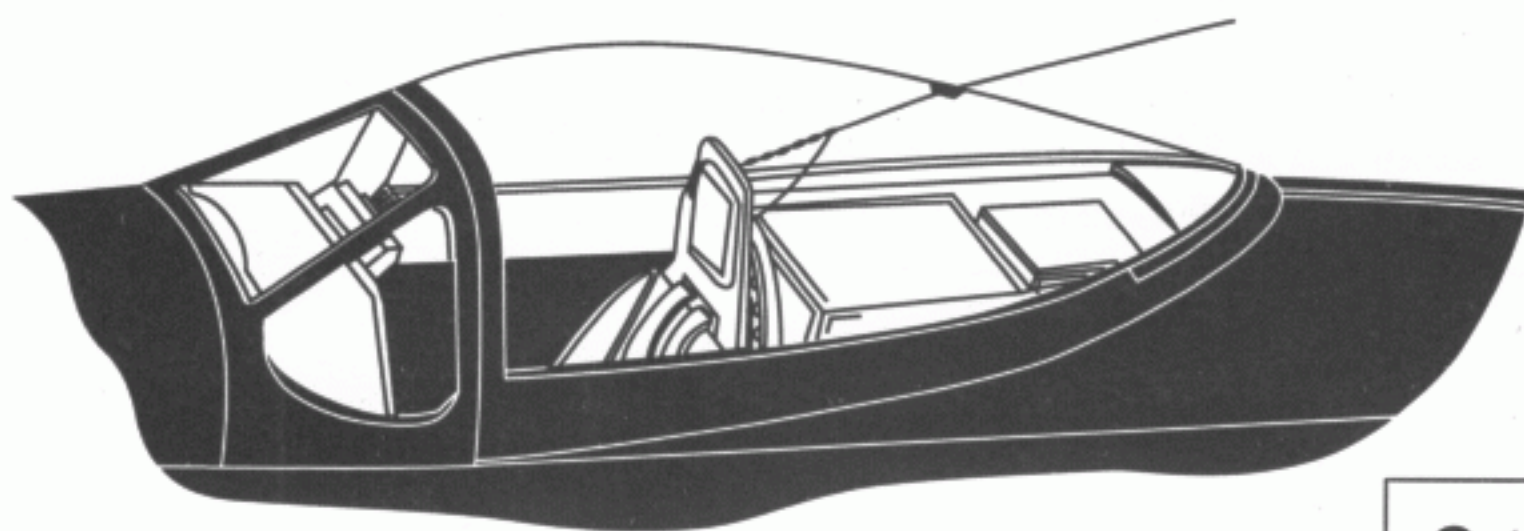
Weights

Empty: 7,368 pounds

Loaded: 10,300 pounds

Standard Armament

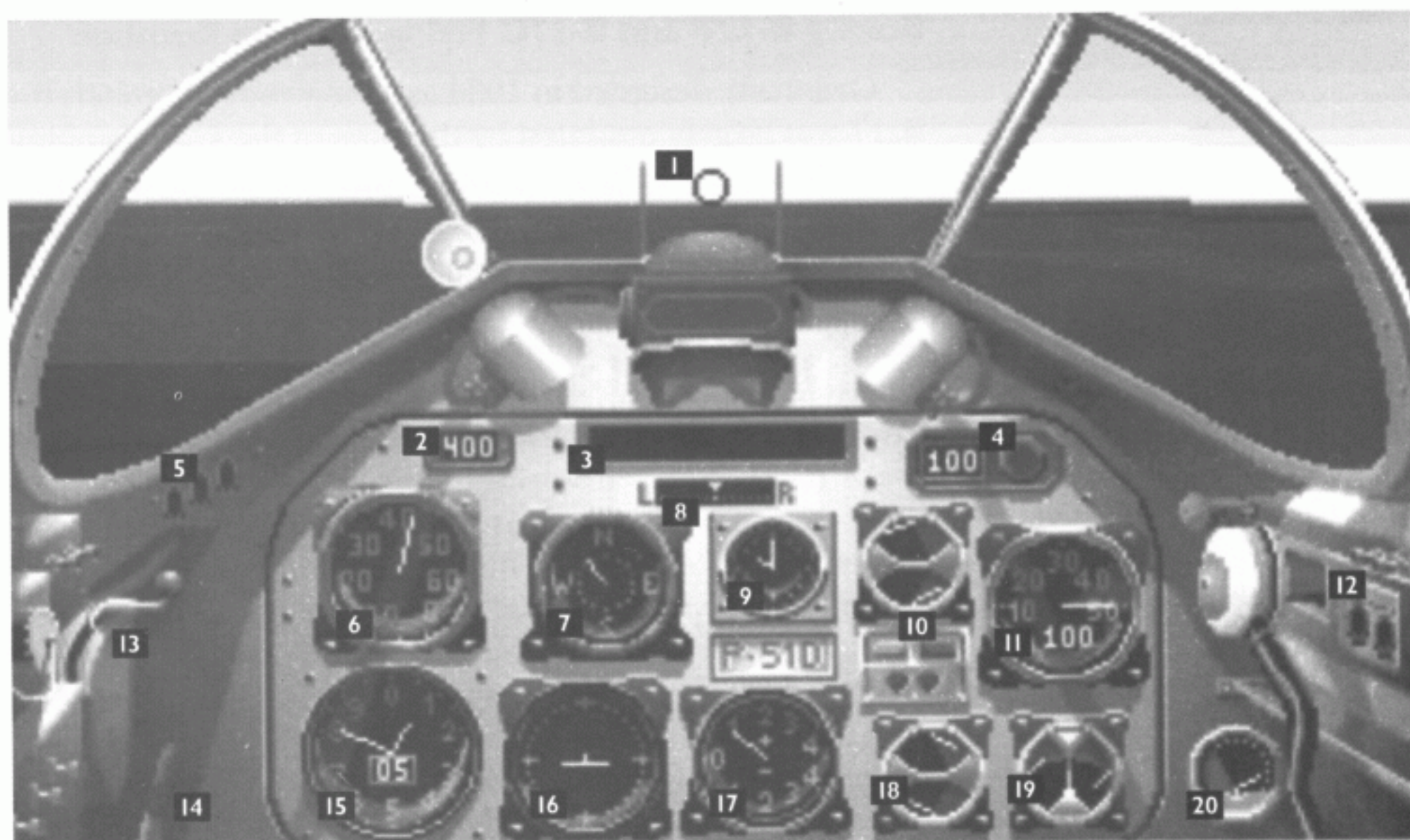
- Six .50-caliber Colt-Browning M-2 machine guns, with a maximum of 270 rounds in each center and outboard gun and 400 rounds in each inboard gun, mounted in the wings



Canopy of a P-51D

Optional Equipment

- Two 75-gallon wing tanks
- Two-thousand-pound bombload



- 1** Cockpit Gunsight
- 2** Cockpit Ammunition Round Indicator
- 3** View Panel
- 4** Gun Camera Indicator
- 5** Bomb Indicator Panel
- 6** Airspeed Indicator
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Cockpit of a P-51D

Boeing B-17F and B-17G Flying Fortress Bomber

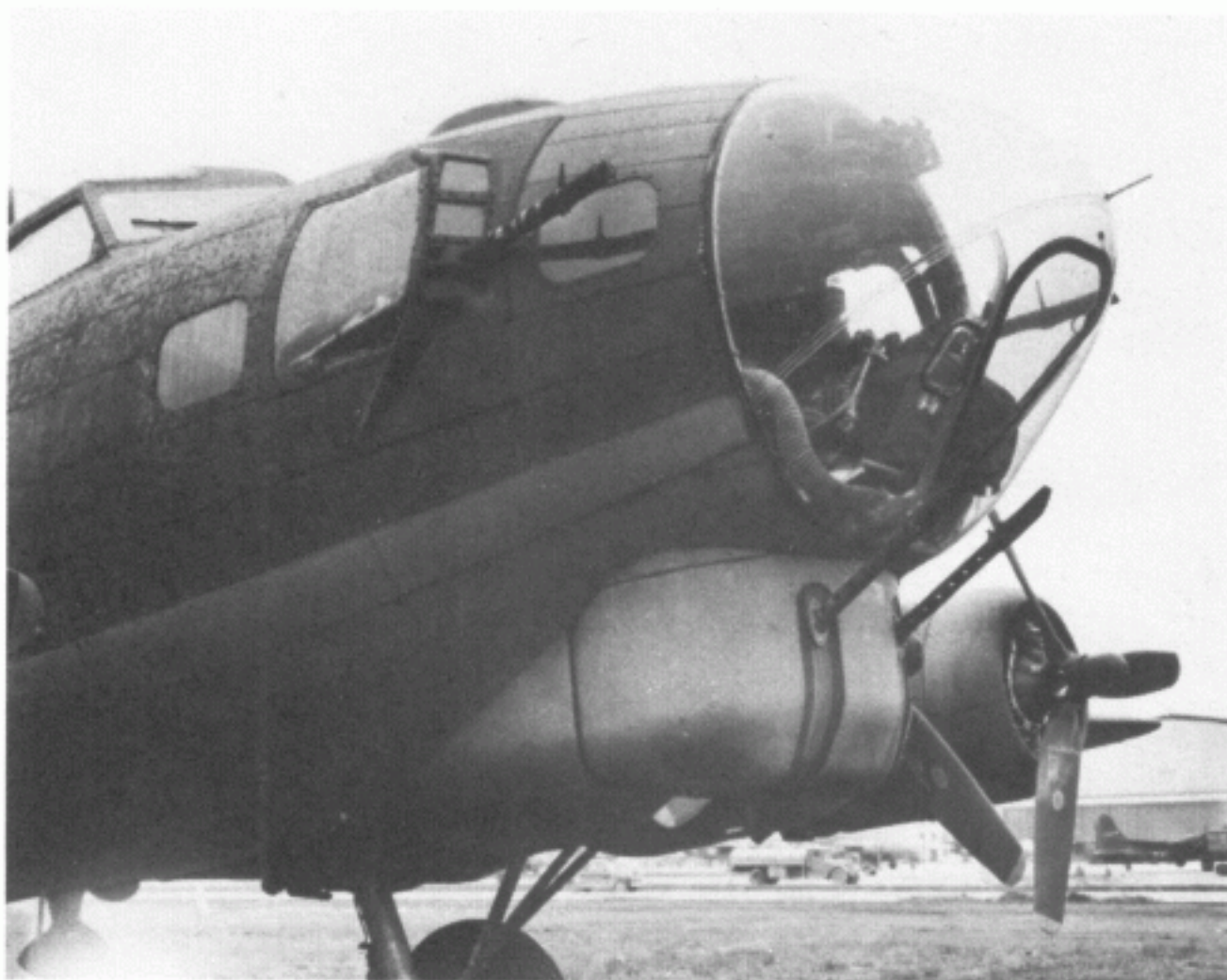
Originally designed in 1934 as a long-range bomber, the B-17 was largely outdated by the time of the U.S. bombing offensive. Yet this heavy bomber was one of the most successful combat aircraft of the war, renowned for its ability to deliver bombloads over long distances, absorb unbelievable amounts of damage, and still return to base, sometimes with one, two, even three engines out. As a strategic bomber, it operated well in large formations, and was a stable platform from which to drop a bombload. B-17s dropped two out of every five U.S. bombs used in the war and over 100,000 more tons of bombs on European targets than B-24s, while destroying more enemy fighters in combat. Aptly nicknamed the "Flying Fortress," it was the bomber upon which U.S. air power advocates pinned their hopes for a heavily armed plane that would not need fighter escort. But even with all its armament, it was vulnerable to frontal attack and suffered heavy losses in 1943 until the arrival of the P-51 Mustang long-range escort fighter.

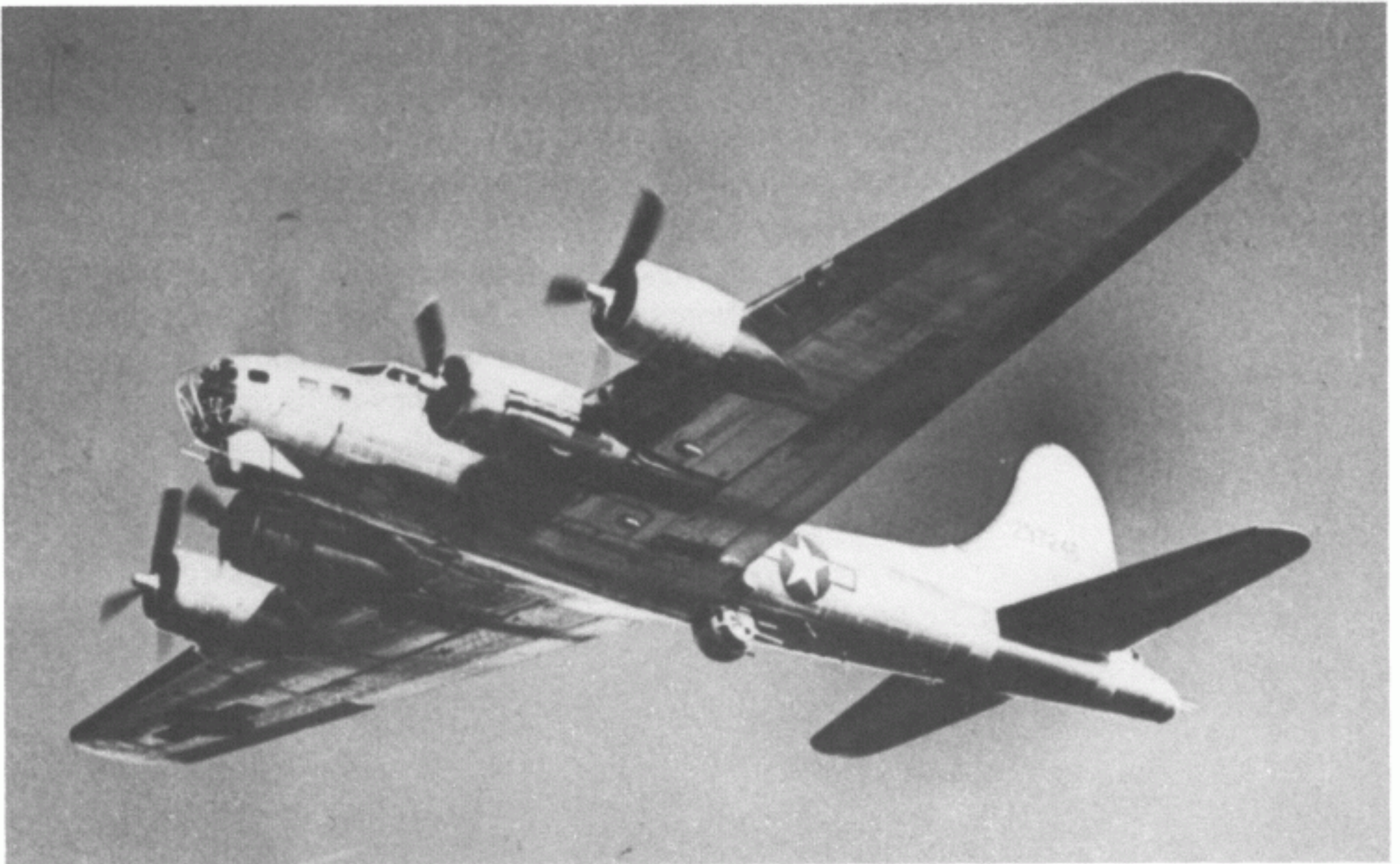
The B-17F was the first true combat-worthy Flying Fortress, and retained many of the design improvements of the earlier B-17E, including a redesigned tail and a rear turret. Other improvements included a large Plexiglas nose and wider, paddle-blade propellers, which raised its service ceiling and increased its speed. Later B-17Fs had extra fuel tanks, called "Tokyo tanks," which increased its range, but the weight of this extra fuel slowed its initial rate of climb. B-17Fs began rolling off the assembly lines in May 1942, and these Fortresses were the first to see action over Europe in the Eighth Air Force.

Since Luftwaffe fighter pilots were becoming increasingly successful at damaging and downing B-17s by frontal attacks, the B-17G was introduced in 1943. It had a twin gun

turret in the nose, which was developed to bring more machine guns to bear on the enemy fighters. Later models of the B-17G also had staggered waist gun positions, to keep the waist gunners from bumping into each other while firing, plus a redesigned rear turret with larger windows. These were the only major improvements, and the B-17G was virtually identical in performance to the B-17F. The B-17G saw its first combat in September 1943 and was the Flying Fortress

The nose of a B-17G, clearly showing the gun turret, which was installed after U.S. bombers encountered deadly frontal attacks from Luftwaffe fighters. Courtesy of the United States Air Force





produced in the largest quantities of any variant, with 8,680 delivered to the U.S. Army Air Force.

Courtesy of the Boeing Aircraft Company

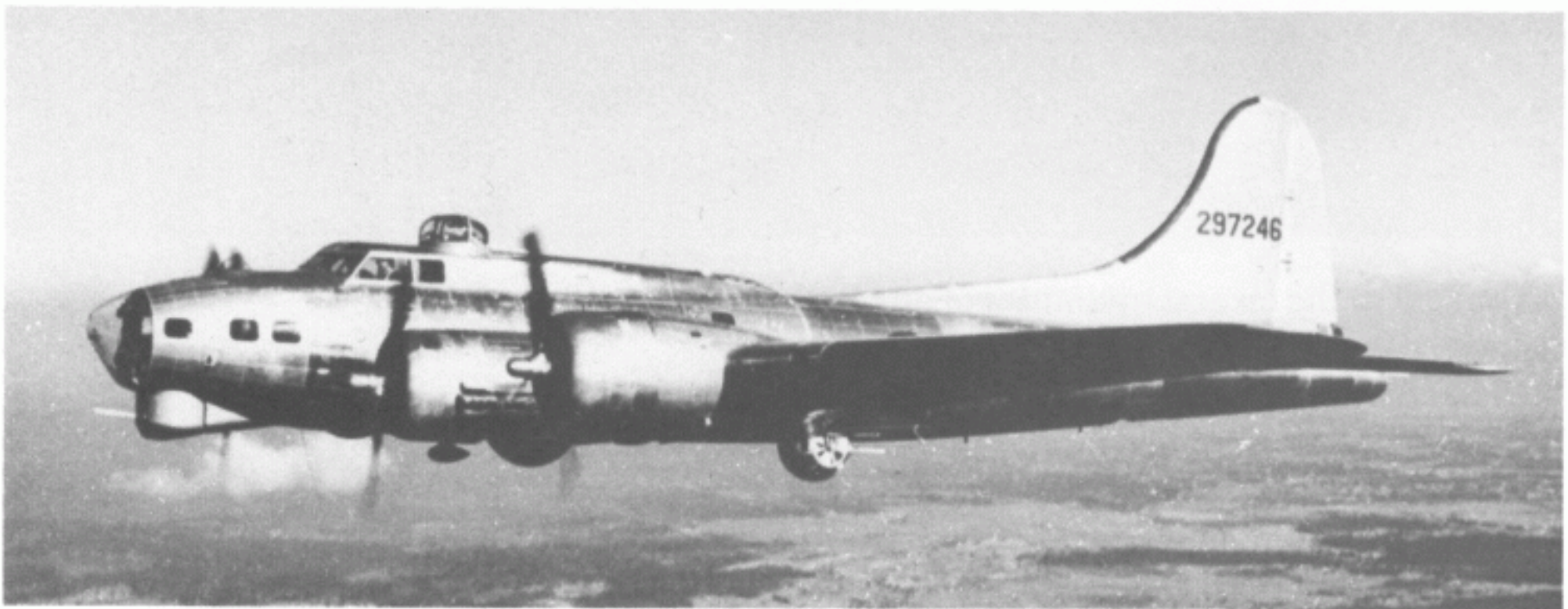
There were ten crewmen aboard a B-17: a pilot, a copilot, an engineer, a bombardier, a navigator, a radioman, two waist gunners, a ball turret gunner, and a tail gunner. Some of these crewmen were required to man machine guns as well as perform their assigned duties. The engineer was required to have a detailed working knowledge of the B-17 and operate the top turret just behind the pilots' compartment. The radioman worked a single .50-caliber dorsal-mounted machine gun in the bomber's midsection on some models. The bombardier sat in the extreme front of the nose section and fired the nose-mounted machine gun or chin turret. The navigator sat between the bombardier and the pilot's compartment and worked a machine gun that was mounted on one side of the nose. The crewmen whose sole duties were to operate machine guns were the two waist gunners, who operated the two machine guns in the middle of the fuselage, the ball turret gunner (usually a small man), who operated the Sperry ball turret located underneath the fuselage, and the tail gunner, who operated the rear gun turret.

"Taking off in a B-17 was like taking off in a Greyhound bus, or an overloaded truck, because you had your bombload, your fuel load, and your ammunition, and you'd just crank that thing up and hold it there.

"The cockpit of a B-17 was the worst place to see anything up there, because you're looking straight ahead and that's it. You really couldn't see around or down. You got more information

from your navigator and bombardier who were out there in a glass ball. I always felt sorry for the navigator and the bombardier. In the cockpit, we had armored plate on the seat and on the back and a little bit on the sides, but all they had around them was Plexiglas. They were right in front, where they could get hit by the shells.

"Once we'd lost a couple of engines on one wing over France, a long ways from home. We had to feather the dead engines, so the props didn't windmill on us, and the flat blades slowed us down. We also cut back on the power to the two remaining engines. Maneuvering with two engines out on one side is tough, because the weight of the dead-side wing causes it to drop. We were so concerned about keeping that wing up, and keeping the airplane flying that we didn't stop to think that it could run right into the ground.



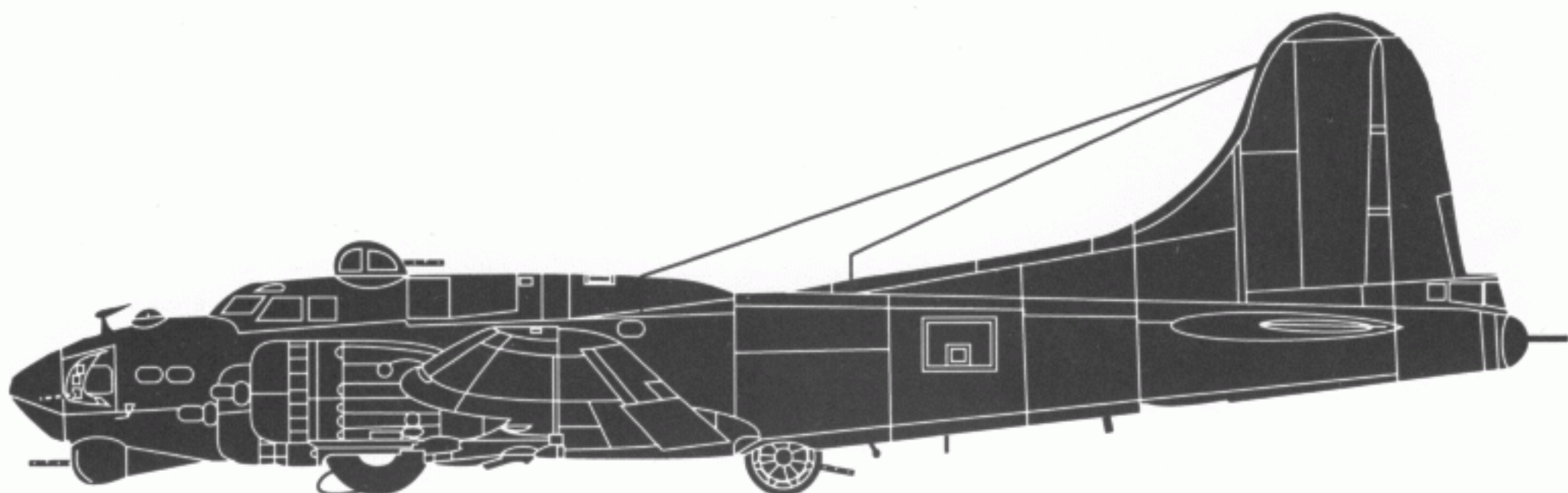
"You monitored all your engines all the time, and checked your oil pressure, your RPMs, especially when you were getting hit by flak."

"The B-17 was an easy plane to fly. I flew a B-24 for a few hours and that was a lot of work. The B-17 was really stable and easy to fly; in fact you'd think, 'This thing can fly by itself.'"

U.S. Army Air Force Pilot Officer Robert Davila

"In the beginning when we were trying to find out what was the best way to attack a B-17, we tried everything, even bombing the bombers with bombs and so on. But we found out that the best tactic was to attack them from the front, and we used the I90 for this from late 1943 on. The time when you could shoot was very short because the closing speed was a very high one. But if you hit the B-17 from the front, you normally hit the cockpit and the engines. After that time, there were only four groups of I90s who were still attacking from behind, called the Sturmgruppen; if the B-17 didn't burn or the crew didn't bail out, these I90s were ramming the bomber on the elevator and the rudder."

Luftwaffe General Walter Krupinski



B-17F and B-17G Flying Fortress Performance Data (figures identical for two models except where noted)

Powerplant: four Wright Cyclone R-1820-97 radial engines

Horsepower: 1,200 at takeoff, 1,000 at 25,000 feet, 1,380 at war emergency power at 25,000 feet

Top speed (F): 299 miles per hour at 25,000 feet; (G): 287 miles per hour at 25,000 feet

Top speed at war emergency power: 302 miles per hour

Maximum diving speed: 310 miles per hour

Rate of climb: 37 minutes to 20,000 feet

Ceiling (F): 37,500 feet, (G): 35,600 feet

Range (standard bombload): 2,000 miles

Crew: ten

Dimensions

Wingspan: 103 feet 9 inches

Wing area: 1,420 square feet

Length: 74 feet 9 inches

Height: 19 feet 1 inch

Weights

Empty: 34,000 pounds

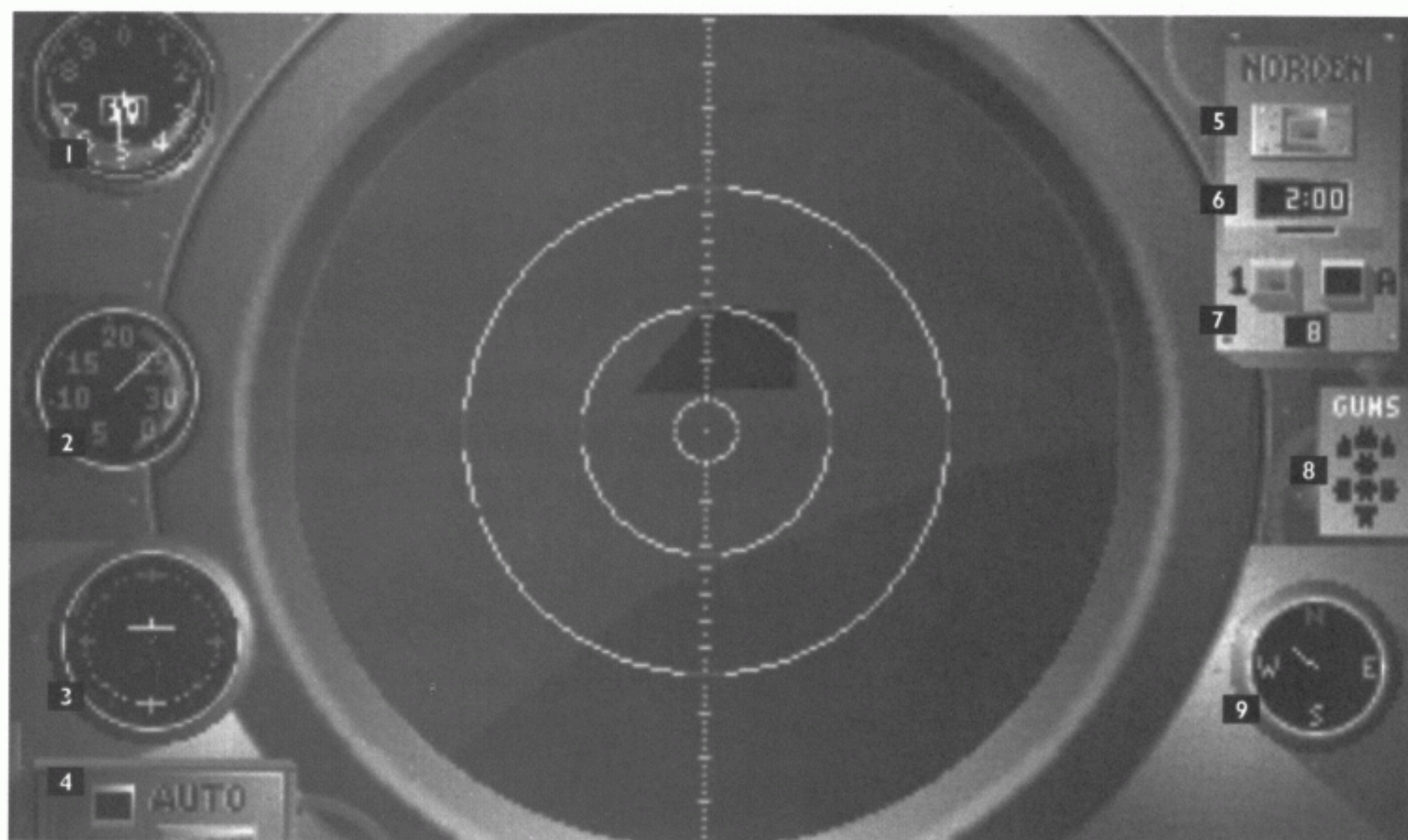
Loaded: 65,500 pounds

Armament

- (F): Eleven .50-caliber Colt-Browning M-2 machine guns; two each mounted in the top, ball, and tail turrets; one mounted in the nose, in each side of the nose (cheek position), and at each waist position

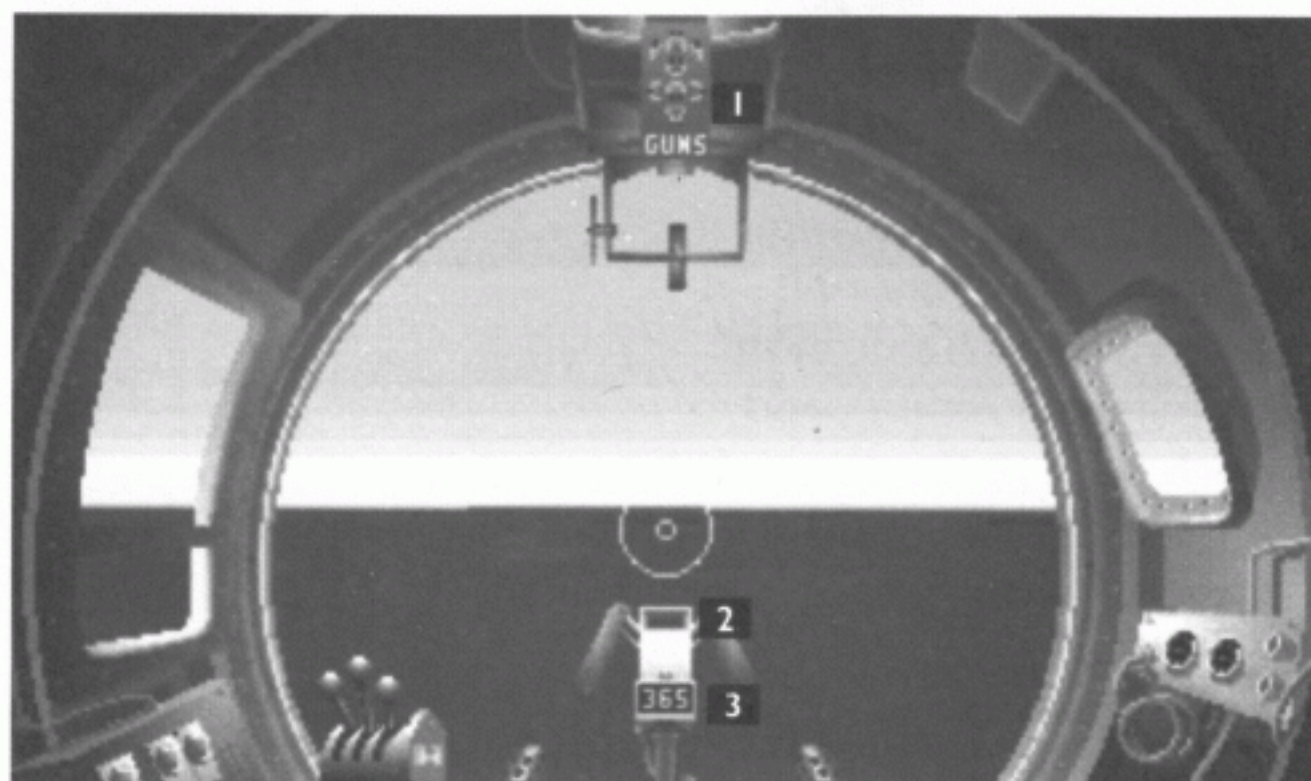
- (G): Twelve .50-caliber Colt-Browning M-2 machine guns; two each mounted in the chin, top, ball, and tail turrets; one mounted in each side of the nose (cheek position), and at each waist position

- Eight-thousand-pound bombload



View of the Norden bombsight

- 1** Altimeter
- 2** Airspeed Indicator
- 3** Banking Indicator
- 4** Automatic Pilot Light
- 5** Bombsight Calculation Light
- 6** Bomb Release Timer
- 7** Bomb Indicator Panel
- 8** Gunner Indicator Lights
- 9** Compass



View from the chin turret position

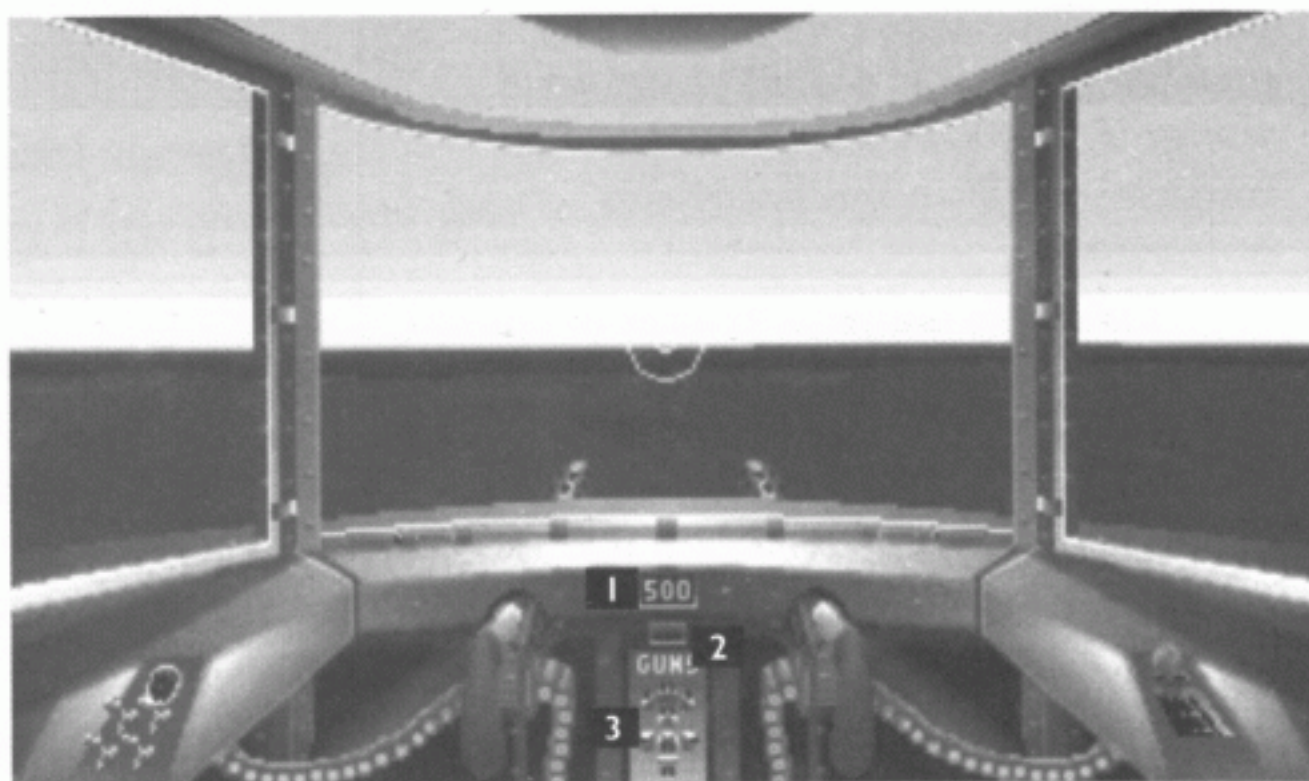
- 1** Gunner Indicator Lights
- 2** Automatic Firing Mode Light
- 3** Ammunition Round Indicator



- 1 View Panel**
- 2 Automatic Pilot Light**
- 3 Hydraulic Pressure Gauge**
- 4 Gunner Indicator Lights**
- 5 Fuel Gauges and Fuel Tank Indicator Lights**
- 6 Compass**
- 7 Banking Indicator**
- 8 Landing Gear Lever and Indicator Lights**
- 9 Engine View Selector**
- 10 RPM Indicators (one per engine)**
- 11 Clock**
- 12 Bomb Indicator Panel**
- 13 Flaps Lever**
- 14 Airspeed Indicator**
- 15 Altimeter**
- 16 Rudder Indicator**
- 17 Rate of Climb Indicator**

- 18 Oil Pressure and Temperature Gauges (one per engine)**
- 19 Manifold Pressure and Temperature Gauges (one per engine)**
- 20 Gun Camera Indicator**

**Cockpit of a B-17F
(B-17G is similar)**



- 1 Ammunition Round Indicator**
- 2 Automatic Firing Mode Light**
- 3 Gunner Indicator Lights**

View from the tail gun position

GERMAN AIRBORNE WEAPONS

Rheinmetall Borsig MG 131 Machine Gun

This powerful 13-mm belt-fed machine gun was used on both the Focke-Wulf 190 and the Bf 109G, and was originally installed as a machine gun that could do the work of a cannon if the latter jammed. The MG 131 fired up to 300 rounds at the rate of 930 rounds per minute, which was a higher rate of fire than the Colt-Browning M-2 .50-caliber machine guns carried by U.S. fighters. However, the MG 131 had a slightly lower muzzle velocity — 2,560 feet per second — than the U.S. machine guns. (Muzzle velocity is the speed at which a bullet leaves the gun barrel; the higher the muzzle velocity, the less time it takes for the shells to reach the target.) Since it had large breech blocks, the installation of the MG 131 in the Gustav necessitated the redesign

of the forward fuselage, and the subsequent fighter was appropriately nicknamed *die Beule* or “the Bump.”

MG FF Cannon

At the time of the Battle of Britain, this was the standard 20-mm cannon, and was wing-mounted on the early models of the Bf 109, as well as on the FW 190A-5. It fired at a rate of 540 rounds per minute and had a relatively slow muzzle velocity of 1,920 feet per second. Though it was well liked by the German air ministry, the MG FF was eventually replaced by the superior MG 151 as standard equipment.

Mauser MG 151/20 cannon

Both the Bf 109 and the FW 190 used this excellent 20-mm belt-fed cannon, which could fire 750 rounds per minute and had a muzzle velocity of 2,310 feet per

second. Although this reliable cannon was ideal for attacking the sluggish U.S. bombers, its rate of fire was too slow against the .50-caliber machine guns carried by U.S. fighters.

Rheinmetall Borsig MK 108 cannon

This powerful 30-mm belt-fed air-to-air weapon was used on the Bf 109, the FW 190, the Me 262, and the Me 163. Designed as an antibomber weapon, it was rushed through development, and it jammed easily at the rate of one stoppage for every hundred rounds fired as a result. The MK 108 could fire 60 eleven-ounce mine/tracer or incendiary shells at a rate of 660 per minute. It had an effective range of 1,300 feet, and with a relatively slow muzzle velocity of 1,705 feet per second, its shells would arc toward

“The Americans, instead of hitting their targets, seemed to bomb everything they got close to. If they had an aiming point, I must say their aiming devices must have been bad. Out of this bombing, the factory or the railway station would be hit, but we saw a lot of bomb craters around areas where nearly nothing was. The British were much better at this. They had the Pathfinders who were flying in front of them dropping flares, and the bombers were dropping their bombs into this flare pattern. They also had much better possibilities to find out what the wind was at the difficult sites and so were much better than the American bombers.”

Luftwaffe General Walter Krupinski

the target and could fall short if the pilot didn't compensate. The MK 108 was nicknamed the "pneumatic hammer" by Allied aircrews because of the monotonous noise it made when fired. Usually a few hits with this formidable cannon were enough to destroy any opposing fighter.

Rheinmetall Borsig MK 103 cannon

An even deadlier antibomber weapon than the MK 108, this 30-mm cannon was mounted in gondolas under the wings of several models of the FW 190, and was intended to be installed in the wings of the Go 229. It had a greater effective range than the MK 108, at 2,000 feet, and a faster muzzle velocity, at 2,820 feet per second. It was also more reliable and less prone to jamming than the MK 108. However, at 420 rounds per minute, it fired its large, high-explosive shells at a slower rate than the MK 108.

R4M Air-to-Air Rocket

These 55-mm missiles were the most formidable antibomber weapons in the Luftwaffe's arsenal. (The name "R4M" was an abbreviation for *Rakete*, or "rocket," 4 kilograms — the weight of each rocket — and *Minen Geschoss*, a thin-walled shell.) They were mounted on two wooden racks under the wings of the Me 262, with each rack holding twelve rockets. All twenty-four rockets could be launched in .03 seconds, and at 1,800 feet the missiles could scatter to cover the space occupied by a heavy bomber. One hit by these highly explosive rockets was sufficient to down a B-17.

The two waist gunners of a late-model B-17. The waist gun positions were staggered so that the gunners wouldn't get in each other's way during fighter attacks. Courtesy of the United States Air Force



SG 500 Jagdfaust Vertically Launched Rocket

This weapon was developed toward the end of the war for the Me 163 in an effort to ensure that the pilots, most of whom were inexperienced at downing aircraft, would score a hit every time. The SG 500 *Jagdfaust* (SG being an abbreviation for *Sondergerät*, or “special equipment”) was a high-explosive 50-mm rocket, and five of these were mounted in vertical tubes on each wing of the Komet. They were fired by a light-sensitive cell that was activated by the shadow of a bomber when the Me 163 would fly underneath it.

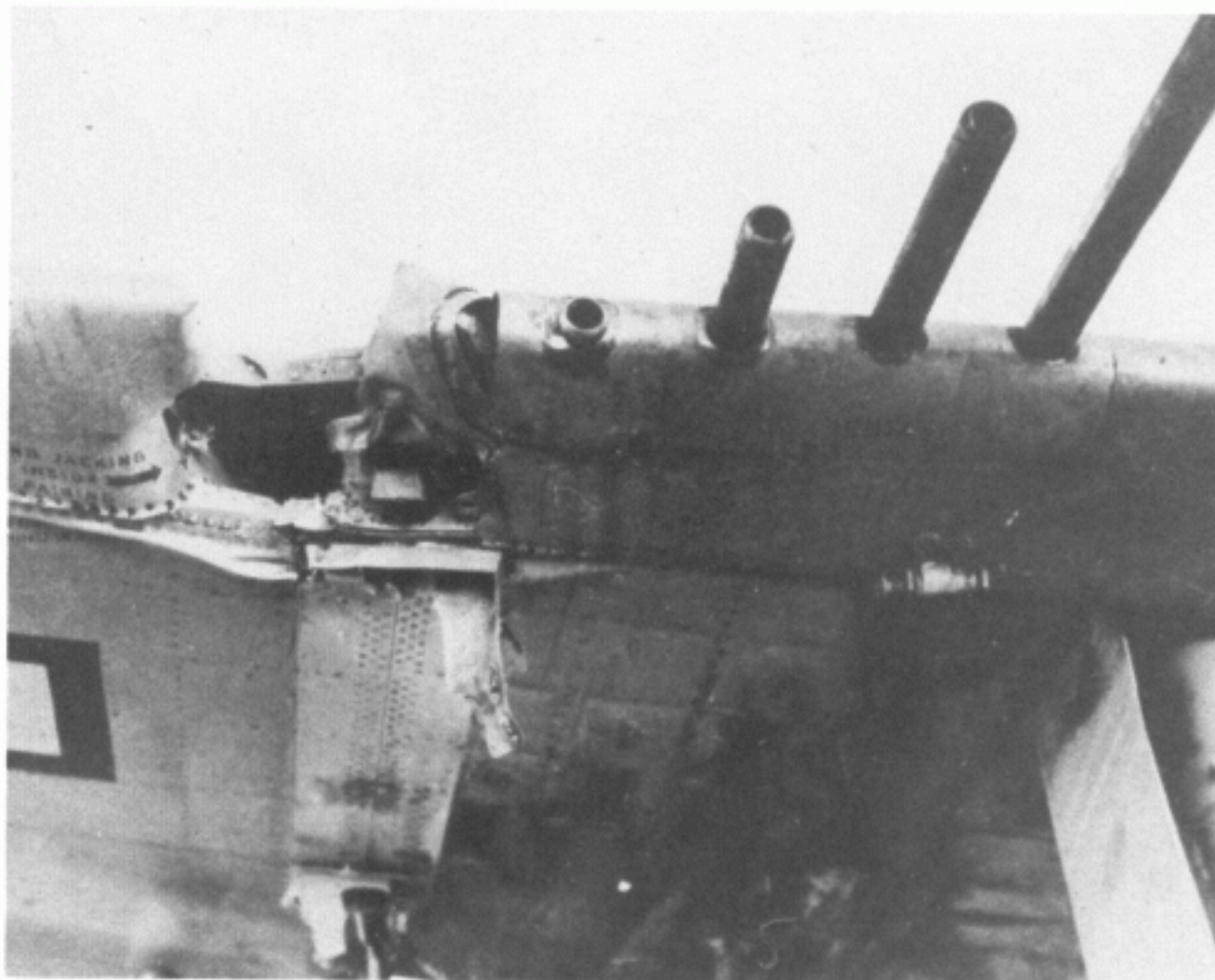
Wfr. Gr. 21 Rocket-Fired Mortars

Two of these 21-cm mortar shells were mounted beneath the wings of the Bf 109 and the FW 190, one per wing. The Wfr. Gr. 21 (which was an abbreviation for *Werfer-Granate*, a rocket-propelled shell) was designed to be fired into tight bomber formations, to break them up so that individual bombers could then be attacked by other fighters. It was first used during the second U.S. bombing raid on Schweinfurt on October 14, 1943, and was launched from outside of the B-17s’ field of fire. The Wfr. Gr. 21 had a slow muzzle velocity of 1,030 feet per second, and at a range of 3,280 feet it had a vertical deviation of 25 feet, which meant that it had to be fired above the bombers, and a horizontal deviation of 130 feet. It could also deviate depending on atmospheric conditions.

110/551/1102/2,205-Pound Bombs

These were general purpose bombs carried by various German fighter-bombers. The 110-pound bomb was carried under the wings of the Bf 109 and the FW 190. The 551-pound bomb was a time-fused fragmentation bomb mounted under the wings of the Bf 109 and the FW 190. It

The hazards of low-level strafing. A collision with a tree punched this hole in the wing of a P-47.



was dropped onto the B-17 formations to break them up, and it had a three-second time delay before detonation. The 1,102- and the 2,205-pound bombs were carried by the Sturmvogel fighter-bomber version of the Me 262.

UNITED STATES AIRBORNE WEAPONS

Colt-Browning M-2 Machine Gun

This excellent .50-caliber machine gun was the standard U.S. Army Air Force machine gun, and was mounted in the wings of the P-51 Mustang and the P-47, and flexibly mounted on various gun positions in the B-17. It could fire at the rate of 900 rounds per minute, and had a muzzle velocity of 2,900 feet per second and an effective range of 3,280 feet. It was possible for a single two-ounce bullet from this machine gun to kill an enemy pilot from as far away as four miles. Each machine gun weighed 69 pounds (not counting the mounts, ammunition trays, or ammunition), and like all Colt-Browning machine guns, it had a reputation for reliability and ease of maintenance. The amount of ammunition carried for the M-2 varied with the aircraft, the mission, and the distance flown.

250/1,000-Pound Bombs

These were high-explosive, general-purpose bombs carried by the B-17, and by the fighter-bomber versions of the P-47 and the P-51. Occasionally, armor-piercing and incendiary bombs were carried by U.S. aircraft. The amount and the type of bombs carried varied, depending on the distance flown and the type of target.

"Bazooka" Rocket

These four-and-a-half-inch rockets were mounted in clusters of three under each wing of the P-47 and the P-51, and were used for attacking ground targets.

"More than once I'd seen a single burst of flak turn a powerful throbbing four-engine plane into an enormous ball of orange flame."

U.S. Army Air Force pilot Allan H. Gillis



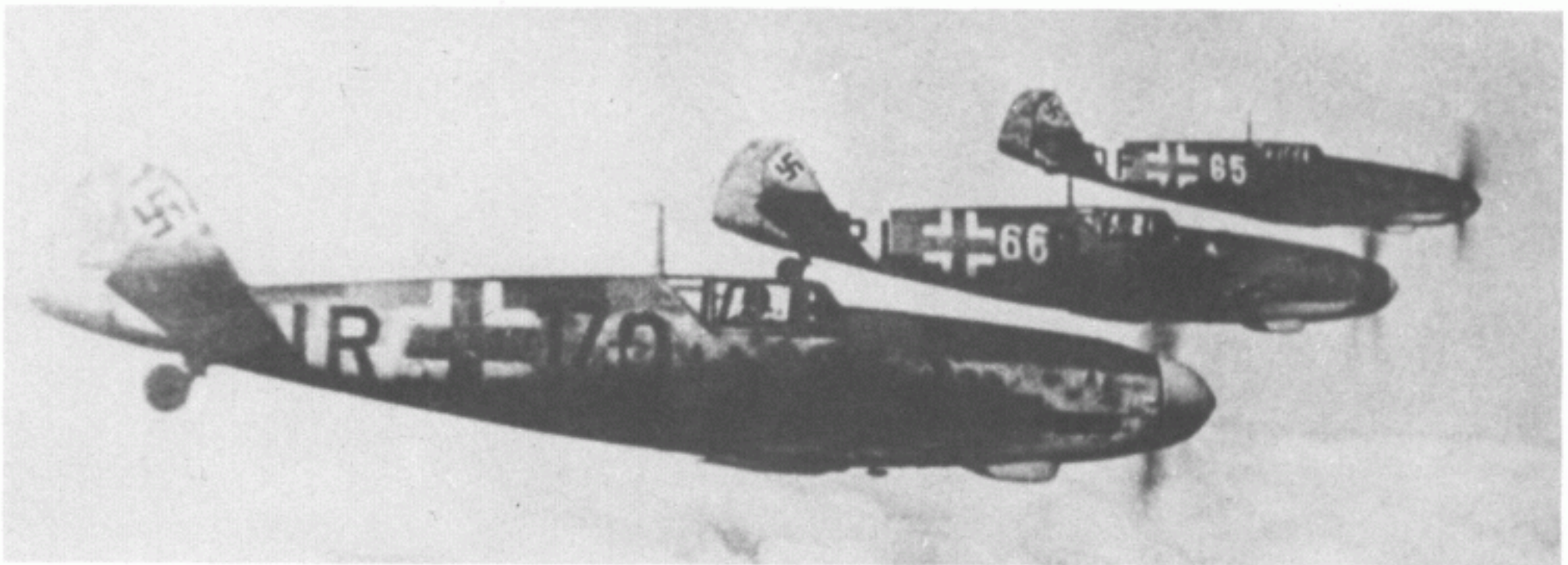
COMBAT TACTICS

This chapter describes the types of fighter and bomber tactics that U.S. Army Air Force and Luftwaffe pilots and crewmen used during World War II. Many of the pilots we spoke with used these tactics in combat, and their comments will be helpful to you in the simulation. Additional useful tips are printed in italics.

You can use the gun camera to analyze your performance in combat so that you may improve your tactics. With the gun camera, you can “film” your dogfights, bombing missions, ground attacks, or other aerial engagements, and then view your “movie” from a variety of camera angles. See the *Film Viewing Room* section of the *Mission Instructions: In-Flight* chapter for more information.

GENERAL FIGHTER TACTICS

One of the many lessons of World War II was that the fighter — and the fighter pilot — ruled the skies. The fighter pilots of the Luftwaffe proved the U.S. theory of unescorted daylight bombing to be a tragic fallacy, and many



A trio of Bf 109Gs.

B-17s were blasted out of the sky until the U.S. developed a suitable escort fighter, the P-51 Mustang. The emphasis in World War II fighter tactics also shifted, from maneuverability, as typified by the dogfights of the Battle of Britain, to speed and sophisticated weaponry, as embodied by the successful Me 262.

But in World War II, as in every war, the key to success in air combat was to know the strengths and weaknesses of your own aircraft — and of your opponent's aircraft. The warplanes of World War II all had a wide range of capabilities, and newer aircraft with greater performance and weaponry were constantly being introduced. A pilot also needed to quickly spot his opponent and determine the direction he was flying. Most importantly, if he wanted to survive and succeed, he needed to be able to size up a given combat situation and to know when to fight — and when to flee.

Preceding page: A P-47 flies above a column of U.S. tanks. Thunderbolts provided invaluable ground support for the Allied armies as they penetrated into France and Germany in 1944–45. Courtesy of the United States Air Force

For vital information about the aircraft you're flying — and fighting against — including their performance data, the types of weapons they carry, and more, see the U.S. and German Aircraft and Weapons chapter.

"A good fighter pilot, the one who survived, was the guy who was always aware and keeping an eye on something besides what was right in front of him. You've always got to be looking some other place, always looking around. Always cover your instruments every thirty seconds, then look up and back, the whole time you're flying." U.S. Army Air Force Captain James Finnegan

Use your view control keys frequently to look around your aircraft, so that you can spot the enemy before he spots you. Use your wing-level view, high view, and scan view to completely cover the sky. See Pilot View Controls in the Mission Instructions: In-Flight chapter for more information.

One way for a fighter pilot to gain an advantage in combat was to surprise an opponent by attacking from a higher altitude or from the enemy's blind spot. This allowed the attacking fighter to build up speed while diving, so it could attack and get away rapidly.

Gaining an altitude that is higher than your opponent's is one of the fundamentals of air-to-air combat and gives you a tremendous tactical advantage. In a dive, altitude translates into speed, so the higher up you can get, the faster you'll be able to pounce on your target, fire your weapons, and get away from other enemy aircraft. The Go 229, with its superior ceiling, can gain an altitude advantage over any other aircraft.

If you don't have an altitude advantage, try approaching your opponent from his blind spot, which is behind and below his aircraft. Those aircraft without bubble canopies, such as the Bf 109, the FW 190, the P-51B Mustang, and the "razorback" P-47, will not be able to see you from this angle.

One of the best ways for a fighter pilot to surprise an opponent was to attack from the direction of the sun.

"We always tried to come out of the sun, but that was only in the late afternoon. We were always flying into the sun in the morning." U.S. Army Air Force Captain James Finnegan

To attack from out of the sun, first use the view controls to locate it, then look for the enemy aircraft you want to attack. Change your flight path so that your fighter will eventually be positioned directly between the sun and the enemy. When you reach this position, turn your fighter toward the enemy. In a perfect attack position, the sun should be at your back and will be visible in your rearview mirror. The enemy pilot, blinded by the sun, will be unaware of your approaching attack, and won't fire at you or execute any evasive maneuvers until you attack.

To avoid surprise attacks, pilots were also advised never

"The [fighter] pilot who sees the other first already has half the victory."

Luftwaffe Major Erich Hartmann

to fly in a straight or level path for more than thirty seconds when enemy aircraft could be nearby.

FIRING WEAPONS

The aircraft of the latter part of World War II had an incredible variety of weapons, including machine guns, cannons, and rockets. Knowing how to fire these weapons accurately was essential to success in air combat. If an enemy airplane was flying straight and level directly in front of him, traveling in the same or the opposite direction, a pilot had only to wait until the airplane was in his gunsight before firing his weapons. Most of the time, a pilot approached and attacked the enemy at an angle and **deflection shooting** was the only way he could hit the target.

“Very seldom did you ever get some guy just sitting right in front of you. It just didn’t happen, but if it did happen, it was because he was trying to shoot some other guy down, and he was more interested in him than in you.”

U.S. Army Air Force Captain James Finnegan

Deflection shooting called for the pursuing pilot to shoot at a point in space just ahead of the flight path of the enemy plane. This was known as **leading**. With the right amount of deflection, the bullets would reach that point at the same time that the enemy plane did. Deflection shooting was difficult, especially for the jet-and rocket-powered Luftwaffe aircraft, since at speeds of over 500 miles per hour, it was hard to judge distances and there was little time to aim and fire. The low muzzle velocity of their cannons and rockets also hindered their ability to score hits with deflection shooting. Me 163 pilots found that since their cannon was ineffective at ranges greater than 2,000 feet, and since they needed to take evasive action at 600 feet to avoid collision, they had less than three seconds to fire. During head-on at-

tacks (see below), the fast closing speed of the two aircraft posed another problem for the fighter pilot, as it left him with but a split second to aim and fire.

If you’re attacking an enemy airplane that’s flying directly at you or directly away from you, you won’t need to use deflection shooting. Position the enemy aircraft directly in the center of your gunsight before opening fire.

To become proficient at deflection shooting, you must compensate for the speed of your target, the angle at which it crosses your line of sight, and its distance from you, which you can determine by sizing the enemy airplane through your gunsight. Lead your shots more if the enemy aircraft is faster, flying a perpendicular flight path, or flying

In the confusion that followed the Allied landings at Normandy on D-Day, only two Luftwaffe aircraft actually engaged the landing forces. Major Joseph Priller and Flight Sergeant Heinz Wodarczyk flew their FW 190s 100 feet over the British-held Sword Beach, raking it with machine gun and cannon fire until their ammunition was gone. Despite a fierce antiaircraft barrage from nearby ships, and the thick Allied fighter cover, Priller and Wodarczyk emerged from their attack unscathed and flew off into the clouds, stunned by the huge invasion armada they had seen.

away from you. Also, if you're flying a jet or rocket fighter, you'll have much less time to figure out the correct angle of deflection and you may want to cut back on your throttle while you're firing. However, this will take away your speed advantage and make you more vulnerable. Look closely at the enemy plane for evidence of your marksmanship, such as pieces of the aircraft breaking off, or smoke or flames pouring out of it.

Weapons with a low muzzle velocity, such as the German MK 108, had problems with accuracy, due to the curved flight path of its heavy, slow-traveling shell. However, if the shell hit enemy aircraft, it would do extensive damage, so Luftwaffe pilots generally fired the MK 108 from close range. Weapons with a high muzzle velocity, such as the U.S. Colt-Browning .50-caliber machine gun, could be fired from greater distances with greater accuracy.

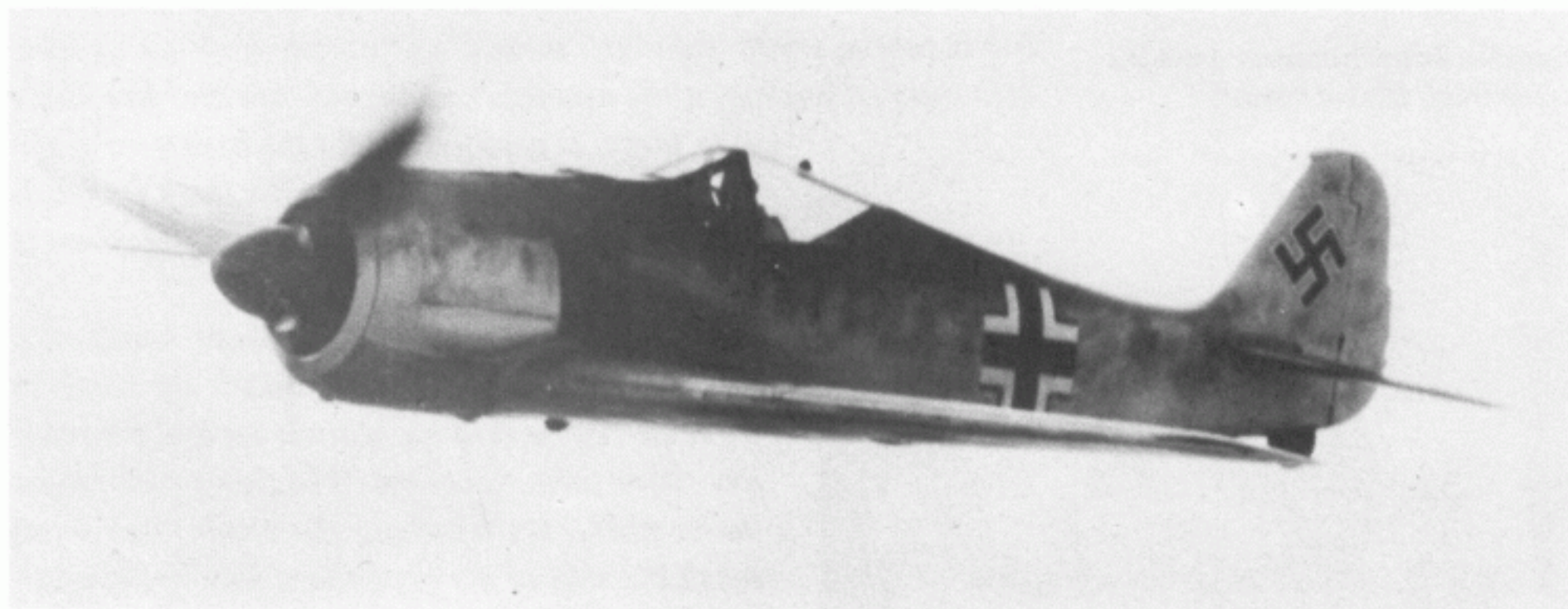
If you're flying a Luftwaffe aircraft, be sure to get as close as you can to enemy aircraft before using your cannon.

To compare the muzzle velocity and firing rate of the various weapons, consult the German and U.S. Aircraft and Weapons chapter.

Luftwaffe pilots had three weapons they could use to break up U.S. bomber formations: an air-to-air bomb, the R4M rocket, and the Wfr. Gr. 21 rocket-propelled shell. The

"You must shoot at a spot out in space which will be full of airplane when your bullets get there."

U.S. Navy Lieutenant Commander James H. Flatley, on the fundamentals of deflection shooting



air-to-air bomb was a fragmentation bomb that was time-fused to explode after five seconds, which meant that the pilot had to be several hundred feet above the formation before releasing the bomb. The R4M and Wfr. Gr. 21 rockets were primitive and had no guidance system: to aim them the pilot had to either point his fighter toward the enemy airplane until it was in his gunsight, or use deflection shooting and fire them ahead of the target. Since they had a low flight velocity, their trajectory was similar to that of cannon shells, and the pilot had to lob these rockets in by firing slightly above the target aircraft. These two rockets were fired from distances of half a mile to a mile, well out of the range of the gunners of U.S. bombers. The R4M rockets were fired in a salvo of twelve per wing, while only one Wfr.

FW 190. Courtesy of the Boeing Aircraft Company

"The Jerries were masters at the art of cutting up enemy fighters."

U.S. Army Air Force Captain Robert Johnson

Gr. 21 could be fired from each wing. Both were time-fused, set to explode after they had been in the air for a certain period of time. If these rockets exploded in a bomber formation and broke it up, the Luftwaffe fighters would proceed to attack the individual U.S. bombers, which no longer had the protection of the machine guns of the formation. Carried in tubes mounted beneath the wings of the Bf 109 and the FW 190, the Wfr. Gr. hampered maneuverability, and made these missile-carrying Luftwaffe fighters easier targets for U.S. escort fighters.

"Toward the end of the war, a few of our Me 262s had this air-to-air rocket, the R4M. We attacked the bombers every time from behind with the R4M, and the bombers pulled up immediately when they saw the detonation of the rocket, and their very close formation spread out a little bit. I was flying with General Galland on one attack, and one of his rockets hit a wing of a bomber and the rest of the aircraft landed on the wing of another bomber and so two bombers were destroyed by one rocket. It was very effective, but you had to shoot it only in one shot, and we had only a few of them." *Luftwaffe General Walter Krupinski*

If you're flying a rocket-armed Luftwaffe fighter, remember that you only have one or two chances, so don't waste them. When attacking bombers, try to approach them from behind, and use as little deflection as possible when aiming. You should aim and fire above your target to compensate for the trajectory of the rockets. Since your accuracy with these rockets is low, try firing them at a formation of bombers to increase your chances of hitting one.

If you're dropping an air-to-air bomb on a bomber formation, try to approach the bombers from the rear and at an altitude several hundred feet above them. Since you'll be flying faster than the bombers, try releasing the bomb just as you reach the rear of the formation, then break away quickly to avoid the explosion.

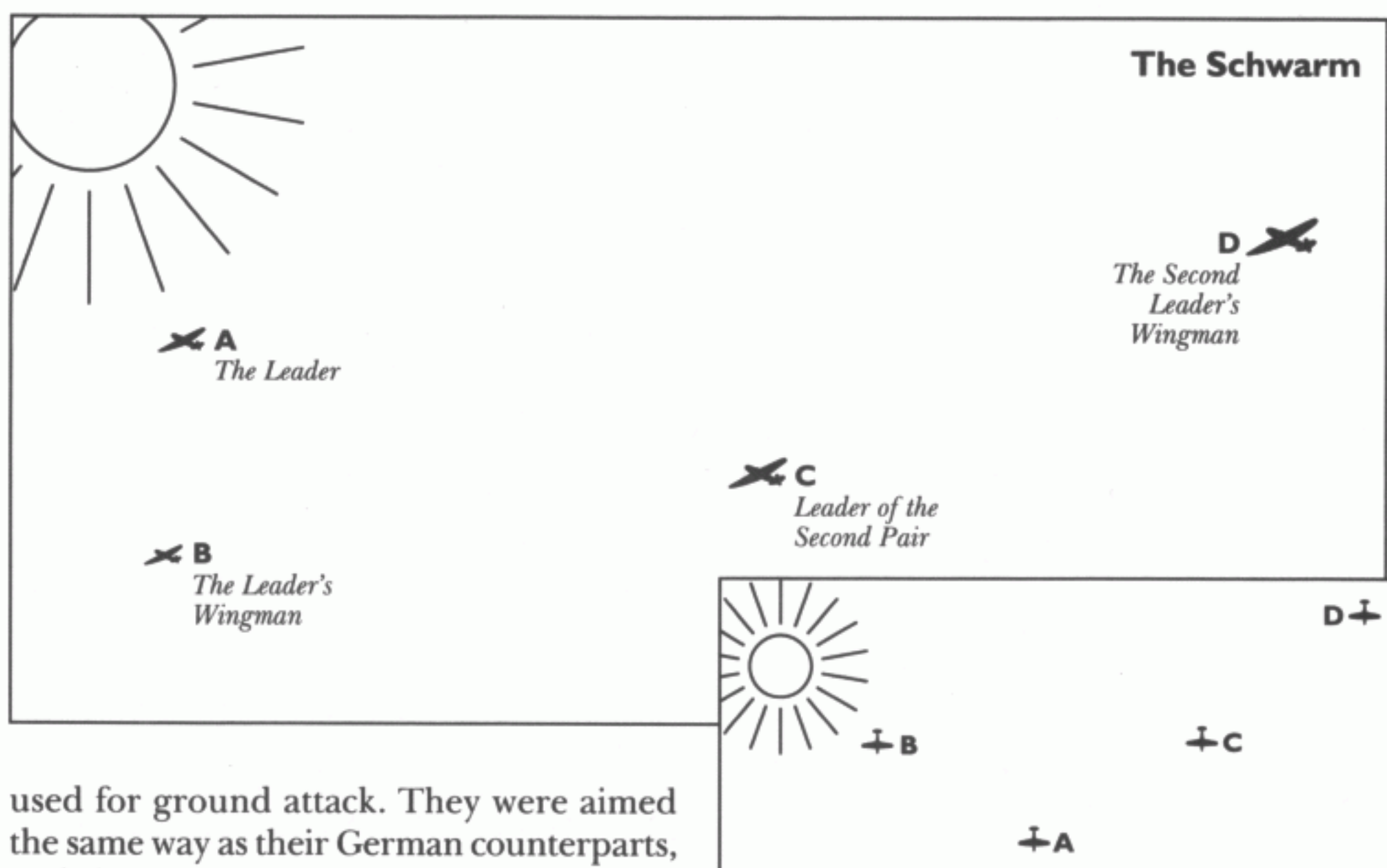
If you're flying an Me 163, you'll be carrying the Jagdfaust, an effective antibomber weapon that was tested late in the war. The Jagdfaust is a vertically launched rocket that is activated by the shadow of a bomber. To use the Jagdfaust, position your Komet so that it is 1,000 feet or less beneath a bomber. The Jagdfaust will fire straight up on its own, but only if you're positioned properly.

To learn more about these weapons, see the German and U.S. Aircraft and Weapons chapter.

American fighters also had rockets, known as bazooka rockets, which were only

Captain Robert Johnson with his crew chief, Ernest Gould.





used for ground attack. They were aimed the same way as their German counterparts, and their accuracy was also low. However, stationary ground targets were generally easier to hit than fast-moving aerial targets. The bazooka rocket was not time-fused but exploded on impact.

Two versions of the Schwarm.
The small diagram shows the view from below the formation.

FIGHTER FORMATIONS

During the Spanish Civil War, three years before the outbreak of World War II, Luftwaffe fighter pilots had flown in tight three-plane formations. Their heavy losses had forced them to develop a looser, four-plane fighter formation, called the **Schwarm**, made up of two pairs of Bf 109s, each pair known as a **Rotte**. The four aircraft flew about six hundred feet apart, a distance based on the turning radius of their plane. The best pilot and best shot was the leader of the formation, who navigated and flew ahead of the other three fighters. The leader's wingman protected the leader, and always flew between the leader and the sun, though at a lower altitude so that the other pilots would not be blinded by the sun while looking for him. The leader of the second *Rotte* and his wingman flew at a higher altitude. The second wingman always had the job of guarding the formation against surprise enemy attacks from the sun side. The heights of the four fighters in the *Schwarm* were staggered, so that they could cover each other in all directions. The formation reduced the risk of collision and, being so spread out, was harder for the enemy to spot.

This four-plane formation was later adopted by the U.S. Army Air Force, which, like the Luftwaffe, stressed the importance of the pair of fighters in combat. When enemy aircraft were spotted, the pilot who was in the best position to attack became the leader, while the second aircraft of the

pair became the wingman and covered him. Because the leadership position could switch several times during a given mission, this tactic was only successful if each pilot in a pair knew how the other was going to react in every situation.

If you're leading a four-plane formation, you're responsible for initiating the attack. Don't fly so erratically that you lose your wingmen, whom you'll need at your side for protection. If you're flying as a wingman, your main responsibility is to cover your leader and to remain by his side.

FIGHTER VERSUS FIGHTER TACTICS

The **stern attack** was a useful tactic, especially when attacking from the direction of the sun. Originally developed during World War I, it called for the attacking pilot to dive on a target, pull out of his dive when he was on the tail of the target, and then fire. If there was a rear or tail gunner firing from the target aircraft, the attacking pilot would try to avoid the gunfire by shooting at an angle slightly beneath

The hunter and the prey. A stricken Bf 109 is chased by a P-47. Courtesy of the United States Air Force



the target's tail. This was the simplest attack because it required no deflection shooting, and was ideal for inexperienced pilots or poor marksmen.

The stern attack is useful if the speed of your aircraft is greater than the speed of the aircraft you're attacking. However, it is useless against a faster aircraft, such as the Me 262 or the Go 229, which can accelerate quickly, leaving you with no chance to catch it.

The most effective tactic against the Me 262 was to dive down upon it from high above to pick up speed, and then to open fire before the jet pilot could react. U.S. fighters would try to knock out one of the Me 262's engines, reducing its speed so that it could not get away. Occasionally, a U.S. pilot would encounter a jet pilot whose reliance on maneuvering, rather than on speed, would slow the jet down enough so that the American could not be shaken. Most of the time,

the U.S. pilots tried to catch the Me 262s when they were most vulnerable — during takeoffs and landings.

“The split-S maneuver is how I got Adolf Galland in his Me 262. I was flying green [top] cover, and he was way down below me, and I didn’t even see him coming. He had some guy with him, and he went through and shot down a B-26, and the next one... BANG... it blew up. After he’d gone through these two B-26s, I watched the two jets, and one guy went off to the right, and Galland went to the left, and he was coming back to make another pass at the other B-26s but his weapons jammed on him and he couldn’t do it. So I’m still horsing around and wondering, “My God, what the hell are these things?” and I turned it over, and when I came out, I was in a perfect position to attack him. I don’t think that he ever saw us — they didn’t know we were sitting up there, since they came at the bombers at an altitude they considered high. I was so close that when I saw him, I had to raise my nose to get the deflection, and I lost sight of him. I probably led a three-second burst at the most. Then, to see what I did, I dropped the nose again, and as I did, I could see strikes on the right side of that 262, and little did I know I had also wounded him. But then, all of a sudden, he turned, and I went beyond him, because I was going so fast, and he disappeared into a cloud. I kept looking for him for two reasons, so I could get another shot at him and, just as important, so he wouldn’t get a shot at me. But he went into that cloud, and I never did find him.”

U.S. Army Air Force Captain James Finnegan

If you’re a U.S. pilot, diving down from above is the best way to attack a faster aircraft, such as the Me 262, the Me 163, or the Go 229. This approach gives you a larger target area to fire at, especially if you’re attacking the Go 229, which offers a very small profile if you attack it from the front, side, or rear.

In most cases, a pilot would try to make a single pass, do as much damage as he could, and then get away. Very rarely would he engage in a turning battle with the opponent, in which each jockeyed for position on the other’s tail.

“I only got into one dogfight in which we got into those stupid circles, where you’re pursuing someone and you’re both turning tighter and tighter. The bad thing about fighting air-to-air is that if you get into those circles, you’re so interested in getting inside him, and getting that nose around, that some other bastard you’re not even paying attention to comes down and takes a shot at you.”

U.S. Army Air Force Captain James Finnegan

On occasions when a pilot wanted to make a second pass, he would sometimes use another World War I maneuver, the **Immelmann** turn. This called for the pilot to pull his fighter almost straight up after the attack, and then stall at the top of his climb and turn the aircraft around in the di-

“Learn to break at the proper time to make a head-on attack—the enemy doesn’t like it. Don’t run. That’s just what he wants you to do.”

**U.S. Army Air Force Colonel
Hubert Zemke**

Captain Dave Hearrell holding on to one of the .50-caliber machine guns of his P-51B Mustang.



rection of his adversary. This maneuver would put the pilot in a position to dive down and make a repeat attack, even if the target aircraft had already turned away left or right.

A risky approach was the **head-on attack**, which was also first used during World War I. A fighter would simply fly head-on toward the enemy fighter and open fire when he was within range. The problem with the head-on attack was that it gave the enemy fighter an equal opportunity to shoot down the attacking fighter, and occasionally two fighters would collide head-on.

A maneuver that P-47 pilots used against the slightly more maneuverable Bf 109 was the **barrel roll**. If a P-47 attacked a Bf 109 from behind, the German fighter would go into a tight turn to lose the American fighter. But if the P-47 pilot first rolled in the opposite direction of the 109's turn, and then pulled back in the same direction as the 109, he would usually find himself on the tail of the enemy fighter in an ideal position to attack.

Equally as important as setting up an attack is knowing how to avoid an attack. One evasive maneuver, relied on especially by Luftwaffe fighter pilots from the time of the Battle of Britain on, was the **split-S and dive**. The fighter pilot would attack bombers and fighters, usually using the head-on attack, and then flip the fighter over on its back and dive straight down. This maneuver worked well in the Battle of Britain against the Spitfire, whose engine suffered carburetion problems and would cut out whenever it went into a dive chasing after the Bf 109. It was also a good maneuver for FW 190 pilots flying against B-17s, since the bomber gunners would usually score hits on the 190 only after it had flipped over and was in a dive, and its heavily armored belly would absorb most of the shots. But those pilots who successfully executed this maneuver had to waste precious minutes to once more reach an altitude from which to attack. Moreover, the split-S and dive was unsuccessful against the fast Allied fighters, especially the much-heavier P-47, whose tremendous weight enabled it to outdive the German fighters. U.S. fighter pilots chasing after these diving Luftwaffe aircraft attacked them from behind with dev-

astating results. Even the ground was no safe haven for Luftwaffe pilots, as U.S. fighters followed them down to treetop level, often running a gauntlet of murderously heavy flak, especially in the Ruhr valley, to score a kill.

"We had at that time no well known, common tactics, so everybody, every group commander, had to find out his own way. I taught my youngsters in Bf 109s that, if we were attacked by Mustangs or Thunderbolts, only the last pair, or the last echelon, would split away and come in again so that the other one could follow the FW 190s to protect them so that the 190s could attack the bombers. That was our main tactic when we were flying over Germany, until the invasion started. After that a lot of things went wrong and didn't work quite properly anymore."

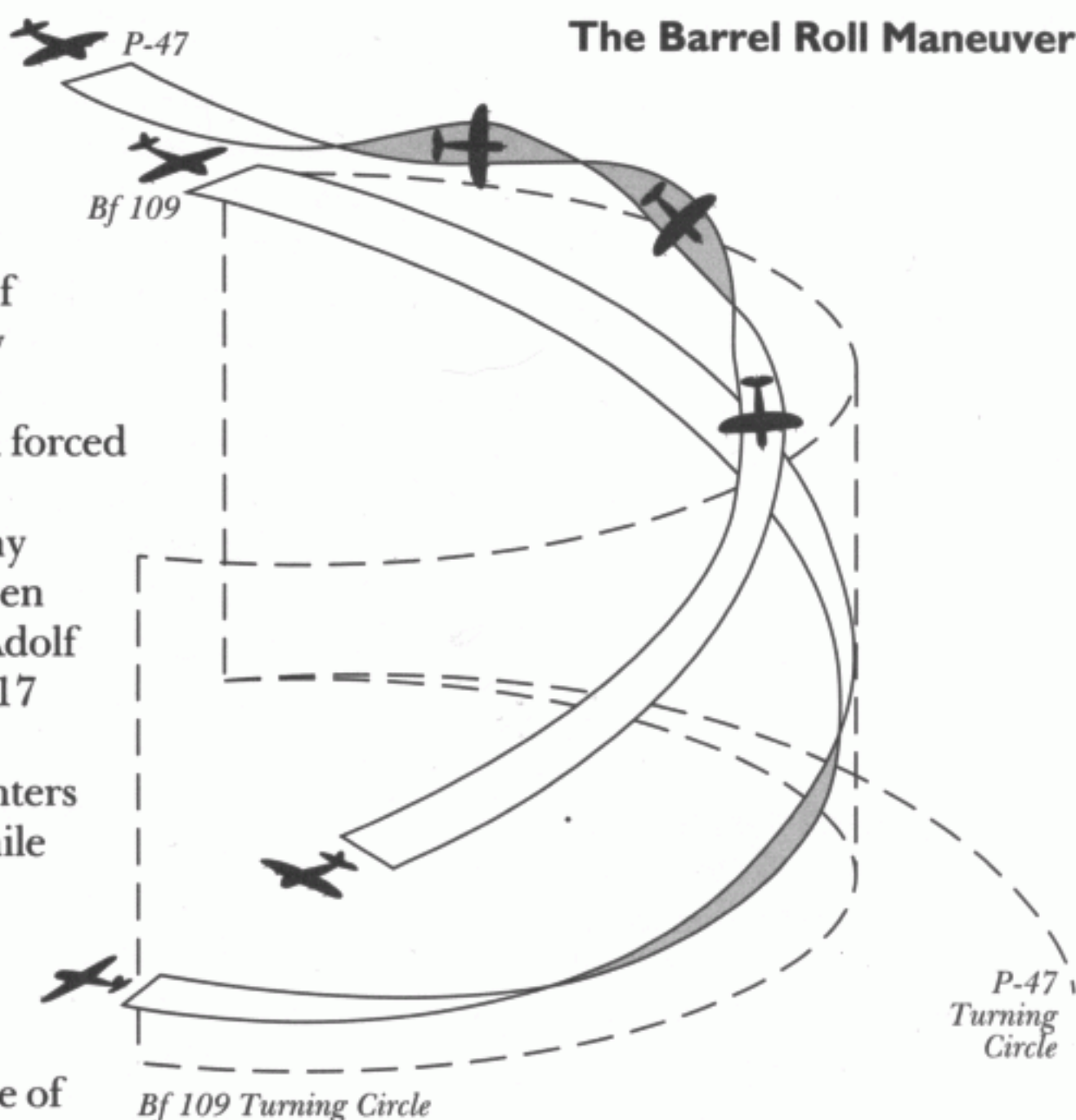
Luftwaffe General Walter Krupinski

Evasive diving maneuvers can get you out of danger only if you're attacked by slower aircraft. If you're flying a Bf 109 or an FW 190 and a P-47 or a P-51 attacks you from behind, or if you're flying a P-47 or a P-51 and a Me 262 or a Go 229 attacks you from behind, you may not be able to dive away from the attacking aircraft, since it can accelerate in a dive faster than you can. You may be able to lose your pursuer by making tight turns inside, or by executing a series of S-turns.

FIGHTERS ATTACKING BOMBERS

Attacking a formation of B-17s could be extremely hazardous for a Luftwaffe pilot, even if the bombers had no fighter escort. A formation of fifty-four of these bombers usually carried a total of 648 fifty-caliber machine guns, which could fire a total of 486,000 rounds, amounting to a veritable rain of bullets for a German pilot to fly through.

Several B-17s that had been forced to crash-land in Europe were patched up and made airworthy again by the Luftwaffe, and when one of these was inspected by Adolf Galland, he discovered that B-17 gunners could bring more machine guns to bear on those fighters that attacked from the rear, while the front was less protected. Luftwaffe fighter pilots were then ordered to fly a course parallel to that of the bombers, and to stay to one side of



"Suddenly we saw the Boeing Fortress IIs ahead in a great swarm. I confess the sight put me in a bit of a flap, and the others felt the same. We seemed so puny against these four-engined giants."

Luftwaffe Corporal Erich Handke, on encountering B-17s for the first time in a fighter in 1943

the formation until the fighters were three miles ahead. They would then execute a half-roll, turn around, and make a shallow drive straight at the approaching enemy formation. At a distance of 2,400 feet, they would level off and fire at the cockpit of a B-17 for a few seconds at the most before taking evasive action. They would escape by either flying over the bombers or diving, and would then repeat the attack.

"In the early part of the war, the German fighters would come at you from the sides and the back, because that way they had time to aim. But with anywhere from twenty-five to thirty B-17s in a group, there was a lot of firepower going at them. So they changed their tactics when they found out that the B-17 had less firepower in the nose, and the top turret couldn't drop down low enough to catch the planes coming in unless they came up. They began coming at us from the front, in a V-formation. To us, it looked like a line straight across, but sometimes they would come at us in an inverted V, where the middle was farther away from you than the two ends, and you'd think it was a line straight across and start shooting towards the middle, where they were still out of range. The next time they might switch around and come at you with the center closer to you than the ends.

"The closure rate on these frontal attacks was really high. They'd be doing 400 miles an hour and we'd be doing 160, and as soon as we'd got in range they'd start shooting 20-mm cannon, aiming at the cockpit, hoping they'd hit something. You could see those twenty millimeters coming, and you just hoped they weren't going to explode or hit you. Then they'd go away and circle around and come at you again. The only time they'd go after a bomber from another direction is when one was straggling behind alone; then they'd come at it from behind and the side. The bombers that had lost one or two engines were all by themselves, and these Luftwaffe guys would just take their time to come up and get behind them and try to shoot the fuel tanks on either side of the fuselage."

U.S. Army Air Force Pilot Officer Robert Davila

For those occasions when the U.S. squadrons could not be intercepted from the front, Galland developed the *Sturmgruppen* tactics, which called for specially modified FW 190s, with four 30-mm cannons, 5- to 12-mm-thick armor plating around the pilot and engine, and a 50-mm-thick bullet-proof windscreen, to attack from the rear, from slightly above or below the bombers' tails. The *Sturmgruppe* would attack from extremely close range, usually at 300 feet or less, where the 30-mm cannon of the FW 190 was most accurate and lethal. Several *Gruppen* of lighter-armed Bf 109s would protect the *Sturmgruppe* and take on the es-

During the fighter sweeps through France before D-Day, Allied pilots used an unusual technique to destroy locomotives. They would first drop their extra fuel tanks on the train, then strafe them so they would catch fire.

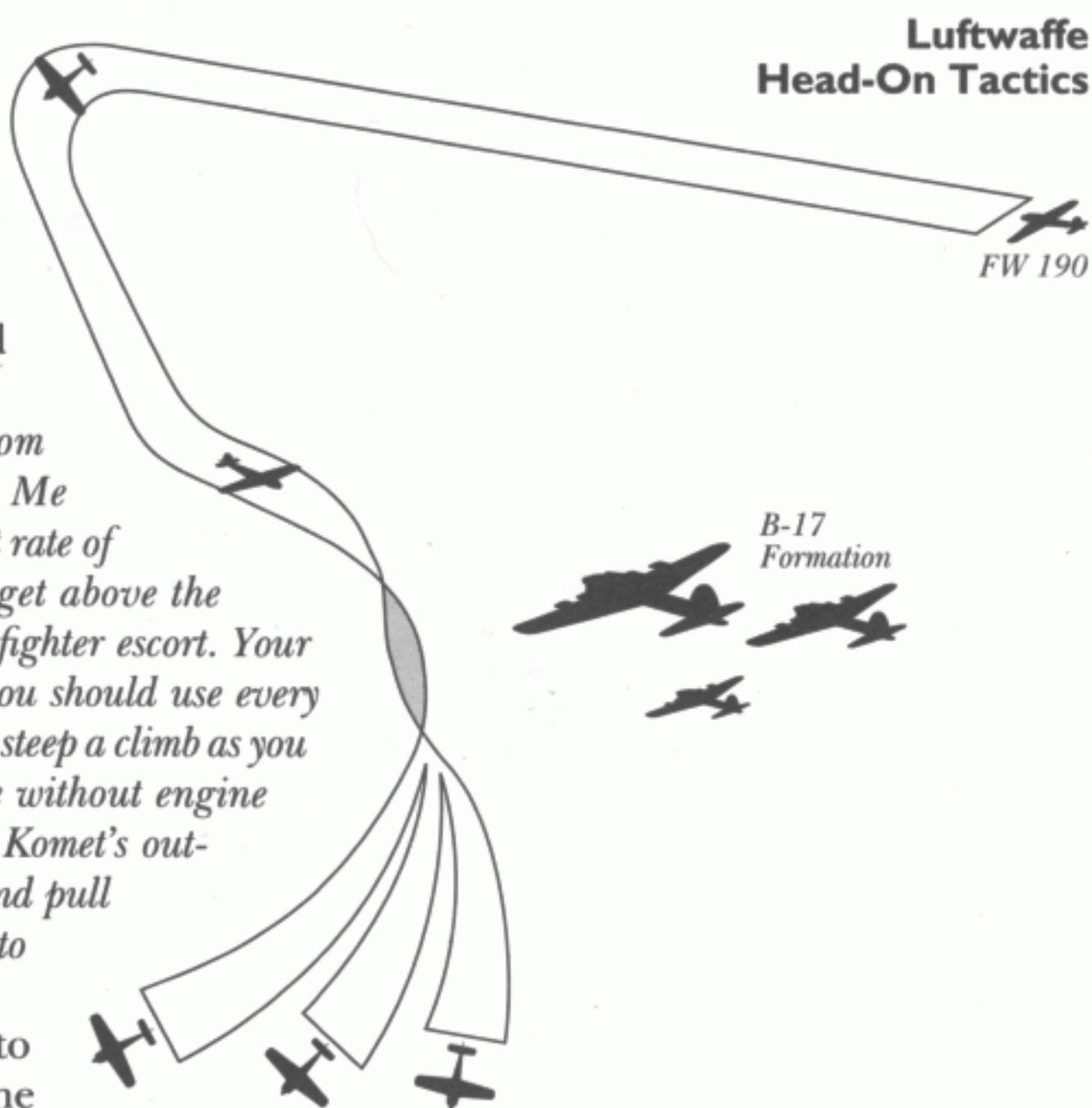
corting U.S. fighters. If P-47s or P-51s broke through the protective cover, the *Sturmgruppe* fighters would continue to press their attacks on the bombers anyway, since with all their extra armor and weaponry they were extremely heavy, and less maneuverable against the U.S. fighters.

"When I came to Germany as a fighter commander, only the FW 190s were attacking the four-engined bombers and the Bf 109s were used as protection for the 190s. Most of the attacks I saw were from front to head. If the bombers realized that the 190s were coming, they often made a certain curve of ten or fifteen degrees in the other direction, an angle that made it very difficult for the 190s to come in front again. Also, there were four groups called the *Sturm* groups who were attacking bombers from behind. When the bomber didn't burn or wasn't dismantled, the *Sturm* fighters rammed it in the rudder and elevator. They had a lot of special armor, made up of a lot of different light metal plates, and a little window with different plates on it. This armor was in the front of the fighter, not behind, and in my opinion, it was good protection. I saw a lot of German pilots bailing out after they rammed the bomber because, if they did it properly, they had a good chance to survive." *Luftwaffe General Walter Krupinski*

Another tactic which worked well for the Luftwaffe called for the attacking fighter to dive on a U.S. bomber from above. The pilot needed to be about a mile above the bomber, and 800 feet ahead of it. Attacking from this angle gave the fighter pilot a greater target to hit, and only the top turret gunner of the B-17 could fire back at him. The drawback of this tactic was that it took a long time to gain the altitude to set it up, and U.S. escort fighters would usually engage the attacking fighter before it could go into its dive.

Diving on U.S. bombers from above is an ideal tactic for the Me 163, since it has an extremely fast rate of climb which will enable you to get above the bombers quickly and avoid their fighter escort. Your fuel capacity is very limited, so you should use every drop to gain altitude and make as steep a climb as you can. Most of your attack will be without engine power, so take advantage of the Komet's outstanding handling as a glider, and pull up after your first diving attack to regain your altitude advantage.

When U.S. fighters began to accompany the bombers all the



way to the target and back, Luftwaffe fighters were ordered to ignore this close-flying escort and fight their way through to the bombers. This tactic proved disastrous for the Luftwaffe when the U.S. escort fighters began to react aggressively and chase the German fighters instead of remaining alongside the bombers.

In the final months of the war, Galland's Me 262 "squadron of experts," Jagdverband 44, attacked bomber formations in three elements of three aircraft each. Unlike the piston-engined Luftwaffe fighters, the Me 262s would not attack bombers from the front, since the jet flew much too fast for accurate marksmanship. Instead, they would be-

A gun-camera photo of an Me 262 just before it was shot down by a P-51 Mustang over the Rhine. Courtesy of the United States Air Force



gin their approach at an altitude of 6,000 feet above the bombers, and about three miles behind them. The three Me 262s in each element would then form a column, and dive until they were 1,500 feet below the bombers and 3,000 feet behind them. This dive would increase their speed to over 540 miles an hour, which was necessary to escape the U.S. escort fighters, although it hampered their firing accuracy. After this dive, the Me 262s would pull up and fly level for the last 3,000 feet. From 2,000 feet away, each Me 262 pilot would launch its twenty-four R4M rockets, since at this distance the rockets could converge on a B-17 from wingtip to wingtip. The pilots would then open fire with 30-mm cannons, and, at a distance of 450 feet, the three Me 262s would climb up toward the top aircraft in the bomber formation, so as to make it harder for bomber gunners to track them. They would not dive under the formation because chunks of debris from damaged aircraft could be sucked into the turbojets of the Me 262s. Once they had flown over the bomber formation, the Me 262s could either dive to get away from pursuing U.S. fighters or attack a different formation.

FIGHTERS PROTECTING BOMBERS

For protection in the air, the U.S. bombers relied on **fighter escort**, fighters that flew with the bombers as far to the target as their range permitted. During the first U.S. raids, the RAF Spitfire was used for fighter escort. Whereas on RAF bombing missions the escort fighters flew close to and alongside the bombers, the Spitfires kept their distance from the American gunners, who in their eagerness to get a kill would often fire on friend and foe alike. Later, the P-47 and the P-38 were used for fighter escort, and these "little friends" generally stayed several thousand feet away from the "big friends," flying on the left and right flanks of the bombers, as well as directly above them. Since fighters were faster than bombers, fighter pilots would do a series of S-turns to keep from flying ahead of the lumbering B-17s and B-24s. However, these maneuvers consumed a lot of fuel, and reduced the range of the escort fighters.

At the time of the first raids into Germany, neither the P-47 nor the P-38 proved to be a completely satisfactory escort fighter. Their limited range was a handicap, as they were forced to turn back to England before the bombers they were escorting reached the target. From the end of 1943 on, the best Allied escort fighter was the P-51 Mustang, which had the range to stay with the bomber formations, and the speed and maneuverability to take on all Luftwaffe fighters, even including the Me 262. Belly tanks improved the range of the P-47 and P-38, but as Mustangs arrived in increasing numbers, these two aircraft were used more often as fighter-bombers.

In early 1944, Lieutenant General James Doolittle, the commander of the U.S. Eighth Air Force, decided that his fighters could do more damage if they weren't "chained" to the bombers in the escort role. Doolittle unleashed many of his fighters, and these **free-ranging** aircraft would sweep ahead, looking for Luftwaffe fighters to chase. Sometimes, these fighters would fly several hundred miles ahead and to the left and right of the bomber formations. If they came across German fighters, the Americans would try to split up the Luftwaffe squadrons before they could attack the bombers. If no German fighters could be found in the air, the U.S. fighters would look for them on the ground, and then strafe them at their airfields.

Luftwaffe fighters would usually try to avoid these free-ranging fighters and concentrate on the bombers. One Luftwaffe trick was to have German fighters meet the U.S. fighter formations just after the Ameri-

"Jerry's favorite place of attack is the nose. A straight-on frontal attack gives him the best chance of scoring a hit without being hit himself. His favorite trick is to swing out to the side of the formation and get out in front of it a few thousand yards, and then come charging back head-on. When he comes in range he starts firing and rolling over on his back, shooting all the way. Then when he gets close he breaks away by doing a split-S out under the Fort."

U.S. Army Air Force B-17 pilot Dave Shelhamer, in his diary, 1943

"You got scared, but it was more because of anticipation. You'd wonder, 'When will we hit flak?' or 'When will the fighters hit us?' and even if nothing happened, you still had the same tension buildup, anticipating what might happen."

**U.S. Army Air Force Pilot
Officer Robert Davila**

cans had crossed the English Channel. Preparing to engage the enemy, the U.S. fighters would have to release their drop tanks, but the German fighters would avoid combat, and now, short on fuel, the escort fighters would be forced to turn around sooner than planned, leaving the bombers unprotected. The Americans countered by assigning certain squadrons to engage these Luftwaffe aircraft, while the remaining squadrons flew on with the bombers; but the Germans later abandoned their tactic for fear that if their aircraft flew over the Channel, it would leave France and the Low Countries without Luftwaffe fighter protection.

"On escort missions, we just kept S-ing back and forth so the ground fire couldn't zero in on us."

U.S. Army Air Force Second Lieutenant Thomas Marsters

"What used to bother me, what really made my hair just stand up, is when our fighters would fly cover, and they'd zigzag around, go up a ways, and then all of a sudden turn and drop their tanks, and just go like hell in another direction. That's when I knew there were German fighters around."

U.S. Army Air Force Pilot Officer Robert Davila

If you're flying a fighter with your drop tanks still attached, and you're engaged by enemy fighters, you should jettison the tanks immediately. If you don't, they will explode if hit by gunfire and will also cut back on the maneuverability of your fighter.

GROUND-ATTACK TACTICS

As the war progressed, the role of the fighter expanded. In 1944, U.S. fighter pilots who were previously ordered to

As the air war began to turn in favor of the Allies, a special suicide unit of the Luftwaffe, called the *Raubvogel*, or "bird of prey," was formed. The pilots of this group flew heavily armored FW 190s and opened fire on U.S. bombers only when they were at point-blank range, pulling away at the last possible second. In April 1945, five members of this unit actually downed U.S. bombers by ramming into them.

stay near bombers in their escort role were now told to destroy "targets of opportunity" on the ground on their return flight if they did not encounter fighters in their patrol area. These targets included railroad marshaling yards, trains, bridges, and especially airfields.

The biggest hazard of these ground attacks was the heavy concentration of flak around key installations. To counter the threat, U.S. fighter pilots relied on two tactics: They would fly toward the target at an extremely low altitude to surprise the gunners. They would also assign several fighters to take out the flak batteries before the rest of the formation shot up the ground target.

"Whenever we attacked airfields, one flight or one squadron had the duty to take on the flak towers first. They were pretty bitter. You'd come down at them, and you were going at them



and they were going at you, and you let all your eight .50s go. Usually you'd approach them low, right on the deck, and when you thought you were there, you'd pop up a couple of hundred feet and then go down to attack. The idea was to get to those flak towers before they got to you. Normally we'd have intelligence as to where they were, but it was still a bitch."

U.S. Army Air Force Captain James Finnegan

A formation of three P-51D Mustangs, plus an earlier-model P-51B.

"If we were attacking a German airfield, we'd just set up a gunnery pattern like we did in training, and fly around and around and strafe the field. If we found a railroad train, we'd set up a little pattern and we'd all strafe the train — we really blew them up. We'd come in at sort of an angle from behind the engine, to hit where the driver was, and zero in on the engine. The P-47 had eight .50-caliber machine guns blowing in there at one time, and sometimes it would just knock a train right off the track. (We could even turn a tank over on the ground if we shot the ground next to the tank.) If we shot the engine up and we still had ammunition left, we shot up the rest of the train, too."

*U.S. Army Air Force
Second Lieutenant Thomas Marsters*

"Depending on how heavy the flak was, the whole flight or the whole squadron would follow the leader to maneuver out of the flak bursts; we'd vary the flight, roll back and forth, up and down, make it unpredictable as best we could. One time, we became so interested in making these maneuvers to keep out of flak that three 109s came down from above and hit us."

U.S. Army Air Force Captain James Finnegan

As U.S. ground attacks were proving enormously successful, both the Thunderbolt and the Mustang were fitted

"The senses are not trustworthy. And the sky is treacherous with flak. The flak bursts around you and sometimes the fragments come tearing through your ship."

War correspondent John Steinbeck

to carry bombs and rockets. These "fighter-bombers" no longer flew escort missions but concentrated solely on bombing and strafing ground targets, often coordinating with Allied ground troops below. The P-47, with its rugged radial engine, could withstand ground fire better than the P-51, and soon, the Thunderbolt became the aircraft of choice for ground attacks.

"We never had any training in dive bombing. We were fighter pilots, and the concept of the fighter-bomber was something new.

"We were to take out two approaches to a bridge behind the lines, to keep the Germans from bringing reinforcements to Normandy. We didn't have bombsights on the P-47; we'd just point that nose down and figure that when we pulled it up we'd release the bomb. I was going down with three 500-pounders, and I saw where some other bombs had hit, and I figured that I'd go along the bridge. That's a better way of attacking a bridge than at ninety degrees, but you're getting fire all along the route, and you're asking for it when you do it. I'm firing my eight .50s and they're kicking, and I'm thinking this isn't too bad. But then as I pull up and let go of my bombs, all of a sudden I see these red things flipping past my wings, and I think, 'Jesus Christ, they're shooting at me, God Almighty' — and then I turned right to give them a deflection shot, so they couldn't shoot at me straight on. That was my first experience at getting shot at. I didn't hit the bridge.

"If you dropped your bomb too low, you could get hit by your own bomb blast, and that happened, particularly when we went after trains. I can remember two guys who got it — they didn't

A P-47 Thunderbolt shoots up a flak tower at a German airstrip. These obstacles were especially hazardous to U.S. pilots.



hit the engine, they hit the damn boxcar. When it blew up, they went through it and got hit by the stuff that was in there.”

U.S. Army Air Force Captain James Finnegan

BOMBER FORMATIONS

After the first few bombing raids on France in 1943, Colonel Curtis LeMay devised several tactics to maximize the firepower of the B-17s and improve their bombing accuracy. One of these tactics was a flying formation known as the **combat box**. In this formation, three squadrons of six or seven bombers each were stacked in boxes on top of one another. The middle box was in the lead, and the other two boxes were stacked 1,000 feet above and below it and 250



B-17s from the 381st Bomb Group line up for takeoff from their base in England.

feet to its left and right. When viewed from the side, this formation resembled a sideways V, with the first planes in the middle box leading the way. The purpose of the combat box was to provide a clear area for the bomber's gunners to fire in, especially if German fighters were attacking from head-on.

“We never used the auto-pilot because our main task was to stay in formation all the time. In training we were told to keep fifty feet apart, but over in Europe we practically buried our wings into each other. It was very tiring to fly formation, especially if you were flying in a low slot, because you had to watch the guy right overhead more than anything else. You're sitting and looking up and looking ahead and looking up all the time, so we'd take turns flying, about fifteen, twenty minutes at a time, and then switch off.

“I'd say the weather over Europe was bad sixty percent of the time. We never had a day where we had clear weather all the

"When flak explodes, it sounds just like somebody's throwing gravel on a tin roof, unless it hits big."

U.S. Army Air Force Pilot Officer Robert Davila

way. When your formation was going through clouds, you just all went in together and hoped that everybody stayed in the same formation, and that no one swerved. In fact there was a very high rate of collisions, of bombers just flying into each other, mainly caused by bad weather."

U.S. Army Air Force Pilot Officer Robert Davila

If rockets fired by Luftwaffe fighters were sighted, the bomber formation would spread out. The individual B-17s would then make evasive maneuvers against further rocket attacks.

When flying a bombing mission, always stay in formation so that your bomber can be protected by the guns of other bombers. If your bomber drops out of formation, you'll find yourself under fierce German fighter attack.

BOMBING TACTICS

Another of Curtis LeMay's bomber tactics was to place the crew most accurate at bombing in the lead position of the combat box. When this lead bomber dropped its bombs, the rest of the bombers in the formation would follow suit. In theory, this would ensure that hits on the target would be close together; however, accuracy was sometimes lost if the lead bomber or its crew fell victim to enemy flak and fighters.

"On a bomb run, the group had to fly straight and everything had to be perfect, so the bombardier could take control of the plane from the initial point when you told him to take over. That was when the flak would come in, because they knew you weren't going to move. As soon as 'bombs away,' there'd be flak coming in at our altitude, and that impressed me. The whole group would just drop down 500 feet together to get underneath the next barrage coming."

U.S. Army Air Force Pilot Officer Robert Davila

If you're flying as the lead bomber, the success of the bombing run depends upon you and your bombardier. Use the sighting mechanism on your Norden bombsight to lock in on a target, and to calculate the proper time at which to release your bombs. If you're not flying lead, keep your eye on the lead bomber and coordinate your bombload drop with that of the leader.

For more information about the Norden bombsight, see the Bombardier Controls section of the Mission Instructions: In-Flight chapter.

FLAK

The word **flak** was enough to strike terror in the heart of B-17 crewmen from 1943 to 1945. "Flak" was an abbreviation of a German word for antiaircraft shells fired at the bomber formations from the ground. These shells were set



to explode when they reached a certain altitude, riddling the B-17 formations with chunks of jagged metal. A bomber that received a direct hit from one of these antiaircraft shells usually went down in flames. The B-17s were required to stay in formation at a prescribed altitude over their target, which made it easier for flak gunners to zero in on them.

The lead B-17 in the formation is rocked by a burst of flak during a bombing raid on Leipzig.

“We had maps that would tell you where the flak concentrations were going to be, but that didn’t mean anything, because the Germans had a lot of guns on rail cars. On my first mission, we lost an engine when a piece of flak cut an oil line. We lost our first navigator — he got hit in the throat by flak, and I found out that I got sick when I saw things like that. Our tail gunner got hit with a piece of flak that had his initials on it — it was part of the lettering on the shell. We caught a lot of flak in the Kiel Canal because the German navy was just churning in the water down there and those navy gunners were good.”

U.S. Army Air Force Pilot Officer Robert Davila





APPENDIX

*"The victor will
always be the judge
and the vanquished
the accused."*

Reichsmarschall Hermann
Göring, during the Nuremberg
war crimes tribunal in 1946,
where he was sentenced to death

SUGGESTED READING

For those of you who would like to learn even more about the aircraft and the air battles of the Second World War, the following books are highly recommended:

The Mighty Eighth by Roger A. Freeman. A detailed history of the U.S. Eighth Air Force and the men who flew its bombers and fighters.

Zemke's Wolf Pack, also by Roger A. Freeman. The story of Colonel Hubert "Hub" Zemke, the commander of the Eighth Air Force's famed 56th Fighter Group, and the top aces who served under him.

Flying Fortress by Edward Jablonski. The story of the B-17 and the men who flew it, from its early development through its participation in many of the major U.S. bombing missions of World War II.

Fortress Without a Roof by Wilbur H. Morrison. A chronicle of the U.S. and British Combined Bombing Offensive of Europe, highlighting both the overall picture of the war and the achievements of several noteworthy participants.

Top Secret Bird by Wolfgang Späte. The story of the Me 163 Komet written by the commander of the Luftwaffe's Operational Test Unit 16 and Jagdgeschwader 400.

Fighter General by Raymond F. Toliver and Trevor J. Constable. The life of Luftwaffe Lieutenant General Adolf Galland, from his days as a top fighter pilot to his rise through the Luftwaffe to his return to active fighter operations with Jagdverband 44.

Luftwaffe by Williamson Murray. A chronicle of the rise and fall of the Luftwaffe during World War II.

Additionally, there are a number of excellent videotapes available, with actual combat footage of the aerial duels between the U.S. Army Air Force and the Luftwaffe, plus interviews with veterans of those conflicts. Noteworthy videos include ***Fighter Aces of World War II***, ***The P-51 Story***, and ***Flying the B-17 Bombers***. Another tape, which might be harder to obtain but well worth the effort, is ***All the Fine Young Men***, an NBC News documentary that was originally aired in 1984. Of the many World War II movies available, one that is highly recommended, for both its combat footage and its gripping story, is ***Twelve O'Clock High***, starring Gregory Peck. The screenplay for this movie was coauthored by Beirne Lay, Jr., an Eighth Air Force veteran who survived the first raid on Schweinfurt. (Look for Gregory Peck's B-17, ***Piccadilly Lily***, which was the name of the plane in which Lay flew.)

Finally, many of the actual aircraft that dueled in the skies over Europe are on display at the National Air and Space Museum in Washington, D.C., and the U.S. Air Force Museum, at Wright-Patterson Air Force Base in Dayton, Ohio. A visit to these two museums is highly recommended.

Preceding page: The skeletal
remains of a Bf 110 factory at
Fürth give mute testimony to
the power of U.S. bombing.

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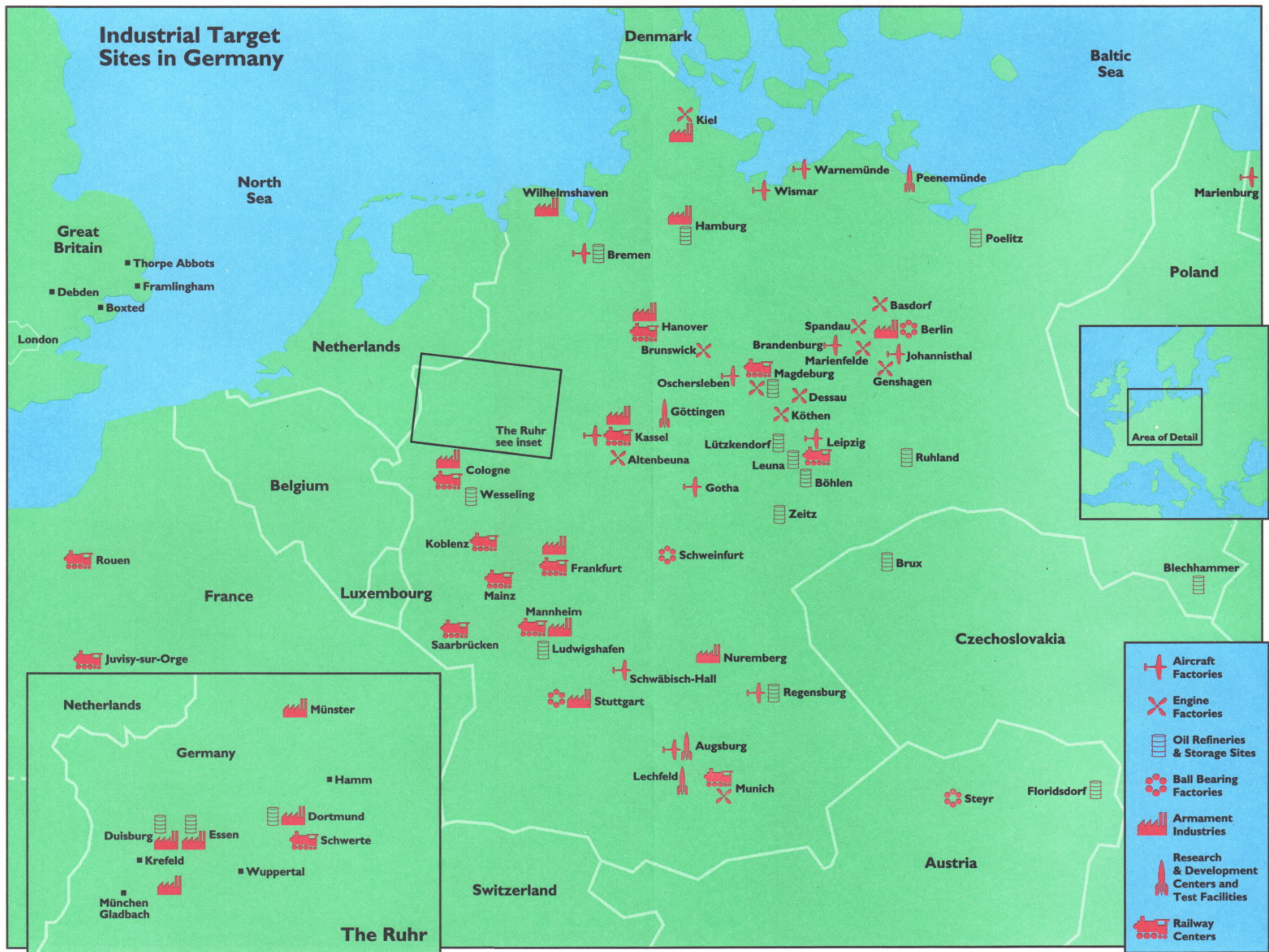
Next page: A formation of B-17s bombs the Brux synthetic oil factories in Czechoslovakia on July 12, 1944.

An aerial photograph of a city, likely Tokyo, during a bombing raid. Several B-29 bombers are visible in the sky, dropping bombs on the city below. The city is densely packed with buildings, and a large plume of smoke is rising from one of the impact points. The title "BATTLE MAPS" is overlaid on the left side of the image.

BATTLE MAPS



Industrial Target Sites in Germany





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