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A WAR WON IN THE SKIES: AIR SUPERIORITY IN THE SECOND WORLD WAR

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Introduction

The Second World War was a conflict decided by the most advanced military technology of its time: the airplane. Conflicts throughout history reveal the trend that the victors of war are most often those who best use and produce the dominant weapon of the era. Just as artillery and the machine-gun had dominated the battlefield of the previous world war, or black-powder weapons of yesteryear, the airplane would forever change the conduct of war in the 20th century. This paper is meant to highlight the immense impact that the war in the skies had on every facet of the war. Bombers rocked the home front for many in strategic bombing raids. Transport planes delivered waves of airborne infantry in the liberation of Europe. Attack planes and fighters fought for supremacy in support of the ground forces in the East, and torpedo planes would sink mighty battle fleets in the Pacific. In all of these theatres of war it was the war in the air that determined the outcome.

This paper, and by extension the war in the air, cannot be properly understood without establishing an understanding of associated terminology, as well as the history of airpower in the military leading up to the onset of war in 1939. Aerial superiority itself is a twofold entity, and is divided between tactical and strategic levels. Tactical superiority exists within a battle which allows for unhindered or lightly opposed operation of air-forces within a battlespace. Strategic superiority allows for large-scale operations with a high chance for success and without a realistic threat of unacceptable casualties or similar retaliation. Strategic bombing is an extension of strategic superiority, but is not the same. Rather, it is the use of aircraft to deliver targeted attacks

behind the front lines to deal damage to enemy morale and production, communication, transportation, or storage centers.

A differentiation between types of aircraft, which will be referred to in shorthand throughout this paper, should also be understood. 'Fighter' aircraft are categorized as those which are designed and used specifically to engage other aircraft. 'Bomber' aircraft are designed and deployed specifically for delivering payloads against ground or naval targets. 'Fighter-bomber' hybrid aircraft were also deployed, and several sub-categories of these broad categories such as dive bombers and torpedo bombers were used. Within the discussion of relative strength of air forces the term 'serviceable' aircraft will be used. This refers to aircraft that are in sufficient condition for combat operation. By extension, non-serviceable aircraft are those which although not destroyed require repair before they are able to be deployed.

Aerial combat was an evolving sphere of military application ever since the French first used hot air balloons to direct artillery fire in 1794. An advance in military aviation brought huge leaps in technology, manufacturing, piloting ability, and human ingenuity. The Second World War was a period of tremendous advancement in all of these areas. At the onset of The Second World War all of the potential applications of military aircraft had not yet been fully realized despite the widespread use of aircraft in the First World War. The airplane was still a relatively new technology when the war began in 1939; as the famous Wright brothers' flight had occurred only three decades before in 1903. The first ever recorded use of airplanes as military aircraft was by the Italian military to spot Turkish forces during the Italo-Turkish War of 1911-1912.

During the First World War biplanes and triplanes battled in the first ever aerial dogfights in history. This was enabled primarily by technological advancement. The Dutch aircraft engineer Anthony Fokker developed an “interrupter gear” which allowed machine guns mounted on a plane to fire through the propeller without damaging the blades. With this advancement the first true fighter aircraft first took to the skies. Soon pilots gained international acclaim for their combat prowess. So called Aces such as the German “Red” Baron Manfred von Richthofen, became celebrities in their own right. The Fokker triplane fighters of the Germans proved to be the largest killer of Allied bomber aircraft during the First World War.¹ These engagements led both sides to begin to outfit bomber aircraft with defensive gunners to stave off enemy fighters. This concept would become a staple of interwar bomber design and particularly resonated with American aircraft designers.

Early bombers were no more than pilots dropping explosives out of their aircraft, but by the end of the war fixed wing aircraft releasing bombs became commonplace. Unlike the larger faster bombers of the Second World War that held their payload within the fuselage and dropped them out of bomb bay doors, First World War bombers carried their payloads on their aircraft’s wings or attached to the underside of the fuselage. The main bomber used by French and American forces was the French designed twelve cylinder engine Breguet Type XIV, which entered service in 1916.² The aircraft could reach speeds of 110 miles per hour, had a maximum flight time of three hours, and could reach altitudes of 19,000 feet. Although reaching these milestones

¹ "Letters From a WWI Fighter Pilot." *Wings Of Gold* 36, no. 4 (2011) 78.

² "Letters From a WWI Fighter Pilot.", 80.

were impressive for First World War era technology, the bomber aircraft of the coming war were vastly superior in every measure.

The first ever 'strategic' bombing raids were attempted by the Germans as large zeppelins attacked Paris and London during the First World War. Although miniscule when compared to the numbers resulting from the Battle of Britain, 254 metric tons of bombs were dropped over England, (which was far removed from the frontlines of France) by German aircraft. These attacks proved both the viability of using aircraft to strike at valuable economic and production centers, as well as the superiority of the airplane over the vulnerable zeppelin airships which were too slow and easy to target by defending aircraft. German air marshals also made early attempts at nighttime bombing, although limited accuracy and visibility proved these attacks to be ineffective.

Airborne infantry did not garner widespread use until the German Fallschirmjagers proved their tactical effectiveness at the beginning of the Second World War, but they were not the first ever parachute infantry. In 1918 the first recorded airborne infantry jump occurred when Italian saboteurs parachuted behind enemy lines. By the end of the First World War both sides had begun to produce aircraft in much greater numbers and deploy them in massed formations over the battlefield.

The interwar period saw vast advances in aircraft design and technologies as world powers began to develop the next generation of airplanes for military and civilian usage. Efficient and streamlined metal fighters soon replaced their wooden and canvas precursors reaching higher speeds and maneuverability than ever before. In the 1930's iconic aircraft such as the American B-17 bomber, British Supermarine Spitfire, and German Ju-88 Stuka dive bomber were all in prototype stages of development and

would be ready for service when the war began. These warbirds would see heavy action throughout the Second World War even as newer aircraft and technologies were developed during the conflict.

The Spanish Civil War of the late 1930's would serve as a proving ground for new Luftwaffe aircraft and mold German strategic thinking moving forward. Newly developed fast attack bombers and fighter/bomber hybrids such as the Stuka showed the extreme effectiveness of combined air and ground forces. German commanders would use lessons learned fighting in Spain to overwhelm much of Europe in the early stages of the Second World War, with a great deal of their successes being attributed to overwhelming aerial dominance over the nations they conquered.

Air-centric operations theory was first developed during the interwar period. This new paradigm of strategic thinking saw future conflicts as being determined by whoever held the skies over the battlefield. The rapid advances in aircraft design and technology only served to fuel the arguments for increased focus on expansion of air power by military leaders such as American Billy Mitchell. Mitchell was an outspoken advocate for the development of American airpower after he experienced firsthand its first real combat applications in France during World War I.³ Mitchell was also a large proponent for the US bomber program and strategic bombing applications, and did have some success in securing funding that would lead to development of bomber aircraft such as the B-17 Flying Fortress.⁴

³ Alfred F Hurley, *Billy Mitchell, Crusader for Air Power*, (Indiana: Indiana University Press, 1975) 3.

⁴ Hurley, 87.

Chapter I: The War in Europe and Strategic Bombing

The skies burned over Europe as the gleaming wings of thousands of metal warplanes took to the air to do battle; the fate of the world hung in the balance. From 1939 to 1945 the Allied and Axis powers waged a constant struggle to stake their claim as masters of the land, sea, and air. Early combat clearly showed that Hitler's Luftwaffe was the superior air power in Europe. The Allied high-command had to catch up. Both sides expended immense resources on the development and production of new warbirds dedicated to serving that end. Unlocking the secrets to technologies such as jet engines and radar would become the focus of scientists around the globe, and young men seeking adventure and wanting to serve their countries would be sent into the sky to fight and die for their homelands.⁵

Allied victory in Europe was a product of aerial superiority. Although it can be argued that other factors pointed to a near certain Allied victory once America entered the war, at the very least the rapidity of the Allied victory can be attributed to achieving

⁵ For information regarding the Luftwaffe and its impact on early Nazi success in the war seek the following sources: R.J. Overy, *The Air War, 1939-1945*, (New York: Stein & Day, 1980); Douglas C. Dildy, "The Air Battle for England: The Truth Behind the Failure of the Luftwaffe's Counter-Air Campaign in 1940". *Air Power History* 63, no. 2 (2016): 27-40.; Williamson Murray. *Strategy for Defeat: The Luftwaffe 1933-1945* (New York: Chartwell Books, 1986). The sources listed here provide great insight into Allied air power during all phases of the war: Marshall L. Michel "The P-51 Mustang: The Most Important Aircraft In History." *Air Power History* 55, no. 4 (2008): 46-57.; Kenneth P. Werrell "Flying Training: The American Advantage in the Battle for Air Superiority against the Luftwaffe." *Air Power History* 61, no. 1 (2014): 34-47. The following sources provide a great deal of information on both Allied and Axis technological development during the war: Hermione Giffard "Engines of Desperation: Jet Engines, Production and New Weapons in the Third Reich." *Journal Of Contemporary History* no. 4 (2013) 821-844.; A. D. Harvey, "German Aircraft Design during the Third Reich." *Air Power History* 61, no. 2 (2014): 28-35.; Fred Strebeigh "How England hung the 'curtain' that held Hitler at bay." *Smithsonian* 21, no. 4, (1990): 120-129.

unquestioned aerial superiority by 1944. This superiority resulted as a combination of several key factors: technological superiority, greater production capabilities and access to more natural resources, superior training, and more effective understanding and deployment of aerial resources at the strategic and tactical levels.⁶ The relatively new concept of air warfare was made paramount by the Allies which turned the tide of the war. Meanwhile, in both the pre-war buildup and during the war itself the German high-command undervalued the battle in the skies.⁷ Failures in foresight and operation of the Luftwaffe ultimately led to German defeat in Europe.

In the buildup to the Nazi invasion of Poland in September 1939 the German war machine was producing more aircraft than any other nation in the world. This initial buildup would lead to great success for the German military, allowing it to easily take Poland and the Low Countries, as well as inflict heavy losses on the British RAF during its failed defense of France.⁸ The Luftwaffe both failed to eliminate the retreating British forces at Dunkirk and successfully clear the path for a German invasion of the British Isles. It is important to note that this failure was not a strategic bombing effort meant to wholly destroy enemy production capacity, but rather an application of airpower for future tactical purposes in order to clear the way for invasion. Ultimately, although the Germans took the initiative in aircraft development and production they could not fully predict and prepare themselves for the demands of the air war. Had the Nazis fully dedicated pre-war resources to gaining air superiority over their future foes the shifted

⁶ R.J. Overy, *The Air War, 1939-1945*, (New York: Stein & Day, 1980) 164.

⁷ Douglas C. Dildy, "The Air Battle for England: The Truth Behind the Failure of the Luftwaffe's Counter-Air Campaign in 1940". *Air Power History* 63, no. 2 (2016) 27.

⁸ Dildy, 32.

balance of power in the skies a swift German victory over the RAF likely would have ensued.

The defeat of the British Expeditionary Force sent to mainland Europe in 1940 led to the first major engagement between the Royal Air Force and the Luftwaffe during the retreat at Dunkirk (May 26 – June 4, 1940). In the eight days of the Dunkirk retreat the British lost thirty-six Spitfires, eight Defiants, and forty-five Hurricane aircraft, which when combined with the 386 aircraft lost during the defense of France took a massive bite out of British air power in the early stages of the war.⁹ In comparison, the German Luftwaffe lost thirty-six fighters and forty-two bombers during the siege at Dunkirk. Despite this loss of aircraft, British aircraft production would soon overtake that of the Germans. The German average of 140 Bf109s per month would soon be greatly outpaced Hurricane and Spitfire production which would reach 500 aircraft per month by July.¹⁰ Lost aircraft could be replaced, but the 186 RAF pilots lost over the European mainland could not. This loss of skilled combat pilots would prove to be a far greater blow to the RAF than the loss of airplanes.¹¹

After British forces retreated back to England, the German bombing campaign over the island began. The Luftwaffe's primary bomber was the Heinkel He111 twin-engine medium bomber. Because of its inadequate defensive armament, it required fighter escort for all daylight missions, which in turn limited its radius of action to the operating range of the Bf 109E, the only truly effective fighter the Germans could field in

⁹ Dildy, 32.

¹⁰ Dildy, 32.

¹¹ Dildy, 35.

the early stages of the war.¹² German intelligence also vastly overestimated the effectiveness of their attacks and thus continued tactics that gave only marginal successes at high cost.¹³ Much like over the skies of Dunkirk, the largest blows being struck by the Germans was in killing Allied pilots whose numbers were depleting at an increasingly alarming rate.

The failure of the German military to outfit the Luftwaffe with the tools necessary to conduct a prolonged air offensive against a large nation is illustrated through the wide-scale production of a fighter-bomber hybrid based upon an outdated design. Although effective in attacking British ground forces left vulnerable on the beaches of Dunkirk, the Junkers Ju 87B “Stuka” dive bomber was highly vulnerable to the faster and more agile fighters defending the British Isles. This was in large part due to its outdated design. Instead of having retractable landing gears, the aircraft had fixed wheels below the aircraft. These would not only slow the aircraft down by providing increased drag, but also severely hamper its turning ability and climb rate.¹⁴ The high rate of attrition suffered by German dive-bombers lead to a cessation of their use to attack strategic targets in England. Remaining Stukas were held in reserve to be used during the German invasion of the United Kingdom, but such operation never took place.¹⁵ By the time they could be used to target enemy troops in action again during the Allied push into France in 1944, Allied air superiority had been achieved and the Stukas were once again left vulnerable to superior fighter aircraft. By providing fighter

¹² A. D. Harvey, “German Aircraft Design during the Third Reich.” *Air Power History* 61, no. 2 (2014) 30.

¹³ Fred Strebeigh “How England hung the ‘curtain’ that held Hitler at bay.” *Smithsonian* 21, no. 4, (1990) 120.

¹⁴ Harvey, 32.

¹⁵ Dildy, 34.

support over their ground units, the Allies were able to in large part neutralize this arm of the German Luftwaffe. This in turn forced the Germans to continue to conduct attacks with true bomber aircraft that were vulnerable to RAF fighters and not given effective escorts.

The efforts of the Reich to clear the path for a full-scale invasion of England became known as The Battle of Britain. It is important to note that unlike the later Allied bombing campaign of mainland Europe, The Battle of Britain was not a strategic bombing campaign effort on the part of the Luftwaffe.¹⁶ Rather, it was meant to destroy the ability of England to properly defend itself against a cross-channel invasion by targeting defensive positions. In a directive sent to high ranking members of the German military, Hitler outlined this as the purpose of the Luftwaffe: “The task of the Air Force will be: To prevent interference by the enemy Air Force. To destroy coastal fortresses which might operate against our disembarkation points, to break the first resistance of enemy land forces, and to disperse reserves on their way to the front. In carrying out this task the closest liaison is necessary between individual Air Force units and the Army invasion forces. Also, to destroy important transport highways by which enemy reserves might be brought up, and to attack approaching enemy naval forces as far as possible from our disembarkation points. I request that suggestions be made to me regarding the employment of parachute and airborne troops. In this connection it should be considered, in conjunction with the Army, whether it would be useful at the

¹⁶ Dildy, 33.

beginning to hold parachute and airborne troops in readiness as a reserve, to be thrown in quickly in case of need.”¹⁷

Hitler’s invasion plan followed that of the successes seen in taking France and the Low Countries. First the enemy air force would be destroyed by the Luftwaffe, which would in turn allow German mechanized infantry and tank units to push through enemy lines without threat of aerial attack. The rapid advance of these units was made possible only by the lack of hostile aircraft to impede their movement, or stop Luftwaffe attacks from softening defensive positions ahead of ground advances. The Luftwaffe was unable to achieve this goal and destroy the fighting capability of the RAF, and so an invasion of England was rendered impossible. In contrast, the Allies achieved this air superiority before their counterattack into Europe in June 1944, and this allowed for an advance into German territory in much the same manner as the Germans took the land earlier in the war. At no point in the war did either the Axis or Allies capture large areas of land without aerial superiority over their foes, which suggests air superiority as being the driving force behind the ultimate Allied victory.

The German airforce was at a severe disadvantage against their RAF counterparts during the air campaign due to several critical errors in aircraft design. First, the Luftwaffe was not in possession of a heavy bomber. Pre-war efforts to design a large four-engine bomber, known as the Dornier D-17 Ural, ended in failure.¹⁸ Although possession of such a bomber would not have had any impact on the Battle of Britain, as medium and light bombers stationed in France could reach targets in

¹⁷ Adolf Hitler, “Führer Directive 16: On preparations for a landing operation against England” (July 16, 1940) World War II Database. <<https://ww2db.com/doc.php?q=316>>

¹⁸ Dildy, 28.

England without needing the operating range of heavy bombers, it would have proved valuable in attacking targets on the Eastern Front.¹⁹ The failure of the program in the mid 1930s also left German aircraft designers reluctant to pursue new bomber designs, and left the Luftwaffe with outdated bombers with which to attack England. Head of the Luftwaffe, Hermann Göring, is quoted as having said regarding the failed D-17 program “Der Fuhrer will never ask me how big our bombers are, but how many we have.”²⁰ This serves to illustrate a critical flaw in thinking: being more concerned with producing large amounts of sub-par aircraft rather than producing those which would provide the best tactical and strategic advantage.

Not only were German bombers inadequate, but their fighter aircraft were as well. The Bf-109 was initially superior to British fighters, but as the RAF produced faster aircraft the Germans had to continually modify the 109, and sacrifice key attributes such as turning ability for raw speed.²¹ Severely hampering German offensive operations was their production of the Bf110. Designed as a heavy fighter for bomber escort, it did boast exceptional range but was far outclassed by some early war RAF fighters in maneuverability.²² This rendered a large number of Luftwaffe fighters virtually unusable in the Battle of Britain, and ultimately were a massive waste of pre-war resources that proved costly to German prospects for victory. Although the Germans held a temporary advantage when the Focke-Wulf FW 190A was introduced in 1941, once the British outfitted the Spitfire with the new Rolls Royce Merlin engine they once again had the

¹⁹ Dildy, 28.

²⁰ Dildy, 28.

²¹ Harvey, 30.

²² Dildy, 31.

superior fighter.²³ The FW190-A also came too late to make a difference in the Battle of Britain, which ended with the cessation of large-scale Luftwaffe bombing in late October 1940. When the Germans countered by producing the FW-190D later in the war, they were again outdone by the American P51D Mustang.²⁴

Another major failure of the Luftwaffe was its inability to successfully hamper Britain's ability to manufacture aircraft during the conflict.²⁵ This was in part due not just to the ability of Britain to successfully defend herself, but also innovation in the aircraft production industry. Government programs such as the Shadow Factory Program sought to increase aircraft production without necessitating the construction of new factories. One aspect of the shadow program was its use of converted management from the automobile industry in order to increase productivity by modeling the rapid production of automobile plants.²⁶ The program also oversaw conversion of many non-aircraft production factories into aircraft production sites. This program accounted for 45% of British bomber production during the war. And also served to confuse the planning of Luftwaffe attacks, as German bombers targeted known aircraft production facilities much more commonly than converted plants whose new purposes were kept secret.

A veritable miracle technology that perhaps was the single greatest contribution to British defense was radar.²⁷ Although the Germans did pursue radar for military

²³ Harvey, 31.

²⁴ Harvey, 31

²⁵ Stephen Little, and Margaret Grieco. "Shadow factories, shallow skills? An analysis of work organization in the aircraft industry in the Second World War." *Labor History* 52, no. 2, (2011) 194.

²⁶ Little and Grieco, 195.

²⁷ Strebeigh, 122.

application before the British began to in the late 1930s, pursuit of a flawed design created inconsequential results, and also lead Göring to severely underestimate, and virtually ignore, the importance of radar in British defensive plans.²⁸ A radar system functions by sending out radio waves in a broad pattern around the station. When these waves strike something, such as an enemy aircraft, they reverberate back to the station which in turn reveals the position of the aircraft on the corresponding display driven by a cathode-ray tube.²⁹ British military officials set up an intricate web of these stations all connected to a hidden central planning office. From here, air wings could be dispatched to intercept German attacks before they reached their targets, and also eliminated the need for general air patrols, which not only saved fuel but also maximized the use of valuable planes and pilots in pointed interception efforts.³⁰

In 1938 German strategist Helmuth Felmy stated “A war of annihilation against England appears to be out of the question with the resources thus far available,”³¹ showing the innate flaw of German strategy to conduct a massive air campaign against Britain: a lack of the necessary sources of oil and aluminum for producing and operating massive amounts of aircraft. However, early war fuel shortages were only a prelude to those that were to come.³² In late 1943 and early 1944 the Germans captured a large amount of fuel in Italy, and had a large special reserve that was not depleted until

²⁸ Strebeigh, 123.

²⁹ Strebeigh, 123.

³⁰ Strebeigh, 126.

³¹ Dildy, 30.

³² Williamson Murray *Strategy for Defeat: The Luftwaffe 1933-1945* (New York: Chartwell Books, 1986) 228.

1945.³³ Therefore the failure of the Luftwaffe in deploying effectively was not due to lack of fuel, but lack of aircraft production capability.

Once the Battle of Britain had been won, and the offensive capability of the Luftwaffe neutralized, the skies over England were safe. The Allies then sought to eliminate German air defense capabilities over the mainland. Once Allied air forces had achieved strategic dominance over Europe, more tactical applications of airpower could ensue. Close-air-support for troop could be conducted at will, airborne forces could be deployed, and the liberation of Europe could begin. An effort which ultimately took the form of the D-Day landings and subsequent Normandy breakout. In order to achieve this goal, Allied bombers would target aircraft production facilities and Axis airfields. By targeting German aircraft on the ground and the facilities necessary to replace them the Allies eliminated the Luftwaffe's ability to stop the Allied bombing campaign and reverse the increasingly likely outcome of the war. The ground advances in Italy and France would have met much greater difficulty without the bombings that preceded them.

The strategic bombing campaign wrought previously unimaginable destruction upon the Axis powers. The damage to German manufacturing, infrastructure, and military impacted every facet of the German war effort and secured Allied aerial superiority. In this regard, the bombing campaign was a self-sustaining measure. With each airfield and factory bombed, future bombing runs would see less resistance. With the Luftwaffe weakened after the Battle of Britain, the British began aerial bombing of German industrial centers. Upon America's entry into the war, they too would begin bombing of Germany and Italy from airbases in England. Although heavy casualties

³³ Murray, 228.

were sustained on the part of the Allies, every plane lost could be replaced by the increasingly powerful multinational war economy. However, every fighter lost and factory destroyed weakened the Luftwaffe. Because of this, the strategic bombing campaign was a war of attrition, wherein one side found itself increasingly at the mercy of the other's bomber fleet.

Due to heavy losses early in their earlier daytime bombing effort against Germany, RAF bombing strategy underwent a major shift. British bombers flew nighttime missions with the goal of saturation bombing as a result of their imprecise targeting in the early war, as well as the reduced threat of interception under the cover of darkness.³⁴ This latter form of bombing was an effort to designate and attack large areas of German industrial cities. Everything from the factories themselves to the homes of workers was deemed a legitimate target. This decision was also a product of the relative ineffectiveness of previous raids regardless of casualty figures. The British Butt Report of summer 1941 found that only 20 percent of RAF bombers were able to make an attack within 75 miles of their intended targets, with only one plane in three able to come within five miles of their target, let alone release their bombload.³⁵

Because German industry was often located on the periphery of a city area bombing which targeted the city center did far less damage to industrial zones than the 'precision bombing' which targeted them directly in the daytime.³⁶ However, the relative risk to Allied bombers was far greater, and damage to workers' homes within the city

³⁴ Michael Bess. *Choices Under Fire: Moral Dimensions of World War II*. (New York: Random House Inc, 2006) 92.

³⁵ John Plowright. *The Causes, Course and Outcomes of World War Two*. (London: Palgrave MacMillan, 2007) 87.

³⁶ Gian P. Gentile. "How Effective Is Strategic Bombing?: Lessons Learned from World War II and Kosovo." *World of War*. (New York: New York University Press, 2001) 80.

could hamper production even if a factory remained unscathed. In addition, it is important to note the relative inaccuracy of precision bombing in the 1940's, as even advances such as the Norden bombsight could guarantee only a small fraction of what could be considered truly precise targeting. In this case, precision bombing was more theoretical than actual. Despite this American aircrews continued bombing during daylight hours while the British 'de-housing campaign' continued at nighttime.

The adherence of American leadership to this impractical doctrine could be explained by political motive rather than strategic thinking. The United States was never attacked by German aircraft as Great Britain was. Therefore, garnering public support for targeting of civilian homes would be difficult at best. However, the British public undoubtedly sought vengeance for the Blitz and so justification of wide-area targeting was more palatable in Britain. Such thinking is further supported by the late war bombing of Japan by the United States, as daytime raids on population centers was common in late 1944 to 1945. However, Japan had first struck the United States at Pearl Harbor through air attack, and so perhaps a similar sentiment to that of the British existed amongst the American Public.

The strategic bombing campaign truly began to increase in scope in 1943. By this time the United States was fully mobilizing for war, and the North Africa campaign had proved a disaster for Germany. During this time 5,092 tons of munitions was dropped on fourteen aircraft production plants. This resulted in noticeable drops in monthly production of German aircraft. 725 BF-109s were produced in July of 1943, but

only 536 in September, with a low of 357 in December. In addition production of the Fw-190 fell from 325 in July to only 203 in December.³⁷

Full mobilization of the German economy for war did not occur until 1944, at a point by which the Allies had already firmly established control over the skies. This mobilization occurred at the direction of newly appointed Reich Arms Minister Albert Speer. Despite earlier bombing successes, aircraft production peaked at 3,375 aircraft per month in September 1944.³⁸ This figure suggests that German wartime production recovered from early successes by the bombing offensive, but to view this figure alone is to see only a part of the picture. Rather, monthly production would have been far higher had the bombing campaign not occurred.

The United States Strategic Bombing Survey was published two years after the war concluded. Within this report is a comprehensive analysis of the effectiveness of the bombing campaign on the German economy. It is in this research conducted after the war that the full impact of the campaign can be made clear. Bombing of German synthetic oil production, which began in earnest in July 1944 provides the best example of this. German refineries were producing an average of 316,000 tons of oil in July. That output fell to 107,000 tons in June and later 17,000 tons in September. Monthly aviation fuel production was reduced from 175,000 tons in April to 30,000 in July and later a mere 5,000 in September.³⁹ As a result monthly aviation fuel losses (fuel which was not replaced in production) increased upwards of 90% during this period according to

³⁷ *The United States Strategic Bombing Surveys: European War, Pacific War.* (Maxwell Air Force Base, Ala: Air University Press. [1987] (1947)) 17.

³⁸ *USSBS*, 19.

³⁹ *USSBS*, 21.

Speer.⁴⁰ This eventually resulted in the cessation of all non-jet aircraft in January 1945, as the new jet engines were more fuel efficient. As further example to the effectiveness of the bomber offensive, Speer remarked after the war that the destruction of Hamburg by the Allies dealt a serious blow to both morale and manufacturing.⁴¹ This provides anecdotal evidence in support of the raw data gathered regarding the impact of the bombing campaign.

The tremendous damage done to Germany was not achieved without great cost. For example, bombing efforts by the 300 plane strong American Eighth Airforce succeeded in reducing German ball-bearing production by sixty-seven percent by early 1943, but it did so at the cost of sixty aircraft with damage suffered to by additional 138.⁴² This resulted in a temporary suspension of operations by the detachment that would not resume until March 1944 when long-range P-51 Mustang fighters were available for escort in large numbers.⁴³ Such high losses were typical of the early bombing offensive from 1942 to 1943. In total, approximately 140,000 Allied airmen (85,000 American and 40,000 British, 10,000 Canadian and over 5,500 Australians and New Zealanders) were killed during the strategic bombing offensive in Europe.⁴⁴

Mirrored in these losses of Allied servicemen was those of the German populace. Approximately 305,000 German civilians were killed with an additional 780,000 wounded in Allied bombing raids.⁴⁵ Property damage was also tremendous, as

⁴⁰ *USSBS*, 21.

⁴¹ Gian, 60.

⁴² Plowright, 88.

⁴³ Plowright, 90.

⁴⁴ Plowright, 81.

⁴⁵ *USSBS*, 36.

415,000 homes were destroyed and an additional 485,000 damaged, rendering approximately 7.5 million homeless.⁴⁶ The moral and ethical implications of such staggering figures are apparent. Categorization of the bombing campaign as a war-crime seems empirically provable given these figures. However, the damage to the Nazi war economy as a result of these raids is irrefutable. Because of this, whether morally justifiable or not, the Allied strategic bombing campaign was undoubtedly integral to the end of the Third Reich.

The success of the Allied bombing campaign was not only a product of overwhelming industrial capacity. The offensive owed its success to a multitude of factors, from superior aircraft design and technology to superior pilot training techniques and conditions. Technology and aircraft design would make much more immediate and recognizable impacts on the conduct of the war, with the effects of improved training programs coming to form later in the war. The technological advancement of the radio proximity fuse was just one of many key technological developments achieved by the Allies, but its design and implementation is emblematic of the many other breakthroughs of the war.

The radio proximity fuse was the first true “smart weapon” in history. Modern missiles and bombs are improved variations on the original concept manufactured during the Second World War. This new fuse allowed for bombs, rockets, and anti-aircraft shells to detonate at the ideal distance from their targets to maximize fragmentation and explosive power.⁴⁷ The fuse consisted of a small radio tube smaller

⁴⁶ *USSBS*, 36.

⁴⁷ “Radio Proximity Fuse-Weapon Behind Victory”, *United News Release 179*, Films Media Group, [2010] (1945).

than the average thumb fitted within a slightly larger casing that housed the remaining equipment needed for a miniature two-way radio at the tip of the explosive. When the explosive was deployed the radio would switch on and begin sending out radio waves to detect a target. The waves would strike their targets and then bounce back to the tube in the fuse, thus giving information to the device about its proximity to said target. Once it reached a predetermined distance the fuse would detonate the explosive it was attached to.⁴⁸ Production of these fuses began in 1942 and would see increased efficiency and design improvements throughout the war.

The effectiveness of Allied bombing was greatly enhanced by this new fuse, creating vastly more efficient munitions to be used over Europe and the Pacific. Previously, bombs dropped from aircraft had three primary means of detonation. Early war bombs would drop on a timed fuse that was predetermined before takeoff. To be effective this required a bombardier to drop their payload at an exact height used in previous calculations, and could not account for variable weather or changing mission parameters. Due to this lack of precision or adaptability many bombs dropped would either detonate too early or too late, causing little damage to intended targets.⁴⁹ The predetermined height required by these munitions also forced pilots to fly their aircraft at a certain altitude over the target, even if anti-aircraft fire was heavy in the area or it took them into the thick of an enemy fighter formation.

⁴⁸ *United News Release 179*

⁴⁹ *United News Release 179*

The flawed design of timed payloads was followed by a traditional contact fuse.

These explosives would detonate immediately on contact with the target or ground. This



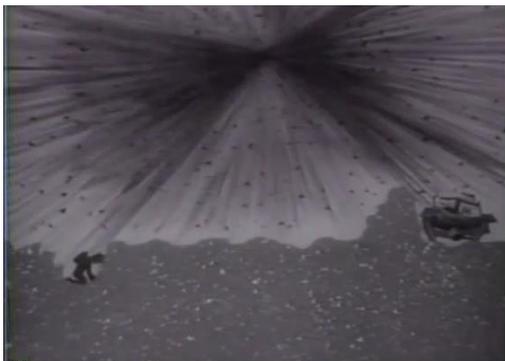
provided adequate damage against unarmored targets such as infantry or factory buildings, but thick armor plating or proper cover would shield intended targets.⁵⁰ Other timed explosives called delayed fuse bombs had timers that would not start until after the bomb had struck its target, allowing for the

munition to penetrate armor before detonation. Although this was effective against armored targets such as tanks and warships, these required direct hits on target to be



effective and had a much smaller area of effect on detonation.⁵¹ Delayed fuse bombs that missed ground targets would often bury themselves underground before detonation and lose nearly all of their effectiveness and provide little to no fragmentation.

With the advent of proximity, also known as variable timed fuses (from now on referred to as VT fuse bombs), the explosives would always detonate at the optimum height from their targets.⁵² For most attacks on enemy ground forces this was about seventy feet above.⁵³ This air-burst detonation pattern would not



⁵⁰ *United News Release 179*

⁵¹ *United News Release 179*

⁵² *United News Release 179*

⁵³ All three images taken from *United News Release 179*

only provide the widest spread of fragmentation and explosive force, but also negate most forms of traditional ground cover for infantry such as sandbags and foxholes.⁵⁴ Vehicles such as tanks were not designed with extra overhead armored plating and thus were also left vulnerable to this new design. Reinforced targets such as concrete bunkers were resistant to VT fuse equipped bombs, but when sorties sought to destroy these targets they would instead be equipped with delayed fuse bombs that could penetrate thick armor. Therefore, Allied bombers could counter any Axis attempts to protect resources from aerial ordinance.

The VT fuse was applied not only with air-to-ground weapons, but also had great success in being applied to air-to-air and ground-to-air platforms. Unguided rockets fired from aircraft had moderate success being used against stationary ground targets but until they were outfitted with the proximity fuse were impractical to use against fast moving aerial targets.⁵⁵ Proximity fuses on rockets had a forward cone of sensitivity of 3,800 square feet projected by the proximity fuse. Much in the same way that the fuse installed on bombs detected distance to the ground, this cone of radio waves detected any objects that entered into it.⁵⁶ When a plane entered that cone the rocket would detonate and spray shrapnel in the area damaging enemy aircraft. Because aircraft were made of weaker and lighter metals than ground targets they were much more vulnerable to damage. Scoring any hit on the target was crucial and could take the enemy out of the sky with only one or two well placed shots. This same principle applied to anti-aircraft shells fired from ground positions. Innovations such as this fuse provided

⁵⁴ *United News Release 179*

⁵⁵ *United News Release 179*

⁵⁶ *United News Release 179*

a massive advantage in aerial defense for the Allies and rendered German bombing raids over positions defended with the new weapon design costly and ineffective.⁵⁷ For example, in one week in 1945, 79% of German V-1 and V-2 rockets fired at London were shot down by anti-aircraft guns making use of the VT fuse.⁵⁸

Perhaps the greatest success of the proximity fuse was not its effectiveness, but the ability of the Allies to keep its design secret throughout the entire war.⁵⁹ Had Axis forces been armed with this weapon the massive strategic bombing campaign undertaken by the Allies would have suffered greater casualties and caused far less damage to German and Italian positions. Interestingly, German scientists began working on a similar design in the 1930's that made use of capacitive radio sensors rather than the Doppler radar format of the Allied VT fuse. However, their work was halted in 1940 as they were directed to other projects deemed more important to German victory.⁶⁰ Had they been successful in developing a working proximity fuse the air war over Europe likely would have been much more difficult for the Allies to win as German bombing would have been vastly more effective and ground targets much more heavily defended.

At the onset of strategic bombing campaign, the US assumed the heavy armament of its bombers would negate a need for fighter escort, ignoring the lessons learned by the Germans in their losses over Britain. However, unlike the Germans they produced a long-ranged fighter; the P-51 Mustang. An aircraft that could not only share

⁵⁷ *United News Release* 179

⁵⁸ *United News Release* 179

⁵⁹ Edward A. Sharpe "The Radio Proximity Fuze - A survey", (2003).
<http://www.smecc.org/radio_proximity_fuzes.htm>

⁶⁰ Sharpe.

the operational range of America's bombers but also out-duel the German interceptors.⁶¹ The P-51D was outfitted with a Rolls Royce Merlin engine much like the later war British Spitfires. This made the P-51 faster than any non-jet driven German fighter and with much better acceleration. It also matched or exceeded German fighters in every measure of maneuverability.⁶² Allied Bombers flew in tight formations to create overlapping fields of .50 caliber machinegun fire and create a protective bubble in and around themselves. This tight grouping also created a more devastating effect on target as it tightly grouped the bombs dropped by the formation collectively. This did however increase the effectiveness of anti-aircraft fire.⁶³ Escort fighters such as the P-51 would fly in advance of these formations in attempt to cut off intercepting aircraft before they reached the bombers.

German strategies to take out tight bomber formations were to either isolate and split off bombers from the group, or attack in massive formations and strafe the formation, aiming for the center of the bombers with the goal of detonating their payload or fuel tanks.⁶⁴ These large formations were effective as it prevented gunners onboard the bombers from targeting single aircraft. However, the attrition suffered by the Luftwaffe during these attacks soon began to outpace their production capabilities and proved costly.⁶⁵ Much as the British struggled to replace pilots during the Battle of Britain, losses of skilled Luftwaffe pilots during the Allied air campaign proved more disastrous than the loss of their aircraft.

⁶¹ Marshall L. Michel "The P-51 Mustang: The Most Important Aircraft In History." *Air Power History* 55, no. 4 (2008) 55.

⁶² Michel, 55.

⁶³ Michel, 49.

⁶⁴ Michel, 49.

⁶⁵ Michel, 50.

In attempt to counter the superior P51D, in June 1944 the Germans put into action the first jet fighter in history: the Messerschmitt Me262.⁶⁶ However, this proved to be a last gasp of the German war machine, borne as much out of production necessity as it was an attempt to gain tactical advantage.⁶⁷ The twin jets of the Me262 was more efficient in terms of both manpower and material resources to produce than traditional piston engines. The Me262 did prove to be an effective fighter due to its raw speed, but it could not be produced in large enough number to turn the tide of the air war; the production capabilities of the Reich had been irrecoverably damaged by the bombing campaign.⁶⁸

Me262s were actually produced in relative safety. In response to the destruction of German factories a large factory was built into Germany's Kohnstein Mountain using labor from nearby concentration camps in late 1943, thus shielding the 1,270,000 square feet of production space from Allied bombing.⁶⁹ The Mittelwerk site produced both Me262s as well as V2 rockets for the duration of the war. Interestingly, the 262 used unrefined aircraft fuel for propulsion rather than the refined fuels used by its predecessors. Using lower grade fuel helped to offset the fact that early jet engines consumed much more fuel than piston engines, and destruction of fuel refining facilities contributed to the need of the Me262.⁷⁰ Although jet aircraft did allow Germany to

⁶⁶ Harvey, 32.

⁶⁷ Hermione Giffard "Engines of Desperation: Jet Engines, Production and New Weapons in the Third Reich." *Journal Of Contemporary History* no. 4 (2013) 822.

⁶⁸ Giffard, 826.

⁶⁹ Giffard, 834.

⁷⁰ *USSBS*, 17.

increase fighter production, this came at a point in the war in which Allied air superiority was assured, and served only to expend more resources in a losing battle.⁷¹

Superior technology and aircraft design were key components of the Allied victory in the skies, but the quality of pilot produced by the Allied nations also became increasingly superior to their foes as the war progressed, and cannot be discounted as a major factor in determining air superiority.⁷² In fact, post-war study determined that the majority of pilots lost during the war were inexperienced or poorly trained, and those who received ample training time almost always outperformed and outlasted other pilots.⁷³

The American pilot training program was a two phase endeavor. Initial flying training consisted of classroom instruction and 75 hours of flight time in training aircraft. From there, pilots moved on to advanced flight school, where they were assigned to train in specific aircraft that they would fly in combat. Although preferences in aircraft were taken into account for top students, most were assigned aircraft based on skills and traits demonstrated during basic flight training. Height and weight of pilots was also taken into account, with smaller men being assigned to fighters to improve maneuverability, and larger pilots to bombers who did not rely on aerial agility to accomplish their objectives. This provided an advantage as American pilots were better suited to their aircraft than their German foes.⁷⁴ In advanced training, fighter pilots

⁷¹ Giffard, 843.

⁷² Kenneth P. Werrell "Flying Training: The American Advantage in the Battle for Air Superiority against the Luftwaffe." *Air Power History* 61, no. 1 (2014) 36.

⁷³ Michel, 50.

⁷⁴ Werrell, 37.

received an additional minimum seventy-five hours of flight time while bomber pilots received eighty-six.

As the war progressed, instructor quality also vastly improved as early-war veterans returned stateside to instruct their replacements.⁷⁵ By March 1945 over 90 percent of the instructors were combat veterans. Gunnery was considered the most important skill a pilot could learn during training.⁷⁶ Hitting a foe's aircraft was a difficult task, especially at the high speed aircraft of the era. When compared to slower aircraft of the previous war, aerial marksmanship became the most important factor in separating good pilots from great ones. Because of the vast manpower available to the American military, those with sub-standard scores in basic or advanced training could be eliminated from the program. This ensured not only an efficient use of military resources, but also saved the lives of skilled pilots relying on wingmen, and the lives of those who would have been easily shot down.⁷⁷

As American pilot training became increasingly effective, Luftwaffe training became decidedly less so. Because of German demands for manpower and skilled pilots during the war, their instructor program also suffered. Due to losses during the Battle of Stalingrad alone 600 instructors were sent to the Eastern Front.⁷⁸ By 1943 the Luftwaffe began suffering from an instructor shortage that had a marked effect on pilot ability and the number trained per year. In addition to this, German training facilities often came under aerial attack, while training facilities in the US were completely shielded from enemy assault in the same manner that American factories were. As the

⁷⁵ Werrell, 38.

⁷⁶ Werrell, 39.

⁷⁷ Werrell, 41.

⁷⁸ Werrell, 44.

war progressed, required hours for German pilots continuously fell, thus lowering the quality of trained pilot, while those for Allied pilots rose to increase pilot effectiveness as pilot demand decreased.⁷⁹

Regardless of how it was achieved, the deployment of an air-centric strategy by the Allies resulting in total and ultimate victory during Second World War proved that air superiority was the determining factor in modern conflict. Much can be said of early war German success in blitzkrieg strategy centering on tank superiority and mechanized infantry for rapid advance, but these gains were all made with total air superiority over inferior air forces to cover the advances. Ultimately air superiority as the determining factor in Allied victory can be simplified into one statement. When Germany held control of the skies they knew nothing but success, but upon losing that control to the Allies, they knew naught but defeat. Thus, whichever power held control of the skies, held control of the war.

Chapter II: The Airborne as an extension of Air Power

In addition to strategic bombing, the deployment of airborne forces is an extension of air superiority. Once aerial dominance has been established over a specific region planes can drop men, rather than bombs, upon the enemy. This provides great tactical flexibility in operational planning, as evidenced by both Allied and German efforts throughout the war. The purpose of this section is to analyze the impact of airborne forces on the war in Europe. From that analysis, it will become apparent that airborne forces, as an extension of air superiority, did serve a vital role in securing

⁷⁹ Werrell, 45.

victory for the Allies. It will do so by first analyzing the German use of airborne forces in the early stages of the war, and the latter Allied measures which deployed airborne units more often and more effectively.

The development of airborne forces did not truly begin until the late interwar period. Although the Italians used parachutes to drop saboteurs behind enemy lines as early as 1918, the aircraft to deploy entire infantry detachments were not feasible during the First World War. Because of this, the creation of airborne infantry units did not take form until the 1930's. During this decade, the Soviet Union began airborne exercises, which inspired Nazi leadership, particularly Hermann Göring, to develop their own paratroop units. These units were considered elite forces in the German military, and were given increased training and advanced weaponry befitting of their status.⁸⁰

As with most new technologies, the use of airborne forces did not come without growing pains. The German invasion of Crete during Operation Mercury was the first invasion in history to use only airborne forces. Although ultimately successful in taking the island, the invasion was marred with difficulties and resulted in immense casualties for the German Fallschirmjäger.

On May 1st, 1941 General Kurt Student was ordered to prepare his elite paratroopers for an airborne invasion of the Greek island of Crete. Germany had already deployed her paratroopers in the Netherlands during the Battle for The Hague, and the units had successfully captured target Dutch airfields but with heavy losses. Student was expected to conduct an even greater operation with only twenty days of

⁸⁰ Robert Mulcahy. "Fallschirmjäger On the Run." *World War II* 21, no. 9 (2007) 45.

preparation.⁸¹ To further compound the difficulty of preparing an offensive operation against an entrenched island defender, the necessary Junkers Ju-52 transport aircraft for the invasion did not arrive until May 15th, and the necessary fuel did not until the 20th.⁸² Because of this the German paratroopers were unable to conduct practice “jumps” beforehand.⁸³ The invasion was initially scheduled to begin on the 15th, and the lack of resources necessitated a postponement until the 21st.

The haste of the operation required the Fallschirmjäger to assist ground crews in the fueling of their aircraft during the night before the invasion, and were given amphetamines to compensate for their lack of sleep.⁸⁴ On the morning of the invasion yet another hindrance to the operation appeared. The German transports were stationed at captured Greek airfields, most of which were no more than dirt or sand airstrips. Because of this, huge dust clouds would be created from the takeoff of even one transport, and so instead of rapid successive takeoff the pilots had to wait an average of seventeen minutes on the ground to wait for visibility.⁸⁵ The properly constructed airfields with paved or grass runways were occupied by Luftwaffe fighter and bomber aircraft which were given priority over the transports.

Pre-invasion bombardment succeeded in forcing RAF aircraft on the island to relocate, thus securing air superiority for the offensive, but they had failed to knock out the majority of Allied anti-aircraft positions on the island, and as a result one third of the

⁸¹ Kelly Bell. "Costly Capture of Crete." *World War II* 14, no. 1 (1999) 50.

⁸² Bell, 50.

⁸³ “Jump”, and “jumps” are shorthanded terms for airborne drops used in the airborne infantry.

⁸⁴ Bell, 50.

⁸⁵ Bell, 51.

Ju-52s were downed over Crete.⁸⁶ Pre-invasion bombing of the landing zones created large smoke clouds which obscured the view of glider and transport pilots, and caused the scattering of attacking forces. Once the German paratroopers and glider infantry made landfall, they were met with stiff resistance from Greek and British forces stationed on the island. Allied defenders numbered 42,000 and, in contrast with their attackers, prepared extensively for an airborne invasion, concealing most of their gun positions around likely landing zones.⁸⁷

The German invasion plan numbered approximately 23,000 infantryman, however 7,000 of those were to attack the island via a naval invasion, and were halted by the British navy. That left the remaining 16,000 airborne infantrymen, who originally were meant to secure and hold key positions in preparation for the beach landings, to secure the island in its totality.⁸⁸ This lofty goal was again complicated by lack of significant air support. Although the skies were clear of Allied aircraft, the majority of German bombers and fighters in the area were diverted to the East for the impending invasion of Russia.⁸⁹ They did so at the cost of 6,000 casualties, causing 9,000 Allied casualties and capturing an additional 17,000. Remaining Allied soldiers escaped the island by sea, as the Royal Navy maintained control of the seas around the island until the defenders were forced to withdraw.⁹⁰

⁸⁶ Bell, 52.

⁸⁷ Bell, 52.

⁸⁸ Bell, 52.

⁸⁹ Bell, 51.

⁹⁰ Bell, 52.

Hitler was personally dissuaded from conducting any further offensive airborne operations as a result of the Pyrrhic victory that was the invasion of Crete.⁹¹ The cost of replacing the necessary aircraft, and the men trained to fly and jump from them, was too great for Germany to afford as the war dragged on and her industrial capacity began to wane. As a result, the Fallschirmjäger became a leg-infantry unit in all but name.⁹² They were deployed throughout the remainder of the war in the West in defensive roles. By winter 1944, the majority of Fallschirmjäger were no longer jump qualified, and the manpower drain on Germany reduced the once elite ranks of the units to old men and young boys.⁹³

German airborne operation had at the very best mixed results, and at their worst were abject failures of both planning and execution. Logic dictates that Allied commanders would be dissuaded from attempting similar operations. However, they saw the German failures as just that; German failures. Their shortcomings could be improved upon to realize the strategic flexibility that airborne infantry lend to offensive operations. As a result, Anglo-American airborne doctrine was synthesized. Their tactics depended upon paratroopers to serve as the main fighting force, while gliders towed to the battlefield bring additional reinforcement, ammunition, and heavy equipment such as jeeps, mortars, and small anti-tank guns that were too heavy to deliver via parachute.⁹⁴

The first major Allied airborne operations of the war coincided with the first major engagement of American forces in Europe. Operation Torch, the Allied invasion of North

⁹¹ Bell, 52.

⁹² Mulcahy 42.

⁹³ Mulcahy 49.

⁹⁴ "Air Assault Tactics", *United News Release* 141, (Films Media Group, [2010] 1945)

Africa through Tunisia, was a naval invasion complimented by parachute infantry. The 509th Parachute Infantry Regiment was assigned two primary objectives during the operation. Airfields at Tafraoui and La Sénia, (15 and 5 miles South of Oran respectively) were to be secured in conjunction with the landings.⁹⁵ Due to the extreme range of the operation, (approximately 1100 miles from London to Tunisia) and poor weather over Spain, transport pilots were unable to navigate to their drop zones.⁹⁶ This forced thirty of the thirty-seven transports to land in a dry lakebed far to the West of their objectives. Despite this, both objectives were taken within acceptable timeframes.⁹⁷

Allied commanders would take several key lessons from Operation Torch with regards to airborne operations. First, operations of extreme range could not be expected to arrive at precise drop zones, and wide unit dispersal would have to be taken into account. As a result, major operations of such extreme ranges would not be attempted for the remainder of the war. Second, clear weather was a necessity for transport pilots to navigate. This lesson is evidenced by the postponements of the Normandy landings due to poor weather over the English Channel. Finally, and most importantly, the success of the airborne units to capture their objectives despite the many obstacles served as a proof of concept. This emboldened Allied war planners such as Eisenhower and Montgomery to include air assaults in future operations.

⁹⁵ Major-General I. S. O. Playfair; Brigadier C. J. C. Molony; Captain F. C. Flynn; Group Captain T. P. Butler, J. R. M. ed. "The Mediterranean and Middle East: The Destruction of the Axis Forces in Africa." *United Kingdom Military Series: History of the Second World War*, 4. (Uckfield, UK: Naval & Military Press, [2004] 1966) 146.

⁹⁶ Playfair et. al. 146.

⁹⁷ Playfair et. al. 149

For good reason, the most well-known airborne operation of the war is that of the D-Day invasion. In addition to the landings on the coast of Normandy 10,000 aircraft filled the skies over France, with over 1,000 of them carrying paratrooper and glider infantry.⁹⁸ Their objective was to drop in behind the German coastal defenses and capture key points to prevent an immediate counterattack on forces landing on the beaches later that morning. The British 6th, American 82nd, and American 101st Airborne Divisions were used to create this “shield” between the beaches and German counterattack.⁹⁹ Many of these key points were bridges that would also be held to prevent German destruction in attempts to slow the Allied advance. Specifically, British units targeted river crossings over the Caen Canal, Orne River, and Dives River.¹⁰⁰

By the time the invasion plan was put into action, British airborne units had completed forty-three practice jumps over England, and had practiced night-time bridge assault tactics for weeks.¹⁰¹ The glider units touched down at twenty minutes past midnight on the morning of June 6th, and were followed by paratroopers at 12:50AM and a second wave of gliders carrying reinforcements and heavy weapons at 3:30AM. Lack of communication between units plagued the early stages of the invasion, as many pieces of radio equipment were lost or destroyed upon landing.¹⁰² In addition, cloud cover and heavy anti-aircraft fire caused scattering of airborne forces.¹⁰³

⁹⁸ “D-Day”, *United News Release* 106, (Films Media Group, [2010] 1944)

⁹⁹ Robert Barr Smith. "Strike from the Sky." *World War II* 17, no. 2 (2002) 54.

¹⁰⁰ David Howarth "D Day Part Two The British Air Drop." *Saturday Evening Post* 231, no. 38 (1959) 43.

¹⁰¹ Smith, 54.

¹⁰² Howarth, 91.

¹⁰³ “Invasion”, *United News Release* 1003, (Films Media Group, [2010] 1946)

The airborne infantrymen were able to overcome these setbacks, and capture their objectives due to a key development in their training following the lessons of Operation Torch. Airborne units were trained to act independently in the case of lack of communication, and if unable to locate or capture their objectives were given general orders to harass and destroy German units they encountered to cause disruption in the defense.¹⁰⁴ This was done to great effect in Normandy, as scattered groups of infantry, often comprised of men from several different units, identified the key objectives nearest to them and fought to secure them even if it was not their pre-invasion goal.

The D-Day plans that were put in motion in June 1944 deployed airborne units more conservatively than many high-level Allied commanders desired. Among them was American Army Chief of Staff General George C. Marshall. Marshall, and American Army Air Corps commander General Arnold proposed an airborne landing much further inland than was planned.¹⁰⁵

[In Reference to his so-called "Plan C"]...Establishes an air-head in keeping with my ideas on the subject, one that can be quickly established and developed to great strength in forty-eight hours. The area generally south of Evreux has been selected because of four excellent airfields.

This plan appeals to me because I feel that it is a true vertical envelopment and would create such a strategic threat to the Germans that it would call for a major revision of their defensive plans. It should be a complete surprise, an invaluable asset of any such plan. It would directly threaten the crossings of the Seine as well as the city of Paris. It should serve as a rallying point for considerable elements of the French underground.

In effect, we would be opening another front in France and your buildup would be tremendously increased in rapidity.¹⁰⁶

¹⁰⁴ "Invasion"

¹⁰⁵ Larry I. Bland ed.; and Sharon R. Stevens ed.. *The Papers of George Catlett Marshall*, 4. "Aggressive and Determined Leadership, June 1, 1943-December 31, 1944." (Baltimore and London: The Johns Hopkins University Press, 1996) 282.

¹⁰⁶ *Marshall Papers*, 283-284.

Marshall sent two staff officers to present Arnold's proposal to Eisenhower and his staff in February 1944, and received the following report from them. "...decision had been made not to use the airborne effort initially as we were proposing, but to use it directly to assist the beach landing and main effort particularly to capture Cherbourg as soon as possible."¹⁰⁷ Eisenhower also personally responded to Marshall with the following, "My initial reaction to the specific proposal is that I agree thoroughly with the conception but disagree with the timing."¹⁰⁸ The Arnold and Marshall's proposal was theoretically sound in the eyes of the Supreme Allied Commander, which lends his voice to the effectiveness of the allied airborne infantry. After the war, Marshall lamented Eisenhower's decision to not deploy the airborne more aggressively.

"...the quick way to end the battle—and that was to seize a field near Paris with glider planes, with parachute troops, and then fly in these small tractors and other things, and then gather in all the motor transport of the surrounding country and, of course, all the French undercover units would have joined us and built up there with the ammunition. . . . We could put in 105 [mm] guns and build up a force there right behind the German line before they had time to get things together, and make it almost impossible for them to do anything but to fight you with small groups. However, that was a hazard. It was a brand new thing and Eisenhower's staff and Eisenhower, I guess, himself didn't feel that it was proper to take the risk. But I always thought it was wrong to divide up the men into little groups everywhere. . . . I believe the air could have been used with great effect in splitting up the Germans very quickly at the start."¹⁰⁹

With the opinions of generals Marshall, Arnold, and (to an extent) Eisenhower, it can be argued with great support that the airborne forces deployed during the

¹⁰⁷ "Evans and Bidwell Memorandum for General Marshall." NA/RG 165. [OCS, 381]. (March 1, 1944)

¹⁰⁸ Louis Galambos ed.; and Daun Van Ee ed.. *The Papers of Dwight David Eisenhower*. 3. "The War Years: Planning Overlord December 1943 to June 1944" (Baltimore: Johns Hopkins Press. 2001) 1736.

¹⁰⁹ General George C. Marshall; Forrest C. Pogue; and Larry, Bland. *George C. Marshall: interviews and reminiscences for Forrest C. Pogue*. (Lexington, Va: G.C. Marshall Research Foundation, 1991) 465-466.

Normandy invasion were done so too conservatively, and that a more aggressive would have made their success even more vital to the outcome of the operation than it already was, and hastened the end of the war. General Marshal's proposal, if employed and properly executed, would have resulted in the encirclement of a large portion of the German army in France. The envelopment and forced surrender of these units would prevent them from being used in the defense against the Allied push into France. Marshal's airborne operation plan circumvents the long breakout from the Normandy beachhead that slowed the Allied advance. Such an aggressive deployment of airborne units posed great risk, but was within the realm of reason in the minds of many Allied commanders, and held the potential for an immense strategic victory.

Ultimately, the D-Day plan was successful in establishing an Allied foothold on the European mainland. The success of the operation did however result in widening the divisions amongst the Anglo-American command structure, as evidenced in the words of General Omar Bradley.

"...the frustration they [the British] experienced here at Caen produced an extreme sensitivity to Patton's speedy advance across France. In setting the stage for our breakout the British were forced to endure the barbs of critics who shamed them for failing to push out as vigorously as the Americans did. The intense rivalry that afterward strained relations between the British and American commands might be said to have sunk its psychological roots into that passive mission of the British on the beachhead."¹¹⁰

Following the Normandy invasion, the next major use of air assault troops would take place during Operation Market Garden. The controversy surrounding the failure of the operation is twofold, first in the strategic planning of the operation itself, which was

¹¹⁰ Omar Bradley. *A Soldier's Story* (New York: Henry Holt & Co. [1981] 1951) 326.

marred by infighting between American and British commanders as referenced above, and in the tactical failures of the operation once it was put into effect.¹¹¹

Market Garden was the brainchild of General Bernard Montgomery, and was an extension of his “Narrow Thrust” philosophy.¹¹² He proposed a bold operation to cross the Rhine in Holland through a massive airborne assault that would secure key bridges for the armored ground assault comprising the second arm of the operation.

Montgomery’s plan required other allied advances along the front to halt so that the bottlenecked supplies coming through Normandy could be funneled to his command to support such a large advance, a decision that was vehemently opposed by American commanders such as Patton, but was approved by Eisenhower nonetheless.¹¹³ His plan was seen at the time, and by many scholars today, as an attempt to increase his own importance within the Allied push into France. By focusing airborne operations on the town of Arnhem, approximately 90 kilometers from the Allied lines,¹¹⁴ he ensured that command of the operation, and thus credit for it, would fall to his staff rather than the American forces to the south. Ultimately, this would prove to be the plan’s undoing, as the objective bridges were too far from and too heavily defended for his units to push through from the Allied line and cross successfully.

The operation was the largest airborne assault (in terms of manpower) undertaken in history, with 35,000 American, British, and Polish troops attacking

¹¹¹ Lloyd Clark. "Market Garden Reconsidered." *World War II* 22, no. 6 (2007) 52.

¹¹² M. Watts "Operation Market Garden: Strategic Masterstroke or Battle of the Egos?" *History* 98, no. 330. (2013) 194.

¹¹³ Watts, 197.

¹¹⁴ “War Communique”, *United News Release* 1020, Films Media Group, [2010] (1944)

Nijmegen and Arnhem by air.¹¹⁵ Such a large operation double the numbers of transport aircraft that the Allies had available at the time, and necessitated the airborne landings be spread out over three days (September 17-20th).¹¹⁶ The jumps over Holland during Market Garden showed incredible improvement in accuracy over those even of just a few months prior, and the majority of airborne troops landed on are nearby their landing zones. This allowed for the initial resounding success of Market Garden, as the airborne forces secured all of their assigned bridges rapidly.¹¹⁷

The downfall of the operation began on September 21st when German panzer divisions began a counterattack against the British forces at Arnhem, which held out against the armored onslaught without heavy antitank weaponry in anticipation of relief from their own armored ground units pushing north which never came.¹¹⁸ Ground forces had tremendous difficulty closing the gap between themselves and the airborne forces at Arnhem and Nijmegen due to the reliance on a single road as their avenue of advance; the German defense thus centered around holding off the advance along this road which became known as 'Hell's Highway'.¹¹⁹ The commander of American ground forces involved in the push remarked that the reliance on the road was like "threading seven needles with one piece of cotton, and we only have to miss one to be in trouble."¹²⁰

¹¹⁵ Clark, 55.

¹¹⁶ Clark, 55,

¹¹⁷ Clark, 56.

¹¹⁸ Clark, 60.

¹¹⁹ Clark, 59.

¹²⁰ Clark, 59.

Operation Market Garden was not an abject failure as this would suggest. At the time, many felt otherwise, including Winston Churchill who labeled the operation “a decided victory.”¹²¹ Montgomery himself also stated that the operation was “ninety percent successful” which speaks to how close the goals of the operation came to fruition.¹²² A strategic success of Market Garden independent of the operation’s outcome was that by bringing the German Army in Holland to battle while Germany was struggling to maintain combat effectiveness across their multiple fronts, it weakened the army in Holland significantly. This would work to Allied advantage in future offensive operations that crossed into Germany in 1945.¹²³

Hypothetically, a similar operation, which targeted crossings closer to the Allied lines, (and thus closer to American ground forces) holds a higher chance for success. This, coupled with Eisenhower’s agreement to Montgomery’s plan makes the concept of an airborne-led Rhine crossing a sound one. In 1945, a similar plan, though not to so great a scale, would be implemented for the Allied crossing of the Rhine.

Operation Plunder was the name given to the crossing of the Rhine in 1945, and was supported by the final great airborne operation of the war entitled Operation Varsity. Airborne units taking off from Britain and the continent jumped into Germany to aid the Allied crossing of the Rhine on March 23rd-24th 1945. Operation Varsity involved over 16,000 airborne troops and concentrated the entire assault force at

¹²¹ Clark, 61.

¹²² Watts, 198.

¹²³ Clark, 54.

Wesel.¹²⁴ It is the largest airborne operation in history to be conducted in one day at one location, as unlike Market Garden the entire airborne force landed on the same day at drop zones adjacent to one another.¹²⁵ Unlike previous Allied airborne operations, the entire undertaking was done during the daylight. Although this cost higher casualties in the landings due to antiaircraft fire, the accuracy of the landings were incredibly precise.¹²⁶

As with previous airborne operations, the forces were assigned key bridges and crossroads in and around Wesel as their primary objectives to aid the Allied ground forces on the opposite side of the Rhine in advancing into Germany once they crossed over.¹²⁷ Varsity was unique however in that the gliders towed to the battlefield which typically were each assigned their own tow plane were instead paired with another glider on one tow plane. In addition, paratrooper units had previously only jumped from one side of their transport C-47s, but during Varsity the transports were outfitted with an additional jump door on the other side which allowed for both a doubling of the drop rate of the paratroopers as well as halving their dispersal over the drop zone.¹²⁸ Learning from the failures of Market Garden, the airborne drop zones were also much closer to

¹²⁴ “Speed Plans for San Francisco Security Meeting”, *United News Release 28A*, (Films Media Group, [2010] 1945)

¹²⁵ “Speed Plans...”

¹²⁶ “Speed Plans...”

¹²⁷ “Rhine Barrier Smashed”, *United News Release 1046*, (Films Media Group, [2010] 1945)

¹²⁸ “Rhine...”

Allied lines, which greatly reduced the amount of time they would have to hold out with only aerial resupply.¹²⁹

Operation Varsity, and consequently Operation Plunder, were resounding successes. Eisenhower remarked that it was "the most successful airborne operation carried out to date."¹³⁰ Adding to Eisenhower's resounding endorsement of the operation was the official report given by Major General Matthew Ridgeway which hailed the operation as "flawless", and that two airborne divisions eliminated German defenses in hours which would have taken days to do otherwise.¹³¹

Several key differences are evident between the successful Allied airborne operations and the failed German assault on Crete. First, Allied air assaults were products of meticulous planning and preparation. This is best shown in the contrast between the years of preparation in prelude to the Normandy invasion compared to the twenty days, (without his aircraft or fuel) Student was given to prepare for the Crete assault. In addition, Allied airborne forces were always deployed as part of a greater battle plan, and were not relied upon to accomplish goals without proper support, unlike the invaders of Crete who had to accomplish the difficult task of capturing a well-defended island without the benefit of naval support or a well-supplied beachhead. Although both enjoyed air superiority, which is a pre-requisite for airborne assaults, the Allies used attack aircraft in much greater conjunction with their airborne forces than the

¹²⁹ James A. Huston. *Out of The Blue - U.S Army Airborne Operations In World War II*. (West Lafayette, IN: Purdue University Press, 1998) 215.

¹³⁰ Huston, 215.

¹³¹ Ridgeway, Major-General Matthew. "Summary Of Ground Forces Participation In Operation 'Varsity'" (1945) 3.

Germans. As with any other form of ground infantry, this provided an incredible boon to the Allied airborne forces. Finally, Allied commanders showed a willingness to continue to improve airborne operations as the war progressed, and did not abandon the concept after early difficulties. The immense resources and productive capacities of the Allies gave them the opportunity to train more men and replace lost aircraft which Germany was incapable of doing.

Even the failed Operation Market Garden was seen by many as a success on the part of the airborne forces. In the contrast that is evident between the German failures, and the Allied successes a concise truth emerges. When given the prerequisites of proper planning, support, and leadership, airborne forces were not only an extremely weapon in the arsenal of the Allies, but a necessary one. Although it can be argued, and perhaps correctly so, that the war would inevitably end in an Allied victory by the time airborne forces saw heavy deployment in 1944, an argument that not using these forces and dedicating the resources elsewhere could have led to a swifter end to the war is without merit. Even if the role of Devil's advocate is taken as correct, that somehow the resources would have been better spent elsewhere, the casualties necessary for the Allied forces to establish a foothold in Western Europe through a D-Day style invasion would have resulted in far greater casualties without the "airborne shield" protecting the beachhead. A massed German counterattack in Normandy unimpeded by airborne forces held the potential for reversing the outcome of the operation, prolonging the war for months if not years. This operation, and the success of others like it serve as sufficient proof of the integral role of the airborne in the liberation of Europe.

The deployment of airborne troops is perhaps one of the great signifiers that air superiority has been established over a battlespace. If shot down, a bomber on a strategic raid may cost the lives of eight or so men. However, a troop transport filled with paratroopers would cost dozens. Thousands of men were dropped from the sky during the D-Day landings, and thousands more during Market Garden. Neither operation would have been planned, let alone executed, without total confidence that the large formations of transport aircraft would be safe from persecution by enemy fighters. Therefore, it can be plainly seen that the airborne both signified the Allied dominance of the air in Europe by 1944, as well as show the benefits that such dominance can reap through the successes of the D-Day landings and Operation Varsity.

Chapter III: The Eastern Front

The war on the Eastern Front brings to mind epic imagery of massive tank battles on rolling plains and street to street fighting in the city of Stalingrad. What is often overlooked in mainstream discussions of the conflict between Germany and the Soviet Union is the unquestionable impact of the battle in the skies that raged above throughout these famous events.

On the eve of Operation Barbarossa, the German Luftwaffe held superiority over the antiquated Soviet VVS (*Voyenno Vozdushnye Sily*, translated to 'Military Air Force'). When the German invasion commenced in June of 1941, the VVS had vast numerical superiority over the Luftwaffe, however the technological gap between the two organizations left the VVS far outmatched. Germany began her assault into the Soviet

Union with approximately 2,800 aircraft.¹³² Due to the secretive nature of Soviet wartime recordkeeping, a precise number of Soviet aircraft at the onset of the war is currently unknown, although it is thought to be within the range of 6,000 to 10,000¹³³ aircraft. Of this number, only 17% were of technological parity with the Luftwaffe.¹³⁴

The superiority of the German aircraft over the quantitatively superior Soviets is evidenced by the staggering losses inflicted upon the Russians in the opening moves of Barbarossa. Estimates of lost Soviet planes on the first day of the invasion range from 1,200 to 3,000 aircraft.¹³⁵ The element of surprise enjoyed by the Germans and confusion within Soviet command at the beginning of the attack greatly contributed to this success, as many of the aircraft were destroyed or captured on the ground before they could be sent into battle.

A later Luftwaffe report further claimed Soviet losses to number 6,233 planes by the second week of July 1941.¹³⁶ Soviet documents confirm the massive blow, and report that by mid-July the Soviet VVS consisted of only 2,516 aircraft. To further compound this issue, less than 1,900 of the remaining aircraft were serviceable.¹³⁷ In total this left the Soviet Union with less than 20% of its initial air force in less than a month of combat.

¹³² Richard C. Lukas. "The Impact Of 'Barbarossa' On The Soviet Air Force And The Resulting Commitment Of United States Aircraft, June-October, 1941." *Historian* 29, no. 1 (1966) 61.

¹³³ Jon Guttman. "In spite of incredible achievements, the Luftwaffe failed to eliminate the Soviet air forces in 1941." *World War II* 16, no. 2 (2001) 67.

¹³⁴ Lukas, 61.

¹³⁵ Lukas, 62.

¹³⁶ Lukas, 62.

¹³⁷ Guttman, 67.

Luftwaffe ace Dieter Hrabak, recipient of both the Knight's Cross and Iron Cross describes the heavy advantage he and his fellow pilots enjoyed over the Soviets early in the war:

"I must say that the really experienced Russians thoroughly trained in peacetime were killed off in the first three months of the invasion. Those that remained flew obsolete aircraft such as the Tupolev SB, which we called the "Martin bomber," and Ilyushin DB-3 bombers, as well as old Polikarpov I-15 and I-16 "Rata" fighters, and used no tactics whatsoever. Furthermore, the Russians lacked the technical training and combat skill that the British had mastered, at least early in the war. The Russians had no stomach for prolonged dogfighting, unlike the British."¹³⁸

The development which left to these striking results within the opening salvos of the German invasion is not a tale of German technological genius, but rather of a doctrinal shift in Soviet thinking that led to early disaster. The Soviet VVS was among the most technologically advanced in the world in the early 1930's. Just as they had been pioneers during the First World War, (the Russian military was the first to use aircraft as a forward 'spotter' for rear artillery), the Russians spent the early 1930's developing new tactics such as paratrooper infantry units, as well as engineering modern aircraft. Stalin's infamous purge of the mid 1930's reversed this trend. As high-ranking military theorists and aircraft designers were stripped from the ranks of the Soviet military, it forced a shift in doctrine from innovation to quantity.¹³⁹ As a result, the Soviet air force shifted from an innovative body to a numerically superior but technologically outclassed onslaught by the turn of the decade.¹⁴⁰

¹³⁸ Colin D. Heaton. "Messerschmitt Master on the Eastern Front." *Military History* 20, no. 6 (2004) 46.

¹³⁹ Guttman, 66.

¹⁴⁰ Guttman, 66.

Following the embarrassing Pyrrhic victory over Finland in the Winter War of 1939-1940, Stalin began an effort to modernize the Soviet military. The Soviet VVS was an integral part of this effort.¹⁴¹ The program was nowhere near completion at the time of Barbarossa, though was well underway by 1941 and greatly contributed to the eventual turning of the tide in the air. New aircraft such as the Ilyushin Il-2, a heavily armed and armored ground attack aircraft, and the Yakovlev Yak-1 fighter, which at the time was the only Soviet fighter capable of outmatching the Bf 109, were just begging to arrive in number. These and other aircraft which were beginning mass production as a result of Stalin's initiative would comprise the bulk of Soviet produced aircraft during the war.

In contrast to the immense quantitative losses in the Soviet VVS, the Luftwaffe lost 460 aircraft in June and 695 in July.¹⁴² Although these losses rightly suggest the superiority of the Luftwaffe at this point in the war, they also mark the beginning of the problem that would ultimately prove the Luftwaffe's undoing: an inability to replace losses. The near 1,200 aircraft lost in the first two months comprised nearly half of the Luftwaffe strength in the east. As the Allied pressure on German industry from the West began to outpace the production demands in the East in the coming years the German war industry was unable to replenish the Luftwaffe pre-Barbarossa strength, just as it had been unable to fully replenish itself after the losses over Britain in 1940. The ability of the Soviets to replenish their immense losses from a seemingly endless supply of

¹⁴¹ Guttman, 66.

¹⁴² Lukas, 63.

men and material, and inability of the Germans to do the same, that has so famously typified the ground war is also true of the battle for the skies above Eastern Europe.

Until the Soviet industry and aircraft production fully mobilized against the German invasion, foreign aircraft served as an invaluable stopgap. Fighter and bomber aircraft from the United States, and to a lesser extent Britain, provided Soviet pilots modern aircraft with which to combat the Luftwaffe and ultimately halt the Nazi advance.

Nearly as soon as the initial losses suffered by the VVS became apparent, the Soviet Union reached out to the United States in hopes of securing aircraft to bolster its crumbling defenses. Constantine Oumansky, the Soviet Ambassador to Washington, sent a 9-Point list of requests to President Roosevelt asking for military aid. Among other things, this list asked for 3,000 fighter aircraft and an additional 3,000 bombers.¹⁴³ If such an order was fulfilled it would have given the Soviets an immediate overwhelming advantage over the Luftwaffe. However, it was well beyond the capacity of the United States to provide so many planes so rapidly.

Soviet requests for American aircraft and material came only three months after the US passed the Lend-Lease Act to support Britain, and a great deal of popular support existed to support the Soviets as well. However, this was out of hope that the Communists and Fascists would “bleed each-other dry” instead of seen as an act defending democracy as the Lend-Lease was. Regardless of the reason, the support handed President Roosevelt a mandate to support the Russians. This sentiment was not shared by many high-level officers of the American military. General Geroge C.

¹⁴³ Lukas, 65.

Marshall expressed in a memorandum to General 'Hap' Arnold vehement opposition to sending aircraft to the USSR due to a severe lack of aircraft in the US military, particularly in the Philippines to counter growing Japanese aggression.¹⁴⁴ The initial wild successes of the invasion also led many to assume that the Soviets would soon capitulate to the Germans, and that sending material supplies to the Russians would ultimately result in aid sent to the Reich.¹⁴⁵

The reservations held by Marshall and others in the United States were not without merit. The US was already committing a great deal of resources to the British rather than its own military. Since the summer of 1940, the British had received more American-produced aircraft in aid than the US Army Air Corps did for its own use.¹⁴⁶ On July 31st a Soviet Diplomatic mission met with President Roosevelt to negotiate aircraft aid. Roosevelt promised to send the USSR two-hundred P-40 fighter aircraft, one hundred and fifty of which were already in Britain and another fifty in the United States.¹⁴⁷ Meeting such an order would in essence totally deplete the Army of their P-40's, which was at the time the Americans' best fighter in production. If the 200 serviceable P-40's were to be shipped to the USSR, that would leave only eight P-40's in the US ready for deployment.¹⁴⁸

The first US aid was sent to the USSR on October 1st, and was mainly industrial material and supplies. On this same day, the three major powers agreed to the Moscow

¹⁴⁴ Lukas, 67.

¹⁴⁵ Lukas, 64.

¹⁴⁶ Lukas, 68.

¹⁴⁷ Lukas, 70.

¹⁴⁸ Lukas, 72.

Protocol, which stipulated that the US would provide on a monthly basis one-hundred fighters and one-hundred bombers to the Soviet Union, with Britain adding another two-hundred monthly fighters through June 1942.¹⁴⁹ This agreement was fulfilled resulting in nine deliveries totaling 3,600 aircraft. The early deliveries were not without challenges however. Early shipment came with few if any spare parts for integral aircraft components. This stemmed from an issue faced by the American military itself and not one put upon the Soviets by design.¹⁵⁰ Despite beginning with only a token shipment, approximately 17% of aircraft used by the Soviets during the war were produced in the United States.¹⁵¹

Although the Curtiss P-40 Warhawk constituted the first American aircraft delivery to the Soviet Union, it was the P-39 Aircobra that was sent in the greatest number to the East, with shipments beginning in November 1942. By July 1943 the number of Aircobras in use by the USSR had increased sevenfold since November of the previous year. Throughout the duration of the war, the US delivered between 4,719 and 4,746 Cobras of varying models, with England shipping an additional 212, with Soviet records showing a total number of accepted Aircobras at 4,952.¹⁵²

The P-39 was a multipurpose aircraft capable of both close air support as well as aerial dogfighting. In this respect, it was the perfect aircraft to be sent to the Soviet Union, as its versatility allowed for mass generalized training for the aircraft and did not

¹⁴⁹ Lukas, 78.

¹⁵⁰ Lukas, 79.

¹⁵¹ Gribanov, Stanislav, and Saxe. "The Role Of US Lend-Lease Aircraft In Russia In World War II." *Journal Of Slavic Military Studies* 11, no. 1 (1998) 99.

¹⁵² Viktor P. Kulikov. "Cobras Join the Battle: P-39s and P-63s in Soviet Forces." *Air Power History* 53, no. 3 (2006) 21.

require separate training for designated fighter or ground-support pilots. In 1942, a Soviet engineering commission deemed the P-39 as the equal of both German and Soviet aircraft in its class, with excellent maneuverability and armament.¹⁵³ The P-39's heavy armament gave it the much needed capability to attack hard targets, such as German heavy tanks and fortified structures. The heated cabin, atypical of Soviet aircraft, also made it a favorite of Russian pilots.¹⁵⁴ The experience of the 'Cobra' on the Eastern front lasted from 1942 until the war's conclusion, and the success of the aircraft and its impact on turning the tide against the Luftwaffe is emblematic of the tremendous impact that the Allied aircraft sent to the USSR had on the Eastern Front.

The majority of air-to-air combat on the Eastern Front occurred between 4,000 and 5,000 meters. At this elevation the Aircobra outperformed contemporary Soviet and Luftwaffe aircraft which reached peak performance and different altitudes.¹⁵⁵ Because of this, Luftwaffe pilots reported engaging the P-39 only when enjoying numerical superiority.¹⁵⁶ Soviet aircraft distribution also shows that P-39 equipped units were most often stationed towards the front while rear units used British Hurricane and American Kittyhawk fighter aircraft. Although regarded as obsolete by British and American pilots, many Soviet pilots remained adamant that the P-39 was the superior aircraft of the war due to its high armament.¹⁵⁷

¹⁵³ Kulikov, 16.

¹⁵⁴ Kulikov, 16.

¹⁵⁵ Kulikov, 19.

¹⁵⁶ Kulikov, 19.

¹⁵⁷ Kulikov, 19.

The Aircobra first saw combat in the East on May 15th 1942 under the 1st Squadron of the 19th Guard IAP over the Karelian front in an indecisive engagement without any victories or losses. The following day against eight Bf 109s the first Aircobra loss in the East was suffered, with the pilot surviving but with serious wounds upon a crash-landing. The first major victory for the aircraft was on June 15th when six Cobras from the 19th Guard intercepted a German sortie of six bombers and sixteen escort fighters, downing nine enemy aircraft without any losses of their own.¹⁵⁸

At the end of June 1942 the 153d IAP Regiment arrived at Voronezhski outfitted with Aircobras. In four months of combat the group flew 1,070 missions, with 64 downed enemy aircraft (45 of them fighters) and only eight losses of their own.¹⁵⁹ Colonel Mironov, the commander of 153d attributed his men's success against the Germans to both their flying ability as well as the superior performance of the Cobra against German aircraft.¹⁶⁰

On April 14, 1943 in the defense of the key port of Murmansk, the 2d Guard SAP repelled a German air-raid with ten Aircobras I fighters and an additional six British-made Hawker Hurricanes. Facing fourteen German fighters they scored five victories and lost only one plane.¹⁶¹ The Aircobra I was inferior to newer P-39D's that the US had begun sending the USSR in November 1942, but all combat-capable aircraft were needed by the Soviets to establish air-parity, and eventually dominance over, the Luftwaffe.

¹⁵⁸ Kulikov, 17.

¹⁵⁹ Kulikov, 17.

¹⁶⁰ Kulikov, 17.

¹⁶¹ Kulikov, 17.

In one sortie in September 1943, twelve pilots from the 19th Guard IAD destroyed 13 German locomotives. The P-39's high caliber cannons were able to penetrate and destroy the boiler engines of the trains.¹⁶² February 1944 saw the pilots of the 9th Guard IAP destroy 13 German planes, 110 motor vehicles, 100 horses, 5 steam locomotives, and an unknown but high number of infantry.¹⁶³ These numbers highlight the role-shift of the P-39 from a multipurpose aircraft to a dedicated ground-attack plane that occurred in mid-1943 in part due to the deployment of modern Soviet-produced fighter aircraft. The total war-record of the P-39 in the East proves the effectiveness of the aircraft. One P-39 was lost per 122 combat sorties, with four enemy aircraft downed during that time on average.¹⁶⁴ The P-39 saw such great success that the Soviets also purchased 2,400 Bell P-63 'Kingcobras', a modernized design based upon its predecessor, from 1943 to 1945.¹⁶⁵

Once the Soviet war economy was mass-producing modern natively designed aircraft, such as the Yak-1 fighter designed during Stalin's pre-war modernization effort, the Luftwaffe had lost its large qualitative advantage over the Soviets. The attrition inflicted as a result of these new aircraft as well as the mass-production of them widened the numerical gap between the VVS and the Luftwaffe. It is no mere coincidence that the greatest successes of the German Wehrmacht in the East occurred when the Luftwaffe was at its strongest. This shift in power in the air fueled by the industrial might of the Soviet Union would in turn shift the war in the east.

¹⁶² Kulikov, 19.

¹⁶³ Kulikov, 19.

¹⁶⁴ Kulikov, 21.

¹⁶⁵ Kulikov, 22.

Germany had planned for a swift victory over the Soviets at the onset of their Eastern campaign. The 'rotten structure' that Hitler labeled the Soviet Union did in fact not collapse when the door was kicked in. The failure of Operation Barbarossa to force a Soviet surrender in 1941 split created a prolonged two-front war that divided German resources. Germany was thus forced to attempt another offensive to seize badly needed resources and perhaps end the war in the East.

Hitler's 1942 campaign known as "Case Blue" was meant to solve Germany's increasingly mounting oil deficiency by capturing the oil-rich Soviet Caucasus.¹⁶⁶ Hitler stressed the importance of this offensive when he remarked on June 1st 1942 "If I do not get the oil of Maikop and Grozny then I must end this war."¹⁶⁷

The Luftwaffe's mission during the offensive was to provide close air support for the advancing two armies. In addition, Hitler ordered that "The early destruction of Stalingrad is especially important." Bombing raids on enemy railways and pipelines were also ordered but special care was to be taken to avoid bombing the refineries themselves.¹⁶⁸ As a whole the offensive was to be split into two separate campaigns in turn split the Luftwaffe's resources. This division of resources between the southern Crimean offensive and push to Stalingrad ran counter to the previously successful German strategy of *Shchwerpunkt*.¹⁶⁹ This doctrine emphasized a single point of effort as the spearhead of an assault. The division of Luftwaffe aircraft to support each army

¹⁶⁶ Joel Hayward. "Too Little, Too Late: An Analysis of Hitler's Failure in August 1942 to Damage Soviet Oil Production." *The Journal of Military History* 64, no. 3 (2000) 769.

¹⁶⁷ Hayward, 771.

¹⁶⁸ Hayward, 777.

¹⁶⁹ Hayward, 784.

separately only increased the growing Soviet numerical advantage in the skies.¹⁷⁰ In turn this left the majority of German ground forces without proper air support, with the exception of the 6th Army at Stalingrad due to Hitler's obsession with the target.¹⁷¹

The initial offensive appeared successful with the capture of the first major objective of Krasnodar with support from the Fourth Air Corps. The wing's commanding officer remarked in his diary on August 8th that the "Bombers performed extremely well against thick enemy columns there."¹⁷² However, with the capture of Krasnodar and later Maikop it became apparent that the Soviets had succeeded in heavily damaging much of the oil production facilities there before capture.¹⁷³

The 4th Air Corps operational strength had fallen from 1,610 aircraft (with 71% of them combat operational) in the four weeks prior to June 20th 1942, to 1,359 (56% combat operational). By August 20th the number dropped to 1,071 aircraft with only 643 (60%) operational.¹⁷⁴ Because of this, by August 1942 the Luftwaffe was incapable of destroying Soviet oil production as it had been earlier in the year. However, it was still capable of dealing a heavy blow.

In his interview, Hrabak discusses how the Soviet VVS evolved into an effective fighting force: "Later in the war, however, a new breed of Russian pilots emerged, flying excellent native aircraft. The best Russia had was placed in elite Red Banner fleets, and

¹⁷⁰ Hayward, 784.

¹⁷¹ Hayward, 789.

¹⁷² Hayward, 778.

¹⁷³ Hayward, 779.

¹⁷⁴ Hayward, 784.

they claimed many German pilots.”¹⁷⁵ The rapidly improving VVS was far superior to its pre-invasion self, and the aforementioned losses show proof of this.

On October 7th Hitler realized that the southern assault could not reach the Caucasus oilfields by winter, and therefore the offensive had failed to achieve its two primary goals.¹⁷⁶ Luftwaffe Field Marshal Wolfram Richtofen was then ordered to attack the unreachable oilfields. Richtofen promptly diverted nearly every bomber from the Stalingrad assault to the South, but the move was made too late and with too few aircraft to cripple the Soviet oil supply.¹⁷⁷ On October 10th Richtofen attacked the oil refineries at Grozny with his remaining bomber force. This consisted of 129 of the remaining 232 Luftwaffe bombers in the East (those not used were not combat-ready at the time). When compared to the pre-campaign bomber force of 323 serviceable bombers (with another 157 not combat ready), the high cost of the Fall Blau to the Luftwaffe becomes readily apparent.¹⁷⁸ Despite the success of this mission, such raids were unsustainable. The Stalingrad sector demanded all the air resources Richtofen could muster in a Furer-directed last-ditch effort to save the 6th Army.¹⁷⁹

Although the Luftwaffe heavily damaged the fields at Grozny, it did little to damage the Soviet war effort as the Baku fields were left untouched. Grozny and Maikop combined for only 10% of Soviet oil production, and so German efforts did little to harm the ‘big picture’.¹⁸⁰ Hitler’s ill-fated 1942 offensive had a sound goal in theory,

¹⁷⁵ Heaton, 46.

¹⁷⁶ Hayward, 791.

¹⁷⁷ Hayward, 791.

¹⁷⁸ Hayward, 792.

¹⁷⁹ Hayward, 792.

¹⁸⁰ Hayward, 793.

but was impractical even if it had succeeded. A March 1941 report by Lt. General Hermann von Hanneken of the War Economy and Armaments Office warned that even if the Caucasus was seized only 10,000 tons of oil could be transported back into Germany per month which would not have solved the fuel crisis.¹⁸¹

The failure of the Caucasus campaign to push further into the USSR and take more oil fields, which would at the very least had denied the Soviets their use even if German oil production would have not benefited from them, was in part due to Hitler's insistence of Stalingrad's destruction.¹⁸² This tied down Luftwaffe aircraft that would have been better used to support the ground advance. *Fliegerkorps VIII* assigned to bomb Stalingrad achieved great destruction of the city in the opening offensive. However, Hitler's insistence on repeated raids on the city resulted in what effectively becoming bombing rubble into smaller bits of rubble.¹⁸³ This wasted both munitions and precious fuel the German war economy could not afford to lose, and also misallocated aircraft that could have assisted the southern offensive.

In August, while the window to strike at Baku (producer of approximately 80% of Soviet oil) still presented itself, Hitler rather focused the Southern Luftwaffe units on Stalingrad to serve as "flying artillery" for the embattled 6th Army in what resulted in a futile gesture to take a strategically insignificant target when compared to the destruction of Baku.¹⁸⁴ The Soviet VVS (Red Air Force) did not have a high concentration of fighters in the Caucasus in August 1942, and those stationed there

¹⁸¹ Hayward, 773.

¹⁸² Hayward, 788.

¹⁸³ Hayward, 789.

¹⁸⁴ Hayward, 789.

were mainly obsolete. This created a brief window for a German bombing campaign of the Baku oilfields. However, requests for more aircraft allowed the Soviets to begin striking back at the Germans from the air by mid-September and effectively defend the oilfields.¹⁸⁵ Hitler issued orders to Richtofen to bomb the Baku refineries on October 22nd, but the reality of this situation left the order unfulfilled.¹⁸⁶ Although successful raids on Baku would not have changed the outcome of the war in the East, it would have prolonged the lifetime of the Reich by delaying the impending Soviet counteroffensives.

The failure of the 1942 offensive, as well as the later offensive against the Kursk salient in 1943 resulted in massive losses for both the Luftwaffe and Wehrmacht. As the German war economy weakened from Allied bombing in the West, and was left without sufficient oil resources, these losses could not be replaced. In contrast, Soviet industry increased dramatically. This difference in production and supply opened the door for the Soviets to push the Germans out of the USSR, and eventually all the way to Berlin. Hrabak describes the war in the air as the tide began to turn: “We were sort of a fire brigade, as the front was always moving back and forth, and we were expected to be at every spot that was burning-to put out the fire, so to speak.”¹⁸⁷

As the Soviets pushed the Wehrmacht back into Germany, the Luftwaffe was decidedly outmatched by the VVS. Hrabak’s description of the desperate defense of the Fatherland by the Luftwaffe paints a dire picture: “The Luftwaffe was very weak at this

¹⁸⁵ Hayward, 785.

¹⁸⁶ Hayward, 791.

¹⁸⁷ Heaton, 45.

point--with two groups JG.54 could never hope to gain air superiority against the mounting number of Russian aircraft.”¹⁸⁸ With the failure of Barbarossa in 1941 and the ‘Fall Blau’ of 1942, Germany was left without the strength or resources to fight a winning war. The Luftwaffe had nearly been bled dry, and with the Allied invasion of Normandy in 1944 it could not provide adequate close air support for the defending Wehrmacht. The ensuing two-front push into Germany would bring the war in Europe to a close in May 1945.

Chapter IV: The Pacific

The war in the Pacific truly reflected the emerging dominance of airpower over the modern battlefield. The largest theatre of war would be dominated by fleets of aircraft, both carrier and land-based, rather than the massive dreadnoughts characteristic of previous naval doctrine. The previous massed ‘fleet in-being’ doctrine of large warships engaging in a decisive battle would give way to carrier strike groups with small nimble aircraft delivering their payload to sink the floating fortresses of yesteryear.

As with the other theatres of war, it would ultimately be the industrial capacity and immense resources of the Allies that would deliver the killing blow to the Axis power. The United States and Japan both took different paths to increase their wartime production, but ultimately the vastly larger and resource rich US would emerge victorious. Where the Japanese could only attempt to replace some of their wartime

¹⁸⁸ Heaton, 47.

losses, the US would both replace and expand the size of their forces in the Pacific until the end of the war.

The catalyst for the Japanese attack on Pearl Harbor was the trade sanctions placed upon Japan by the United States in response to Japanese aggression in the Pacific region, specifically that into China. This move was not an unpopular one, even if it did ultimately provoke Japanese aggression. A 1939 survey revealed that approximately 80% of American voters surveyed favored the cessation of sale of war materials (including oil) to Japan.¹⁸⁹ Due to the incredibly vast distances of the Pacific theatre, the importance of the aircraft was increased exponentially over that of Europe. Only aircraft could be used to cross the vast ocean between bases and fleets and strike the enemy. A wartime commentator remarked during the early stages of the war that "Because of its vast distances, the Pacific is of all the oceans the one where air power seems destined to play perhaps its greatest role."¹⁹⁰

Pre-war Japanese planning reflected the reality of the emerging technology of the era and the distances it would face during any wartime operations. Japan realized that airpower would be the determining factor in the Pacific theatre, and its pre-war behavior makes this readily apparent. General war-planning began with the mindset of defense from counter-attack. Japanese leadership knew that if it did secure resource-rich areas in the Pacific, it would certainly face some form of counter-attack by the West. Rather than focusing on creation of a massive surface fleet, they would defeat

¹⁸⁹ W.H.M. "Economic warfare with Japan or a new treaty?" *Foreign Affairs* 18, (1940) 366.

¹⁹⁰ Grayson Louis Kirk. "Wings over the Pacific." *Foreign Affairs* 20, (1942) 293.

this threat with a network of ground-based attack aircraft.¹⁹¹ A wartime commentator best explained this strategy as a product of Japanese doctrinal shift from a naval focus to one of air-power:

“...not until the war was actually in progress did it become plain that Japan had assigned her Navy third place among the branches of her armed services. The expanded empire which Japan coveted was to be seized by the forces of all arms, with the Army and the Air Force taking the leading parts. It was to be defended from counterattack principally by air power.”¹⁹²

Japan realized reliance upon their navy would bring defeat as early as their victory in the 1905 Russo-Japanese war after the great naval battle at Tsushima. Japan’s hard fought victory did lead to victory in the conflict, but at great cost. The battle had left the Imperial Navy severely crippled. To replace the losses suffered would cost immense resources, chief among them being time. The losses at Tsushima revealed that the large industrialized powers of the West could easily rebuild their fleets and do so in a fraction of the time that Japan could.¹⁹³ It was this early realization, one that predated even the Wright Brothers’ flight, which would lead the Japanese military to reform their strategic thinking. At the 1935 London Naval Conference Admiral Osami Nagano reiterated the lessons learned from Tsushima and the First World War:

“Even if the Power with a superior navy sends only a part to engage the inferior navy of its enemy in such decisive battle, the part of the superior navy remaining in

¹⁹¹ Alexander Kiralfy. "Watch Japanese air power." *Foreign Affairs* 23, (1944) 66.

¹⁹² Kiralfy, 66.

¹⁹³ Kiralfy, 67.

other areas will serve as a latent force which constitutes a definite menace, direct as well as indirect, to the defenses of the weaker naval Power. We need only recall the naval engagements of the Russo-Japanese and World Wars to be convinced that this is a truth to which history itself bears witness."¹⁹⁴

An American aviation journal observed: "As the naval ratio of Japan is, under the Washington treaty, 60 percent of the American naval strength, it may be seen that Japan is spending money on her naval air force far in excess of her allotted ratio of naval strength, aiming in that service evidently at parity with that of the American Navy."¹⁹⁵ This observation turned out to be incredibly accurate, as Japan's true appropriations for its air-forces was hidden behind line-items in the naval budget of the 1920's through line-item titles such as 'smaller warships'.¹⁹⁶ This development was aided by German aircraft design company Dornier who assisted Japan throughout the 1920's. They also dedicated vast resources toward one particular goal, to designing an aircraft capable of delivering a large payload to the Philippines, specifically to the American bases on Manilla.¹⁹⁷

The design of these aircraft was as much a product of geography as it was of Japan's resources. During wartime, the continental "front" that Japan faced to the West of its home islands was easily defensible, with traditional army deployment on the mainland. However, the Eastern "oceanic front" which spanned over 12,000 miles (from the Kurile Islands to New Guinea and Indonesia, with all other islands taken by Japan

¹⁹⁴ Kiralfy, 68.

¹⁹⁵ Kiralfy, 70.

¹⁹⁶ Kiralfy, 71.

¹⁹⁷ Kiralfy, 71.

early in the war adding another 1,000 miles) was vulnerable to outside Naval threats which Japan could not meet with traditional naval doctrine.¹⁹⁸ The Japanese defensive strategy was to create a network of long-ranged land based aircraft which could takeoff from the many airstrips on the dozens of small islands that Japan occupied before 1941.

This doctrine, first proposed by Admiral Baron Kato in 1921, would result in rapid concentration of massed air forces to overwhelm any advancing enemy fleet or invasion force before it could penetrate the perimeter.¹⁹⁹ The thinking followed the notion that massed amount of ground aircraft would be able to overwhelm the comparatively small numbers brought by enemy aircraft carriers. These massed attacks was similar to Japanese Army doctrine, as these pilots were treated more like expendable land infantry than highly trained specialists, and their strength would lie in numbers rather than ability.²⁰⁰

Japan's quest for naval superiority over the West was not exclusive to secretive domestic aircraft production and design. At nearly all of the major naval conferences of the pre-war era Japan sought to change international law to its benefit.

The Japanese delegation to the Washington Naval Conference of 1921 was willing to agree to a loss of capital ship and carrier parity to the US and Britain. They sacrificed both number and tonnage of their own ships in return for some concessions

¹⁹⁸ Kiralfy, 68.

¹⁹⁹ Kiralfy, 72.

²⁰⁰ Kiralfy, 73.

from the West for their naval budget.²⁰¹ This move shows the major commitment the Japanese had made to ground-based aircraft for its defense rather than large fleets.

At the London Naval Conference of 1930 the Japanese pushed for both a reduction in Battleship tonnage from 35,000 tons displacement to 25,000 tons, and also an increased “age limit” from 20 to 26 years.²⁰² This would render potential adversaries more vulnerable to attack from the air. Two years later in Geneva, the Japanese advocated for a complete ban of ship-based aircraft, and by extension aircraft carriers which would significantly hamper any offensive naval operations against Japan.²⁰³ Although this request was not met, this certainly shows their planned reliance on ground-based aircraft to defend their sphere of influence from naval threat. Again in 1934 Japan attempted to eliminate the carrier threat when Yamamoto offered to the US and Great Britain an abolition of the Japanese submarine program in return for an abandonment of carriers in the Western fleets.²⁰⁴ This was of course denied once again. Following this, Japan refused to renew the Washington Naval Treaty of 1922 and quit the London Naval Agreement of 1935-1936. In March of 1939 Japan announced a new naval expansion program that focused on carrier buildup.

The war in the Pacific began with the attack on Pearl Harbor, as well as with simultaneous attacks on the Philippines, Indonesia, and Burma. These achieved the intended goal of both seizing resources (chief among them gasoline, rubber, and bauxite) to fuel the Japanese war effort as well as close the gaps in the Pacific

²⁰¹ Kiralfy, 70.

²⁰² Kiralfy, 72.

²⁰³ Kiralfy, 72.

²⁰⁴ Kiralfy, 72.

defensive perimeter. At this point Japan was only seriously threatened along her Pacific front by carrier-led naval assault,²⁰⁵ which she had been preparing to defend against for the past two decades.

The conduct of the war in the Pacific was not one dominated by large surface fleets engaging in battleship duels. Rather, it became one of carrier groups employing massive amounts of aircraft to destroy opposing air forces and sink capital ships with well-aimed torpedoes and dive bombs. Although the Allied 'Germany First' strategy bought Japan some time, as the full weight of Allied resources could not be brought to bear upon her immediately, the odds were most certainly against the nation despite the Japanese decision to launch a surprise attack against the United States.

Failure by the Japanese Navy to destroy the American aircraft carriers stationed at Pearl Harbor was undoubtedly the most significant outcome of the attack, save only the guarantee of American entry into the global conflict. Retention of those vessels and their respective aircraft deprived Japan of a potential major advantage over the American fleet. The war in the Pacific would come to prove that naval warfare had become as much a question of projecting airpower as it was of warships. Therefore, it is apparent that the survival of the American aircraft carriers at Pearl ensured that the US Navy could conduct aerial operations from the onset of the war, as showcased by the famous Doolittle raid. Furthermore, it allowed for resources to be spent on expanding rather than repairing the Navy's carrier fleet.

²⁰⁵ Kiralfy, 73.

The Battle of Midway in June 1942 was a decisive point in the battle for airpower in the Pacific. The loss of four Japanese carriers: *Akagi*, *Sorya*, *Kaga*, and *Hiryu* compared to only one for the US Navy, the *USS Yorktown*, tells the tale of the American victory. The loss of these ships, which were critical for any naval action beyond the range of land-based airfields forced the Japanese on the defensive. The war in both hemispheres had proven that ships without proper air support, even mighty battleships such as the German *Bismarck* or British *HMS Prince of Wales* would be easy prey for enemy torpedo planes and dive bombers.²⁰⁶ Earlier that spring, American aircraft had also proved the effectiveness of air attack against naval vessels when at the Battle of the Bismarck Sea a Japanese troop convoy was attacked resulting in the loss of the entire 51st Division as well as four of eight destroyer escorts.²⁰⁷

Two years later in June 1944 American carrier and by extension air superiority over the Pacific was made unassailable. The battle of the Philippine Sea resulted in the further reduced Japanese carrier strength, effectively eliminating the possibility of effective future carrier operations for the Imperial Japanese Navy. Furthermore the IJN lost 243 of 347 aircraft while the US Navy lost only twenty-nine, resulting in the moniker “the Marianas Turkey Shoot”.²⁰⁸ Ultimately, it was not the loss of their carrier fleet that doomed the Japanese Navy, but the inability of the comparatively small island nation to replace them. From 1942 to 1944 the US put fourteen new carriers to sea, whereas Japan could only manage six.²⁰⁹ This disparity would have ensured at the very least

²⁰⁶ Plowright, 115.

²⁰⁷ Plowright, 116.

²⁰⁸ Plowright, 116.

²⁰⁹ Plowright, 115.

American numerical superiority over the Japanese, even if no carriers were destroyed by either nation.

American qualitative superiority over Japanese aircraft was firmly established during the Solomon Isles Campaign, and later reinforced in the actions around New Guinea. It soon became apparent the small airfields cut out of the dense jungle of many islands simply did not have enough aircraft to contend with the number of planes brought to battle by US carriers. This underestimation would undermine the entire Japanese defensive plan.

The number of American carriers, as well as the number of aircraft they carried was sufficient to attack both Japanese carrier groups, as well as ground-based airfields to disrupt the “flow” of aircraft to battle. This in turn give American pilots numerical parity with the Japanese, as well as allowed ground forces to land on islands and capture the Japanese airfields themselves.²¹⁰ This American battle plan was employed to great effect in the 1944 Saipan campaign.

A contemporary author proclaimed that the American spirit of self-reliance and ingenuity gave their pilots an advantage in combat due to an innate ability to improvise when compared to the Japanese who were from a more regimented ‘order-taking’ society: “Japanese fliers have been commanded to use initiative; such men are certain to come off second best when put up against men accustomed to use their own wits in the face of an unexpected problem almost as instinctively as they breathe.”²¹¹ Although this point likely originates from a source of personal bias, the examination of the pilots

²¹⁰ Kiralfy, 75.

²¹¹ Kiralfy, 76.

flying the aircraft is just as important as the analysis of the aircraft themselves. Very much mirroring the divide in training time between Allied and German pilots in the West as the war progressed and demand for pilots for the Axis increased, American pilots enjoyed much more thorough training than their Japanese counterparts throughout the war. The author also argues that Japanese pilots were not properly nourished when compared to American pilots, and that this caused both issues with hearing and eyesight that gave American pilots an advantage in the skies even when the aircraft were comparable in ability.²¹² The author goes on to argue that this disparity is the largest factor explaining American success against the modern Japanese air force, but this seems to be more conjecture than fact.

Despite the immense challenges facing the Japanese wartime industry, it did produce a remarkable amount of aircraft given the circumstances. Although lack of natural resources was an undoubtedly important factor, it was not the major limiting force in the aircraft production industry. Rather, it was the structure of the system that proved its undoing, as a lack of small 'special parts' would limit aircraft production. Japan's fighting strength ranged from 4,000 to upwards of 6,000 aircraft when it attacked the United States in 1941.²¹³ When viewed in combination with an American report that claimed that the US had destroyed approximately 12,000 Japanese aircraft from December 7th 1941 to June 29th 1944 the capacity of Japan's aircraft industry becomes apparent.²¹⁴

²¹² Kiralfy, 75.

²¹³ Kiralfy, 77.

²¹⁴ Kiralfy, 77.

Until the early 1930s, the Japanese aircraft industry was very small producing only 100 to 200 planes annually. However, in 1944, it produced some 24,000 aircraft.²¹⁵ The wartime production system in Japan which made this possible was called *kyoryoku kojo* (cooperative factories) which rather than centralizing production spread it out across the home islands.²¹⁶ This system increased the share of the aircraft production dramatically in the greater scope of Japanese industry. Where it had only constituted 8.2% of the national industrial sector in 1941, this number would explode to 33.9% by 1944.²¹⁷ Monthly Japanese airframe (just the frame of the aircraft, not the final aircraft itself) production, which was 306 in January 1939, increased to 2,541 in May 1944.²¹⁸

The 'Final Reports' of the United States Strategic Bombing Survey after the war studies Japanese industrial organization in detail. It found that the entire industry depended upon the steady supply of small yet integral parts.²¹⁹ These parts were produced not by the major firms such as Mitsubishi, whose plants would instead focus on creating engines and airframes. Rather, their production was outsourced to smaller factories scattered throughout the country. The non-concentrated industry did provide some benefits to the Japanese, chief among them being the increased resistance to aerial bombing it provided. Much of German industry was centralized, which allowed for single raids to completely incapacitate an entire production system. In contrast, the destruction of one plant in Japan would not halt production. Although this advantage

²¹⁵ Okazaki Tetsuji, "The supplier network and aircraft production in wartime Japan." *The Economic History Review* 64 no. 3 (2011) 976.

²¹⁶ Tetsuji, 974.

²¹⁷ Tetsuji, 976.

²¹⁸ *USSBS*, 161.

²¹⁹ Tetsuji, 974.

was noticeable during the early stages of American bombing of the mainland, (which began in earnest after the capture of the airfields on Saipan in 1944) eventually the unrelenting bombing would create a production bottleneck.

By 1944, there were 204 sub-contractor factories feeding the Japanese aircraft industry which produced parts such as bearings, springs, and internal machinery.²²⁰ The 'Final Reports' also indicate that MHI (Mitsubishi) contracted out 32% of its work on aircraft production to subcontractors.²²¹ This made the greater plants reliant upon the small sub-contractors in order to produce completed aircraft. These special parts could not be produced in mass quantities by large facilities as the few such facilities that Japan had were dedicated to the production of engines and airframes. It was not until the end of 1944 when US strategic bombing began to take a heavy toll on Japanese industry that a lack of these so-called "machine parts" would hinder and ultimately devastate Japanese aircraft production.²²²

As a result of the massive losses sustained at Midway and the Battle of the Coral Sea in 1942, the Imperial Navy sent requested a massive expansion of the aircraft industry, proclaiming it as an absolute necessity for the continuation of the war.²²³ This led to a September 1943 'Conference in the Presence of the Emperor' that stated 40,000 aircraft needed to be produced in 1944 to effectively defend what was termed

²²⁰ Tetsuji, 984.

²²¹ Tetsuji, 983.

²²² Tetsuji, 993.

²²³ Tetsuji, 979.

the 'absolute defense sphere'.²²⁴ This order corresponded to a government evaluation of the aircraft that concluded nearly 50,000 aircraft could be produced per year.²²⁵

Ultimately the industry could only produce half of this perceived maximum. This can be mainly attributed to aforementioned lack of parts, rather than other factors. Surprisingly, population was not a limiting factor in wartime production. The small island nation was able to fully mobilize itself for war, with the majority of the adult population either in the military or working in production, greatly due to the structure of its society. The Japanese Government 'Factory Survey' concluded with regards to the labor force: "...the fact that the requested labour force was not satisfied did not cause actual damage to production... as the expansion of our equipment and the production expansion of outside part suppliers did not keep pace with the increase in labour force, the labour force was in excess."²²⁶ Further evidence to the wealth of labor that Japan did enjoy comes from the estimates by the Ministry of International Trade and Industry. It reported that employment in the manufacturing industry in 1944 was approximately 2.5 million, a workforce population five times larger than it was in 1936 when the war with China began.²²⁷

Mass labor would not be enough to hold back the advancing Americans, just as mass attacks in the air or on the ground could not. No matter how many workers filled the factories of Japan, the lack of parts and constant realities of the American strategic bombing campaign prevented production sufficient for an effective defense. Much as

²²⁴ Tetsuji, 979.

²²⁵ Tetsuji, 979.

²²⁶ Tetsuji, 986.

²²⁷ Tetsuji, 975.

the Luftwaffe in the East faltered due to lack of replacement aircraft, the Japanese military would see itself with a severe aircraft deficit when compared to the United States in 1945.

Much as the Allies began bombing of mainland Europe after the offensive capabilities of the Luftwaffe was destroyed, the United States began strategic bombing of mainland Japan once the Japanese navy's capacity for offensive operations was greatly reduced, and their defensive capabilities insufficient to resist the new American B-29's and P-51 escorts. The strategic bombing effort against Japan as heavily influenced by its predecessor in Europe. General Curtis Lemay, the previous director of American bombing in Europe was reassigned to direct the strategic bombing of the Japanese mainland. His experience and research teams studying the effect of certain bombing patters and munitions in Europe, as well as the layout of Japanese cities influenced American air strategy moving forward.

One such study was commissioned by Army Air Corps General 'Hap' Arnold who ordered a study of Japanese cities and their susceptibility to fire in February 1942. This study was completed in November 1943 and concluded that incendiary area attacks, rather than 'precision' bombing, would produce the greatest production loss for the Japanese, due in part to the dispersed nature of Japanese cities and production therein. The report also remarked that "frame-built cities of Japan are highly combustible and can be more readily destroyed than the massive-built cities of Germany."²²⁸

²²⁸ Gian, 82.

Undoubtedly the results of this report partly influenced Lemay's decision to employ incendiary bombs against Japan in March 1945.

Before March 9th, Lemay's bombing strategy mirrored that of the European strategy. High-altitude bombing with traditional munitions had minimal results. The percentage of bombs dropped (from an average height of 30,000 ft) that hit intended target areas was less than 10% before March 9th.²²⁹ On March 9th, incendiary nighttime bombing began from a low height of 7,000ft targeting four main Japanese cities: Tokyo, Nagoya, Osaka, and Kobe. Over 31 sq. miles of those cities were completely destroyed at a cost of only twenty-two American airplanes.²³⁰ Over 70,000 Japanese civilians were killed in Tokyo alone as a result of the March 9th raids.²³¹ Daytime attacks also were conducted at a much lower altitude after this date, and bomb accuracy increased substantially to 35-40% within 1000ft of the target in daylight attacks conducted at 20,000ft or lower.²³²

The decision to use the new incendiary bombs and modify bombing strategy against the primarily wooden Japanese cities led to incredible damage to the Japanese war economy as well as massive casualties and property destruction. As a result of the bombing campaign, 470,000 barrels of oil, 221,000 tons of food, and 2 billion square yards of textiles were destroyed.²³³ Many sectors of the Japanese production industry also saw incredible reduction in total output as a result of the nine month bombing

²²⁹ *USSBS*, 84.

²³⁰ *USSBS*, 85.

²³¹ Gian, 86.

²³² *USSBS*, 85.

²³³ *USSBS*, 87.

campaign. Oil refineries saw an 83% reduction in total output, with similar results mirrored in other key industries. Aircraft engine plants saw a 75% drop in production, airframe factories 60%, and communications equipment plants 70%.²³⁴ National aluminum production was also reduced to only 9% of its 1944 peak, and total national production dropped approximately 40%.²³⁵ Much as in Germany, immense casualties were also suffered by the Japanese populace. Total civilian casualties are estimated at 806,000, with 330,000 of those killed. For comparison, Japanese combat casualties during entire war are estimated at 780,000.²³⁶

The post-war Strategic Bombing Survey concluded that even without direct air attack on the home islands the interdiction of imported material to the home islands would have caused production to drop by 40-50% by August 1945.²³⁷ However, it is unlikely that this alone would have led to surrender. However, the immense damage caused by the strategic bombing campaign likely forced Japan to surrender without the need for an Allied invasion. One post-war report concluded the nation likely would have surrendered prior to November 1st due to the immense destruction wrought by the continuing firebombing campaign, and that the atomic bombs merely accelerated that surrender.²³⁸ The deployment of the atomic bombs was the ultimate escalation of the bombing campaign, and when coupled with the previous firebombing campaign it is

²³⁴ *USSBS*, 88.

²³⁵ *USSBS*, 88.

²³⁶ *USSBS*, 92.

²³⁷ *USSBS*, 82.

²³⁸ Gian, 104.

clear that the strategic bombing campaign forced the Japanese surrender and ended the war in the Pacific.

The flaw in Japanese strategic thinking for operations in the Pacific was not on their reliance on air power. Rather, it was their belief that air power could be used to hold out indefinitely under the proposed Kato “umbrella” against the Western powers. The lack of consideration for the industrial capacity of foes such as the United States to produce superior as well as greater quantities of aircraft to defeat the Japanese aerial defenses would doom the Japanese war effort. This is an intellectual oddity as the Japanese doctrinal shift was very much a product of the realization that they could not compete industrially in naval production, and yet believed that they could do so with aircraft production.

Perhaps this belief arose from an assumption that captured rubber and aluminum resources in the Pacific that would occur in the opening moves of the war would bridge the resource gap with the West. Although this is somewhat true, the sheer number of factories producing aircraft, and dockyards producing aircraft carriers to ferry them, in the United States would overwhelm Japan. The range of American aircraft produced later in the war also far exceeded the pre-war expectations of Japanese war planners, which left their home industry vulnerable to bombing once the Allies had established a foothold in the Japanese defensive sphere.

Once they had committed to war, only an offensive doctrine, focused upon elimination of the American coastal facilities used to replenish their fleet could bring about victory. However, such a battle plan was likely beyond the capability of the Japanese at any point during the war and also assumes a willingness to surrender on

the part of the Americans that was highly unlikely without virtually unachievable success by Japan.

Conclusion:

Both the tactical and strategic benefits provided to a modern military became abundantly evident during the Second World War. Since the conclusion of the war in 1945, aircraft have continued to dominate the battlefield. In modern conflicts such as the First Gulf War it is still readily apparent that the advantage of aerial superiority is vital to success on the modern battlefield. The global conflict of the Second World War was the first to showcase the ability for the airplane to facilitate conducting war on a truly global scale. Aircraft allowed for the projection of force across oceans and vast tracts of land that would otherwise have been incredibly costly and time-consuming. Ultimately, in every theatre of war during the great conflict it can be said unquestionably that whichever side claimed control of the skies claimed control of the battlefield. Once control of the skies was lost by the Axis powers in Europe and the Pacific, the battlespace, and therefore the war, was also lost.

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