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Honors Scholars Program.

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Director Date

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Abstract

Although the idea of aviation has existed since the dawn of time, it has only been within the past century that these ideas have been realized through the invention of the airplane. One of the airplane's most notable contributions to history has been its use and involvement in warfare. The stage for its place was set during the First World War and although its involvement was crude, strategies began to develop as leaders saw the potential. This potential was further explored during the interwar period as military strategists published their predictions while Hitler was building up an army. Many of these ideas did indeed come to fruition throughout the course of warfare in the Second World War on both the side of the Allies and within the Axis Powers. This documentary seeks to explore both the origins of the involvement of the airplane as well as the means by which it contributed to success in both the Pacific and Atlantic theaters. The contributions will be analyzed: chronologically in battles where airplane contribution was significant; through examining what mechanical advancements that particular plane possessed in the battle; and by seeing how accurately the predictions made in the interwar period reflected the reality of how the airplane was involved in the Second World War.

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HNR 499 Honors Thesis

30 April 2012

The Airplane: A Revolution in Warfare 1939-1945

The airplane: An invention of the 20th century that dramatically changed the lives of people all over the world. When human flight became a reality in December of 1903, its inventors, Orville and Wilbur Wright believed that the airplane would make warfare impossible. However, and quite to the contrary, the introduction of aircraft into the world changed forever the strategy and outcome of all wars that followed. The First World War was a testing ground for the new craft, and it helped theorists during the interwar period to develop further ideas for the plane's use. However, these contributions merely set the stage for the conflict that would come to be fundamentally shaped by its use of air power – World War II. This documentary will explore “The Airplane: A Revolution in Warfare, 1939-1945”.

Prior to the turn of the century, warfare was limited to the ground and sea, with the main mechanical contributions being ships, cannons, and guns (Treadwell, vi). The air was just becoming a new arena. Military theorists before World War I and during the interwar period that saw the potential of the plane. However, it was difficult for generals and top military personnel to embrace this revolutionary thought, considering that barely fifty years had passed since the Civil War, and even some of the best and most advanced countries were still using cavalry (Grattan). According to the war historian, Robert Grattan, the restricted use of planes was due to the fact that the “military [was] suspicious

of new ideas, for experience [had] shown that in war events seldom work out exactly as planned, and there [was] assumed to be less risk in using tried methods.” Thus, World War I did see the introduction of planes, but only in a limited capacity.

Nonetheless, the airplane’s involvement in the First World War provided essential experience that would be used to create the framework for the strategic airpower doctrine used in WWII. The *idea* of an offensive action emerged during this war and with it came a need for counter air attack strategies. A prime task in air war was to counter the enemy’s air forces and, initially, the German air force fought in the air as a means of gaining air superiority. However, the advantage of destroying the enemy on the ground was soon recognized through bombing, even if the means at the time were at the earliest stages of development (Grattan 160).

Now that the role of air bombing had been established, aircraft could not carry a heavy load over a long range so initially the bombs were small, bombing accuracy was a problem, and weather could severely disrupt operations. Nonetheless, bombing did cause damage and adversely affected enemy military morale, but not to the extent military theorists predicted at the time (Grattan 165).

Prior to the onset of the First World War, no army had made plans for use of aircraft in a strategic offensive role. Most pilots never even considered the possibility that they might fight against each other. In fact, many pilots were prohibited from carrying firearms on the planes for safety reasons (Grattan 162). The first air-to-air conflicts were fought with hunting rifles, shotguns, and pistols, almost as if they were on horseback. Here again, the military resorted to the traditional type of warfare with which it was familiar, rather than using new strategies designed for its new technology (Grattan

170).

Military tacticians approached achieving and maintaining air superiority pragmatically in the First World War because there was no theory or doctrine to guide those planning air operations. It was obvious that the air could not be defended in the way the land could be, with trenches, redoubts and static emplacements. The air war was more analogous to the war at sea, where opposing forces maneuvered in, but did not “hold” areas of the oceans. The naval doctrine at the time was to seek out and destroy the enemy wherever it might be found, an idea well suited to developing air doctrine (Treadwell 16). The air was a battleground on which the struggle for superiority was waged, but the aircraft had to return to land as their fuel ran low, and the airspace could then quickly become empty. Air battles were fleeting, and a battle won once had to be fought again and again.

We must also remember that the design and production of aircraft and engines were in their infancy. Performance of the available aircraft limited the effectiveness of the air forces, and the shortcomings of the productive capacity prevented the formation of a force of decisive proportions. The shortage of machines exacerbated the competition for resources between the navy and the army (Treadwell, 60).

By the end of World War I, over 25,625 men were lost in aerial combat (centennial of flight). The enormous losses suffered on both sides in the air war might lead to the conclusion that this struggle was one of attrition, but the aircraft over that static war of trenches was the only means available to maneuver and to attack the enemy’s lines of communication and reserves (Grattan 200). The air was the only mobile element that could be used. It might be argued that, after 1916, the tank restored a degree

of mobility to the land forces, but they were not yet in extensive use. In any case, air power resources available were insufficient for a decisive blow in the First World War (Treadwell 57).

According to Grattan, one test of the value of air power in the First World War was to consider the nature of the conflict if aircraft had not been invented (a risky means of assessment, but interesting to consider nonetheless.) The probability was that the war would have followed a similar course and would have lasted just as long as it did without air power. Perhaps if one side had possessed aircraft but not the other, it might have been easier to see the impact it had (Grattan 140). Once aircraft was invented, however, air supremacy became a necessary strategy in war. Air power was here to stay and the events of the First World War laid the ground for how war in the air was to be fought in the years and conflicts to come.

Though the role of the airplane in the First World War was limited, and its use and strategies were only in their infancy, there were several notable characters that influenced its course. One of the greatest players in the First World War was Britain's Hugh Trenchard, commander of the Royal Flying Corps. By the end of the war, he was head of the newly formed Royal Air Force and a strong advocate of the plane. Trenchard proved to be an important liaison between his pilots and those in the high command. He had to have a plan so that he could convince higher command in London of his need for resources, but operationally his strategy emerged from day to day. He needed a clear vision of what could be achieved through air superiority, but his strategy had to be firmly anchored in reality. This reality was being manifested through the pilots with whom he spoke, who expressed their ideas about strategy as well as their complaints about the

equipment (Trenchard).

When looking at how various European powers carried out their use of aviation in World War I, striking differences emerge. Under the command of Trenchard, the RFC aggressively operated over the German lines and imposed its will on its opponents, whereas the Germans focused on defense and flew barrier patrols over their own territory to gain superiority by attrition. Attrition proved to be too slow and reactive, and the advantage was gained by the more proactive British (firstworldwar.com).

The Germans, after an air battle against the British at the Battle of the Somme, changed their strategy and made greater efforts to seek out and destroy. From the experience of these two approaches, the naturally aggressive nature of air power became apparent. Damaged German aircraft could land behind their own lines and the crew could fight again, while British aircrew in the same predicament became prisoners of war. The aggressive action of the British, however, allowed them to retain the initiative, making the Germans react rather than dominate. Annihilation worked better than attrition in the air. Trenchard saw and implemented this strategy (Gatton, 142).

Trenchard's idea that offensive tactics were key in gaining military air superiority proved to be the foundation for other theorists in the wars' interim. During the interwar period, one man became known as the "Father of Airpower"—Italian General Giulio Douhet. Douhet argued that air power should be directed toward the utter obliteration of the enemy's industrial base and should always operate in mass to "crush the material ... resistance of the enemy" (Clode). He wrote that "In terms of military results, it is much more important to destroy a railroad station, a bakery, a war plant, moving trains, or any other behind-the-lines objective, than to strafe or bomb a trench. The results are

immeasurably greater in breaking morale ... in spreading terror and panic..." Douhet foresaw the importance that the airplane would have on manipulating enemy morale (Clode).

For Douhet, one fundamental way of supporting the potential for massive, uninterrupted strikes was to employ all of a society's available aircraft. This could best be accomplished, he argued, through a reliance on civil aviation. Douhet thus assumed that the typical civilian airplane could be easily converted into a heavy bomber, a premise that was highly questionable even in his own day (Eula). It was hard for those in the interwar period to envision how fast the airplane itself would progress in the course of technology, and that civil planes would not be possible to use. In fact, by the onset of World War II, a whole new type of plane emerged and that this idea of adapting civilian planes for military purposes just didn't pan out because those kinds of planes couldn't meet the needs of aerial combat moving into the Spanish Civil War and the Second World War (Glaes).

On the American side, one of the most influential and controversial aviation/military theorists was Bill Mitchell, one of the first who publicly espoused a vision of strategic airpower that would dominate future war. He believed that aircraft were inherently offensive, strategic weapons that revolutionized war by allowing a direct attack on the "vital centers" of an enemy country. These vital centers were the mighty industrial areas that produced the vast amounts of armaments and equipment so necessary in modern war (Billy Mitchell). He did not see this as either illegal or immoral. In fact, given the trench carnage of the First World War that slaughtered millions, he argued that airpower provided a quicker and more humane method of waging war. To carry out

effectively this mission of strategic attack, he campaigned for another bold change—the separation of aviation from the Army and Navy, which he felt were too traditional and surface-oriented.

Well sooner than the world was ready to believe, the strategists of aviation saw their ideas realized publically on September 1, 1939 with the invasion of Poland by Germany. Of course, as history tells us, World War II had many fronts and different strategies were applied to each, but Germany had decided that it would not make the same mistakes on land or in the air as it had in the last world war. When it came to the battles, Germany wanted to avoid getting themselves into a stalemate in the trenches. Even before the First World War, Germany had perceived itself as being surrounded by enemies who were superior both in numbers and resources (Foley). German strategists, most notably Alfred von Schlieffen, had predicted that Germany could not win a long, protracted war against such opposition. Thus, in order to win, Schlieffen knew the German army would have to defeat its opponents quickly and decisively. Always outnumbered by its enemies, it would have to battle quantity with quality. Schlieffen set about creating a doctrine that would allow the outnumbered German army to outfight its opponents. This doctrine of Blitzkrieg, as it came to be known, stressed speed maneuver and attacking the enemy where it was weakest, which usually meant attacking the flanks (Blitzkrieg). The Nazis amassed impressive tanks together with its rebuilt Air Force and combined them in the Blitzkrieg in a way unanticipated by their opponents. Since 1936, Germany had involved itself in the Spanish Civil War, and covertly used this conflict as a military lab for testing out the Blitzkrieg. With their bombings in the Basque Provinces in Guernica, Germany could clandestinely test the new theories of airpower in war.

Together, airplanes and tanks served as effective offensive weapons. The tanks were concentrated along a narrow front, which would drive a breach in enemy defenses permitting the armored tank divisions to penetrate rapidly and roam freely behind enemy lines, causing shock and disorganization among the enemy defenses. Meanwhile, the use of planes, or *stuka* dive-bombers were able to contribute by preventing the enemy from adequately resupplying and redeploying forces and thereby from sending reinforcements to seal breaches in the front. This allowed German forces to encircle opposing troops and force surrender with speed and devastation until now unseen in warfare.

The plane's use in the Blitzkrieg allowed the plans to far surpass even the visions that Schlieffen himself foresaw because of the way it was able to complement the tanks by efficiently destroying enemy obstacles in the tanks' paths, thereby adding to the quickness and "lightning effect" that was desired. However, the plane itself, the *Stuka*, was impressive in its own right. It was perfectly suited for its role of tactical precision dive-bomber. The *Stuka* had a dedicated autopilot system that automatically brought it to a dive when the pilot extracted the dive brakes (Stuka). This prevented damaging pilot stirring during the dive while not limiting the pilot's ability to aim, and then automatically pulled the aircraft out of the dive and back to level flight when the bomb was dropped. The *Stuka* pilot had an excellent view from the cockpit and special indicators which conveniently informed him of his dive angle and when he reached the optimal bomb release altitude, allowing him to focus entirely on precise aiming during the fast steep dive. The *Stuka* was also very stable, making it easier for the pilot to aim the bomb. The *Stuka* had a fixed landing gear with front wheel covers, which allowed the *Stuka* squadrons to land and take off from primitive unprepared front line "airfields", allowing

them to stay close to the rapidly advancing German ground forces (Stuka).

Finally, as if the sight and sound of an enemy bomber diving right at someone on the ground would not be frightening enough, Adolf Hitler ordered to equip the *Stuka* with a screaming siren that made the sound of its dive far more frightening, giving it a greatly enhanced psychological effect which terrorized enemy civilians and soldiers alike, including some anti-aircraft gunners who could fire at it but were too stunned (Stuka).

Germany quickly overran much of the continent and was victorious for more than two years by relying on the Blitzkrieg. With the Blitzkrieg doctrine, despite being outnumbered in tanks and combat aircraft, they were able to outfight the Allies at every turn in 1940, and caused the down fall of Poland in September 1939, Denmark in April 1940, Norway in April 1940, Belgium in May 1940, the Netherlands in May 1940, Luxembourg in May 1940, France in May 1940, Yugoslavia in April 1941, and Greece in April 1941 (Blitzkrieg). By 1941, Germany either occupied or was allied with most of the European continent, save for Britain, which Germany never quite broke as an island nation-state, Spain (controlled by a right-wing dictatorship that was friendly toward Hitler), and Switzerland and Sweden, who were both neutral (Glaes).

While the Blitzkrieg was an incredibly effective strategy, one lone island across the English Channel finally provided a formidable opponent to this seemingly impenetrable offensive in the Battle of Britain. What exactly did this small country possess that could possibly match the German war machine? Besides a united nation under incredible leadership, they possessed an array of extremely gifted pilots who finally bore the technology to match Germany. In Fact, the Battle of Britain was the first

major battle fought entirely in the air. To launch their invasion (code-named Operation Sea Lion), the German Blitzkrieg relied on the combined power of land and air forces. While the German air force flew to the island nation of Britain, the German ground troops had to cross the English Channel on barges before reaching the Kent and Sussex beaches. This latter effort was threatened by presence of the British Royal Air Force (RAF) and the British Navy. The Germans fought these British forces for control of the Channel, and to control the Channel, the Germans had to control the air. The contest of air superiority between the German Messerschmitt 109 and the British Spitfire famously began, with the support of the *Stuka* dive-bombers as well as the British Hurricane (Churchill).

The Spitfire and Hurricane designs made them into extremely effective war machines against the German onslaught. To begin with, the Spitfire had a stressed-skin aluminum structure and a graceful elliptical wing with a thin airfoil that, in combination with the Merlin's efficient two-stage supercharger, gave it exceptional performance at high altitudes (Spitfire). Faster than its formidable German opponent the Bf 109 at altitudes above 15,000 feet and just as maneuverable, Spitfires were sent by preference to engage German fighters while the slower Hurricanes went for the bombers. More Hurricanes than Spitfires served in the Battle of Britain, and they were credited with more "kills," but it can be argued that the Spitfire's superior high-altitude performance provided the margin of victory (Hawker Hurricane).

Looking at the battle in retrospect, surprisingly, considering Germany's incredible dominance in the war up to that point, the forces involved in the battle of Britain were

well matched at the onset of the engagement. In fact, Britain may have had the upper hand to begin with. Britain possessed an effective air defense system, first-rate fighter pilots, and a great military leader in Air Marshal Hugh Dowding. On the other hand, the Germans had major problems: they had no navy left after the costly conquest of Norway, their army was unprepared for any form of amphibious operations, and the Luftwaffe had suffered heavy losses in the west. The first two factors made a seaborne attack on the British Isles impossible from the first (Battle of Britain).

Even more serious, the Germans had poor intelligence and little idea of British vulnerabilities. It also must be noted that Britain had RADAR, which gave the British early warning of the approach of the German planes. The Germans wasted most of July in waiting for a British surrender and attacked only in August. Although air strikes did substantial damage to radar sites, on August 13–15, the Luftwaffe soon abandoned that avenue and turned to attacks on RAF air bases under the command of the Head of the Luftwaffe, Herman Goring—a controversial decision to this day (Battle of Britain). A battle of attrition ensued in which both sides suffered heavy losses with an average loss of twenty-one percent of the RAF's fighter pilots and sixteen percent of the Luftwaffe's fighter pilots each month during July, August, and September. Eventually, Hitler permanently postponed a landing on the British Isles and suspended the Battle of Britain. This battle, which left Britain as the sole allied hold out in Europe, marked the first loss for the Nazis (Battle of Britain).

So why then did this German offensive strike against Britain fail? To begin with, the Germans fought too far away from their bases in France so that refueling and rearming were impossible. Because of this, the German fighters had a very limited time

that they could spend over Britain before their fuel got too low. This incident foreshadows the importance that long-range bombers played in the war, and how Germany never fully embraced this strategy. On the other hand, since Britain was fighting on their home front, they did not have to worry about the same problems that Germany did. The British fighters could land, refuel, and rearm and be in the air again very quickly. Another note was Goring's poor choice to change bombing targets, since it was possible Britain would not have been able to recover from the loss of their radar stations.

Looking at the planes themselves in the battle, Britain produced superior quality aircraft. Its Spitfires could turn tighter than Germany's ME109s, enabling them to better elude pursuers; and its Hurricanes could carry 40mm cannon, and would shoot down, with their American Browning machine guns, over 1,500 Luftwaffe aircraft during the course of the battle. The German single-engine fighters had a limited flight radius, and its bombers lacked the bomb-load capacity necessary to unleash permanent devastation on their targets (Messerschmitt). The short range of the Bf 109E prevented it from escorting Luftwaffe bombers past London, leaving the greater part of the British Isles free from enemy attack on training and production sites. This problem was a significant contribution to the Luftwaffe's defeat in the Battle of Britain (Luftwaffe).

As a testimony to the masterful RAF pilots that kept hope alive in the Allied world, Prime Minister Winston Churchill famously spoke of them: (Clip in video)

The Battle of Britain was a significant turning point of World War II. To begin with, it was the first battle in which a victory could be decidedly made almost solely by the use of aircraft against aircraft. In the end, Germany's Luftwaffe failed to gain air

superiority over the Royal Air Force despite months of targeting Britain's air bases, military posts and, ultimately, its civilian population (Battle of Britain). It was an interesting case because Germany followed most of the ideas of the interwar theorists to perfection, yet they still did not succeed. The Luftwaffe targeted both military bases and factories on the home front in an attempt to destroy morale and expedite the process of winning. However, the fact that Germany underestimated the morale of the British nation as well as the superiority of the British air force, and unfortunately it operated under poor leadership decisions ultimately led to defeat. Britain's decisive victory was the result of its air force that saved the country from a ground invasion and possible occupation by German forces while proving that air power alone could be used to win a major battle.

While the skilled RAF air resistance and stubbornly determined morale of the British people proved a unique impediment to what was in theory a solid air-powered offensive by the Germans, their Axis allies would kick off their own offensive with a textbook execution of an aerial attack of enemy military bases. It was the Japanese who launched a surprise attack at Hawaii's Pearl Harbor on December 7, 1941.

It was Sunday morning, and many military personnel were given passes to attend religious services off base. At 7:02 a.m., two radar operators spotted large groups of aircraft in flight toward the island from the north, but, with a flight of B-17s expected from the United States at the time, they were told to sound no alarm. Thus, the Japanese air assault came as a devastating surprise to the naval base. At 7:55 a.m. Hawaii time, on that "day that will live in infamy," a Japanese dive bomber bearing the red symbol of the Rising Sun on its wings appeared out of the clouds above the island of Oahu. A swarm of

360 Japanese warplanes followed, descending on the U.S. naval base at Pearl Harbor in an assault (Wagner).

All three US Pacific aircraft carriers were out at sea on training maneuvers and would luckily be spared from the onslaught; however most of the Pacific fleet *was* docked in the strategic harbor and thus rendered useless by the Japanese attack. Because of the capabilities of their primary planes, notably the A6M Zero fighter plane and the Aichi D3A dive bomber, five out of eight US battleships, three destroyers, and seven other ships were sunk or severely damaged, and more than 200 American aircraft were destroyed. A total of 2,400 Americans were killed and 1,200 were wounded, many while valiantly attempting to repulse the attack (Pearl Harbor). As a result, the United States could no longer call this “Europe’s War” and shortly after they declared war on both Japan and Germany.

The Japanese dealt a blow that day which would leave the harbor vulnerable for weeks and which prevented the US from launching a successful offensive for several months, while they themselves only lost some thirty planes, five midget submarines, and fewer than 100 men (Pearl Harbor). America also sustained a severe loss of confidence and morale. While devastating and tragic for the US, this attack was a decisive victory for the Japanese and one that would never have been possible or even conceivable without the use of airpower.

This event, like so many of World War II, typified the stunning power of offensive air warfare. But the events that would follow in the Pacific Theater, the virtual testing ground for the most extreme of offensive strategies, would demonstrate that aggressive fighting styles instigated a defensive craft design. In fact, it could be said that

one created the need for the other. Following Japan's stunning initial success, America in its comeback would epitomize defensive aircraft design.

The attack on Pearl Harbor had failed to deliver a truly fatal blow as the navy was badly wounded but the American aircraft carriers had been safe from attack, and these vessels served as the bases for aircraft in the enormous battlefield of the Pacific Ocean. With these critical tools intact, and a powerhouse of American production capable of rapidly replacing the equipment lost, the US had retained its air war arsenal, and thus its fighting chance.

The events of Second World War were already demonstrating at this point in the war the accurate predictions of the interwar theorists, Douhet, Mitchell, and Trenchard in the way that the airplane would manipulate morale. This influence would come into play less than four months after the attack on Pearl Harbor, when sixteen American B-25 bombers were launched from the aircraft carrier USS Hornet 650 miles east of Japan to attack the Japanese mainland. This raid did little real damage, but its leader, then Lieutenant-Coronel Jimmy Doolittle, would later explain that

The Japanese people had been told they were invulnerable ..[and]. An attack on the Japanese homeland would cause confusion in the minds of the Japanese people and sow doubt about the reliability of their leaders. There was a second, and equally important, psychological reason for this attack ... Americans badly needed a morale boost (Dokken).

And for good reason, as the early years of the Pacific saw the outdated planes of the US Air Force facing what seemed to be a wonder plane: the Japanese' main fighter the A6M Zero (Model 21). In its creation of the Zero, the Imperial Japanese Army Air

Service, the IJAAF, focused on plane specifications designed for quick, aggressive carrier-based air warfare. Small and fuel efficient, the Zero could attain speeds of 330 mph and reach a tremendous range of over 1,600 miles which allowed it to venture far from its carrier to fly over distant battlefronts, giving Allied commanders the impression that there were several times as many Zeros as actually existed. It was also incredibly agile, with an extremely small turning radius, which allowed it to outmaneuver any other fighter of the time (Tyson). This carrier-based craft was very technologically advanced and prior to 1941, the Allies knew little about it, except that its excellent maneuverability and firepower were taking a deadly toll in Japan's attacks on China.

Yet even during the early conflicts of the Pacific theater when the Zero easily out-matched the Grumman F4F Wildcat used by US Air force at the time, the American pilots of these inferior planes still managed to muster a decent defense. In May of 1942 (about a month after Doolittle's Raid) the Japanese navy attempted to make an amphibious landing at Port Moresby in southeast New Guinea. The Allied fleet assembled to protect the island (and its valuable port) in what came to be known as the Battle of the Coral Sea. This battle saw the first ever sea conflict in which opposing ships never saw each other and the planes alone fought to determine the outcome. There was never a chance that the Wildcats would out-match the Zeros, but they could sustain a great deal of attack while still remaining in the air, and this was significant as it was useful in the defense of Port Moresby (Grumman). Though the Battle of the Coral Sea was a tactical success for the Japanese, who caused a great deal of damage sinking the carrier, the USS Lexington, it was a *strategic* victory for the Allies, whose Wildcat fighter had managed to foil the Japanese objective.

So how could the heavier, slower, less-agile Grumman Wildcat hold out against the razor-sharp maneuvers of the Japanese Zero? Well, the bulk of the Wildcat allowed it to sustain significant battle damage as one Japanese WWII ace, Saburo Sakai, found as he, "...Closed in from the best firing angle, [with]...full confidence in [his] ability to destroy the Grumman... [which he] had decided to finish off [with his] 7.7mm machine guns." To his frustration and surprise Sakai found that, "For some strange reason, even after [he] had poured about five or six hundred rounds of ammunition into the Grumman, the airplane did not fall, but kept on flying...To [his] surprise, the Grumman's rudder and tail were ripped to shreds, looking like an old torn piece of rag...A Zero which had taken that many bullets would have been a ball of fire by now." The real issue was the Zero's lack of defense. These omissions kept the Zero lightweight, but made it fragile. The pilot was totally unprotected by armor, the fuel tanks were thin and light, and there was nothing onboard to extinguish a fire (Tyson). And it was these sort of defensive features that even the worst/more obsolete American aircraft had in spades. Though the Wildcats were inferior in a dogfight and couldn't easily take the offensive, because their designs focused on pilot safety, with self-sealing gas tanks, parachutes, superchargers, and reinforced cockpits, they could withstand significantly more battle damage than the Zero. This kept some (but not all) American pilots alive through the multiple losses in the six months after Pearl Harbor including Malaysia, Singapore, the Dutch East Indies, the Philippines and numerous other island groups.

The battle of the Coral Sea showed how effectively the plane could be used in cooperation with navy. At the same time, however, battle ships were not even needed to influence the outcome of this battle. Long-range bombers and carriers determined the

level of damage and the outcome of the battle (Miller). While the Americans did not perform as expected, they did learn from their mistakes in the battle and made improvements to their carrier tactics and equipment, including fighter tactics, strike coordination, torpedo bombers, and defensive strategies, such as anti-aircraft artillery, which contributed to better results in later battles (Miller). In addition, the defensive aircraft design increased American pilots' survival, allowing them to gain the experience and skill needed to compensate in battle against a strong enemy air offensive and would continue to help them in the course of the war.

A fear that the US may prove to be a growing threat, and a correct suspicion that the Doolittle air raid had been launched from Midway Island, impelled Japanese Admiral Yamamoto to destroy the U.S. Pacific Fleet before it was large enough to outmatch his own. A thousand miles northwest of Honolulu, the strategic island of Midway became the focus of his scheme to smash U.S. resistance to Japan's imperial designs. Yamamoto's plan consisted of a feint toward Alaska, followed by an invasion of Midway by a Japanese strike force (Lambert). When the U.S. Pacific Fleet arrived at Midway to respond to the invasion, the plan was that it would be destroyed by the superior Japanese fleet waiting unseen to the west. If successful, the plan would eliminate the U.S. Pacific Fleet and provide a forward outpost from which the Japanese could eliminate any future American threat in the Central Pacific (Lambert). Unbeknownst to the Japanese, U.S. intelligence had broken the Japanese naval code in an extremely clever scheme, and the Americans anticipated the surprise attack.

As the Japanese fleet was approaching the island 200 miles to the northeast, by a stroke of pure luck two U.S. attack fleets caught the Japanese force entirely by surprise

and destroyed three heavy Japanese carriers and one heavy cruiser. The only Japanese carrier that initially escaped destruction, the Hiryu, unleashed all its aircraft against the American task force and managed to seriously damage the U.S. carrier Yorktown, forcing its abandonment. At about 5:00 p.m., dive-bombers from the U.S. carrier Enterprise returned the favor, mortally damaging the Hiryu. It was scuttled the next morning (Lambert).

When the Battle of Midway ended, The U.S. lost the carrier Yorktown, the destroyer USS Hammann, 145 aircraft and suffered approximately 300 casualties. But Japan had suffered far worse and lost four carriers, a cruiser and 292 aircraft, and suffered an estimated 2,500 casualties (Lambert).

The importance of what damage the airplane could wreak as well as what a tremendous and crippling blow it was to lose that many carriers as the Japanese did showcased the importance air power was playing. Japan was never able to recuperate from the losses suffered at Midway. In fact, Japan's losses and American morale gained helped to mark Midway as the turning point in the Pacific theater of World War II. In August 1942, the great U.S. counteroffensive began at Guadalcanal. This battle, and the subsequent introduction of the Wildcat's replacement, the F6F Hellcat in 1943 would begin the American offensive in the Pacific that proved to be unstoppable.

When the Hellcat, a well-fortified plane with greater speed and equal maneuverability to that of the Zero entered the war, it signaled the downfall of the mighty Japan encroachment in the Pacific. The Hellcat was specifically designed to defeat the Zero. Its fuel-efficient design and extremely powerful engine gave it equal range and agility while remaining faster than the A6M and just as agile (Hawks). The armor plating

and six 0.5 caliber machine guns provided ample protection. It was heavier than the zero, though this was another advantage as it allowed for fast dives and absorption of battle damage. Subsequently, Zeros went down in huge numbers and their technological design demanded a complicated production process, which exacerbated their inability to battle the Hellcat. When all else was equal in the offensive capabilities of aircraft, the plane whose design provided defense proved the victor (Hawks).

What is more, the heavy protective features that proved so useful for the Hellcat and Wildcat in the Pacific were characteristic of nearly all American aircraft. In fact the most produced American aircraft of WWII, the P-47 Thunderbolt, weighed some 12,000 pounds (bigger even than the hellcat) and proved to be an incredibly useful and almost absurdly durable fighter in both theaters. Though it wasn't generally seen in the Pacific before June 1943, it had been introduced to the European theater in 1942 and first served as a fighter escort for the B-17 Bombers in their raids over Germany and Nazi occupied territory (Republic).

It was this offensive action against Germany by Allied bombers and their protective flocks of fighter planes that literally came to define the air war of Europe, and it was in that theater that the ideals and predictions of interwar theorists would come to their fullest and most accurate realization. (Sherman)

The Eighth Air Force (8AF) was organized in England in early 1942. Its mission - to destroy Germany's ability to wage war, through daylight bombing raids (complementing the RAF's nighttime attacks). Massed formations of Flying Fortresses would roam over Occupied Europe, wreaking havoc on the German war machine, while relying on the

bombers' speed, altitude, and own firepower for protection.” (Sherman). This was the strategy designed by Operation Pointblank and implemented on German targets like the Wilhelmshaven submarine yards (the first offensive that struck against the German interior (as opposed to occupied land). Such offensives relied on the bombers own defensive features because escorting Thunderbolt fighters possessed a short range and could not escort the bombers all the way to their target. Although the B-17s bombings were very effective, the lack of sustained fighter support against the defensive strategies of the Luftwaffe began to take a heavy toll on the 8th Air force. The solution to this problem came at the close of 1943 with the introduction of the US fighter the P51 Mustang. “The Eighth Air Force had struggled with its daylight bombing missions over Germany; unescorted, the bomber losses were unsustainable. With the Merlin engine, the Mustang could fly over eight hours, and have time to dogfight the Luftwaffe as well” (Sherman).

This fast, agile, craft performed well at low altitudes and was well rounded as a fighter, but where the P51 outclassed all other fighter planes was in its range. The first fighter that could reach Berlin from Britain, the Mustang replaced the Thunderbolt as the primary fighter escort of the Flying fortress for the 8th air force (Sherman). Chief Naval Test Pilot and C.O. Captured Enemy Aircraft Flight Capt. Eric Brown, CBE, DSC, AFC, RN, tested the Mustang in RAE Farnborough, and noted:

The Mustang was a good fighter and the best escort due to its incredible range, make no mistake about it. It was also the best American dogfighter. But ... it could not by any means out-turn a Spitfire. No way...I would say the pluses to the Spitfire and the Mustang just about equate. If I were in a

dogfight, I'd prefer to be flying the Spitfire. The problem was I wouldn't like to be in a dogfight near Berlin, because I could never get home to Britain in a Spitfire.

With this new weapon in hand, the 8th air force would proceed to deliver severe blows to the Axis powers in the next few months of the war

Although it seemed that the airplane was finally aiding the Allies in taking the upper hand, with these victories also came some more controversial decisions. One such event was the Schweinfurt raids in Germany by the 8th Air Force. Factories in and around Schweinfurt produced a significant amount of Germany's ball-bearings, parts which were vital for all manner of war machines. After this German ball bearing "bottleneck" had been identified by the Allies in 1942, ball bearings were named the second-most-vital Pointblank industry for the Combined Bomber Offensive in March 1943 (Reichert).

This day's work served to raise still higher the general level of bombing accuracy, which had shown distinct improvement since summer. In July 1943 the Eighth as a whole placed only 12.7 per cent of its bombs within 1,000 feet of the aiming point and 36.7 per cent within 2,000 feet. In October these figures had been raised to 27.2 per cent and 53.8per cent, respectively. However, when looking at the bombing figures, it is scary to think that these figures were considered "high," and one wonders what else was damaged. One must realize that even though these factories were producing military parts, it was industrial workers who were being bombed in the first place, many other civilians were unintentionally killed (Reichert).

The bombings at the Schweinfurt factories showcased what the interwar theorists

saw as the airplane's capacity and destiny to target the industrial home front of the enemy. Here, the American's had isolated one part that was used in virtually every German machine at the time, and thus the manufacturing of thousands of machines would be put on hold without it. Yet, it also showed the death and destruction as the result of the airplane, both for the people it targeted and the pilots operating the machines.

While the bombing of the ball-bearing plants was only semi-controversial, a far more controversial event in terms of bombing in the war was the bombing of Dresden, Germany. Dresden, a city unaffected by bombing up to that point in the war, lost many thousands of civilians in the firestorm that was created by the Allies.

Between February 13th and February 14th 1945, between 35,000 and 135,000 people were killed by Allied bombing in Dresden. Historians still argue over the number of deaths. However, there were so many refugees in the city at the time that the real figure will almost certainly never be known (1945).

Unfortunately, the fire bombings at Dresden have remained one of the lesser-known controversies of the war, even though the number of people killed was comparable to those killed in another far better known event—the use of the atomic bombs. On August 6, 1945, an American B-29 bomber dropped the world's first deployed atomic bomb over the Japanese city of Hiroshima. The explosion wiped out 90 percent of the city and immediately killed 80,000 people; tens of thousands more would later die of radiation exposure. Three days later, a second B-29 dropped another A-bomb on Nagasaki, killing an estimated 40,000 people. Japan's Emperor Hirohito announced his country's unconditional surrender in World War II in a radio address on August 15, citing the devastating power of "a new and most cruel bomb" (Atomic Bomb).

The final act that ended this long and protracted war was dealt by that very machine was once stated by its inventor to make warfare impossible. Well, war was still possible, but in the case of the Second World War, the fighting had finally ceased, but at a deadly cost.

Looking at the plane's role throughout the war, examining its full-scope in each country and contributions would be well beyond this documentary. However, there are several key mistakes and miscalculations that they Axis Powers made that the Allied Powers did not that helped to contribute to their final defeat.

In the Pacific, Japan's vice admiral Kuwabara said that Japan had made the mistake of entering the Pacific war too soon. By this, he meant that Japan went head-to-head with the Western Powers before the country was technologically ready. This was true. While Japan possessed a mighty military weapon in the Zero, they were never able to innovate beyond that plane, nor could their country's industry and economy meet the needs of demand for more planes (Harris 176-182). However, whether or not the opinion that they entered the war too soon was true will never be known. What can be stated is that the Japanese were equipped to fight a limited tactical war on land, so they lacked personnel capable of fighting a long distance war. On the other hand, thanks to the interwar theorist Billy Mitchell, the U.S. had invested in the long-range heavy bomber, the B-17 early on in the war. Finally, the Japanese were too offensive and aggressive both in their approach to the war as well as in their technology. The defensive nature of the well-structured American planes won out in the end (Harris 183-193).

The German Luftwaffe had very different reasons for failing to win air superiority

in the war. Unlike Japan, Germany was very prepared against their enemies at the onset of the war, thanks to their involvement and practice in the Spanish Civil War. However, the well-trained crewmembers who took part in the early war attacks were soon lost to attrition as the Germans became outnumbered by 1941. They could no longer keep up with the Allied numbers and industrial capacity (Harris 204-210). They also had severe doctrinal failures such as failure to have an army in conjunction with their navy. This hurt them in the battle of Britain of Britain from which they were never again able to recover. The Germans suffered from poor leadership all around, whether it be Goring's pride and inability to adapt to the changing times or Hitler's optimism and underestimation of the Allied Powers (Harris 212-217).

In the end, the Allies were able to achieve victory by many means. Over all, the Allied Powers had a greater industry to provide the number of planes necessary as well as a strong morale in the people. In addition, with the training of the skilled pilots they were able to use their superior aircraft with the underestimated doctrine of defensive measures and mechanics. They were willing to innovate. And, as always overlooked, the role of luck can never be ignored.

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