THINKING THROUGH TRANSITION:

USAF DOCTRINE, TECHNOLOGY

AND THE F-111A

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A DISSERTATION

Submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy
in the Department of History
in the Graduate School of
The University of Alabama

TUSCALOOSA, ALABAMA

2016

ABSTRACT

The dynamic created in the USAF between technological advances and strategic bombardment doctrine dates from the earliest systematic attempts to codify air doctrine after World War I. These ideas seemed to be validated by the advent of atomic weapons and long range bombers during World War II. By the 1950s, strategic bombardment and technologically advanced aircraft had become the lens through which airmen viewed modern warfare. Airmen were generally persuaded that war was total, and would be fought with nuclear weapons, despite a growing body of evidence that the geostrategic environment had changed since World War II.

This dissertation uses the F-111A as a case study to demonstrate the consistency of USAF thinking concerning doctrine and technology, which ultimately affected procurement decisions. As envisioned in 1959, the F-111A was the product of not only the latest aircraft technology available, but also a persistent preference for strategic bombardment doctrine within the USAF. Acquired as a long-range high-speed tactical nuclear fighter-bomber to counter the Soviet nuclear threat in a general war, the F-111A was sent to Southeast Asia in 1968, and again in 1972, to face an insurgent threat in a limited war. Enamored with technology, airmen believed that the F-111A, with its advanced systems, could solve the tactical problems encountered in Southeast Asia that were unforeseen in institutional doctrine. The complicated history of the F-111A serves to illustrate the pitfalls of static doctrine in an ever-changing strategic environment. This study addresses why the USAF arrived in Southeast Asia equipped for a general war in Europe, and illuminates the continuing challenge of matching technology and doctrine.

DEDICATION

This dissertation is dedicated to my loving wife, Lisa, who believed in me, encouraged me, and supported me through the highs and lows that are an inevitable part of any Ph.D. program.

ACKNOWLEDGMENTS

This project would not have been possible without the assistance of many individuals, some of whom may never realize their contributions. I will begin by thanking my committee chair, Harold Selesky, who patiently guided me in transforming my ideas into a work of history. I am grateful for my committee members, John Beeler, Dan Riches, Rich Muller, Howard Jones, and Andrew Huebner, who generously gave their valuable time to improve this project. The staff of the Air Force Historical Research Agency at Maxwell Air Force Base was invaluable in helping me to locate and declassify primary source documents. I would also like to thank the staff of the Muir S. Fairchild Research Information Center, also at Maxwell AFB, for their assistance in finding obscure secondary sources and helping to locate documents among their special collections.

As important as professional guidance was the personal support I received throughout this project. I would like to thank all of my colleagues, friends, and extended family for the words of encouragement and other forms of assistance that you gave along the way. But most of all, I need to thank my immediate family. My daughters, Beth, Sophia, and Hannah, who were little girls when I went back to school, have become young ladies in the process. Thank you for believing in me and putting up with a dad who seemed always to be working. Finally, I owe an enormous debt of gratitude to my wife Lisa, who held the family together, and without whom this dissertation would never have become a reality.

CONTENTS

INTRODUCTION

On 17 January 1991 at precisely 3:05 a.m., Baghdad time, F-15E Strike Eagles began dropping bombs in the first attack of Operation DESERT STORM. Five years after its first flight, America's newest, most advanced, and second most expensive fighter (after the F-117A) made its combat debut.[1] The United States Air Force was pleased with its performance, saying "the F-15Es flexibility was the key to its success."[2] This justified for the USAF not only the plane's expense, but also the decision to commit it to combat. Significantly, at the exact same moment in a different part of Iraq, F-111Fs began dropping their ordnance. The USAF was pleased with the F-111 as well, calling its performance "outstanding."[3] The F-15E and the F-117 represented the state of the art technologically, but the F-111 was nearing the end of its operational service. Yet, all three provided the precision guided munition capability upon which the INSTANT THUNDER air campaign was built, and by hindering the Iraqi ability to make war, all three seemed perfect expressions of Air Force doctrine. Indeed, the F-111 would end its career on a very different note than that on which it began.

Twenty-three years earlier the Air Force had committed the F-111A, its newest, most advanced, and most expensive fighter, to combat operations in Southeast Asia. The decision to deploy six F-111A aircraft quickly became the subject of much debate, as the loss of three aircraft would call into question not only the decision to commit the plane to combat, but also the

[1] William L. Smallwood, *Strike Eagle: Flying the F-15E in the Gulf War (*Washington: Brassey's Inc., 1994), 64-65.
[2] White Paper: Air Force Performance in Desert Storm, April 1991, http://www.dtic.mil/dtic/tr/fulltext/u2/a235941.pdf , accessed 30 March 2016, 3.
[3] Ibid, 4.

decision to buy and build the expensive fighter. Many have formed an unfavorable opinion of the aircraft due to its beginning as the Tactical Fighter Experimental (TFX), and the belief that Secretary of Defense Robert McNamara forced the plane on the Air Force. While it is true that McNamara forced the Air Force and the Navy to cooperate on the procurement of the plane, the Air Force obtained most of what it desired from the project. The Air Force wanted a fast, long range, tactical nuclear bomber incorporating state of the art airframe, engine, and avionics technology, which fit with the corporate conception of doctrine and the equipment the United States would need to prosecute the next war.

These two examples demonstrate a certain continuity of thought in how airmen consider technology and doctrine, and how that is expressed in airframe design. Since the advent of manned flight, technology and doctrine have been inextricably linked in the minds of American airmen. Although technology changes relatively quickly, and doctrine changes more slowly, each informs the other. This is not because specific technological changes inform doctrine, but rather because USAF doctrine has always assumed a reliance on the next technological innovation. Technology and doctrine do not operate in a vacuum, however, as the geostrategic environment also affects the two. The changes in the strategic environment are the hardest for airmen to anticipate, and the political strategic environment changes more rapidly than doctrine. These changes in the political situation cause military planners the most problems, because the procurement cycle for military hardware often places them in the situation where the equipment procured was based on doctrine that was derived from old political assumptions. Strategy, technology and doctrine are always in transition. This monograph explores the way airmen think through these transitions.

This dissertation is a case study of the F-111A, and how the aircraft as conceived and developed represented the intersection of technology and doctrine in the late 1950s. I argue that the F-111A is, counter to conventional wisdom, the airplane the US Air Force wanted due to an enduring institutional faith in superior technology and a belief in the efficacy of strategic bombardment. I submit that airmen procured the F-111 based on their assumptions about the strategic environment in the late 1950s. These assumptions, however, were based on thinking that dated to the 1930s, which they believed had been validated in World War II. Advances not only in aircraft technology, but also in weapons technology seemed tailor made for the doctrine they had developed, which in turn informed their procurement decisions. I contend that airmen failed to recognize changes in the strategic environment that were already clear by the early 1950s. More forward thinking leadership may have made different procurement decisions had they chosen to see the changes in the geostrategic environment. Instead, they doubled down on their old thinking and procured a fast, long range, nuclear bomber, designed to defend Western Europe from the communist hordes just across the Inner-German Border.

This project is influenced by John Lewis Gaddis work, and his use of the operational code as a means for understanding foreign policy professionals, and by Wayne Lee and his work on military culture. The term "operational code" was not new to Gaddis, as he credits political scientist Alexander George for offering the term as an explanation for how political leaders make decisions. Gaddis defined the operational code as "a set of assumptions about the world, formed early in one's career, that tend to govern without much subsequent variation the way one responds to crises afterwards."[1] I contend that the concept applies equally well to military

[1] John Lewis Gaddis, *Strategies of Containment: A Critical Appraisal of Postwar American National Security Policy* (New York: Oxford University Press, 1982), viii-ix. For more on the operational code, see Alexander L. George, "The 'Operational Code' A Neglected Approach to the study of Political Leaders and Decision-Making," in *International Studies Quarterly* Vol. 13 No.2 (June1969).

officers. Lee's work on culture is also important to this project, because he suggests that groups form beliefs and assumptions that are not readily visible to the outside observer. Also important to his definition of culture is that these beliefs and assumptions are passed on to the next generation. He asserts that culture "provides a repertoire of choices" that "does not limit individual possibility, but it shapes individual vision." Lee contends that military organizations transmit cultural values not only through "doctrine, training, theoretical literature, and stated policy," but also "in actions, as well as words."[2]

The concepts presented by Gaddis and Lee work together when one attempts to understand how Air Force officers approach problems. The US Air Force culture began with the acquisition of the Wright Flyer by the US Army, and the creation of the Army Air Service. The first airmen were Army officers, steeped in the tradition of "hard war" against enemy resources, forged during the defeat of the Confederacy in the US Civil War, as well as the harsh struggle against the Filipino insurrectos. The internal collapse of the Central Powers during the Great War reinforced the notion that a nation deprived of resources cannot continue to fight a modern war. Aircraft technology seemed to promise a way in which airmen could strike at enemy resources, unimpeded by geography or enemy surface forces. Guilio Douhet was among the first to commit to paper the thought of using aircraft to strike directly at the sources of enemy power, but his ideas probably belonged to a community of thought shared among the first generation of airmen.

It was during the interwar years that the US Army Air Corps began to develop air doctrine. The veterans of the last war crafted a theory of airpower around the destruction of the enemy's industrial web. The theory was based on the idea that the individual parts of a nation's

[2] Wayne E. Lee, ed., *Warfare and Culture in World History* (New York: New York University Press, 2011), 2-3.

industrial base were connected like a web, and if critical nodes could be identified and destroyed, the whole edifice would come tumbling down. In order to bring down the web, the airmen argued, the nation needed bombers capable of carrying a heavy load of bombs deep into the interior of an enemy nation, and the ability to drop those bombs accurately on the assigned targets. The pace of technological change convinced airmen the United States could have the bombers it needed before another war came about. These ideas and beliefs were transmitted formally through training, especially at the Air Corps Tactical School, and no doubt informally at the Officer's Club bar where the "old heads" told their war stories and gave their opinions to young officers who had yet to see combat.

When American airmen next went to war, they were members of the US Army Air Forces, and they believed modern technology had provided them with the weapon they needed to defeat Germany. The fast, long range, high flying B-17, equipped with the Norden bombsight, represented the state of the art, and was the expression of their belief that a strategic attack upon the industrial web would bring the Third Reich to its knees. A true assessment of the effectiveness of the strategic bombing campaign would show that bomb accuracy was a major problem, and that the results were inconclusive concerning how much damage had been wrought upon German industry. As the war was winding down, an even faster, longer range, higher flying plane became available – the B-29. It was no more accurate than the B-17, but technology seemed to have solved the accuracy problem with the advent of atomic weapons. Turning their eyes toward the atomic future, airmen failed to learn lessons about air superiority and close air support that had been forged during the conflict. Veterans of World War II passed to the next generation the idea that strategic bombing had destroyed German industry, and that atomic

bombs were powerful enough to destroy a city, its industry with it, and that was how one won a modern war.

The community of airmen did not understand the Korean War, because the conflict did not fit their paradigm about how war should be fought. By this time the Strategic Air Command, keeper of the heavy bombers and the 5 ton atomic bombs of the period, assumed a preeminence not only within the USAF, but also among the other services. Even though the United States had lost its nuclear monopoly, airmen believed that US nuclear superiority should have been enough to deter communist aggression on the Korean Peninsula. The geostrategic situation had changed, however, and the Truman administration put well defined limits on the use of violence during the war in Korea. Airmen introduced new aircraft technology during the war, the results of exploited German technology after World War II. But with conflict coming so close on the heels of the last war, they had not had time to think about how this new technology could best be used to their advantage. They simply reacted with their new planes, relying on the doctrine that had worked in the last war. When Truman left office in 1953, he took his ideas on nuclear weapons into retirement, but the Air Force passed their ideas on to the next generation of airmen.

The Eisenhower Administration's New Look policy, which relied on the threat of inflicting massive nuclear retaliation upon an aggressor nation, was a doctrine that accorded nicely with Air Force strategic bombardment doctrine. The lessons concerning air superiority and close air support that had been learned during World War II, and relearned during the Korean Conflict, were forgotten shortly after the fighting in Korea ended. President Eisenhower's view of nuclear weapons was more nuanced than his predecessor's had been. In David Alan Rosenberg's view, Truman conceived of the bomb as an "apocalyptic terror weapon, a weapon of last resort." Rosenberg said that Eisenhower entered office with "a more thorough

knowledge of nuclear weapons than any president before or since."[3] Eisenhower brought a soldier's view of nuclear weapons to the White House, and at least early in his administration, probably believed the United States could win a nuclear exchange with the Soviet Union.

The miniaturization of nuclear warheads changed the calculus for small, tactical aircraft. SAC continued to rely on big bombers because they were long range and able to carry more of the smaller bombs. As more of the small bombs became available, Tactical Air Command and Air Defense Command acquired a nuclear capability as well. ADC obtained the Genie rocket and aircraft that could fly very fast in a straight line to intercept incoming Soviet bombers. The Genie was their preferred weapon, because accuracy was still a problem in early semi-active radar and heat seeking missiles. The TAC mission changed the most in the new environment, as the day air superiority fighters and fighter-bombers that the Korean experience suggested transitioned to tactical nuclear strike. Older fighters were retrofitted to deliver nuclear weapons, and each new fighter to enter the inventory during the 1950s had more emphasis placed on the nuclear mission, to the detriment of the air superiority mission, and to an extent, the conventional bombing mission as well. This was the state of Air Force thought when the new fighter for the 1960s, which would eventually be known as the F-111, was envisioned in 1959. The community of airmen did not recognize that the geostrategic environment had changed, or that the concept for their new fighter was based on old assumptions.

This study is arranged chronologically rather than topically, so that the reader can follow the development of the thought that led to the F-111A. It is separated into five chapters, the first of which is very general, and proceeds to the very specific. Chapter One traces the development of strategic bombardment doctrine from the beginnings of flight to its application during the

[3] David Alan Rosenberg, "The Origins of Overkill: Nuclear Weapons and American Strategy, 1945-1960" in *International Security*, Vol 7, No. 4 (Spring 1983),11, 27-28.

Second World War. It will review all of the major airpower theorists of the interwar years, with a particular emphasis on the theories developed at the Air Corps Tactical School, which in effect became doctrine. Chapter Two discusses the exploitation of German aerospace technology after the war, and the changed strategic environment. It focuses on the Air Force conception of war in the nuclear age, the plans airmen made for war with the Soviet Union, and how that affected the aircraft they acquired. This chapter ends with the Korean War, and how an Air Force prepared for total nuclear war faced the challenge of limited conventional war. Chapter Three discusses in depth the miniaturization of nuclear weapons and development of the Century Series Fighters. The emphasis is on technological advances and how USAF doctrine determined the aircraft the Air Force procured.

The final two chapters are specific to the F-111A. Chapter Four chronicles the plane's beginning as the Tactical Fighter Experimental (TFX), the advanced technology it would incorporate, and the controversy surrounding the procurement process. While this study does not look in depth at the US Navy's procurement of aircraft, this chapter of necessity considers the F-111B, the ill-fated Navy version of the jet. This chapter also covers the development of the F-111A against the backdrop of the war in Vietnam, and the tactical problems the Air Force sought to solve with its new fighter. Chapter Five explores the two deployments of the F-111A to Vietnam, the controversial COMBAT LANCER deployment in 1968, and the more successful CONSTANT GUARD V deployment in 1972. This chapter illuminates USAF thinking on the role of technology and doctrine when both are put to the test in actual combat, realizing that the war the United States found itself fighting was not the one for which the Air Force had prepared. The narrative in each of the five chapters weaves back and forth between doctrine and technology, all against the backdrop of the geostrategic environment.

The goal of this study is to illuminate how the USAF has transmitted its cultural beliefs and assumptions within the organization. By using the F-111A as a case study, I intend to illustrate how airmen thought about technology, doctrine, and aircraft procurement at one specific point in history. Despite folklore to the contrary, the areas in which the Air Force had to compromise with the Navy on the F-111 turned out to be minimal. It was the Navy who had to compromise too much of what it needed in a carrier based interceptor, although many of the features introduced in the F-111 later appeared in the carrier-based F-14 Tomcat. The F-111 was an Air Force program from the beginning, and was primarily the very fast, long range, tactical nuclear bomber that airmen desired. It was a plane conceived for a different era than the one in which it entered service, yet it was able to transition to the conventional role the Air Force required. Judging by official Air Force statements, the organization concluded that it transitioned successfully. Perhaps studying the F-111 will shed some light on how military organizations think and improvise their way through transition.

CHAPTER 1

THE FOUNDATIONS OF USAF BOMBARDMENT DOCTRINE

The desire to rain death and destruction from the sky upon one's enemies is at least as old as the Biblical account of the destruction of Sodom and Gomorrah. It is a seductive theory of war, as there appears to be no defense against one who is able to fly over enemy territory and strike at will, wreaking havoc not only on armies in the field, but also in the rear areas which sustain those armies. Throughout most of recorded history, however, man was technologically unable to exploit the third dimension. This began to change in the eighteenth century with the advent of hot air balloons. The calculus changed forever at the beginning of the twentieth century with the advent of heavier than air flight. Military men began to envision a future in which they could exploit the third dimension.

Yet the military planners were not the only ones who considered future conflict. Indeed, as the Twentieth Century dawned, various authors across the globe thought about the future of armed violence. H.G. Wells thoughts on twentieth century warfare, published in 1901, were eerily prescient. He foresaw the trenches of the Great War, the use of observation balloons for artillery spotting and the mechanization of warfare with "iron clad road fighting machines." Wells was very much aware of the experiments with powered flight being conducted by scientists such as Langley, Chanute, and Lilienthal. Wells imagined "aeroplanes" and predicted that the first task for either contender would be to gain "command of the air." Once command of the air had been attained, he imagines the victor of the air battle ranging through the enemy's rear areas to "drop explosives and incendiary matters upon them." Wells thought that aerial war

machines would certainly be available by the end of the twentieth century, and thought they could possibly be ready by 1950. His timing was only off by five decades.[1]

The birth of American military aviation can be dated to 1908, when the U.S. Army purchased a Wright Flyer and contracted with the Wright Brothers to train its first pilots. European militaries quickly acquired the new heavier than air machines, all intending to use the new craft for observation. By 1911 the Italians were using airplanes and airships against the Turks in Libya, first for reconnaissance, and eventually to drop bombs on the enemy. The bombs were of no appreciable effect, as they either missed the mark or were so small as to be of little use.[2] When Europe went to war in 1914, the great powers all fielded a new and for all intents and purposes untested weapon, whose value was as yet unrealized. By 1918, the crucible of war had proved the worth of the air weapon, "as combatants amassed and used aircraft in sufficient quantity and quality to affect the outcome of engagements."[3] While the airplane was initially employed for reconnaissance, other missions followed quickly. Pursuit was born as fast, single seat single engine planes were armed and dispatched to prevent the two seat observation craft from completing their assigned mission. Early in the conflict, within the first several weeks, the opposing forces began dropping small projectiles onto enemy troop concentrations, giving birth to the bombardment mission.[4]

As the war progressed, the exploits of pursuit pilots may have captured the public imagination, but the public feared aerial bombardment. As early as August 3, 1914 there were

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[1] H.G. Wells, *Anticipations of the Reaction of Mechanical and Scientific Progress Upon Human Life and Thought,* (New York: Harper and Brothers, 1901),193-202; for more on the work of futurists, see William Le Queux, *The Invasion of 1910: With a Full Account of the Siege of London* (London: Eveleigh Nash, 1906), and Sir Julius Vogel, *Anno Domini 2000; or Women's Destiny* (London: Hutchinson and Company, 1889).
[2] Lee Kennett, *The First Air War: 1914-1918* (NewYork: The Free Press, 1991), 7, 17-18.
[3] John H. Morrow, Jr., *The Great War in the Air: Military Aviation from 1909 to 1921* (Washington: Smithsonian Institution Press, 1993), xiii.
[4] Kennett, *The First Air War,* 41.

false reports that the French had bombed Nuremberg, and that German zeppelins had attacked England. Kennett called Europeans "particularly predisposed" to believe these reports, as the years before the war had been filled with a public discussion of the threat posed by aircraft. The German claim that the French had bombed Nuremburg was ludicrous, as France did not possess a plane capable of reaching Nuremberg with a load of bombs in August 1914. Of the initial combatants, Germany alone possessed any true strategic bombing capability due to the prewar investment in zeppelins. The zeppelins possessed both greater range and greater lifting capacity than early aircraft. But highly flammable hydrogen provided their lift, which made them extremely vulnerable to enemy fire.[5]

By the end of 1914, all of the major combatants were dropping bombs on their enemies. While the initial targets for the Allies were fielded military forces and supply depots to the rear of the front, French bombers were soon attacking industrial targets in Germany that supplied the fielded forces. Despite a desire to bomb England, early German bombers did not possess the range to reach the island nation. By early 1915, however, German zeppelins were attacking targets in England. By 1917, the Germans had developed large multi-engine bombers capable of striking England. Because these early bombers were not very accurate, emphasis was placed on attacking enemy morale.[6]

As the war on the ground stagnated, the combatants increasingly used the air weapon to target the enemy's will to resist. In a contemporary account, R.P. Hearne spoke of "the principle of psychological influence," and the actions of airmen were justified as making war on the morale of the enemy people as attacks on urban industrial areas increased.[7] There is an ongoing

[5] Lee Kennett, *A History of Strategic Bombardment* (New York: Charles Scribner's Sons, 1982), 18-22.
[6] Ibid, 27.
[7] Kennett, *Strategic Bombardment,* 24; R.P. Hearne, *Zeppelins and Super Zeppelins,* (London: John Lane, 1916), 1-6.

debate about to what degree morale was actually affected. Daniel Mortensen asserts that there is evidence that morale was affected by aerial attack, claiming that absenteeism was high among factory workers. However, he does not cite any statistics to support this claim. Contemporary firsthand accounts chronicling the fear that aerial bombardment produced do not seem to exist. Perhaps this is a result of a desire to hide the effects of the attacks from the enemy. Civil and military officials seem to have recognized that bombing had an effect on morale, yet no one could quantify this effect or back it with statistics.[8]

The Great War ended with the abrupt German collapse at the end of 1918. The exigencies of war had in four short years transformed the airplane from a fragile craft considered possibly useful for observation into an offensive weapon deemed necessary for success. Technology changed rapidly during the war years. I.B. Holley stated:

> Foreign aviation missions in Washington during the spring of 1917 agreed that a 225 h.p. engine should be developed for use in the following year. Three months later it was evident that a 330 h.p. engine would be required if aircraft of the AEF were to compete successfully with the enemy.[9]

Much of the airplane's development as a weapon was ad hoc. Hallion stresses the importance of wood working in the construction of lighter, sturdier airframes.[10] Morrow argues that while aircraft types changed rapidly and frequently required modification, the development of engine technology was preeminent.[11] Machine guns, bomb racks, and armor were among the technologies developed as military organizations sought ways to strike at the enemy from the air. A problem specific to bombers was accuracy, or how the air crew could determine the correct

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[8] Daniel R. Mortensen, "The Air Service in the Great War," in *Winged Shield, Winged Sword: A History of the United States Air Force*, ed. Bernard C. Nalty (Washington: Air Force History and Museums Program, 1997), 41.
[9] I.B. Holley, Jr., *Ideas and Weapons* (Washington: Air Force History and Museums Program, 1997), 120. [Originally published by Yale University Press, 1953.]
[10] Richard P. Hallion, "Wooden Aircraft and the Great War," in *Journal of Forest History* Vol. 22, No. 4 (Oct 1978), 200-202
[11] Morrow, *The Great War in the Air*, xvi.

release point in space to actually hit the target. While early sighting methods that accounted for such dynamics as wind drift were developed, they were notoriously inaccurate. One author notes that after action reports reveal that the flyers relied on their own experience and developed personal techniques for aiming their payloads.[12]

While much thought was given to the tactical employment of the new weapon system, and even its operational implications during the war, it was after the guns were silenced that men began to think and write about the strategic implications of the Wright's invention and how it might be employed in the next war. Among the first to commit his thoughts concerning the air weapon to paper was the Italian General Giulio Douhet. An artillery officer who never earned pilot's wings, Douhet became the chief of the Italian Air Service during the war. He was among the first to extol the significance of the air weapon in *The Command of the Air,* published in 1921. Undoubtedly influenced by the rugged, mountainous terrain of his home country and the restrictions thus placed on the movement of armies, Douhet contended that the airplane was unrestricted by geography. He argued that the airplane could strike targets beyond the range of artillery, and advocated striking what he called the vital centers of the enemy war effort. These vital centers consisted of industry and commerce, important buildings both public and private, transportation infrastructure and the enemy populace. Douhet believed that destruction of the enemy's vital centers would target the true objective of war, which is the enemy's will to resist.[13]

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[12] Stephen L. McFarland, *America's Pursuit of Precision Bombardment, 1910-1945* (Washington: Smithsonian Institution Press, 1995), 8-25; George K. Williams, *Biplanes and Bombsights: British Bombing in World War I* (Maxwell Air Force Base: Air University Press, 1999), 120.

[13] Guilio Douhet, *The Command of the Air,* trans. Dino Ferrari (Washington DC: Air Force History and Museums Programs, 1998); Col Philip S. Meilinger, "Giulio Douhet and the Origins of Airpower Theory," in *The Paths of Heaven: The Evolution of Airpower Theory,* ed. Col Philip S. Meilinger (Maxwell Air Force Base, AL: Air University Press, 1997); David MacIsaac, "Voices from the Central Blue: The Air Power Theorists," in *Makers of Modern Strategy from Machiavelli to the Nuclear Age,* ed Peter Paret (Princeton: Princeton University Press,1986).

Douhet believed that the airplane was an offensive weapon that should be targeted against enemy morale. As such, he advocated a massive bombing campaign on the enemy population centers at the onset of hostilities. He believed that a large fleet of heavily armed bombers would wreak enough havoc to disrupt any offensive plans the enemy might have. Douhet called for a mixture of high explosive, incendiary and chemical bombs in these attacks. The high explosives were meant to break up buildings in cities, the incendiaries were to start fires, and the chemicals were intended to inhibit the work of emergency responders. All of this was meant to disrupt the enemy's vital centers and to target the morale of the enemy populace. He thought pursuit planes were a waste of resources, calling for defensive armament on his bombers to defend against enemy fighter aircraft. Douhet called for an independent air force, coequal to ground and naval forces, and led by airmen. He was convinced ground commanders did not understand the air weapon or its proper employment in war.[14]

General Douhet's theories were controversial at the time and are often trivialized today. Meilinger points out that he missed the development of radar and effective defensive measures against the bomber. The Second World War showed that morale was much more resilient under air bombardment than theorists believed possible at the end of the Great War. MacIsaac does qualify the assessment by saying that by eschewing chemical weapons, the combatants never fully implemented Douhet's bombing theory. Yet, it remains that airmen in all of the developed nations were familiar with his works. His works were especially well known in France, since the original Italian language was not too difficult for a French-speaker to read. Douhet remains today one of the first to commit his thoughts concerning the air weapon to paper, and offered airmen a method for thinking about its employment.[15]

[14] Douhet, *The Command of the Air*.
[15] Meilinger, "Giulio Douhet and the Origins of Airpower Theory"; MacIssac, "Voices from the Central Blue."

Scholars often turn to the British airman Hugh Trenchard and his protégé John Slessor when attempting to understand the development of air power theory after World War I. Trenchard is probably best known for his leadership of the Royal Air Force, the first independent air force, at a time of meager budgets and general aversion to continental involvements. He did not record his ideas in a book as did Douhet, however, his thoughts on the proper use of airpower are easily discerned from official memos and the organization he established in the Royal Air Force. British airpower theory flowed from the nation's traditional method of waging economic warfare. Much like Douhet, Trenchard believed in the strategic effects of bombardment and the effects on enemy morale. Where he differed was in his abjuring of direct attacks on enemy population centers, believing instead that attacks on industry would have sufficient effect.

Trenchard was not a prolific writer, but his influence is evidenced "in the surprising consistency of thought and application reflected by most of the leading British airmen of World War II – Portal, Leigh-Mallory, 'Mary' Conningham, Slessor, Harris, Saundby and others..."[16] Slessor did commit his thoughts to paper in the book *Air Power and Armies,* which Meilinger called "perhaps the best treatise on airpower theory written in English before World War II."[17]

The first American attempt at a systematic airpower theory was the work of William "Billy" Mitchell. When America went to war with Spain in 1898, young Mitchell enlisted in the Army. His father, a United States Senator, secured him a commission in the Signal Corps. Mitchell remained in the Army after the war with Spain, serving in the Philippines and Alaska,

[16] Eugene M. Emme, "Technical Change and Western Military Thought – 1914-1945" in *Military Affairs,* Vol. 24, No. 1 (Spring 1960), 13.
[17] Col Philip S. Meilinger, "Trenchard, Slessor and Royal Air Force Doctrine before World War II" in *The Paths of Heaven: The Evolution of Airpower Theory,* ed. Col Philip S. Meilinger (Maxwell Air Force Base, AL: Air University Press, 1997),

and as an instructor at the signal corps school at Fort Leavenworth, Kansas. He recognized the military significance of dirigibles and the first fragile aircraft early in his career. Mitchell learned to fly at his own expense in 1916, however, he did not receive his military wings until he was in France during the war. Even though he did not fly in the punitive expedition against Mexico, he was one of the senior officers in the Signal Corps Aviation section when America entered World War I. Hurley called him "one of the significant figures of the years between World Wars I and II."[18]

Major Mitchell was the first American officer to enter the war zone, sent to Europe as an aeronautical observer in the spring of 1917. He arrived in France four days after the United States declared war on Germany. The war was two and a half years old when America entered the conflict, and the aerial antagonists had gained valuable experience during that period. Mitchell seems to have arrived with no preconceived notions on how to prosecute the air war, as he spent time meeting with French and British airmen to absorb what they had learned in combat. The lessons he learned seemed to be that the airplane is an offensive weapon, that one must control the airspace over and beyond the front lines, and that constant pressure must be applied to the enemy rear areas. When General John J. "Black Jack" Pershing arrived in France, Mitchell already had a plan for organizing the American Expeditionary Force (AEF) aviation based on knowledge gleaned from the French and British.[19]

Perhaps Michell's most significant accomplishment during the war was leading an allied force of 1481 planes during the St. Mihiel Offensive in late 1918. Most of the assembled strike force was French, British and Italian, as the AEF never had more than 650 planes, most of which were French, not American designs. The mix of his force reveals much about what Mitchell

[18] Major Alfred F. Hurley, *Billy Mitchell: Crusader for Air Power*, (New York: Franklin Watts, Inc., 1964), x.
[19] Ibid.

thought was necessary to affect the attack by 1918. Comprising almost half the force were the 701 pursuit planes, necessary to gain command of the air, or air superiority in modern parlance. The remainder were divided nearly equally between 366 observation craft and 414 bombers. The bombers were further divided into 323 day bombers and 91 night bombers. Mortensen contends that while bad weather limited their effectiveness, "Mitchell's aviators contributed to a clear cut victory on the ground."[20]

Mitchell was a prolific writer after the war, writing letters, composing articles and publishing *Our Air Force* in 1921. The most complete expression of his ideas appears in his 1925 book, *Winged Defense.* Mitchell's ideas were influenced by America's geographic position, and the nation's traditional defensive posture behind the Atlantic and Pacific Oceans. As such, he advocated a balanced approach to air power, with a great emphasis on pursuit aviation. It was this focus on defense that led him to advocate the use of bombers for coastal defense and his conflict with the Navy over missions. The sinking of the German battleship *Ostfriesland* not only demonstrated the feasibility of his ideas, but also encouraged him to adopt a more confrontational stance, which eventually led to his court martial and retirement from active service.[21] While Mitchell is best known for his insistence on an independent air force, Clodfelter contends that "his welding the notion of air force autonomy to a progressive view of 'independent' air operations, such as strategic bombing, that aimed to achieve independent results" was his greatest contribution to air power thinking.[22]

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[20] Mortensen, "The Air Service in the Great War," 65-66.
[21] William Mitchell, *Winged Defense: The Development and Possibilities of Modern Air Power – Economic and Military* (New York: G.P. Putnam's Sons, 1925).
[22] Lt Col Mark A. Clodfelter, "Molding Airpower Convictions: Development and Legacy of William Mitchell's Strategic Thought," in *The Paths of Heaven: The Evolution of Airpower Theory,* ed. Col Philip S. Meilinger (Maxwell Air Force Base, AL: Air University Press, 1997), 79.

Scholars have made much of Mitchell's association with the British airman Hugh Trenchard during the war as well as his later association with General Giulio Douhet when they search for the origins of American airpower theory. There is a temptation to draw a direct connection between their thoughts and his, particularly when considering Mitchell's ideas on strategic bombardment and attacks on vital centers. As Hurley notes, the ideas of most early airmen belonged to a community of thought.[23] Mitchell's ideas may not have been wholly original; however, he brought a truly American perspective to airpower thought. Thomas Bruscino asserts that US military theorists after the U.S. Civil War were familiar with Clausewitz, but applied the German thinker's theories to the conditions specific to America, calling American military thinkers "naturally Clausewitzian."[24] As an Army officer, Mitchell had certainly studied the American Civil War early in his career, including William Tecumseh Sherman's campaign in Georgia and the Carolinas, and Phillip Sheridan's campaign in the Shenandoah Valley. The target of these actions was Confederate resources and morale and ultimately, their will to resist. He would have come away with the understanding that the way to win a war was to take away the enemy's ability to continue the conflict. When applied to airpower, that translated into a bombing campaign against the enemy's vital centers.

Historian Robert Frank Futrell credits Billy Mitchell with making the first written statement of American air power doctrine. On 2 July 1917, shortly after America's entry into the war, a cavalry officer named Maj Frank Parker made a report to a board of officers on the state of aviation. His report, which outlined roles for tactical and strategical aviation was subsequently published by Mitchell as "General Principles Underlying the Use of the Air Service

[23] Hurley, 139.
[24] Thomas Bruscino, "Naturally Clausewitzian: U.S. Army Theory and Education from Reconstruction to the Interwar Years," in *The Journal of Military History* 77, num. 4 (October 2013).

in the Zone of Advance A.E.F." It is probably safe to assume that the work was Mitchell's and that Parker only delivered the report.[25] Haywood Hansell, a prominent World War II aviator, said Lt Col Edgar S. Gorrell made the "earliest, clearest and least known statement" of American air power doctrine. Gorrell headed a team that produced the U.S. bombing survey after World War I, which one historian said "helped to shape bombing policies and operations of the U.S Army Air Corps and the U.S. Army Air Forces (USAAF)."[26] General Benjamin F. Foulois is mentioned as a prominent early airpower advocate, known for publically advocating an independent air force in Congressional Hearings in 1919. Thomas Greer said that immediately after the war Foulois was "the most aggressive and defiant spokesman within the service," which is quite an acknowledgement, given Mitchell's later reputation.[27] Other prominent airmen such as Henry A. "Hap" Arnold testified before Congress as well. These early airmen seem to have acquired a belief that the airplane was an offensive weapon which could only be employed properly when commanded by airmen in an autonomous organization coequal with ground and naval forces.

While prominent, high ranking airmen articulated a vision for airpower, it was often the work of nameless staff officers who made that vision a reality. Lt Col Edgar Gorrell was tasked by General Mason Patrick to compile lessons learned after the war. Gorrell had headed the Air Service strategical section, as they called it then, and had planned a strategical air campaign for 1919 which was never put into effect due to the armistice. Very interested in the effects

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[25] Robert Frank Futrell, *Ideas, Concepts, Doctrine: Basic Thinking in the United States Air Force 1907-1960*, Volume I (Maxwell Air Force Base: Air University Press, 1989) , 22 [originally published 1971]; Mauer Mauer, ed., *The US Air Service in World War I, Volume II, Early Concepts of Military Aviation* (Washington: Office of Air Force History, 1978), 119-120.

[26] Thomas H. Greer, *The Development of Air Doctrine in the Army Air Arm, 1917-1941* (Washington: Office of Air Force History, 1985), 10 [originally published 1955]; Mauer Mauer, ed. *The US Air Service in World War I, Volume IV, Postwar Review* (Washington: Office of Air Force History, 1979), 504.

[27] John F. Shiner, "Benjamin D. Foulois: In the Beginning," in *Makers of the United States Air Force*, ed. John L. Frisbee (Washington: Office of Air Force History, 1987), 20; Greer, 22.

bombing had on the enemy, Gorrell assembled twelve teams to survey bomb damage and to glean as much information as possible. Mauer writes that they were instructed to assemble information in five areas:

> (1) General, that is, the basic facts about each raid – time, name of factory, its product, etc. – with each alert being covered, whether or not the place was bombed; (2) material damage; (3) bombing of railroads, including the length of time that trains were held up; (4) measures adopted in factories and town; and (5) moral effect.[28]

Additionally, they were to determine whether day or night bombing yielded the best results. Clearly, Gorrell looked to quantify the effects with an eye toward the next war and how bombers might best be employed.

Gorrell's teams did not have access to every site bombed, particularly those east of the Rhine, and in many cases they could obtain no information. But they diligently compiled information where it was available and produced a report that effected the course of U.S. bombing doctrine. They not only attached a monetary value to damages, but also to such things as how much the enemy spent to protect against the attacks, and lost production. They were interested in work time lost in factories, as most factories ran around the clock and the time lost could not be recovered. Naturally, they counted the number of killed and wounded. What the teams could not quantify was the effect on morale. The U.S. Bombing Survey concluded that the most important bombing campaigns were, in order of importance, those directed against war industry, railroads, and then troop concentrations. The survey offers a critique of the recent conflict, stating that there was no coordinated plan to attack the industries most vital to the enemy's war making potential. It suggests a careful study of industry to determine which factories were most critical, the destruction of which would case the greatest damage to the enemy's war making potential. The survey expresses the opinion that the effects of bombing on

[28] Mauer, *Vol IV, Postwar Review,* 364-365.

morale were plainly visible, while offering a sort of dissenting opinion that enemy morale was not sufficiently shaken by bombing to hinder military operations.[29]

American airmen's thoughts on how to properly employ the air weapon gradually coalesced into something clearly recognizable as doctrine at the Air Corps Tactical School (ACTS). Between its inception in 1922 and when the last class graduated in 1940, ACTS significantly influenced airpower thought in the US Army air arm. Its impact is evidenced by the fact that over 80% of the general officers during World War II were graduates of the course, including all three four star generals, and eleven of the thirteen three star generals. Established as the Air Service Tactical School at Langley Field, Virginia in 1922, the institution followed an Army tradition of establishing professional development schools for each of its branches. The name was changed to the Air Corps Tactical School in 1926 when the Air Service became the Air Corps, and the school moved to Maxwell Field, Alabama in 1931. ACTS differed, however, from other Army schools in that there was no officially codified body of air power doctrine to teach the students. The curriculum therefore focused on the possibilities of airpower, and instructors projected a vision of the future based on conjecture and the pace of technological change. The gap between precedent and possibility led one historian to remark that "the school became inextricably involved in developing air doctrine."[30]

Offensive-minded army aviators developed a strategic bombardment doctrine during a period when the official policy of the United States was one of defense. Thomas Greer goes so far as to say that there was no strategic vision during the 1920s, and no likely enemy that the

[29] Ibid., 495-504.
[30] Robert T. Finney, *History of the Air Corps Tactical School, 1920-1940* (Washington: Air Force History and Museums Program, 1998), *v*, 43, [originally published 1955].

military and naval establishment actually prepared to face.[31] After the Great War, Americans had returned to an isolationist foreign policy, following the traditional avoidance of entanglements that had been advocated by George Washington. Yet, while America avoided military alliances and shunned the League of Nations, the nation was quite involved in world affairs. The United States hosted the Washington Naval Conference in 1921-22 and was a cosponsor with France of the Kellogg-Briand Pact in 1928. One historian was prompted to call the period 1921 to 1931 one of "involvement without commitment."[32]

Perhaps not receiving word that U.S. Secretary of State Frank B. Kellogg and French Foreign Minister Aristide Briand had outlawed war, the War Department continued to plan for the next conflict. While publicly preparing to defend the nation's shores from invasion, the plans produced by the War Department seemed to envision a repeat of the last war, complete with an expeditionary force and a grand land battle on the enemy's shores. The Air Service embraced both alternatives, running into conflict with the Navy over who was best suited to patrol the seas in the coast defense role while preparing to support the Army in the grand land battle it conceived. As airmen considered these roles and missions, they argued that air superiority was the key to victory, and pursuit aviation assumed a certain primacy. In the early post war years, Billy Mitchell remained the primary advocate for these views. Over time, however, airmen began to believe that the bomber was the aircraft type best suited to meet the nation's strategic needs. These thoughts gradually became doctrine at ACTS.[33]

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[31] Thomas H. Greer, *The Development of Air Doctrine in the Army Air Arm, 1917-1941* (Washington: Office of Air Force History, 1985), 30. [Originally published 1955.]
[32] George C. Herring, *From Colony to Superpower: U.S. Foreign Relations since 1776* (New York: Oxford University Press, 2008), 436.
[33] Greer, 31.

Early attempts to define an air mission took a balanced approach, with pursuit aviation assuming a primary role in protecting the nation from hostile air attack. A 1924 text from the Air Service Tactical School defines bombardment "in the broad sense of attacking ground objectives by means of projectiles dropped from aircraft." The text also explains that bombardment aviation needed to be controlled by the army commander.[34] By the 1930s, however, independent bombardment had assumed a primacy in the thinking of the instructors at the course. A text from 1936 states that "the most significant feature [of airpower] is that it may be used independently of land and sea forces." The text asserts that aircraft can strike "the vital structure of a nation directly and immediately upon the outbreak of hostilities" and that this is "the most important and far reaching military development of modern times."[35] In less than a generation, officers at the ACTS began to develop what came to be known as the industrial web theory.

Major Donald Wilson, who in 1933 developed a course called Air Force at ACTS, is recognized as the originator of the industrial web theory. Wilson had worked in the railroad industry and was familiar with the problems caused throughout the system by a problem at one vital link. Wilson concluded that if one could identify and destroy the vital links in a modern industrial nation's infrastructure, that nation's ability to continue hostilities would be greatly impaired and the will to resist eroded. Unable to gather intelligence on any potential enemy since the official policy of the United States was defensive, Wilson adopted a novel approach and applied his theory to American cities. Using readily available unclassified sources the Air Strategy and Tactics division of the ACTS identified 17 targets in New York City that were vulnerable to air attack, destruction of which would, according to Haywood Hansell, make the city uninhabitable. While Wilson was one of many officers at the school who contributed to the

[34] 1st Lt. C. McK. Robinson, "Bombardment: Course 1924-1925," AFHRA 248.101-9.
[35] "Air Warfare: 1938," AFHRA 248.101-1.

development of bombardment doctrine, the name most associated with bringing said doctrine to fruition was Harold L. George.[36]

"Hal" George was a Reserve Cavalry Officer and a law student at George Washington University when America entered World War I. He resigned his reserve commission and became a bomber pilot, flying missions in Europe until the end of the war. After the war, George returned to civilian life and finished his law degree. Destined to never practice law, he re-entered the Army in order to continue his flying career. Assigned to bombers, he was one of the officers chosen to participate in the sinking of the *Ostfriesland.* It was during this time that George became a disciple of Billy Mitchell, fully embracing his vision of airpower, and publicly demonstrating his devotion by testifying at Mitchell's court martial. His biographer described George as "having an unusually bright mind" and believed his law training "added a talent for logical thought and persuasive presentation." Perhaps these qualities are what made George an effective spokesman for bombardment theory. George was selected to attend ACTS in the class of 1931-1932, and remained at the school as a bombardment instructor after graduation. George served as chief of the school's bombardment section for two years. During his tenure the school reorganized, creating the Air Force Section, which for the first time sought to coordinate the employment of attack, bombardment, and pursuit aviation. Prior to this reorganization, each of these missions had been taught in a vacuum. George was appointed director of the new Department of Air Tactics and Strategy. It was in this assignment that strategic bombardment began to assert a primacy in Air Corps thought as George partnered with Wilson as the latter developed the industrial web theory.[37]

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[36] Finney, 65-66; Haywood S. Hansell, Jr., "Harold L. George: Apostle of Air Power," in *Makers of the United States Air Force,* ed. John L. Frisbee (Washington: Office of Air Force History, 1987), 78.
[37] Hansell, 73-77.

Airmen at ACTS did not develop strategic bombardment theory in the dark, but rather with a great awareness of the rapid advances in aircraft technology between the wars. As it was necessary to communicate over vast distances in the United States, the fledgling American airlines demanded transport aircraft with longer range, increased lift capability and increased speed. Aircraft engineers obliged by supplying airplanes that represented the latest in design technology. Advances in metallurgy created light weight, corrosion resistant aluminum alloys to replace wood as the primary structural material. Monoplanes replaced the strong, boxlike biplane as cantilevered wing designs became practical, reducing drag and increasing efficiency. Retractable landing gear and improved engine nacelles also worked to reduce drag and increase performance. Aircraft engines became more powerful and lighter, and with the addition of superchargers more efficient at higher altitudes. Petroleum engineers developed high octane aviation fuels which led to greater engine efficiency. Variable pitch propellers allowed more efficient operation during all phases of flight. Cabin pressurization systems were developed between the wars as well.[38] Engineers in the Material Branch at Wright Field kept abreast of these developments, and published reports in an information circular distributed by the Chief of the Air Corps.[39]

While American air transport designs initially grew out of World War I bomber designs, the opposite was true in the 1930s as the Air Corps sought new bombers. Robert Futrell said that "technology was catching up with requirements, and the Air Corps was learning to write military characteristics for planes that would be good yet attainable."[40] It was ultimately commercial

[38] John David Anderson, *The Airplane: A History of Its Technology* (Reston, VA: American Institute of Aeronautics and Astronautics, 2002); Charles Harvard Gibbs-Smith, *Aviation: An Historical Survey from its Origins to the End of World War II* (London: Her Majesty's Stationery Office, 1970.)
[39] "Air Corps Information Circular," Index and articles numbered 601-677, AFHRA 162.42-1 V.7.
[40] Robert Frank Futrell, *Ideas, Concepts, Doctrine: Basic Thinking in the United States Air Force*, vol. 1, 1907-1960 (Maxwell Air Force Base: Air University Press, 1989), 69.

transports like the Lockheed Vega and the Douglas DC-3 that influenced military bomber specifications. Boeing led the way in all-metal construction, producing the P-26 monoplane fighter and the B-9 twin engine bomber. Even though it represented a major leap technologically, one author was prompted to call the B-9 "a little before its time," as it was soon eclipsed by the Martin B-10.[41] The B-10 was about thirty miles per hour faster, had a service ceiling about 4,000 feet higher, and its 1240 mile range was more than double that of the B-9. When the B-10 entered service in 1933, it was faster than fighters of the day, and sported gun turrets for self-protection. No doubt, the plane appeared to validate the theories of precision bombardment developed at the ACTS. When the Boeing B-17 appeared three years later, it seemed to airmen that they had found a plane capable of carrying out the mission they had envisioned. The four engine B-17C cruised almost forty miles per hour faster than the B-10, its range was almost double, it was capable of altitudes 12,000 feet higher, and carried even more defensive armament. This airplane appeared to be able to fly deep inside an enemy's territory with impunity.[42]

An aerodynamically capable aircraft only solved half the problem of destroying an enemy's industrial web. A pilot from a later generation accurately summarized, albeit with a hint of sarcasm, the dynamics of the conventional dive bombing problem when he wrote:

> All you have to do is be at the right place at the right time, at the right airspeed, at the right dive angle, at the right slant range, at the right g-loading, at the right wind corrected aiming point. And, oh yes, you must be in perfectly coordinated flight.[43]

[41] Eric Schatzberg, *Wings of Wood, Wings of Metal: Culture and Technical Choice in American Airplane Materials, 1914-1945* (Princeton: Princeton University Press, 1999), 154.
[42] Gordon Swanborough and Peter M. Bowers, *United States Military Aircraft since 1909* (Washington: Smithsonian Institution Press, 1989.)
[43] Major Nelson Allen, "Put the Ordnance on the Target," *Aerospace Safety*, October 1967, 1.

Even level bombers required accurate bombardment systems to destroy the precision targets envisioned by the Air Corps. Ironically, it was the Navy contract with inventor Carl Norden that seemed to answer the Air Corps problem. The Norden bombsight was essentially a gyro-stabilized telescope that the bombardier adjusted for wind, altitude, and airspeed. It was connected to the autopilot, allowing the bombardier to steer the plane to the correct release point.[44] So, while Major Oscar Westover's statement in 1925 that aerial bombardment had "developed to the point where it is accurate and destructive" was more boast than fact, when the Air Corps adopted the Norden bombsight, it was the most accurate in the world.[45] Combined with the new four engine, long range B-17 bomber, airmen believed they had found the range and precision to destroy an enemy's industrial web.

While the Air Corps as a whole trended toward a belief in the efficacy of strategic bombardment, not all airmen agreed. The most vocal dissent within the organization came from another ACTS instructor, Claire Chennault, who served as chief of pursuit aviation from 1931-1936. He is best known for leading the American volunteers known as the Flying Tigers in China. Chennault believed in the versatility of pursuit aircraft, which could be used either offensively or defensively. Much of the developing doctrinal debate centered on whether bombers could protect themselves or if they needed fighter escort. Ironically, Chennault did not support escort fighters, arguing that pursuit aircraft needed to operate independently, seeking out and destroying enemy fighters before they reached the bomber formation. He asserted that with sufficient warning, fighter aircraft could intercept and destroy attacking bombers, and developed observation and early warning systems. Instructors at ACTS had no knowledge of radar, which

[44] "Norden Bombsight," *The Science Newsletter,* Vol.46, No. 24 (Dec 9, 1944), 382.
[45] Westover quoted in David E. Johnson, *Fast Tanks and Heavy Bombers: Innovation in the U.S. Army 1917-1945* (Ithaca: Cornell University Press, 1998), p.93; McFarland. 129.

was being developed in great secrecy, and existing technology seemed to favor high speed, heavily armed bombers. Chennault retired from the Air Corps at the rank of Captain, and advanced his ideas on pursuit aviation with the American Volunteer Group in China.[46]

Between the wars, Air Corps officers were not the only ones within the defense establishment who were developing doctrine around new, technologically advanced weapons systems. The Navy was also developing doctrine around the air weapon. The results of the *Ostfriesland* tests were not lost on naval aviators, and a group of officers that Melhorn called "small, but far-sighted and influential" advanced the aircraft carrier as the only way to meet the nation's policy aims in the Pacific during the interwar period.[47] Naval aviators spent the interwar years solving the technical problems associated with launching planes from ships, attacking enemy vessels at sea, and recovering those planes safely. Requiring an incredible amount of precision to sink a ship underway, the Navy rejected high altitude level bombing in favor of dive bombing and torpedo bombing. Ironically, the Norden bombsight, which seemingly solved the Air Corps' precision problem, resulted from the Navy's examination and subsequent rejection of the level bomber.[48]

Airmen in each of what were to become the major combatants in the next war also contemplated how aircraft fit into their own strategic vision during the interwar period. While theory abounded, geography played a major role in how each nation thought about airpower. France is generally recognized as having ended the First World War with the best air force in the world. In the post-Versailles era, the French strategy was to defend against Germany, and to

[46] Futrell, 82; Finney, 76-77; Martha Byrd, *Chennault: Giving Wings to the Tiger* (Tuscaloosa: The University of Alabama Press, 1987).
[47] Charles M. Melhorn, *Two-Block Fox: the Rise of the Aircraft Carrier, 1911-1929* (Annapolis: Naval Institute Press, 1974), ix.
[48] McFarland, 62-63.

form alliances among the new nations in the east. French airmen considered strategic bombardment, but the French experience in the First World War was that strategic bombardment required great resources and provided limited results. Ultimately the French air force became subordinated to the army. Cain attributes the failings of the *Armee de l'Air* in 1940 not to a lack of strategic vision, but rather to an attempt to do too much. The French sought both to defend and to go on offense against the Germans, while simultaneously policing an empire. Airmen in France never developed a clear doctrine for employment and were left totally unprepared for the German *Blitzkrieg.*[49]

German air doctrine was driven by its position in Central Europe, the yearning for revenge against France, and the desire for *Lebensraum* in the East. The Germans had used aircraft defensively in the Great War, and during the interwar period concluded that the airplane was essentially an offensive weapon which led to the development of an offensive doctrine. Unlike the *Armee de l'Air,* which was subordinate to the army, the *Luftwaffe* worked in concert with the army, and much literature has been devoted to the German conception of combined arms. Corum does, however, argue that during the interwar period the *Luftwaffe* developed a broadly based air doctrine, and was in fact more capable of carrying out a strategic bombing campaign than the British during the first years of war. The *Luftwaffe* eventually abandoned the strategic bombardment mission due to a greater appreciation of what was technologically feasible.[50]

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[49] Anthony Christopher Cain, *The Forgotten Air Force: French Air Doctrine in the 1930s,* (Washington: Smithsonian Institution Press, 2002); Andrew Barros, "Razing Babel and the Problems of Constructing Peace: France, Great Britain, and Air Power, 1916-1928" in *English Historical Review*, Vol. 126, No. 518, (February 2011), 75-115.

[50] James S. Corum, *The Luftwaffe: Creating the Operational Air War, 1918-1940* (Lawrence: University Press of Kansas, 1997); James S. Corum and Richard R. Muller, *The Luftwaffe's Way of War: German Air Force Doctrine, 1911-1945* (Baltimore: The Nautical and Aviation Publishing Company of America, 1998); Williamson Murray, "Strategic Bombing: The British, American and German Experiences" in *Military Innovation in the Interwar Period*, Williamson Murray and Allan B. Millett, eds. (New York: Cambridge University Press, 1996).

The Soviet Union experimented with strategic bombing as well, and given the vast expanse of that nation, long range bombardment seems a reasonable path. However, Soviet airpower thought during the interwar years focused on support of the army.[51] The Imperial Japanese Army focused its aviation on the projection of power onto the Asian mainland. The vast distances in Asia suggest that the Japanese would have developed a strategic bombardment doctrine, however, they did not. Japanese airmen were very much aware of the development of strategic bombardment in Europe, prompting one author to remark that the army used the fear of Russian bombers to wrest money for fighters from the government, although he does not discuss what the military planned to do with those fighter aircraft. The vast distances in the Pacific and the restrictions on capital ships enacted by the Washington Naval Conference led the Imperial Japanese Navy to concentrate on the development of carrier based naval aviation. Carrier aviation was focused on projecting power into the resource rich South China Sea.[52]

Great Britain was the only nation that developed a strategic bombardment concept similar to that which emerged in the United States. While the German Zeppelin and Gotha raids during the Great War made the island vulnerable to attack, the traditional British reliance on the English Channel as a defense played a role in the development of air doctrine. Like their American counterparts, British airmen wanted to strike the enemy's vital centers, yet, the prewar Royal Air Force never developed a comprehensive plan like the ACTS industrial web theory, prompting one historian to recall the words of Sir John Slessor when he called British belief in strategic bombardment "a matter of faith."[53] Another author called the British approach "uncritical," and

[51] James Sterrett, *Soviet Air Force Theory, 1918-1945* (New York: Routledge, 2007); John Buckley, *Airpower in the Age of Total War,* (Bloomington: Indiana University Press, 1999).
[52] Greg Kennedy, "Anglo-American Strategic Relation and Intelligence Assessments of Japanese Air Power, 1934-1941," in *The Journal of Military History,* 74, Iss. 3 (July 2010).
[53] Malcom Smith, "'A Matter of Faith': British Strategic Air Doctrine before 1939," in *Journal of Contemporary History* 15, No.3 (July 1980), 423.

argues that the RAF failed to develop tactics, operational plans or proper equipment to carry out a strategic bombardment campaign.[54]

While airmen across the globe devised methods for employing the air weapon during the interwar years, their thoughts remained simply theory until the middle of the 1930s, only tested during scripted exercises. Conflict in Spain and China supplied the first empirical evidence since the last war on how the latest theories of air warfare held up during actual combat conditions. The Italians, the Germans, and the Soviets intervened in what Corum called "the most significant example of modern warfare between the two world wars," the Spanish Civil War.[55] These air forces learned valuable lessons about the value of close air support and battlefield air interdiction, although Stalin squandered much of the experience gathered in Spain with his purge of air force officers. The Soviet air force was forced to relearn many of those lessons in the crucible of combat after June 1941. Another lesson of the Spanish conflict was that strategic bombing was not very accurate and that civilian morale held up remarkably well in the face of bombardment. American and British intelligence estimates of the use of area bombardment during the Sino-Japanese conflict came to the same conclusion.[56]

Among the major powers not involved in the Spanish Civil War, the French seemed more interested in the conflict than either the Americans or the British, and drew many of the same conclusions that the Germans, Italians and Soviets had drawn. France actually began to reorganize its air force, which had been purely defensive, to take advantage of the offensive potential of aviation. The reforms, however, were tragically killed by a less progressive

[54] Scot Robertson, "The Development of Royal Air Force Strategic Bombing Doctrine Between the Wars: A Revolution in Military Affairs?," in *Airpower Journal* 12., No 1 (Spring 1998).
[55] James S. Corum, "The Spanish Civil War: Lessons Learned and Not Learned by the Great Powers," *The Journal of Military History* 62, No. 2 (April 1998), 313.
[56] Ibid, 330-334; Greg Kennedy, "Anglo-American Strategic Relations and Intelligence Assessments of Japanese Air Power 1934-1941, 759-760.

government in 1938. The RAF paid virtually no attention to the conflict and continued to advance theories of strategic bombardment, although former army officer Basil Liddell-Hart and then-serving army officer J.F.C. Fuller saw the value of air support for armies. The U.S. Army Air Corps paid scant attention to Spain, although they were extremely interested in the Republican airlift at the beginning of the conflict. American airmen generally dismissed Spain as not representing a true test of precision bombardment and the industrial web theory. Ignoring the lessons learned about air and ground cooperation and interdiction, they proceeded to concentrate on precision strike and strategic bombardment.[57]

Interwar theory was put to the test for the French and British when Germany unleashed war on Europe in 1939. The lessons of the Spanish Civil War seemed clear when air and ground coordination in the form of the German *Blitzkrieg* overran Poland, Denmark, Norway, the Low Countries, and even France in quick succession. The French air force was woefully unprepared for the onslaught as evidenced by the rapid disintegration of the French military. After its long intellectual dependence on strategic bombing, the RAF seemed unwilling to unleash its bombers on Germany during the period known as *Sitzkrieg,* and only began daylight raids against the Ruhr industries during the Battle of France in the spring of 1940. Many of the difficulties associated with strategic bombardment were revealed during the Battle of Britain. Without effective fighter escort, Luftwaffe bombers were easy prey for British fighters, and Hitler eventually cancelled a planned invasion of the British Isles and turned his attention to the invasion of Russia, largely because the Luftwaffe could not achieve air superiority over the island. Britain, with no effective escort fighter, began sending its own bombers on night area

[57] Corum, "The Spanish Civil War."

bombing raids in the hope of accomplishing some material damage while prosecuting an ill-defined attack on German morale.[58]

While not initially drawn into the conflict, most Americans believed their nation would eventually need to confront Hitler's aggression. The Roosevelt administration began preparations, with an emphasis on hemispheric defense and a strong reliance on air power. Several months before the invasion of Poland, the U.S. Army Air Corps embarked on a program of expansion, tripling the number of aircraft and building air bases. In 1940 the Air Corps published its first true doctrine manual, Field Manual 1-5, *Employment of the Aviation of the Army*. Two months later, Roosevelt announced his plan for the production of at least 50,000 aircraft per annum. As the ground forces had begun a program of expansion as well, it became necessary to give the air forces more autonomy in order to expedite the process. In January 1941, the United States and Great Britain entered into an informal alliance by beginning military to military conversations which became known as ABC-1. In a June 1941 War Department reorganization, the Army Air Corps became the U.S. Army Air Forces, with General Henry A. "Hap" Arnold as its chief and General George C. Marshall's deputy for air.[59]

Observing the conflict in Europe, American airmen generally concluded that their prewar assumptions about the nature of modern conflict between industrialized nations were essentially correct. Most interpreted the Luftwaffe's quick victories as a validation of American strategy, which was to destroy the opposing air force on the ground, strike interdiction targets in the enemy rear area, then proceed to close support of the army. In an incredible feat of intellectual gymnastics, they also viewed the Battle of Britain as a victory for their theories. In

[58] Richard J. Overy, *The Air War: 1939-1945* (Washington, DC: Potomac Books, Inc., 2005); Buckley, *Air Power in the Age of Total War.*
[59] Futrell, *Ideas, Concepts, Doctrine,* Vol 1, 90-96, 101-105.

their view, the Luftwaffe was not properly equipped to carry out a strategic bombing campaign, and had the RAF been better equipped for strategic bombardment, it would have been able to inflict much more damage upon the Germans than simply preventing an invasion of the home islands.[60] Not all were convinced that strategic bombers properly armed and flown could survive fighter defenses, as Hap Arnold called for the development of an escort fighter. Even so, although it was evident by the late 1930s that even with the Norden bombsight it was difficult to achieve the accuracy necessary for strategic bombardment to work, American airmen pressed forward with their prewar plans to use unescorted bombers to attack the German industrial web.[61]

American airmen began formally planning for war in August 1941. In a July 9 memo, President Roosevelt directed the Secretaries of War and the Navy to develop production requirements should the United States be drawn into the conflict. In the US Army, the task fell upon the War Plans Division, and air planning was undertaken by the newly formed Air War Plans Division. The division was headed by Lt Col Harold George, coming from an assignment as the commander of the nation's only B-17 Heavy Bombardment Group, and who, according to Haywood Hansell, turned down a career enhancing assignment to the Army War College to accept the assignment to the Air War Plans Division.[62] The planning team consisted of George, Lt Col Kenneth Walker, Maj Laurence Kuter and Maj Haywood Hansell, all of whom had been instructors at the Air Corps Tactical School in the 1930s. In fact, George, Walker, and Kuter had all been bombardment instructors, and Hansell had taught in the Air Force section, which suggests that there was little diversity of thought among the team members. They were all

[60] Ibid, 96-101.
[61] McFarland, *Precision Bombing*, 96-99.
[62] Haywood S. Hansell, Jr., *The Air Plan that Defeated Hitler* (Atlanta: Higgins-McArthur/Longino & Porter, Inc., 1972), 1.

committed to the idea that strategic bombardment was the way to win wars against modern industrial nations.[63]

After receiving the go ahead from the War Plans Division, George and his team completed a plan entitled *Munitions Requirements of the Army Air Forces,* but more commonly known by its number: AWPD-1. Completed in just nine days, the plan systematized the USAAF doctrine as informally developed during the decades between the end of the Great War and America's entry into the next. Broadly based on the goals set out in ABC-1 and the Rainbow-5 Plan, AWPD-1 went beyond the President's direction to explore "overall production requirements required to defeat our potential enemies"[64] and defined a plan to potentially win the war through strategic attack. In line with the industrial web theory taught at the ACTS, the plan lists USAAF tasks as the destruction of Germany's war making capacity, restriction of air operations, and to support an invasion of the continent, all while holding a strategic defensive against Japan. Destruction of the Luftwaffe was seen as an enabler, while attacks on naval targets were viewed as diversionary. The plan goes on to list 154 targets, the destruction of which airmen believed would bring Germany to its knees. The targets were chosen based on the team's assessment of their importance to the German war effort and their vulnerability to air attack, and include electric power nodes, transportation systems, oil production, aircraft assembly plants, aluminum production and magnesium production. Noticeably absent from the plan was much consideration of Italy, already disregarded as a serious industrial power.[65]

Prominently expressed in AWPD-1 was the hope that strategic air attack would make invasion unnecessary. American airmen persisted in the belief that they could successfully

[63] Finney, 102-110.
[64] "AWPD-1: Munitions Requirements of the Army Air Forces", AFHRA Call # 145.82-4, IRIS # 118167, Part 2, Tab A.
[65] Ibid., Part 2, 1-10.

execute a daylight precision bombardment campaign, even though the RAF had switched to night area bombardment in early 1940 due to prohibitive daytime losses. Hal George's planning team placed their faith in the B-17, believing that tight formations with appropriate defensive armament, flying fast and at high altitude would allow the bombers to reach their targets. They could not see the need for escort, mentioning in AWPD-1 that an escort fighter "may be necessary." The team believed that once the bombers reached the target, the Norden bombsight would allow for precise destruction. Seeming to grasp that enemy morale was not as fragile as had been previously believed, the plan still called for attacks on cities when the "proper psychological conditions" existed. How these conditions were to be determined is not addressed, but a window into their thinking is summarized in the statement that a successful air campaign "might cause a collapse of the German government." Unstated, but clearly understood, is the knowledge that the German government had indeed collapsed in 1918.[66]

A portion of AWPD-1 is devoted to mathematical calculations used to determine the numbers of planes required for the war effort, which in turn drove manpower requirements and ultimately answered the President's original question concerning production requirements. The heart of the calculations concerns how many bombers it would take to destroy a target. In essence, the planners took peacetime results achieved on bombing ranges and multiplied them by a factor of 2.5 based on British combat experience. Most historians are critical of the planner's method, and in hindsight there is surely much to critique. George's team was, however, sailing into uncharted waters and it appears they were aware of that fact. In the explanation of their method, the planners capture the essence of the problem as they saw it:

> Only a smattering of facts are available as the basis on which to answer the question, "How many bombardment airplanes should we employ in two or three years hence to penetrate the resistance which may be interposed against us at that time to reach and find

[66] Ibid., Part 2, 11; Part 2, 7; Part 2, 12.

> those objectives and to be practically sure that the necessary number of the proper sized bombs hit their targets and that the mission will be accomplished?"[67]

They all but admit that they did not know what they would be facing. Williamson Murray, in a critique that he admits "may seem harsh," said the airmen "gave disproportionate weight" to their own conception of air warfare over combat experience and should have studied the wars that began in the 1930s more carefully.[68] The proponents of the industrial web theory, however, convinced themselves that strategic bombardment as they conceived it had never been properly attempted, so they proceeded with their plans.

As America planned to enter the European war, the nation found itself compelled to declare war against the Empire of Japan following the attack on Pearl Harbor. It was Germany's subsequent declaration of war against the United States that allowed the American military establishment to pursue the "Germany First" strategy agreed upon in the staff conversations with the British, and the USAAF to proceed with its plans to attack the German industrial web. Despite promising results from their initial bombing sorties on the fringes of German occupied Europe, it was in the skies over the Reich that American airmen discovered their prewar rhetoric did not match the realities of modern air combat.[69] Prophets of airpower had predicted that the air weapon would render obsolete the horrors of trench warfare and the battle of attrition that had occurred on the ground during the Great War, and in this prognostication they were correct. The battle of attrition was transferred to the air.[70]

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[67] Ibid., Tab No. 2b.
[68] Williamson Murray, "Strategic Bombing: The British, American and German Experiences," in *Military Innovation in the Interwar Period* (New York: Cambridge University Press, 1996), 126.
[69] Tami Davis Biddle, *Rhetoric and Reality in Air Warfare: The Evolution of British and American Ideas About Strategic Bombing, 1914-1945* (Princeton: Princeton University Press, 2002).
[70] Mark K. Wells, *Courage and Air Warfare: The Allied Aircrew Experience in the Second World War* (London: Frank Cass and Co., Ltd., 1995), 27.

Even though the British had long since abandoned the concept of daylight precision bombardment, the Americans persisted in the belief that their high altitude, heavily armed B-17 formations would be able to penetrate German defenses and strike the proper nodes in the industrial web with the Norden bombsight. They found the Luftwaffe to be a determined enemy, causing aircraft and crew losses to rise to a prohibitive level by early 1943. The USAAF also found the weather in Europe to be an enemy. The near constant cloud cover made visual bombardment difficult, and forced American airmen to adopt the British H2S radar system, which they fielded as the H2X, to allow bombing through the clouds. An already dubious accuracy was degraded even more by the use of blind bombing systems. Yet, whether for moral concerns, belief in their theories, or a combination of both, the Army Air Forces refused to resort to the night area bombing adopted by the British.[71]

It was only when external fuel tanks were added to P-47 fighters in July 1943, and their subsequent adoption on the P-51 Mustang that the Allies were able to effectively engage the Luftwaffe for control of the skies over Europe. Many have criticized the USAAF for their failure to adopt external, droppable fuel tanks earlier. Biddle is particularly harsh in her criticism, saying the USAAF "thought it wise to hedge their bets" and at least include a discussion of long range escort fighters in AWPD-1.[72] Admittedly, the solution was right before them. However, Williamson Murray points out that the Germans had experimented with drop tanks on the Me 109, but failed to use them during the Battle of Britain. The British did not see this as the solution either, as they turned their strategic bombers against the Reich in the only

[71] Biddle, 211; 223.
[72] Biddle, 207.

way available to them to strike back at the Germans for a time. Suffice it to say that the air war began to tip in the Allies favor once they adopted the external fuel tank.[73]

While the escorted bombers were able to penetrate more deeply into the Reich to prosecute their attack on the German industrial web, the strategic campaign did not obviate the need for invasion. The most controversial claim of the bomber barons, that enemy morale would buckle and that they would lose the will to continue the fight once the economy collapsed, never materialized. However, by the summer of 1944, fighters equipped with drop tanks had won air superiority over the battlefield, which allowed the bombers to make significant contributions to the success of Operation Overlord. The attacks on the German transportation system helped to isolate the invasion beaches and hindered the arrival of reserves, and strategic bombers dedicated to Operation Cobra assisted the breakout of the ground forces at Saint Lo. Overy argues that the "Overlord plan finally resolved the ambiguities and indecisiveness of bombing strategy."[74] In other words, Overlord gave strategic ideas an operational focus. However, the neglect of close air support for the ground forces during the interwar period required hard lessons in air-ground cooperation to be learned not only in North Africa, but also in Normandy as well.[75]

There is much debate about how much strategic bombardment actually contributed to the final victory in Europe. John Buckley argues that strategic bombardment made three vital contributions to the war effort: damage to the German economy, reallocation of resources that might have been better used on the Eastern Front, and the destruction of the Luftwaffe. Many

[73] Murray, *Military Innovation*, 133.
[74] Overy, 76.
[75] Daniel R. Mortensen, *A Pattern for Joint Operations: World War II Close Air Support, North Africa*, (Washington DC: Office of Air Force History and U.S. Army Center of Military History, 1987); Thomas Alexander Hughes, *Over Lord: General Pete Quesada and the Triumph of Tactical Air Power in World War II* (New York: The Free Press, 1995),

historians argue that the industrial web theory was an abysmal failure in practice. They usually point to the fact that German production actually increased from 1942 until 1944, and that enemy morale was much more resilient than had been believed. Buckley counters the first argument by asserting that prior to 1942 German industry was not operating at full capacity, and that there is no way to measure how much more Germany would have produced without the bombing offensive. He answers the second argument by producing statistics suggesting that enemy morale was affected, just not to the degree prewar strategists believed. The diversion of resources has been measured, and there is no doubt that the Luftwaffe became increasingly unable to field aircraft in the latter stages of the war.[76]

Airpower was critical to the war in the Pacific as well. Much to the chagrin of the USAAF, however, until late 1944 it was a naval air war and carrier based aviation carried the war to the enemy for three years. Early in the war, much had been made of Jimmy Doolittle's B-25 raid on Japan at a time when American morale needed some sort of victory, and General George Kenney had cobbled together a tactical air force to support General Douglas McArthur's offensive in the South Pacific. But it was only the introduction of the new B-29, which flew higher, faster, and twice as far as the venerable old B-17, paired with the capture of island bases in the Marianas to put the B-29 within range of the Japanese home islands, that the USAAF was able to attack the Japanese economy and morale in earnest. Flush with apparent success in Europe, Haywood Hansell came to the Pacific to conduct a strategic bombardment campaign against the Japanese. Hansell was soon to discover that the pervasive cloud cover over Japan hindered the ability to identify targets visually. Another problem was the previously unknown

[76] Buckley, 164-168.

jet stream, which could create tailwind and crosswind problems beyond the technical capabilities of the equipment and the training of the bombardiers.[77]

One of the architects of AWPD-1, Hansell remained committed to precision bombardment at a time when the war weary public wanted results. He was ultimately relieved of command, replaced by the less idealistic and more pragmatic General Curtis LeMay. Drawing on prewar assessments that Japanese cities, largely constructed of wood and paper, would be vulnerable to incendiary attack, LeMay switched from day precision targets to night area attacks. Understanding that the Japanese did not possess an effective night fighter, Lemay stripped the B-29s of defensive armament in order to increase fuel loads and sent them in at low altitude, armed with incendiary bombs. Beginning in March 1945 with an attack on Tokyo, LeMay's bombers burned 66 Japanese cities with these new, ruthless techniques. The firebombing of Tokyo alone resulted in an estimated 100,000 deaths. American airmen had been careful to avoid such indiscriminate bombing in Europe. Possibly due to the racial animus on both sides, the USAAF pursued a campaign in Japan that "had little to distinguish it from Bomber Command's night time city raids over Germany."[78]

While General LeMay was busy firebombing Japan, a team of civilians and military personnel was busy investigating the results of strategic bombardment in Europe. The United States Strategic Bombing Survey began its work before Germany surrendered, examining areas coming under Allied control, securing records before they could be destroyed, and interviewing captured officials in order to analyze the effects and to determine the effectiveness of the campaign. The conclusion that airpower was "decisive" in Europe has been much criticized,

[77] Overy, Buckley, Biddle.
[78] Overy; Buckley; Biddle,; also see John Dower, *War Without Mercy: Race and Power in the Pacific War* (New York: Pantheon Books, 1986).

with most historians only conceding that airpower was an important factor in the ultimate victory. In fact, the Survey is not even a measure of the total effectiveness of airpower, as it only included the results of four-engine bomber missions.[79] Indeed, the team's agenda was to magnify the effects of the strategic bombing campaign. The documents do, however, illuminate some of the problems encountered, such as the need to suspend missions until a suitable escort fighter could be found, and that civilian morale was not nearly as fragile as had been believed when USAAF doctrine was conceived. It also stressed the need for repeated attacks since no critical industry was ever eliminated by just one raid. The Survey published "signposts," which "may be of guidance to the future."[80] While the survey is not perfect, the European summary does represent an attempt to examine the results of the bombing offensive in Europe and to suggest that there were some lessons to be learned, since the nation was still at war.

The war in the Pacific came to an abrupt end after the two atomic bombings on August 6 and 9, 1945. While the military establishment prepared for the invasion of the Japanese home islands, the scientists working on the Manhattan Project finalized atomic theory for use in war. Much controversy surrounds the use of the atomic weapons today which did not exist at the time, and Ward Wilson suggests that the Soviet entrance into the Pacific War on August 8 had a more decisive effect on the Japanese decision to surrender than what appeared to the Japanese as just two more air raids. He asserts that Americans viewed the atomic weapons from an economy of force vantage point, and for the potential to save American lives. Casualty estimates for the invasion of the Japanese home islands ranged from 250,000 to over a million, which is confirmed by D.M. Giangreco who asserts that half a million deaths seemed to be the agreed

[79] Conversation with Mr. John Conway, Air Force Research Institute, Maxwell Air Force Base, Alabama, August 28, 2014.
[80] *The United States Strategic Bombing Surveys: Summary Report (European War) (Pacific War)*, (Maxwell Air Force Base: Air University Press: 1987), 37.

upon number when the upper echelons of the U.S. command structure discussed the proposed invasion.[81]

The end of hostilities in the Pacific was followed by the Strategic Bombing Survey team, fresh off their report on Europe. The Pacific summary, however, has a different tone than the European report. This report was produced after Hiroshima and Nagasaki, and one senses from the authors a belief that air warfare had changed forever. The Pacific Summary seems less concerned with destruction of the proper targets; target destruction seems to be assumed. While it catalogs the three and a half year attack on the Japanese economy, the tone is not as critical as the European report. Just like the European summary, the Pacific report stresses the need for command of the air, but there is not nearly as much ink dedicated to target selection and destruction. The Pacific report gives the impression that the USAAF now possessed the perfect bomb.[82]

Some within the Army Air Forces, like Major General Elwood R. "Pete" Quesada, Commander of the IX Tactical Air Command, argued that the nation should not ignore the contributions of the tactical air forces and close air support during the war. In a 1990 interview, Quesada said "there was great arrogance in victory."[83] Immediately following the war however, his was a voice crying in the wilderness. Heavy bombers armed with atomic weapons seemed to vindicate the air power theory developed prior to the war. The United States Army Air Forces, soon to become the independent United States Air Force, possessed the perfect weapon. Airmen embarked over the next several years on a quest for a better bomber to deliver that weapon.

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[81] Ward Wilson, "The Winning Weapon?: Rethinking Nuclear Weapons in Light of Hiroshima" in *International Security* 31, No. 4 (Spring 2007), 162-179; D.M. Giangreco, "Casualty Projections for the U.S. Invasions of Japan, 1945-1946: Planning and Policy Implications" in *The Journal of Military History* 61, No. 3 (July 1997), 521-581.
[82] *Strategic Bombing Surveys*, 49-120.
[83] Quoted in Hughes, *Over Lord*, 310.

CHAPTER 2

THE BOMB, GERMAN TECHNOLOGY, AND AIR DOCTRINE

The Second World War ended with Germany and Japan defeated, but a world that did not feel more secure. During the closing days of conflict in Europe, it was becoming apparent that the wartime cooperation between the Western Allies and the Soviet Union was coming to an end, to be replaced by an ideological struggle between capitalism and communism. As communist governments took root in the national capitals liberated by the Red Army, diplomats rushed to find a strategy and soon settled on containment. Military men tasked to implement the containment strategy sought ways to accomplish the new mission within the confines of shrinking postwar budgets. The United States Army Air Forces faced the new geostrategic reality with a monopoly on atomic weapons, bombers capable of delivering them, and a strategy they believed had proved successful in the last war. The appearance of German jet aircraft at the end of the war, however, had exposed deficiencies in American engine and airframe research and suggested that the next planned bomber, the intercontinental range B-36, was already approaching obsolescence. American airmen therefore determined to implement the containment strategy by exploiting German aircraft technology after the war.

President Franklin Delano Roosevelt's strategy toward the Soviet Union predates American involvement in World War II. Gaddis explores the complexities of FDR's policy, suggesting that the President was fully aware of both the need to defeat Hitler and the need to keep the Soviet Union from dominating Europe after the war. These competing needs were complicated by the need to defeat Japan as well after Pearl Harbor. FDR settled on a strategy

which utilized American industry and Russian manpower in Europe through Lend-Lease, and counted on Soviet manpower to help defeat Japan had the atomic bomb not worked. Speaking of the postwar world, Gaddis asserts that Roosevelt understood that "Soviet hostility stemmed from insecurity," and that the West could win Soviet trust by granting them their rightful place in maintaining the peace. Indeed, the Four Policemen that FDR envisioned were the United States, Great Britain, China, and the Soviet Union.[1]

Roosevelt's death in the closing days of the war ensured that he would not implement his postwar strategy toward the Soviet Union. Vice President Harry Truman was not privy to the President's thoughts, so when he became President he relied heavily on FDR's advisors, who had their own agendas. Truman initially attempted to bargain with the Soviets on a quid pro quo basis, but found them increasingly intransigent. It was early in 1946 that George Kennan, a low level diplomat in Moscow, sent his now famous Long Telegram which became the basis for the containment strategy. In essence, Kennan said that the previous approach to the USSR had been all wrong. He advocated that the United States should not attempt to roll back communism, but rather should attempt to contain communism where it existed. He believed that the foundation of the communist state was weak, and that internal problems within the Soviet Union would eventually cause the entire edifice to collapse. Quickly seized upon by diplomats in Washington who were increasingly frustrated with efforts to deal with the Soviets, containment became the nation's policy until the collapse of the Soviet Union in 1991. Military planners were expected to implement the new containment policy.[2]

[1] John Lewis Gaddis, *Strategies of Containment: A Critical Appraisal of Postwar American National Security Policy* (New York: Oxford University Press, 1982), 4-12.
[2] Ibid., 14-22

For the War and Navy Departments, implementation of the containment strategy began in 1946 as well. As the Western Allies demobilized, the Soviet Union continued its wartime occupation of Iran and demanded oil concessions. Soviet troops in Bulgaria threatened Turkey, as Stalin demanded a renegotiation of the treaty governing control of the Bosporus Strait. These Soviet threats to Iran and Turkey, combined with support of Communist governments in the liberated nations of Eastern Europe alarmed the West. Eduard Mark argues that Stalin backed down when his spies warned him that the United States was prepared to go to war over Turkey. He contends that while there was probably never a true threat of war, American policy makers *believed* that war was a real possibility and acted accordingly.[3]

Those who debated policy in the dawning atomic age confronted a new reality in that they believed warfare itself had changed. Yale political scientist Bernard Brodie, who had spent his early career as a naval strategist reportedly told his wife, "Everything that I have written is obsolete" when he read the news of the Hiroshima bomb.[4] As early as November 1945, Brodie wrote that the atomic bomb introduced "a change not merely in the degree of destructiveness of modern warfare but in its basic character."[5] Frederick Dunn described how the new weapon had changed not only military policy and international relations, but also "the organized international machinery for peace and security," no doubt referring to the new United Nations.[6] .

Even though America possessed a monopoly on atomic weapons, most understood this advantage would be short lived. Strategic thinkers began to believe that war had become an even less rational means of solving international problems than before. Arnold Wolfers argued that

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[3] Herring, *From Colony to Superpower,* 606-611; Eduard Mark, "The War Scare of 1946 and Its Consequences," in *Diplomatic History* 21, No. 3 (Summer 1997).
[4] Brodie quoted in Fred Kaplan, *The Wizards of Armageddon* (New York: Simon and Schuster, Inc., 1983), 9.
[5] Bernard Brodie, *The Atomic Bomb and American Security* (New Haven: Yale Institute of International Studies, 1945), 2.
[6] Frederick Dunn, "The Common Problem" in *The Absolute Weapon: Atomic Power and World Order,* ed. Bernard Brodie (New York: Harcourt, Brace and Company, 1946), 17.

when one considers the amount of destruction the Germans wrought by conventional means on the Soviet Union and the fact that the latter did not surrender, there was no reason to believe that the Soviets would not continue to fight after an atomic attack.[7] Dunn contended that prior to Hiroshima "one did not have to contemplate the probable annihilation of both the victor and the vanquished." Brodie even conceived the possibility of rendering whole areas uninhabitable with radioactive waste in an early iteration of the dirty bomb, and called the atomic bomb "a powerful inhibition to aggression".[8] Yet even as the idea of war in the atomic age became increasingly unthinkable, historian Melvyn Leffler remarked that "prudence, nevertheless dictated that Pentagon planners think seriously about what they would do if war erupted."[9]

Unthinkable or not, military planners did indeed think about how atomic weapons might be used to wage the next war. They were obsessed with the thought that an enemy could carry out an atomic strike without warning, leaving the United States powerless to strike back. This led them to consider a first strike option, and debated how they could sell the President, Congress, and ultimately the public on the idea of preventative war, which was anathema to the American ideal.[10] Gian Gentile contends that planners "were often cryptic in advocating preventative war," however argues that "the concept existed and influenced postwar planning.[11]

The immediate strike that these planners envisioned was more dream than reality in the early postwar years. Early atomic bombs were very large, weighing over 10,000 pounds and

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[7] Arnold Wolfers, "The Atomic Bomb in Soviet-American Relations" in *The Absolute Weapon: Atomic Power and World Order*, ed. Bernard Brodie (New York: Harcourt, Brace and Company, 1946), 147; 141.
[8] Dunn, "The Common Problem" 4; Brodie, *The Atomic Bomb and American Security*, 19, 12.
[9] Melvyn P. Leffler, *A Preponderance of Power: National Security, the Truman Administration, and the Cold War* (Stanford: Stanford University Press, 1992), 114
[10] JCS 1891/10, "The Final Report of the Joint Chiefs of Staff Evaluation Board for Operation Crossroads," 29 December 1947, 110-111, reprinted in Steven T. Ross and David Alan Rosenberg, editors, *America's Plans for War Against the Soviet Union, 1945-1950, Volume 9, The Atomic Bomb and War Planning: Concepts and Capabilities* (New York: Garland Publishing, Inc., 1989).
[11] Gian P. Gentile, "Planning for Preventative War, 1945-1950" in *Joint Forces Quarterly*.24, (Spring 2000), 69.

they required special handling by specially trained crews. It took two days for these crews to assemble the various components and once assembled, they needed to be partially disassembled after two days to replace the internal batteries. Additionally, only one group of twenty-seven B-29 bombers, the so-called Silverplate Bombers of 509th Bombardment Group, were configured to carry atomic weapons. Finally, there were not enough atomic weapons in the inventory to carry out the massive strike envisioned, let alone to survive an enemy first strike and retaliate. In 1947, the United States only had thirteen atomic bombs, and was really incapable of carrying out the planned atomic assault before 1950. Even then, Ken Young argues the assault would have been "by no means a decisive one."[12]

For the U.S Army Air Forces, planning for war in the atomic age meant a strategic bombardment campaign very much like the ones recently waged against Germany and Japan. Gentile refutes Russell Weigley's claim that the United States immediately adopted a policy of atomic deterrence, arguing that American planners were less concerned with deterring wars than they were with fighting and winning them. They were not unaware of the deterrent value of the bomb, but planned for a situation where deterrence had failed. The military was also keenly aware of the size of their nuclear arsenal. Without the benefit of numerous atomic weapons, planners conceived a sustained conventional assault on Soviet industry reminiscent of their attack on German industry during the last war. In fact, the first postwar air plan in 1946 envisioned a conventional assault against the Soviet oil industry. In the minds of airmen, the bombardment of Germany and Japan had been decisive, and would no doubt prove decisive against the Soviet Union as well.[13]

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[12] Steven T. Ross, *American War Plans 1945-1950* (Portland, OR: Frank Cass, 1996), 12; Ken Young, "US 'Atomic Capability' and the British Forward Bases in the Early Cold War" in *Journal of Contemporary History* 42, No.1 (January 2007), 135.
[13] Gentile, "Preventative War," 70; Mark, "The War Scare of 1946," 405.

In another parallel with World War II, American air war planning relied heavily on overseas bases from which to operate. The limited range of the B-29 negated the possibility of striking industrial targets deep inside the Soviet Union from bases in the United States, so postwar planning counted on the use of bases in the United Kingdom and Egypt. General Carl Spaatz and Air Chief Marshall Sir Arthur Tedder reached an agreement in 1946 to prepare a total of seven airbases to receive B-29s. Two of the seven were modified to accept the atomic capable Silverplate bombers with their special weapons handling requirements. American planners assumed access to British air bases in Egypt by virtue of a 1936 Anglo/Egyptian treaty.[14] Forward basing would not have been a problem had the intercontinental range Consolidated B-36 been available in 1946. The bomber was conceived in 1940, at a time when England's survival was in doubt and American airmen thought they would need this long range bomber to attack the German industrial web from the United States. As Allied fortunes improved, the bomber fell victim to competing wartime priorities and the decision to prioritize the B-29. The B-36 did not fly until six years after the initial contract was awarded, and did not reach an operational unit until June 1948.[15]

Yet, even as the USAAF looked forward to acquiring the B-36, airmen realized that the massive six-engine propeller driven bomber was already approaching obsolescence. The appearance of Germany's jet powered Me 262 fighter over the battlefield during the summer of 1944 heralded a revolution in aircraft propulsion technology. In an arena where speed and altitude were considered vital to success, a contemporary report labeled the Luftwaffe's jet "the

[14] Young, *'Atomic Capability' and British Forward Bases,* 117-125; Peter L. Hahn, *The United States, Great Britain, and Egypt, 1945-1956: Strategy and Diplomacy in the Early Cold War* (Chapel Hill: The University of North Carolina Press, 1991), 23-29.
[15] Marcelle Size Knaack, *Encyclopedia of U.S. Air Force Aircraft and Missile Systems, Volume II: Post World War II Bombers, 1945-1973* (Washington: Office of Air Force History, 1988), 3-21.

fastest plane in European skies." The same article also notes the appearance of the rocket powered Me 163, which it mistakenly identified as a jet, and noted that the Me 163 had been successful against the B-17. American airmen were not so much surprised by the appearance of the German jet, as they had their own jet program, but rather by the fact that their own jet program was so woefully behind the German program.[16]

When the Bell XP-59A, America's first jet aircraft flew on October 2, 1942, it was seventeen months behind Great Britain's first jet flight, and more than three years behind the Luftwaffe's first jet flight in August 1939 – mere days before the invasion of Poland. It had been a small group of Europeans who advanced jet theory during the interwar period, as Americans concentrated on developing viable commercial engine technologies. Most industrialized nations had considered jets, but it was only in Germany and Great Britain that jet programs proceeded, and then in relative isolation. Sterling Michael Pavelec contends that the USAAF jet program owed its existence to the vision of General Henry H. "Hap" Arnold, who first saw the British jet on a trip to England in April 1941. In fact, the General Electric engine that powered the XP-59A was not an American innovation, but rather a copy of the British jet designed by engineer Frank Whittle. While the Whittle engine allowed America to enter the jet age, it was an inauspicious beginning. Pavelec notes that the XP-59A was "an exceptional airplane for its revolutionary technology, but was quite ordinary in its performance capabilities."[17]

As the war began to wind down, General Arnold was already considering future enemies and the next war. Michael Gorn wrote that the technically minded Arnold "faced a dilemma: how to introduce the most advanced scientific ideas into peacetime long-range planning." This was no easy feat in a nation steeped in the tradition of the citizen-soldier and comfortable with

[16] Hanson W. Baldwin, "America at War: The Winter Months" in *Foreign Affairs* 23, No. 3 (April 1945), 396.
[17] Sterling Michael Pavelec, *The Jet Race and the Second World War* (Annapolis: Naval Institute Press, 2007), 132.

neither a large standing army nor large peacetime military expenditures. Perhaps because he understood that aircraft technology had moved beyond the capabilities of mechanics who tinker with simple machines, Arnold sought to retain the services of the scientists and engineers who had assisted the military during the war. In September 1944, Arnold met with eminent physicist Theodore von Karman, convincing the scientist to complete a report on the state of American air and space technology before the scientific community returned to their normal academic pursuits. Arnold's goal was to maintain American air superiority into the foreseeable future.[18]

Von Karman assembled a team of scientists known as the Scientific Advisory Group (SAG). This group reported directly to Arnold, and were tasked with keeping him abreast of the latest scientific developments relating to air warfare. Arnold's 7 November 1944 letter to von Karman, which commissioned the SAG, gives a window into his thinking. Quite aware of the pace of technological change, the General was concerned that Congress would be lulled into a "false sense of security" by the quantity of obsolete weaponry available at the end of the war. He flatly stated that the AAF had not "overcome the problems of great distances, weather and darkness," and listed "more potent explosives" and "supersonic speed" among future "requirements."[19] Unstated in his letter, yet no doubt foremost in the General's mind, was the idea that the quickest route to American air superiority was to exploit the German technological lead. The SAG's efforts were guided by Arnold's vision, which was summed up in his simple quote, "Whatever the Germans have of worth, we shall have; whatever they hope to develop, we shall know about."[20]

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[18] Michael H. Gorn, ed., *Prophecy Fullfilled: "Toward New Horizons" and Its Legacy (*Washington D.C.: Air Force History and Museums Program, 1994), 1-3.
[19] Memorandum, General H.H. Arnold to Dr. von Karman, 7 November 1944, reprinted in Gorn, *Prophecy Fullfilled,* 85-87.
[20] Memorandum, Colonel D.L. Putt to Brigadier General L.C. Craigie, 21 November 1945, History of Army Air Forces Participation in Project Paperclip, AFHRA Call No. 201-56 V.1 Part 2, IRISNUM 00142007.

The first of two AAF programs meant to exploit German technology was known as Operation LUSTY, the acronym created from the words LUftwaffe Secret TechnologY. That LUSTY was given a priority equal to that of combat operations attests to the importance Arnold placed on the program.[21] LUSTY had goals beyond exploiting German technology for American research purposes, to include assessing the German nuclear program, determining the amount of technology which had been transferred to the Japanese, and finally, keeping as much German technological information as possible away from the Soviets. Two separate teams combed occupied Germany in the wake of the advancing Allied armies. The first consisted of a group of pilots, mechanics and engineers led by test pilot Colonel Harold E. "Hal" Watson. Known as "Watson's Whizzers," this group was charged with collecting advanced German aircraft, preferably intact and in flyable condition. The second group consisted primarily of scientists, and their goal was to capture German research documents before they could be destroyed and to interview German scientists and technicians about their work. Hardware, documents and scientists were all shipped to Wright Field outside Dayton, Ohio for evaluation.[22]

LUSTY was a short-lived operation, lasting only until February 1946, but the Army Air Forces considered it a grand success. The AAF collected not only German jet aircraft but also their latest propeller driven aircraft, many still crated and never flown. The booty also included V-1 and V-2 missiles, a jet helicopter, and much flight related equipment to include advanced engines, state of the art wind tunnels, bombsights, parachutes, and ejection seats. Even more impressive was the capture of more than 1500 tons of documents, and hundreds of German

[21] Parphrase of USSTAF Teletype dated 22 April 1945, History of Operation LUSTY, AFHRA Call No. 570.650A V.1, IRISNUM 00241258.
[22] Wolfgang W. E. Samuel, *American Raiders: The Race to Capture the Luftwaffe's Secrets* (Jackson: University Press of Mississippi, 2004); Dik Daso, "Operation LUSTY: The US Army Air Forces Exploitation of the Luftwaffe's Secret Aeronautical Technology, 1944-45" in *Aerospace Power Journal* 16, No. 1 (Spring 2002); Charles R. Christensen, *A History of the Development of Technical Intelligence in the Air Force, 1917-1947: Operation LUSTY* (Lewiston, NY: The Edwin Mellon Press, 2002), 80-81.

scientists, engineers and technicians who assisted with the translation of the documents and the testing of the hardware.[23] The official historian for Operation LUSTY voiced the AAF position when he wrote that the results of the project more than compensated for the effort and expense.[24] Yet, before LUSTY was even complete, von Karman issued a stern warning to Arnold when he said "problems never have final or universal solutions and only a constant and inquisitive attitude toward science and a ceaseless and swift adaptation of new developments can maintain the security of this nation through world air supremacy."[25]

Project Paperclip was the second AAF program meant to exploit German technology. Explaining the genesis of the project, one author said that "the victorious powers engaged in covert competition for the minds of the vanquished."[26] Paperclip began life under the codename Overcast. The name, but not the program, was changed early on when the original codename was compromised. It was originally conceived as a short term program to use German scientific knowledge in the ongoing war against Japan. Perhaps in response to von Karman's warning, it eventually grew into a long range program, which aimed to secure American air superiority far into the future. The desire for technological advantage underscored the splintering of the wartime alliance, as former allies became rivals. Officials in occupied Germany complained that the American zone was "literally crawling with French and Russian agents" who were scooping up desired specialists because America was not offering them work contracts in an expeditious manner. Gimbel points out that while the Cold War was not the primary purpose for the project, it eventually became Paperclip's raison d'etre.[27]

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[23] Christensen, *Development of Technical Intelligence,* 115-116, 179*;* Daso*, "Operation LUSTY," 32.*
[24] History of Operation LUSTY, AFHRA, Call No. 570.650A V.1, IRISNUM 00241258.
[25] Letter of Transmittal, von Karman to Arnold, 15 December 1945, reprinted in Gorn, *Prophecy Fulfilled,* 90.
[26] Clarence G. Lasby, *Operation Paperclip: German Scientists and the Cold War* (New York: Atheneum, 1971), 5.
[27] History of Army Air Forces Participation in Project Paperclip, AFHRA, Call No. 201.56 V2. Part 1, IRISNUM 00142008; Walter J. Boyne, "Project Paperclip" in *Air Force Magazine* 90, No. 6 (June 2007); Memorandum for Commanding General AAF, History of Army Air Forces Participation in Project Paperclip, AFHRA, Call No.

The competition for German scientists was indeed fierce, as the wartime Allies sought the best intellectual talent available in the crumbling Reich. The most well-known of the captured Germans is rocket engineer Wernher von Braun, father of the Saturn rocket that put Astronaut Neil Armstrong on the moon. Against the backdrop of the Cold War space race, many believe that the international competition was specifically for rocket specialists. However, of the nearly 700 scientists, engineers and technicians who eventually immigrated to the United States, approximately forty per cent worked for the Army Air Forces (which became the United States Air Force in 1947), and they represented various fields of aeronautical research. Not only were scientists representing fields like supersonic flight highly sought after, but also those working in unheralded fields like aviation medicine.[28] Indeed, Boyne maintains that on VE Day, "the United States had in custody almost every leading German aircraft engineer," and that among them was Hans-Joachim Pabst von Ohain, who had invented the German jet engine.[29]

Paperclip was a controversial program at the time, and remains so today. Much of the controversy stems from the nature of the program itself. In the initial phases, when the exploitation of the Germans looked more like interrogation than collaboration, people within the defense establishment no doubt did their duty with the understanding that by doing so they were aiding in the war effort against Japan. Many Americans, however, objected to cooperating with people who had so recently been considered the enemy when it became apparent that the Germans were remaining in the U.S. That is, in fact, the basic difference between the Soviet and American programs. The Russians were only interested in the immediate intelligence value of the Germans, as evidenced by the fact that after several years they were returned to Germany.

201.56 V1, Part 2, IRISNUM 00142007; John Gimbel, "Project Paperclip: German Scientists, American Policy and the Cold War" in *Diplomatic History* 14, No. 3 (Summer 1990).

[28] Boyne, 71; Lasby, 257.

[29] Boyne, 72.

The Americans, however, were interested not just in the knowledge the Germans brought, but also in the German minds. The captured scientists brought a new way of thinking to America. Therefore, the immigration laws of the United States were waived to allow nearly 700 scientists and their families citizenship in the United States.[30]

The nature of the controversy today centers on a body of literature that questions why the United States would grant citizenship to people who had ties to the Nazi Party and who had forged the weapons so recently used in a war of aggression. There is also an objection to the fact that many German weapons were built using slave labor. This literature tends toward conspiracy theory and the belief that the U.S. government somehow hoodwinked the American public. While these authors raise important questions which should not be taken lightly, they tend to overlook the uncertainty of the times. Many inside the government were concerned about the increase in Soviet intransigence as victory drew near, and their outright aggression after the guns had fallen silent.[31] That both the United States and Russia benefitted from the knowledge gleaned from the German scientists is without question. Boyne says of the German scientists that "their influence on the world of aeronautics and astronautics is felt to this day." Even Bower concedes that "despite any dubious morality or circumventing of justice, the Pentagon's Paperclip conspiracy was, within its limitations, unquestionably successful."[32]

The first fruits of Operation LUSTY and Project Paperclip for the United States Air Force were the North American F-86 Sabre fighter and the Boeing B-47 Stratojet bomber. The F-86 was not America's first operational jet fighter, nor was the B-47 America's first jet bomber, but

[30] Harriet Buyer and Edna Jensen, History of AAF Participation in Project Paperclip, AFHRA, Call #201-56 V.1, Part 1, IRISNUM 00142006; Lasby, 269.
[31] Tom Bower, *The Paperclip Conspiracy: The Hunt for the Nazi Scientists* (Boston: Little, Brown and Company, 1987); Annie Jacobsen, *Operation Paperclip: The Secret Intelligence Program that Brought Nazi Scientists to America* (New York: Little, Brown and Company, 2014).
[32] Boyne, 74; Bower, 277

both were the first in their categories to benefit fully from the information gleaned from the two programs. The appearance of the Me-262 over the battlefield only served as a warning that America needed to speed up its own jet program. It was the German research into jet engine technology, swept wing designs, and the problems associated with supersonic flight that proved how woefully American aerospace research lagged the recent enemy. No doubt this raised questions about the state of aerospace research among future enemies. General Arnold's edict to have what the Germans have and to know what the Germans know resulted in the F-86 and the B-47. These planes combined axial flow compressor technology and swept wing airframe technology, areas where German research led the world.[33]

The official historians of the AAF in World War II, stated that all of the successful jet engines produced in America before 1945 were based on the British Whittle engine. These jets used a technique called centrifugal flow to create the amount of air compression required to produce thrust. America's first operational jet fighter, the Lockheed F-80 Shooting Star, was powered by a single General Electric (GE) J-33 centrifugal flow engine. The German jet engines were based on a technique known as axial flow. While the centrifugal compressor is easier to design and build, the axial flow compressor produces a higher air flow rate, making it capable of higher thrust and greater fuel efficiency. Axial flow compressors were not unknown in the United States, in fact, Lockheed engineers proposed such an engine in 1940. The Lockheed engine was, however, much too complex and technically unfeasible for the time, although it

[33] Richard P. Hallion, "The Air Force and the Supersonic Breakthrough" in *Technology and the Air Force: A Retrospective Assessment*, Jacob Neufeld, George M. Watson, Jr and David Chenoweth, eds. (Washington, D.C.: Air Force History and Museums Programs, 1997), 55.

would eventually become the basis for the J-57 engine that powered the B-52 and several of the early Century Series fighters.[34]

It was only after the exploitation of captured German documents that the GE J-35 axial flow jet engine appeared, which was used to power the Republic F-84 Thunderjet. While the technology involved in fielding the P-59 was innovative, the jet was "for all practical purposes a 350-mph airplane – no faster than the prop driven fighters of its day." The lessons learned from the P-59, however, were incorporated into the F-80 which was "capable of speeds approaching 600 mph."[35] The F-84, with its axial flow engine was capable of 600 knots, or nearly 700 mph. The F-86 was America's first operational fighter to achieve supersonic flight, and it was powered by the next generation GE J-47 axial flow jet engine. America's first jet bomber, the North American B-45 Tornado was propelled by four J-47s and was capable of 500 knots, while the B-47 sported six of the engines and could achieve almost 530 knots. Four J-47s were even added to the B-36D (and retrofitted on the B-36B), in order to give the venerable old bomber some high speed dash capability.[36]

Another aspect of German aerodynamics that bore immediate results for America was their research into the problems associated with supersonic flight. As an airplane flies into what is known as the transonic region, around Mach 0.75, several things happen that effect not only performance but also the structure of the aircraft. These anomalies include a massive shock

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[34] Wesley Frank Craven and James Lea Cate, eds., *The Army Air Forces in World War II, Volume 6: Men and Planes* (Washington, D.C.: Office of Air Force History: 1983), .252-253; James O. Young "Riding England's Coattails: The Army Air Forces and the Turbojet Revolution" in *Technology and the Air Force: A Retrospective Assessment,* Jacob Neufeld, George M. Watson, Jr and David Chenoweth, eds. (Washington, D.C.: Air Force History and Museums Programs, 1997); Compressor, https://engineering.purdue.edu/~propulsi/propulsion/jets/basics/comp.html accessed 18 June 2015.

[35] Young, "Riding England's Coattails," 25, 26.

[36] Marcelle Size Knaack, *Encyclopedia of U.S. Air Force Aircraft and Missile Systems, Volume I: Post World War II Fighters, 1945-1973* (Washington: Office of Air Force History, 1988), 1-81; Knaack, *Volume II: Post World War II Bombers,* 59-158.

wave, a reduction of lift, and an increase in drag. These problems were well known to American researchers, as conventional piston engine aircraft often entered the transonic region in a dive. They knew that different aircraft had different dive characteristics, for instance, the P-47 and P-51 handled well in a high speed dive, but the P-38 did not. American scientists and engineers were amazed by the amount of research the Germans had done on the problem.[37]

The American scientific community was most impressed with the research the Germans had completed on swept wing designs, utilizing high speed wind tunnels. Once again, this concept was not new to the Americans, but the German technical data validated the concept. The Me 262, in fact, was a swept wing design. The AAF had nine different jet aircraft in various stages of design or production on VE Day, and all were conventional straight wing designs. The F-80 and F-84 were already in production. The B-45 was given the production go-ahead, with the caveat that it would be cancelled should another jet bomber prove better able to meet the desired specifications. Two aircraft companies, North American and Boeing, made the fateful decision to redesign their projects, the F-86 and the B-47 respectively, to incorporate swept wing designs. Interestingly enough, both companies did some quick calculations and independently arrived at 35 degrees as the optimum wing sweep angle.[38]

Even with the influx of German technology, it was an American innovation and collaboration with the British that enabled the bombers – air refueling. The 150 hour flight of the Question Mark in 1929 is generally recognized as having validated the concept, although Hap Arnold had airmen under his command experimenting with air refueling as early as 1923. Air refueling had not been seriously considered as a way to extend the range of escort fighters

[37] Hallion, "Supersonic Breakthrough," 49-51
[38] Ibid, 54; Robert F. Dorr, *F-86 Sabre: History of the Sabre and FJ Fury* (Osceola, WI: International Publishers & Wholesalers, 1993), 7-8; Jan Tegler, *B-47 Stratojet: Boeing's Brilliant Bomber* (New York: McGraw Hill, 2000), 1-10.

during the war, however, with the advent of jets the concept was revisited. Early jet engines were notoriously thirsty, and fuel efficiency and range were sacrificed to obtain faster speeds and higher altitudes. The British had developed a system of grappling hooks to connect the tanker and the receiver which the Americans adopted, but only until Boeing developed the flying boom tanker. Even with forward basing, it was air refueling that extended the range of the new jet bombers and made them potentially a more credible threat.[39]

According to the USAF this future potential, along with the wartime performance of the AAF, led to the creation of the United States Air Force on September 18, 1947. Air Force independence came when President Truman signed the National Defense Act of 1947 into law. The legislation created the National Military Establishment and several other agencies, to include the National Security Council. The Act eliminated the War Department, and made the Departments of the Army, Navy and Air Force coequal branches subordinate to the National Military Establishment. It codified the Joint Chiefs of Staff, which had been an ad hoc wartime organization. The military chiefs no longer had direct access to the President, but rather were answerable to the civilian Secretary of Defense. All of this was done to streamline the nation's security apparatus and to prepare it for future conflict.[40]

The Army Air Forces had already begun to reorganize for future conflict a year prior to Air Force independence. While there had been a proposal to consolidate all combat aircraft in one large Air Combat Command, airmen eventually decided to divide combat power into three commands along functional lines. The March 1946 reorganization of the Army Air Forces

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[39] Thomas A. Julian, "The Origins of Air Refueling in the United States Air Force" in *Technology and the Air Force: A Retrospective Assessment*, Jacob Neufeld, George M. Watson, Jr and David Chenoweth, eds. (Washington, D.C.: Air Force History and Museums Programs, 1997), 75-94; Phillip S. Meilinger, "Getting to the Target:The Penetration Problem in Strategic Air Command during the 1950s" in *Air Power History* 61, No 3 (Fall 2014), 41-43.
[40] U.S. Air Force History, Missions Part Two: Airpower Comes of Age in World War II, http://www.airforce.com/learn-about/history/part2/, accessed 6 July 2015; William Frye, "III. The National Military Establishment" in *American Political Science Review* 43, No 3 (June 1949), 543-555.

created Tactical Air Command (TAC), Air Defense Command (ADC), and Strategic Air Command (SAC). TAC consisted of ground attack planes, and was primarily dedicated to supporting the Army's ground operations. The mission of ADC was to protect the airspace over the United States. ADC had been originally organized in 1940 when the threat of air attack on the United States seemed real, but was disbanded in 1944 when the threat no longer appeared plausible. The growing fear among airmen that an enemy armed with atomic weapons made America again vulnerable led to the command's revival, and it was armed with interceptors. SAC was the home of the bombers, viewed by airmen as the nation's offensive firepower.[41]

While the new command arrangement appeared to be a division of functions between equals, Strategic Air Command was without doubt preeminent within the Air Force. Some indication of the importance AAF leaders placed on SAC is that it was led by George Kenney, one of only three 4-star generals in the AAF in 1946. ADC was commanded by George E. Stratemeyer, a 3-star, and TAC was commanded by a 2-star, Elwood "Pete" Quesada. While Quesada was a logical choice since he had experience supporting the ground forces during the war, the rank structure gives an indication of the importance airmen placed on each mission. General Spaatz described SAC as a command equipped with heavy bombers, armed with atomic weapons and capable of carrying out a global mission independent of the other services. There was nothing new, however, in the General's statement. Spaatz was expressing thoughts that had been formulated after the Great War, institutionalized in the 1930s at the Air Corps Tactical School, attempted during the Second World War and, in the minds of airmen, validated with

[41] J.C. Hopkins and Sheldon A. Goldberg, *The Development of Strategic Air Command 1946-1986: The Fortieth Anniversary History* (Offutt AFB, Nebraska: Office of the Historian, Strategic Air Command, 1986); Phillip S. Meilinger, *Bomber: The Formation and Early Years of Strategic Air Command* (Maxwell Air Force Base: Air University Press, 2012), 75-77.

atomic bombs at Hiroshima and Nagasaki. This was the doctrinal thinking that airmen brought with them to the new National Defense Establishment.[42]

The same reorganization that created SAC established Air University (AU) at Maxwell Air Force Base, which had been the home of the Air Corps Tactical School before the war. Along with conducting professional military education, the Air Force charged AU with developing and publishing air doctrine. AU was conceived as a place where officers thought about the future of warfare. The first commandant, Maj Gen Muir S. Fairchild, wanted to avoid "accepting answers from the past instead of digging them out of the future." However, many of the people who were instrumental in founding Air University were graduates of ACTS. It was a generation of airmen who believed in the efficacy of strategic attack against the enemy's industrial base. It did not matter that Fairchild said, "This is not a post-war school system – it is a pre-war school." Airmen looked to the recent example of B-29 bombers armed with atomic bombs when they thought about how they would conduct warfare in the future.[43]

Air University published Air University Manual-1: *USAF Basic Doctrine* (AUM-1) in October 1951. While the Army Ground Forces had derisively referred to War Department Field Manual 100-20 (FM 100-20) as an AAF declaration of independence when it was produced in 1943, AUM-1 was the first true Air Force doctrine manual. As much as General Fairchild wanted airmen to think of the future, AUM-1 reads more like a history of WWII. The first paragraph of Section I, "The Nature of Modern War" defines war as

> …total international conflict involving the violent use of military forces together with all other techniques of conflict. It involves all resources of the nation, including population, national resources and production capacity.

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[42] Meilinger, *Bomber*, 77.
[43] Futrell, *Ideas, Concepts, Doctrine*, 210-212; Fairchild quoted in Silvano A. Wueschner, *A Brief History of Air University, 1946-2009* (Maxwell AFB, AL: http://www.au.af.mil/au/images/AU_History.pdf accessed July 10, 2015, 10-11

This definition is important because it shows that even after conflict had begun on the Korean Peninsula, airmen did not officially recognize the concept of limited war. The next paragraph addresses modern weapons and says that "a nation can quickly and decisively impose its power upon another" with atomic bombs and other weapons of mass destruction. In another allusion to the last war AUM-1 speaks of fighting with coalitions that have "conflicting purposes," and assumes that the next war will be fought against a totalitarian dictatorship, a historical reference to Fascism and an all too clear contemporary reference to the Soviet Union.[44]

That the nation was preparing to fight the last war is clear from the four National Objectives outlined in Section II of AUM-1. The first, "to prevent unacceptable damage of our national strength and interests from any action by another power" is a clear reference to Pearl Harbor. The next two objectives speak of preventing "any unacceptably dangerous increase in strength" and the ability of an enemy to "interfere with the self-determination" of other nations. These two objectives are an attempt to prevent the appeasement of the 1930s. The final national objective calls for the United States to give "convincing proof" that it will rally the international community to action if the peace is threatened, striking a blow at the inactivity of the League of Nations. The memory of Pearl Harbor takes on a special meaning in this document. The possibility of an atomic surprise attack had been theoretical before the Soviets tested their first atomic bomb in 1949. Airmen lobbied in their doctrine for the need to have a "force in being" since a decisive strike could come from nowhere without the benefit of the traditional build up phase, which no longer seemed to apply to modern warfare.[45]

[44] Futrell, *Ideas, Concepts, Doctrine,* 137-138; AUM-1 USAF Basic Doctrine, October 1951, AFHRA, Call No. 168.7104-72, IRISNUM 01030698, 1.
[45] AUM-1 USAF Basic Doctrine, October 1951, AFHRA, Call No. 168.7104-72, IRISNUM 01030698, 3, 1.

In addition to writing doctrine, Air University trained the next generation of senior officers. Much like the Air Corps Tactical School, the Air Command and Staff School (ACSS) and the Air War College (AWC) became the forums where ideas concerning advanced strategy were transmitted to field grade officers. The AWC curriculum in the early 1950s began with a study of international conflict, which was meant to lay a foundation for thought on the use of military force. This portion of the curriculum emphasized the bipolar view of the world that had developed since 1945. Upon this foundation, the course advanced to military studies. The students examined military theory, the roles and missions of the other services, and finally, the role of the USAF. Air warfare was divided into three sections: The Defensive, The Offensive, and Theater Operations. The historical examples the students examined were primarily from World War II. The Battle of Britain figured prominently in the study of air defense. When it came to offensive operations, the faculty had by this time adopted the writings of Giulio Douhet as the prototype for offensive air warfare.[46]

A review of an AWC exercise entitled "Air Power Projected" opens a window into the fruits of USAF Professional Military Education and the thoughts on air war planning at the time of the Korean War. Originally classified Top Secret, the exercise assumed war with the USSR in 1954. It also assumed the status quo in China and a "settlement of the Korean dispute," which suggests that they did not view the Korean conflict as war. A typical solution begins with "an immediate atomic offensive," while defending Europe and the Middle East, the Far East and the Western Hemisphere. The solution put forward by one seminar contains a statement on the relationship between air and surface forces. They declare that air power "must be regarded as a method of warfare rather than an adjunct or supporter of surface forces." It seems that airmen in

[46] Faculty – Air War College 1952-1953 Curriculum: Studies Nr. 1 thru Nr. 10, AFHRA, Call No. K239.04231-71.

the early 1950s felt the need to continue the battle to secure the independence which they had already won.[47]

The Air Force developed its doctrine during a time of limited budgets, as the nation attempted to return to peacetime spending levels. Certainly the Air Force share of the $14 billion 1947 military budget seemed paltry when compared with wartime budgets in the neighborhood of $90 billion in 1944 and 1945. The new budgetary reality forced airmen to economize. As early as February 1944, Arnold was planning for a post war air force. His vision for the striking arm was 105 operational groups, which General Marshall rejected immediately as too costly. A year later, airmen estimated they would need seventy-eight groups to meet post war challenges, but by V-J Day the number of groups was down to seventy. By December 1946, the War Department had settled on fifty-five groups as the size of the post war air force.[48] To put the size of the fifty-five group air force in perspective, at the end of the war the AAF had 41 groups of B-29s alone. Even so, airmen held out hope for seventy groups, as they referred to their new circumstances as "the fifty-five group phase" of the larger requirement. [49]

Peacetime budgets forced airmen to make decisions about how they wanted to spend their circumscribed funding. SAC rested its hopes on the planned B-52 bomber. Envisaged in 1945 as a follow on to the B-36, the B-52 that entered the Air Force inventory in 1954 was a radically different airplane than that envisioned in the original specifications. The original design was for a straight wing aircraft powered by six turboprop engines, but the design that emerged was a swept wing aircraft based on the B-47 design, powered by eight turbojet engines. The originally

[47] Air War College Study History File, AFHRA, Call No. K239.04231-62, Part 2, IRISNUM 00917785.
[48] Futrell, *Ideas, Concepts, Doctrine*, 203-215
[49] *The Budget of the United States Government for the Fiscal Year ending June 30, 1946* (Washington: United States Government Printing Office, 1945), VII; *The Budget of the United States Government for the Fiscal Year ending June 30, 1948* (Washington: United States Government Printing Office, 1947), M16; Walton S. Moody, *Building a Strategic Air Force* (Washington, D.C.: Air Force History and Museums Program, 1995), 29; 77.

proposed aircraft was capable of delivering a single 10,000 pound atomic bomb on a 4300 nautical mile combat radius at 260 knots. The model that entered the inventory was over twice as fast and carried over four times the bomb load. The unrefueled combat radius was only 3100 nautical miles, however by this time Boeing had perfected the flying boom air refueling system, greatly increasing the range.[50]

The B-52 would not be ready until the mid-fifties however, which seemed an eternity in the immediate post-war world. The recent surprise over German technological superiority combined with uncertainty concerning Soviet intentions and the fear generated by the idea of sudden atomic attack created an unease among airmen. This unease led to a sense of urgency that drove them to acquire the best immediately available equipment. This led the Air Force to buy the B-45 with the understanding that the contract would be cancelled if a more capable jet bomber was developed, which the B-47 proved to be. They also acquired an upgraded version of the B-29D, re-designated the B-50, and considered the B-35 and B-49 flying wing designs, all while awaiting the B-52.[51]

Historian Walton Moody called 1948 "the year of crisis," referring to events in Prague and Berlin that year. The communist coup in Czechoslovakia during March not only caused a diplomatic crisis, but also "caused the western Allies to abandon hope for a peaceful coexistence with the Soviet Union." It spurred the U.S. military establishment to consider whether or not it was ready for another war while still drawing down from the last.[52] Ready for war or not, the Berlin Blockade, which began in June of 1948 provoked a military response. The blockade, which lasted eleven months, began when the Soviets cut road and rail access to Berlin from the

[50] Knaack, *Volume II: Post World War II Bombers,* 205-212.
[51] Knaack, *Volume II: Post World War II Bombers,* 61; 161.
[52] Moody, *Building a Strategic Air Force,* 187; Igor Lukes, "The 1948 *Coup d'Ét*at in Prague Through the Eyes of the American Embassy," in *Diplomacy and Statecraft* 22, Iss. 3 (September 2011), 431.

western occupation zones. By cutting food and fuel to the American, British and French occupation zones of the city, the Soviets hoped to force the western nations out of the German capital. Army General Lucius Clay, military governor of Germany, proposed sending an armed convoy into the city. The national response, however, relied on the Air Force. Unarmed cargo planes were dispatched to airlift supplies into the city. In order to provide muscle to the seemingly weak response, B-29s were deployed to Europe to add the specter of the atom bomb. This atomic sabre rattling was a hollow threat, as the units deployed were not atomic-capable. It is unclear whether or not the Soviets knew this at the time. The deployment of the bombers, however, demonstrated how deeply ingrained the idea of strategic bombardment had become in American strategy.[53]

If 1948 can be called the year of crisis, perhaps 1949 should be known as the year of consternation. The Berlin Airlift ended in May with a Western victory. Since the Soviets had been unable to force the Western powers out of Berlin, they finally lifted the blockade and allowed road and rail traffic again. The chest thumping and back patting came to an end, however, with President Truman's September announcement that the Soviet Union had exploded an atomic device sometime in August. This knowledge sent shockwaves through the Western world. While those inside the national defense establishment understood that the U.S. monopoly on atomic weapons would one day come to an end, the Soviet bomb came at least three years before most intelligence estimates had predicted. The rival bomb caused anxiety, as no one knew how many bombs there were in the Russian arsenal. Not knowing generated fear because while unlikely, it was possible that the Soviets had more bombs than the Americans and could

[53] Roger G. Miller, *To Save a City: The Berlin Airlift 1948-1949* (Washington, D.C.: Air Force History and Museums Program, 1998); Meilinger, *Bomber*, 109-113; Harry R. Borowski, *A Hollow Threat : Strategic Air Power and Containment Before Korea* (Westport Cn: Greenwood Press, 1982).

win a nuclear exchange.[54] While Americans were still trying to understand the ramification of a nuclear armed Soviet Union, Mao Zedong proclaimed the People's Republic of China in Beijing on 1 October. The Soviet Union's quick recognition of the new communist government in the world's most populous nation added to the trepidation felt in the West as the whole world seemed to be opting for communism and allying with the Soviet Union.[55]

The Soviet atomic bomb had heightened fears throughout the West of another general war. The U.S. Air Force's official history of the Korean War remarks that since Truman's announcement in September 1949 "everyone" in FEAF (Far East Air Forces) understood that World War III could break out at any moment.[56] On 25 June, 1950, along what one historian called an imaginary frontier of the Cold War,[57] a war to reunite the Korean Peninsula quickly pitted the United States and its Western allies against the USSR and its new ally, the People's Republic of China. While the attack itself is generally recognized as a strategic surprise to the West, not only the communist nations, but also America's allies in South Korea were surprised by the speed of the American military response as occupation troops in Japan were rushed to the peninsula. Acting upon the containment policy, America inserted itself and the United Nations into an old Asian conflict that it did not understand.[58]

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[54] William L. Laurence, "Soviet Achievement Ahead of Predictions by 3 Years," *The New York Times,* 24 September 1949, http://search.proquest.com/docview/105920795?accountid=14472; Hanson W. Baldwin, "The Effects of Russia's Bomb on Our Military Strategy," *The New York Times,* 25 September 1949, http://search.proquest.com/docview/105768648?accountid=14472

[55] Walter Sullivan, "Reds Proclaim a Republic in China, Chou is Premier," *The New York Times,* 2 October 1949, http://search.proquest.com/docview/105933947?accountid=14472; C.L. Sulzberger, "Russia Continues to Play Her Double Game," *The New York Times,* 2 October 1949, http://search.proquest.com/docview/105904816?accountid=14472

[56] Robert F. Futrell, *The United States Air Force in Korea 1950-1953* (Washington: Office of Air Force History, 1983), 5.

[57] Lloyd C. Gardner, "Korean Borderlands: Imaginary Frontiers of the Cold War" in *The Korean War in World History,* William Steuck, ed. (Lexington: University Press of Kentucky, 2004), 126.

[58] William Steuck, *Rethinking the Korean War: A New Diplomatic and Strategic History* (Princeton: Princeton University Press, 2002), 187; Bruce Cumings, *The Korean War: A History,* (New York: Modern Library, 2010), *xv-xvii*.

The U.S. Air Force responded with a strategic bombardment strategy and doctrine that had been conceived before and forged during the last war. Initially, however, it was the fighter aircraft of the Far East Air Force (FEAF) that responded to the challenge. These fighters were the jet powered F-80 and the F-82 twin Mustang all-weather fighter. On 26 June, the fighters' first mission was to provide air cover for freighters in the soon-to-be-famous port of Inchon which were conducting an evacuation of US citizens and other foreign nationals. As the situation worsened the next day, the fighters covered C-47 and C-54 transports dispatched to air evacuate civilians. Clearing some confusion in the pilots' minds the day prior on the extent of their mission, FEAF authorized an active defense of the transports. Once the evacuation was complete, the fighters displayed the flexibility airmen had preached was inherent in airpower, as their mission changed to halting the North Korean advance.[59]

While Air Force doctrine called for the use of bombers in strategic attacks on enemy industry, the bombers of FEAF were initially involved in evacuation and interdiction operations. Available types were the B-26 and the B-29, both of World War II vintage. Within days of the initial invasion, however, airmen were planning a strategic bombardment campaign. Futrell remarks that by early July of 1950, it was clearly evident that the primary sources of North Korean supply were the Soviet Union and the PRC. But the political situation surrounding the growing confrontation imposed limits that had not existed for airmen on 7 December 1941. The fear of widening the war precluded attacking sources of supply beyond the Korean borders. Undeterred, airmen quickly assembled a list of strategic targets within North Korea's industrial areas and by the end of July were attacking them. It is important to note that this was before the big battle for survival around Pusan had begun. By the end of September 1950 the strategic

[59] Futrell, *USAF in Korea,* 3-13.

bombing campaign was over. The Air Force had exhausted its target list, having achieved the desired levels of destruction. By this time Mac Arthur's landing at Inchon was complete, victory seemed assured, and air strategy must have appeared validated. Yet, the conflict would continue for nearly three more years.[60]

The Air Force retained the ultimate weapon in its strategic arsenal, the atom bomb. While its use was considered at various phases during the conflict, the bomb was never used as anything more than a threat. Bruce Cumings remarks on B-29 missions over North Korea simulating an atomic attack profile, asking his readers to "imagine the steel nerves required in Pyongyang" as they awaited what could be a real attack.[61] Both the Army and the Air Force concluded early in the conflict that there was little to gain militarily and much to lose politically from the use of atomic weapons in Korea. General Curtis LeMay qualified his reservations on the use of the bomb with the caveat that it would be useful in a campaign against China. Futrell chastises General MacArthur for not understanding the utility of conventional air power in an interdiction role, and the Army for a later study suggesting that the bomb could have been used effectively against concentrations of Chinese troops. Certainly, the Soviet bomb entered into America's policy calculations. Ultimately, however, it was the damage to American prestige in world opinion that persuaded President Truman to exercise restraint.[62]

In many ways airmen had to learn again a lesson from World War II and the need for air superiority. The North Korean Air Force was destroyed at the beginning of the war, unable to challenge the United Nations' air forces. It was only after the Chinese intervention that the

[60] Ibid, 183-198.
[61] Bruce Cumings, "On the Strategy and Morality of American Nuclear Policy in Korea, 1950 to the Present" in *Social Science Japan Journal* 1, No. 1 (April, 1998).
[62] Conrad C. Crane, "Raiding the Beggar's Pantry: The Search for Airpower Strategy in the Korean War" in *The Journal of Military History* 63, No. 4 (October 1999), 896; Futrell, *USAF in Korea*, 701-702.

Soviet built MiG-15 fighter challenged the United Nations' forces control of the airspace. The MiG-15 was a very capable plane, and was the product of exploited German aerospace technology after the war. The United States met the challenge with the F-86 Sabre, which also resulted from captured German technology. While each plane had strengths and weaknesses, most agree that superior training allowed United Nation's forces to achieve a 10-to-1 kill ratio and maintain command of the air. Even so, the MiGs were a constant nuisance, and forced B-29 missions into the night sky. Daylight missions were accomplished by fighter aircraft, which Crane called "more agile and less vulnerable." A constant complaint of airmen was that the MiGs were allowed sanctuary north of the Yalu River because political considerations put the destruction of Chinese airfields off limits.[63]

The most controversial air mission of the Korean Conflict was the close air support (CAS) mission. The main source of controversy seems to be the two systems that emerged from World War II, one practiced by the Army and its Air Forces, the other practiced by the US Marines. The reason for different systems for the different services was simple. Army divisions possessed more organic artillery than Marine units. Marines trained for amphibious assault eschewed artillery in favor of offshore naval gunfire and, of course, airplanes dedicated to close support. In the early days of the conflict, when UN and ROK forces were fighting for their lives, an ad hoc system was worked out to coordinate Navy, Marine and Air Force planes providing support to friendly forces. The controversy stems from the time after Pusan, when Army officers sought to keep operational control of tactical air beyond what airmen considered necessary. Airmen argued that airpower was inherently flexible, and that aircraft were more efficiently used when executing interdiction missions far beyond the lines. High ranking Army officers charged

[63] Futrell, *USAF in Korea*, 694-699, Crane, "Raiding the Beggar's Pantry," 886.

the Air Force was uncooperative. While the internal debate raged within the military establishment, a parallel public debate ensued when a news article appeared praising the Marine system of close support.[64]

Air Force Chief of Staff Hoyt S. Vandenberg publicly answered the charges against the Air Force in a February 1951 *Saturday Evening Post* article. Far from being a simple answer to the CAS controversy, Vandenberg took the opportunity to educate the American people on the role of airpower. Indeed, the article is entitled "The Truth About Our Air Power," implying that people did not understand the truth, or even that the truth had been withheld from them. Before wading into the CAS controversy, Vandenberg recited his credentials as a fighter pilot and tactical airman. Yet the article, from beginning to end, is an explanation of strategic bombardment doctrine. This is important, because it demonstrates how deeply this notion was now ingrained in the minds of American airmen. It had become their operational code, or the lens through which they approached the problem, and the doctrine that was passed on to the next generation of airmen.[65]

The Korean War came a mere five years after the greatest conflagration the world had ever witnessed. The first conflict of the Cold War was a limited war, which meant it was purposely limited in size and scope, primarily to keep from provoking a general war between the USA and the USSR. When the armistice was signed, the lines had settled near the original 38th Parallel, which can be interpreted as a victory for the containment strategy. Doctrine had not evolved much during the five year hiatus, and American airmen were confident they knew how to win the war. Aircraft technology had changed, but there had not been time to consider how

[64] Futrell, *USAF in Korea*, 704-708; John Schlight, Support *From Above: Air Force Close Air Support of the Army, 1946-1973* (Washington, D.C.: Air Force History and Museums Program, 2003), 113-141.
[65] Hoyt S. Vandenberg, and Stanley Frank, "The Truth About Our Air Power" in *Saturday Evening Post* 223, no. 34 (February 17, 1951).

the new technology might best be exploited. Both airmen and engineers spent their time trying to understand the new technology.

Ultimately, it was the jet fighters inspired by exploited German technology that won the battle for air superiority and increasingly performed daylight interdiction and CAS missions. Once classified as very heavy bombers, the piston engine World War II relic B-29 medium bombers were used primarily in an interdiction role, and were occasionally called upon for CAS duty. Yet airmen clung tenaciously to the idea of strategic bombardment, and it was the B-29 that spearheaded the short-lived strategic bombardment campaign. General Vandenberg's article discussed attrition rates and air defenses, and alluded to the idea that the United States needed to stay ahead of Soviet technological developments. He spoke of the mainstay of the strategic force, the B-36, and mentioned that the Air Force was about to field its next generation jet bomber, which was of course the B-52. His article signaled that the B-52 should only be viewed as the next technological step, and that the USAF would continue its quest for a better bomber.

CHAPTER 3

THE NEW LOOK, MORE BOMBS AND SMALLER BOMBERS

As the Korean War ended, Americans viewed the Soviet Union as the enemy and war as total. The fighting ended in a stalemate, allowing American policymakers to claim that the containment strategy had been appropriate. President Truman had ruled out atomic weapons as an option in Korea, yet his successor, Dwight D. Eisenhower, based his entire postwar strategy on the threat of massive nuclear retaliation. Known as the New Look, Eisenhower's national security policy included the new thermonuclear device, called the Super Bomb at the time, and more commonly known since as the hydrogen bomb. As the Eisenhower Administration sought to provide security while simultaneously reducing the national budget, military men once again sought ways to implement the new strategy. The period following the Korean Conflict was one during which the United States Air Force consumed almost half the defense budget. The idea of strategic bombardment was still alive and well in the minds of airmen, and shaped their views as they prepared for future conflict.

Since political and military leaders in the United States viewed war as total and the Soviet Union as the enemy in the early 1950s, they looked to World War II, not Korea, as the template upon which planning for future conflict should be based. The lesson of Korea seemed to be that "the enemy's action may be sudden and surprising," which created an unease among military men and drove an imperative to be ready to meet aggression at all times.[1] Statements by

[1] Thomas D. White, "The Scope of United States Air Strategy" in *Annals of the American Academy of Political and Social Science* 299, Air Power and National Security (May 1955), 28.

incoming President Dwight D. Eisenhower, Secretary of State John Foster Dulles and Chairman of the Joint Chiefs of Staff Admiral Arthur W. Radford were clear that the U.S. economy could not afford to maintain a strong presence everywhere that communism threatened. They all held that the nation's military forces should not be diverted from the core task of defending Western Europe from Soviet aggression. Futrell summarized the prevalent thinking when he wrote "the nation's military leaders agreed that the Korean conflict – which had to be fought as a limited war – was abnormal."[2]

President Eisenhower based his national security strategy, known as the New Look, entirely on the use of nuclear weapons. The policy is spelled out in the formerly Top Secret document NSC 162/2, dated 30 October 1953. Eisenhower saw a dilemma between the need to meet the Soviet threat and the imperative of keeping the domestic economy strong. Eisenhower "believed that security and solvency were two sides of the same coin."[3] NSC 162/2 assumed that Soviet foreign policy was based on an "irreconcilable hostility" between East and West; it acknowledged that the USSR had a growing capability to launch an atomic attack on the United States, and accepted the inevitability of a future in which the Soviets would be able to threaten the US with hydrogen bombs. Understood in the concept of massive retaliation was the knowledge that the United States possessed a vastly superior nuclear arsenal and more bombers capable of delivering those weapons than did the Soviet Union when Eisenhower entered office.[4]

The New Look relied on the deterrent power of nuclear superiority. Because maintaining a fleet of bombers and nuclear weapons was less expensive than maintaining massive

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[2] Futrell, *Ideas, Concepts, Doctrine*, 419-420.
[3] Andreas Wenger, *Living with Peril: Eisenhower, Kennedy and Nuclear Weapons* (New York: Rowman & Littlefield Publishers, Inc., 1997), 14.
[4] United States Department of State, William Z. Slany, Ed., *Foreign Relations of the United States, 1952-1954. National Security Affairs (in two parts), Volume II, Part 1* (Washington: U.S. Government Printing Office, 1952-1954), 577-599 accessed at http://digital.library.wisc.edu/1711.dl/FRUS.FRUS195254v02p1

conventional armies overseas to meet the Soviet threat, it met Eisenhower's goal of keeping the federal budget in check. Yet, there is an underlying assumption that a war using nuclear weapons could be fought and won by the United States. As Andreas Wenger explained, "Nuclear war, it was perceived, need not lead automatically to mutual destruction." Numbers of atomic weapons at the beginning of Eisenhower's Administration were still fairly limited, and the thermonuclear weapons available were extremely limited. From the U.S. strategic standpoint, it was believed that the nation could survive a nuclear exchange and emerge victorious from a future conflict. With the guidance provided in NSC 162-2, the Department of Defense began to plan for future war.[5]

Preeminent in the New Look strategy was the USAF, the keeper of the long range bombers which would deliver nuclear weapons if called upon. The Department of Defense budgets voted by Congress throughout the Eisenhower Administration favored the Air Force, which consistently received over forty per cent of the available funds. From 1957 until 1960, the Air Force share of the budget approached fifty per cent. There was a continuity between the Truman and Eisenhower administrations in the belief that the USAF now epresented the first line of defense for the nation. Truman's final budget, for the year 1954, originally sought to hold Army and Navy spending at the then-current level and requested an increase in funds for the Air Force. While the USAF did not receive as much as the President had originally requested in 1954, the allocation of funds demonstrated the direction of strategic thinking at the highest levels of government.[6]

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[5] Wenger, p. 54.

[6] *The Budget of the United States Government for the Fiscal Year ending June 30, 1954* (Washington: United States Government Printing Office, 1953, 554-695); *The Budget of the United States Government for the Fiscal Year ending June 30, 1955* (Washington: United States Government Printing Office, 1954), 480-587; *The Budget of the United States Government for the Fiscal Year ending June 30, 1956* (Washington: United States Government Printing Office, 1955), 504-609; *The Budget of the United States Government for the Fiscal Year ending June 30, 1957* (Washington: United States Government Printing Office, 1956), 504-605; *The Budget of the United States*

Because of the World War II experience, Air Force doctrine during the early 1950s emphasized strategic bombardment and attack on enemy industry, which was considered the source of strength for modern industrialized nations. Air Force Manual 1-2 (AFM 1-2), dated 1 April 1955, emphasized the same themes airmen had developed in the 1930s at the Air Corps Tactical School. AFM 1-2 perpetuated the idea that airpower was "decisive,"[7] and that the Air Force could win wars without assistance from the other branches. Also prominent was the idea that the Air Force struck at the source of a nation's strength. Airmen clearly believed that they alone could attack not only fielded forces, but also the industry that supported those forces.[8] Historian James Mowbray was prompted to say of the USAF's initial forays into written doctrine that "it sounded so much like the ACTS faculty of the 1930s that it might as well have been written by them." Clearly, this thinking had become a part of the airmen's operational code.[9]

Initially, it was the Air Staff that decided on targets for a nuclear attack, which were forwarded to the JCS for approval. The JCS approved target list was then sent to SAC for operational planning. When he became SAC Commander in January 1951, General Curtis E. LeMay changed the calculus by arguing that the targets chosen by the staff, and approved by the JCS, put unreasonable demands on his operational resources. LeMay convinced the Air Staff to allow SAC to review target lists before sending them on to the JCS for approval, which essential yielded the lead in nuclear planning to SAC. Graduates of ACTS and veterans of the strategic bombing campaigns of World War II prepared for an assault on Soviet industry with nuclear weapons. Planning this nuclear strike was no easy task, as the closed nature of Soviet society

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Government for the Fiscal Year ending June 30, 1958 (Washington: United States Government Printing Office, 1957), 484-585; *The Budget of the United States Government for the Fiscal Year ending June 30, 1959* (Washington: United States Government Printing Office, 1958), 431-520; Futrell, *Ideas, Concepts, Doctrine,* 421.

[7] AFM 1-2 United States Air Force Basic Doctrine, 1 April 1955, FRIC Special Collections, 4.

[8] Ibid., 3,8.

[9] James A. Mowbray, "Air Force Doctrine Problems: 1926 - Present" in *Airpower Journal* 9, Iss. 4 (Winter 1995), 29.

forced them to rely on outdated maps, sometimes dating back to before World War I. Unable to identify accurately critical industrial complexes, as early as 1948 SAC was targeting the enemy population and was beginning to think of enemy industry as collateral damage. The precision bombardment rhetoric of the 1930s was gone, as planners increasingly designated urban areas as targets.[10] Target planners desired weapons with ever increasing yields so that one bomb could destroy multiple targets. Planners referred to industry destroyed in these indiscriminant attacks as a "bonus effect."[11]

As SAC emerged as the striking arm of the Air Force, its commander, General LeMay emerged as the embodiment of nuclear warfare. His record of combat leadership during World War II was viewed as one of continued success, as he had led B-17 units in Europe before being transferred to the Pacific to lead B-29 raids on Japan. He was noted for developing procedures and techniques that were adopted throughout the Army Air Forces.[12] LeMay was a demanding leader, working hard to improve operational readiness and morale while preparing the command for war at a moment's notice. David Alan Rosenberg described LeMay as "a powerful personality and consummate operational commander." The force of his personality is legendary, but Rosenberg's implication is that he was not necessarily a thoughtful strategist, which is what the USAF needed.[13]

Under LeMay's leadership, Strategic Air Command stood ready to implement the massive retaliation posed by the New Look. When President Eisenhower announced his national security strategy, the mainstays of the SAC retaliatory force were the intercontinental range B-36

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[10] David Alan Rosenberg, "The Origins of Overkill: Nuclear Weapons and American Strategy, 1945-1960" in *International Security* 7, No. 4 (Spring 1983), 14-20.
[11] Futrell, *Ideas, Concepts, Doctrine*, 437.
[12] Official Air Force biography, Curtis E. LeMay, accessed at http://www.af.mil/AboutUs/Biographies/Display/tabid/225/Article/106462/general-curtis-emerson-lemay.aspx , 1/11/16.
[13] Rosenberg, 19.

bomber and the medium range B-50, which required forward operating bases to reach targets in the Soviet Union. Both of these World War II vintage piston engine bombers were acknowledged as obsolescent, but advances in aircraft technology seemed to promise SAC a continued ability to strike targets in the Soviet Union. As Eisenhower was taking office in 1953, the jet powered B-47 was entering the Air Force inventory to replace the B-50. While the B-47 still required forward operating bases, the intercontinental B-52 jet bomber was on the horizon. Even as the B-52 began to enter the inventory in 1955, SAC was already planning its next generation bombers – the high altitude, Mach 2 capable B-58 Hustler and the B-70 Valkyrie, able to reach speeds of Mach 3 at even higher altitudes.[14]

Weapon technology was also a major component of the massive retaliation strategy. Within days of the announcement that the Soviet Union had exploded a second atomic bomb, American scientists began working on a thermonuclear device. Theoretically a thousand times more powerful than the fission bombs dropped on Hiroshima and Nagasaki, the idea of a bomb that fused hydrogen atoms was not new to nuclear scientists. Indeed, it had been considered within the realm of possibility during the early days of the Manhattan Project. The fusion bomb was, however, rejected in favor of the fission bomb which was considered more quickly achievable. On November 1, 1952, the United States tested a hydrogen bomb on Eniwetok Atoll in the Pacific Ocean, a little more than a year after the project was begun in earnest. Where the fission bomb that destroyed Hiroshima was estimated to be in the range of 15 kilotons (KT), or fifteen thousand tons of explosive power, the hydrogen bomb tested that day produced a yield of 10 megatons (MT), or ten million tons of TNT. An eyewitness on a ship thirty miles away said the blast "blotted out the whole horizon." The blast completely vaporized the island upon which

[14] Knaack, *Volume II: Post World War II Bombers,* 236, 357-358, 559.

the test was carried out, and left a mile wide crater a couple of hundred feet deep in the ocean floor.[15]

President Truman's decision to develop the hydrogen bomb because the Soviets might do it is often viewed as ill-advised, especially in light of General Omar Bradley's widely known comment that he could see no military purpose for the bomb. One must consider, however, that when the Manhattan Project was initiated, the national security establishment believed it was in a race to develop a super weapon before the Germans could do so. In the immediate postwar period, the American scientific establishment was shocked by the advanced state of German jet engine, airframe, and rocket development. The Soviet Union had developed an atomic bomb at least three years before American intelligence believed it would, and American intelligence had very little information concerning Soviet military intentions. In this context, Truman's decision does not really seem much different than Roosevelt's earlier decision about what he believed the nation needed to accomplish to keep secure.[16]

While Truman made the decision to build the H-bomb, it was during the Eisenhower Administration that strategists began to consider the use of these new weapons. Some began to question the need for such a powerful weapon. Scientists had been debating the use of nuclear weapons since the end of World War II, and their arguments centered on the morality of the weapons. The fission bomb provided a certain military efficiency, since one plane carrying one bomb replaced hundreds of sorties and thousands of conventional bombs. But use of the fusion bomb seemed to violate accepted norms of proportionality. The industrial nature of war in the twentieth century had blurred the lines between the combatants and the noncombatants behind

[15] Richard Rhodes, *Dark Sun: The Making of the Hydrogen Bomb* (New York: Simon and Shuster, 1995), 482, 505-509.
[16] Meilinger, *Bomber*, 219.

the lines who supplied them. Airmen were fairly conservative and still thought in terms of strategic bombardment and the need to attack enemy industries, which tended to be concentrated in cities. They thought in terms of target destruction and military victory, not human lives. So they eschewed the doctrine of precision bombardment and planned to fight wars with nuclear weapons.[17]

Even as the hydrogen bomb afforded larger yields, the technological advance that made implementation of the New Look possible was the miniaturization of nuclear weapons. The mainstay of the U.S. inventory in the late 1940s and early 1950s was the Mark 3 fission bomb, which was the type used on Nagasaki. The Mark 3 was very inefficient in its use of nuclear materials. The Sandstone Nuclear Tests of 1948 tested more efficient ways to trigger a fission reaction. These tests led to smaller atomic bombs with larger yields.[18] The B5 was the first lightweight nuclear weapon, introduced into the inventory in 1952. It weighed only 3,100 pounds and produced a yield of 120 KT, as compared with the Mark 4 (an improved Mark 3) then in use which weighed almost 11,000 pounds and produced a yield of 31 KT. The Mark 7, also introduced in 1952, weighed only 1,700 pounds, produced a 61 KT yield, and could be carried externally on a fighter aircraft.[19] These smaller warheads turned even tactical fighters, to include carrier based attack aircraft, into nuclear bombers. They also paved the way for the advent of nuclear artillery shells and ballistic missiles.[20]

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[17] Peter Galison and Barton Bernstein, "In Any Light: Scientists and the Decision to Build the Superbomb, 1952-1954" in *Historical Studies in the Physical and Biological Sciences* 19, No. 2 (1989), 267-268; George F. Lemmer, The Air Force and the Concept of Deterrence:1945-1950, AFHRA, Call #K168.01-13 C.1, IRISNUM 01075288, 3, (overall classification of this document remains SECRET, some pages are redacted)
[18] Robert P. Jameson, "Armageddon's Shortening Fuse: How Advances in Nuclear Weapons Technology Pushed Strategists to Mutually Assured Destruction, 1945-1962" in *Air Power History* 60, Issue 1 (Spring 2013), 44;
[19] Norman Polmar and Robert S. Norris, *The U.S. Nuclear Arsenal: A History of Weapons and Delivery Systems since 1945* (Annapolis: Naval Institute Press, 2009), 40-41.
[20] Ibid., 9-10.

The idea of using nuclear weapons in a tactical role was not new. General Marshall had, before Hiroshima, advocated using the atomic bomb against a purely military target. Early in the planning process, a Japanese fleet concentration at Truk was suggested as a possible target. After the Trinity test, General Leslie Groves explained to General Marshall the effect of an atomic bomb on troop concentrations. Groves reported that the bomb would "wipe out…resistance over an area 2000 feet in diameter; …paralyze it seriously over an area a mile in diameter; and…impede it seriously over an area five miles in diameter."[21] Immediately after Hiroshima, an admiral planning support for Operation Olympic, the invasion of the Japanese home islands, requested six atom bombs to suppress resistance on the proposed landing beaches. It was, however, the Air Force doctrine of strategic bombardment and the hope of victory without an invasion that carried the day when targets were selected for the first atomic bombs. Cities were chosen as appropriate targets for the bomb for their psychological value, as the attack on enemy morale was expected to bring about the desired strategic result, which was surrender without invasion and the attendant loss of American lives.[22]

An Air Force-commissioned study known as Project Vista, released in early 1952, recommended basing the defense of Europe on tactical nuclear weapons. California Institute of Technology researchers argued that given Soviet advantages in conventional weapons, tactical nuclear weapons could be initially more effective in blunting a Soviet conventional offensive than a strategic nuclear attack. The study also suggested that tactical nuclear weapons in Europe could serve as a deterrent to Soviet aggression. A very thorough study, Vista examined how these weapons might be utilized, to include target categories and weapon yields. While not

[21] Groves quoted by Barton J. Bernstein, "Eclipsed by Hiroshima and Nagasaki: Early Thinking about Tactical Nuclear Weapons" in *International Security* 15, No. 4 (Spring 1991), 161.
[22] Ibid., 149-173.

directly challenging the prevailing wisdom of strategic bombardment, it did question the efficacy of cities as targets.[23] The report affirmed that the "U.S. had a technological advantage, and it should be exploited"[24] and suggested that "all U.S. tactical combat aircraft in units in SHAPE [Supreme Headquarters, Allied Powers Europe] should be capable of carrying atomic weapons."[25]

Despite commissioning the report, the USAF leadership rejected Vista and its findings. It seems their major objection to the study was that it appeared to threaten the preeminent position that SAC had assumed within the defense establishment. Perhaps the Air Force had commissioned the study to lend academic support to their preconceived notions concerning nuclear strike, but they were not to find them within the study. Indeed, the Cal Tech researchers maintained from the beginning that they were not really qualified to speak on strategic bombardment. Some airmen, such as General Lauris Norstad, appeared to understand that tactical and strategic nuclear weapons were not mutually exclusive, but this distinction was lost on most. Even Norstad was clear, however, that he considered the SAC mission "essential." Those who disagreed with the findings were in the majority. They saw to it that copies of the report were collected and archived until the Vista project was declassified in 1980.[26]

While the Strategic Air Command continued to garner attention, and funding, in its role as the first line of defense in the West, the leaders of the Tactical Air Command considered the future of their organization. The conflict in Korea had demonstrated that non-nuclear limited wars were indeed possible in the nuclear age, and that air superiority and close air support

[23] David C. Elliot, "Project Vista and Nuclear Weapons in Europe" in *International Security* 11, No. 1 (Summer 1986), 163-173.
[24] Ibid., 170.
[25] Ibid., 173.
[26] Ibid., 174-177.

continued to be vital missions. Even so, fighter advocates believed that tactical nuclear weapons had changed the face of warfare. Increasingly, fighter pilots came to believe that they could defend Europe with the use of tactical nuclear bombs, just as the Vista report suggested. Indeed, NATO planning began to incorporate what they called "special weapons." Historian Caroline Ziemke argued that under the leadership of Generals John K. Cannon and Otto P. Weyland, TAC remade itself into a miniature SAC in order to survive as a command.[27]

The F-84G Thunderjet was the first tactical fighter that the USAF configured to carry atomic weapons. Originally conceived as an air superiority fighter in 1944, the plane was outclassed by the MiG-15 in Korea. While it did escort B-29s on bombing missions in Korea, it was pressed into service as a conventional fighter-bomber. The G-model, which entered operational service in 1951, was the first production fighter to incorporate a receptacle to accommodate flying boom air refueling, and it was retrofitted to carry one Mk 7 tactical atomic bomb. In an early demonstration of the fighter aircraft's ability to flex TAC's nuclear muscle, seventeen F-84Gs flew nonstop from Turner Air Force Base in Albany, Georgia to RAF Lakenheath in the United Kingdom in August 1953. The planes refueled in flight and covered almost 4,500 miles. The record setting flight demonstrated the ability to rush tactical nuclear weapons to hotspots anywhere in the world.[28]

The early 1950s were a time when technology was changing rapidly, and new aircraft were entering the inventory every few years. Using information gleaned from Project LUSTY, along with the cooperation of the scientists retained in Project Paperclip, the U.S. aeronautical industry produced advanced airframe designs. There was still much to learn, and new models

[27] Elliot, 181-183; Caroline Frieda Ziemke, "In the Shadow of the Giant: USAF Tactical Air Command in the Era of Strategic Bombing, 1945-1955," (Ph.D dissertation, The Ohio State University, 1989), 302.
[28] Knaack, *Volume I: Post World War II Fighters,* 22-37.

were built almost on a trial and error basis. The unease produced by the fear of a surprise nuclear attack drove airmen to acquire immediately the best available technology. Often aircraft were already in production when a problem might occur in testing. Sometimes the necessary changes were made immediately, causing different configurations in a single variant of the aircraft. At other times, the series was completed, with the understanding that the problem would be fixed in the next variant produced. The Air Force demanded more speed, and aircraft designers developed airframes that were more aerodynamic to comply and compete.[29]

But it was not just airframe design that was changing. The new field of aircraft electronics, or avionics, had emerged in the aircraft industry. Since the early days of flight, aviators had recognized the need both to reduce pilot workload and to provide accurate navigation and weapons delivery solutions. By the 1950s, the speed of jet aircraft coupled with the increased complexity of the modern battlefield made avionics a necessity. Aircraft were increasingly equipped with radios, airborne radars, analog computers, and navigational aids. All of this equipment had to be housed within the already limited space of a fighter fuselage, therefore had to be considered in the airframe design. The avionics equipment also added weight, which had to be considered in the flight characteristics. Essentially, more powerful engines were needed to carry the heavier jets airborne while still attaining the desired speeds.[30]

Jet technology was also advancing, as engines producing more and more thrust became available to meet the demand. The F-86 was the first jet fighter to incorporate an afterburner. Only a small percentage of the air passing through an axial flow jet is used for combustion, the rest is used to cool the engine. An afterburner injects fuel directly into the hot exhaust,

[29] Ted Spitzmiller, *The Century Series: The USAF Quest for Air Supremacy 1950-1960* (Atglen, PA: Schiffer Military History, 2011), 12-13.
[30] Paolo Quaranta, "The Evolution of Avionic System Architectures" in *Military Technology* 24, Iss. 10 (2000), 86-87.

producing more thrust. It drives up fuel consumption, but can deliver extra thrust for takeoff and for short bursts of speed in flight. Innovations such as this became standard on fighter aircraft. As planes became heavier because fuselages had to be larger to accommodate avionics packages which themselves added weight, jet engines had to produce more thrust. These more powerful engines required advances in metallurgy to withstand the high temperatures and the high rpms the improved engines generated.[31]

These technological trends in aircraft design converged in a group of fighter aircraft known as the Century Series Fighters.[32] The Century Series is so called because the first production aircraft in the series was the F-100 Super Sabre. North American Aviation began work on a project known as Sabre 45 in 1949 as an air superiority fighter to replace the F-86. The most notable upgrade was that the wing sweep angle had been increased from 35 degrees to 45 degrees. It also incorporated the larger J-57 engine and a redesigned intake, which made it the first fighter to exceed Mach 1 in level flight. The single seat, single engine fighter was initially armed with four 20mm cannon for air-to-air combat. North American proposed the plane to the USAF in January 1951, and the Air Force made its decision to go ahead with the new fighter in October 1951, no doubt spurred by the battle for air superiority over Korea. The F-100A, called the Super Sabre by the USAF, began to enter the Tactical Air Command inventory in September 1954.[33]

The USAF is often disparaged for not learning the lessons of the Korean War. The decision to produce a fighter-bomber version of the F-100 in 1953, however, suggests that airmen closer to the actual fighting were aware of the need for interdiction and close air support.

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[31] Spitzmiller, 26-28, Bill Gunston, *The Development of Jet and Turbine Aero Engines* (London: Patrick Stephens Limited, 1995), 50-52.
[32] Spitzmiller, 12-14.
[33] Knaack, *Volume I: Post World War II Fighters,* 112-115, Spitzmiller, 70-71.

The F-100C retained its air-to-air capability, but was configured with avionics and hard points on the wings and centerline, enabling it to deliver conventional bombs. The wing was redesigned with internal fuel tanks to increase the range, and the plane was equipped for probe and drogue refueling as well. The C-model entered operational service in 1955, bypassing the F-100B which incorporated so many changes that the USAF redesignated it as the F-107A. Improvements continued on the basic design, and the F-100D incorporated airframe improvements to correct stability problems, the provision to carry external fuel tanks to further increase range, and the ability to carry the smaller, tactical nuclear weapons that were entering the inventory. As the New Look became a reality in TAC, all models of the F-100 were eventually configured to carry nuclear weapons. The "Hun," as the pilots affectionately called their mount, had become a nuclear bomber.[34]

Of course, nuclear bombers had been the primary concern of SAC since atomic weapons became technologically feasible. SAC's only concern with fighters was the threat enemy fighters posed to their bombers, so the command somewhat reluctantly sought to acquire a long range "penetration fighter" to escort the bombers, at least initially, into the Soviet Union. The second of the Century Series fighters, the McDonnell F-101 Voodoo, began life as this penetration fighter. The original iteration of the penetration fighter, the XF-88 Voodoo, had been cancelled in August 1950. The realization that the B-29 needed fighter escort in the face of MiG-15 opposition in Korea led to the program's reactivation in January 1951. A go-ahead decision for the improved Voodoo, now known as the F-101, was made in October of the same year. SAC, always preoccupied with how to reach the designated target against determined opposition, also experimented with parasite fighters which the bombers could carry into the combat zone.

[34] David A. Anderton, *North American F-100 Super Sabre* (London: Osprey Publishing Limited, 1987), 23; Knaack, *Volume I: Post World War II Fighters,* 112-126, Anderton, 99-101.

SAC eventually gave up on the idea of escort fighters, preferring electronic jamming and deception methods, but the F-101 found a home in both Tactical Air Command and Air Defense Command.[35]

Since the F-101 had been originally conceived as an escort fighter, it rolled off the assembly line in August 1954 with four 20mm cannon. Probably a result of its origin in SAC, the F-101 already had the ability to carry one tactical nuclear bomb externally on the aircraft centerline. It had two J57 jet engines, which made it very fast, and it boasted a long range. When SAC decided it did not need the Voodoo, the plane was already in production and General LeMay was Air Force Vice Chief of Staff. It seems that LeMay decided that TAC should take the fighter. One wing of F-101s was assigned to TAC, and one wing of the nuclear-capable F-101s joined USAFE at RAF Bentwaters in England. While USAFE was not pleased to have a non-standard aircraft type at only one wing, the appearance of the F-101 in Europe was not lost on the Soviets.[36] One author wrote that the Soviet Air Force recognized its "atomic" capability and he summarized the Soviet evaluation of the F-101 as "an exceptionally fast warplane with respectable range and load-carrying capability."[37] Ultimately, a reconnaissance version of the Voodoo found its consummate role in TAC. Even the ostensibly unarmed RF-101A and C, however, retained a nuclear delivery capability.[38]

Air Defense Command was concerned with nuclear bombers as well, only its interest was intercepting and destroying enemy bombers. The Air Force set out requirements for a supersonic, high altitude interceptor in 1950. A contract was extended to Convair, but

[35] Spitzmiller, 93; Knaack, *Volume I: Post World War II Fighters,* 135-137; Phillip S. Meilinger. "Getting to the Target: The Penetration Problem in Strategic Air Command during the 1950s" in *Air Power History* 61, Iss. 3 (Fall 2014), 40-48.
[36] Knaack, *Volume I: Post World War II Fighters,* 135-157; Robert F. Dorr, *McDonnell F-101 Voodoo* (London: Osprey Publishing Limited, 1987), 95-100.
[37] Ibid., 100-101.
[38] Spitzmiller, 103-104.

development problems delayed the plane that would eventually become the F-102A. A two seat version of the F-101 was considered and adopted as a stop-gap interceptor, due to its speed and long range. Officially designated as the F-101B, the go-ahead decision was made in February 1955 but the plane did not enter service until January 1959. By the time the B-model was in development, rocket technology was improving and many believed that the day of the gun as air-to-air armament had passed. Accordingly, the primary armament for the F-101B was not the gun, but two unguided AIR-2 Genie rockets. The Genie boasted a 1.5 KT nuclear warhead which made the F-101 a nuclear interceptor. The F-101B also carried two GAR-1 Falcon[39] semi-active radar guided missiles with conventional warheads. The unguided Genie was the primary weapon because radar guidance systems, still in their infancy, often failed to intercept the target. Airmen had come to realize that with a nuclear warhead, one need only be close to achieve acceptable results.[40]

While the F-101 filled the gap, the interceptor ADC wanted was the delta wing F-102. Convair had experimented with delta wing designs, and had successfully flown the subsonic delta wing XF-92 in 1948. A request for proposals was sent out in June 1950 to meet the Air Force requirement known as the 1954 Interceptor, named for the year it was supposed to be operational. Convair was awarded a contract in 1951 for the supersonic, high altitude interceptor designated the F-102A Delta Dagger. Theoretically, aeronautical engineers believed the delta wing should have had no problem surpassing the speed of sound. However, when the F-102A first flew it actually slowed down in the transonic region, and was not able to exceed Mach 1. Meanwhile, a civilian research engineer at the National Advisory Committee for Aeronautics

[39] The GAR-1 and GAR-2 were redesignated the AIM-4A and 4-B respectively in 1962, which is the more familiar nomenclature for the Falcon family of missiles.
[40] Knaack, *Volume I: Post World War II Fighters,* 150-152; Dorr, *Voodoo,* 132-141; Spitzmiller, 97-98.

(NACA) had discovered a heretofore unknown phenomenon that he called the area rule. Essentially, the delta wing and cylindrical fuselage combination created so much sonic drag that the plane actually slowed as more power was applied. Gently narrowing, then widening the fuselage corrected the problem, resulting in what became known as the "coke bottle" shape.[41]

The war in Korea, the appearance of advanced bombers in the Soviet inventory, and the Soviet test of a thermonuclear device in 1953 may have kept the troubled F-102 program from cancellation. The Delta Dagger entered operational service in April 1956, two years after the projected operational date. The interceptor was armed with the GAR-1 semi-active radar Falcon missile, and an infrared (IR) or heat seeking version of the Falcon known as the GAR-2. The Genie was tested with the F-102, but was never carried operationally. All F-102As after the first ten produced were redesigned to incorporate the area rule, making it the first "coke bottle" shaped fighter of the era. Other post production problems and upgrades were to be incorporated in the F-102B. However, as more was learned about the performance of the delta wing configuration in the transonic region and more powerful engines and more advanced avionics became available, the B-model was redesignated the F-106 Delta Dart, and it entered operational service in May 1959.[42] Like the F-101, the F-106 was a nuclear interceptor as it carried the Genie along with two radar missiles and two IR missiles internally in missile bays beneath the aircraft.[43]

Republic had proposed an innovative solution that far exceeded the requirements for the 1954 Interceptor requirement. The Air Force wanted a plane capable of Mach 2 at 55,000 feet, but Republic submitted a proposal for a Mach 3 at 70,000 feet aircraft design. The delta wing

[41] Knaack, *Volume I: Post World War II Fighters,* 159-164; Spitzmiller, 124-127; Richard Hallion, "Richard Whitcomb's Triple Play" in *Air Force Magazine* 93, No. 2, (February 2010), 68-71.
[42] Spitzmiller, 127-130;
[43] Ibid., 189.

design incorporated both a standard turbojet for takeoff and landing, and a ramjet engine, which was more fuel efficient for high speed high altitude cruise. Technically, the Republic proposal was "a generation beyond" the requirement, which was filled by the F-102A.[44] The USAF, however, was intrigued by the possibility and awarded a contract for the XF-103 in 1951. Ultimately, the Republic design proved too far ahead of its time. The project was cancelled in 1957 as development was progressing too slowly. Metallurgy and engine technology had not yet reached a point where the aircraft skin and engines could withstand the heat generated at such speeds and altitudes. These problems were solved by the early 1960s, and the performance characteristics of the XF-103 appeared in the SR-71 Blackbird reconnaissance aircraft.[45]

By 1952, TAC was looking for an air superiority fighter to replace the F-100. Aware of the perceived need, Lockheed proposed a new air superiority fighter to the Air Force based on their F-90, which never went into production. The Air Force decided to go-ahead with the Lockheed design, now known as the F-104 Starfighter, in July 1954, the same time the F-100A was entering operational service. The Lockheed design was somewhat radical, in that while other companies were offering swept wing or delta wing designs, the F-104 featured a short, razor thin, relatively straight wing mounted fairly far back on the fuselage. The fuselage did not have the coke bottle shape, because the area rule did not apply with the Lockheed wing-fuselage combination. Smaller and lighter than other planes in the Century Series, the F-104 looks like a rocket. Powered by the new J79 engine, which was lighter and produced more thrust than the J57, the F-104 was able to achieve Mach 1 in a climb and was the first operational jet fighter to achieve Mach 2 in level flight.[46]

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[44] Ibid., 137.
[45] Knaack, *Volume I: Post World War II Fighters,* 329; Spitzmiller, 136-141.
[46] Knaack, *Volume I: Post World War II Fighters,* 174-177; Spitzmiller, 145-151: Bill Gunston, *World Encyclopaedia of Aero Engines, 3rd Ed,* (London: Patrick Stephens Limited, 1995), 69.

While designed as an air superiority fighter, the F-104A was never good in that role. It was not an effective dogfighter because the short wings did not allow for a tight turn radius. One recognizes a growing recognition of the air-to-ground role TAC fighters needed to maintain, as the Starfighter came off the assembly line with four hard points on the wings for weapon carriage. ADC considered the plane as an interceptor, even though it was relatively short range, but TAC was not initially excited about the design. The F-104C was therefore upgraded to make it more palatable to TAC. It increased the wing hard points to six, made provisions for carrying external fuel tanks, and added a removable, but not retractable, refueling probe. Most important for the times, the C-model had the capability to deliver one tactical nuclear bomb or one Genie rocket.[47]

The F-105 Thunderchief was another tactical fighter that was born in the immediate wake of the Korean War. Republic Aviation developed this supersonic replacement for its F-84 Thunderjet and proposed it to the USAF in 1951. The company was very much in tune with current Air Force thinking, as the F-105 was designed as a nuclear bomber first, while retaining an air-to-air capability. Gone was any pretense that the F-105's primary role was as anything other than nuclear weapons delivery, as evidenced by the internal weapons bay. Carrying the bomb internally reduced the drag associated with external stores, which increased the plane's range and allowed the weapon to be carried faster. Also of note is that the F-105 did not have a bubble canopy, which aids the pilot in "checking six" during a dogfight. The back of the cockpit is solid, shielding the pilot from nuclear flash and blast from the weapon detonating behind the aircraft. TAC liked the F-105, and gave the go-ahead decision in May 1952.[48]

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[47] Knaack, *Volume I: Post World War II Fighters,* 175-189; Steve Pace, *Lockheed F-104 Starfighter: Design, Development, and Worldwide Operations of the First Operational Mach 2 Fighter* (Osceola, WI: Motorbooks International Publisher and Wholesalers, 1992), 44-45.
[48] Knaack, *Volume I: Post World War II Fighters,* 191; Spitzmiller, 168.

As jet aircraft became more complex, more problems arose in the development process. This was certainly true of the F-105, which went through three iterations that were never operational before the D-model went into production in 1958. Most of the problems with the F-105 involved adding a few thousand pounds of avionics to make it all-weather strike capable. The jet boasted the AN/ASG-19 fire control system, which used the radar and a bombing computer to allow air to ground weapon delivery solutions. The fire control system also produced a computer aided visual delivery capability, and provided cues in the cockpit for terrain avoidance in adverse weather. The radar could be used to deliver semi-active radar missiles as well, since the F-105 retained an air-to-air capability. The F-105D finally became operational in 1960.[49]

Speed was not the only concern that drove engine technology. The F-105 was a much heavier aircraft than its predecessors in the Century Series, having a maximum takeoff weight with a full bomb load of 52,500 pounds. The RF-101C was about the same weight, but the Voodoo had two of the J57 engines that powered the much lighter F-100 and F-102 single engine fighters. The F-105 was equipped with a single J75 engine, which was an improved J57. The engine was lighter and produced fifty percent more thrust than the J57. The J75 also introduced a technique known as water injection to fighter aircraft. Air temperature effects the amount of thrust a jet engine produces. It can be a critical on the takeoff roll, or the amount of runway it takes to get airborne, on a hot day. Water injected at the intake cools hot air, increasing the density of the air entering the engine, resulting in more thrust and the ability to get airborne sooner. Shorter takeoff rolls allow operations from shorter runways. Introducing water injection

[49] Knaack, *Volume I: Post World War II Fighters,* 196-200; Dennis R. Jenkins, *F-105 Thunderchief: Workhorse of the Vietnam War* (New York: McGraw Hill, 2000), 45-47.

was one way the engineers solved the problem of increasing aircraft weight, which was ultimately less expensive than lengthening runways.[50]

As the Century Series fighter aircraft entered the inventory, airmen thought about how the new weapon systems might be employed in the next conflict. SAC had possessed a clearly defined mission since the dawn of the nuclear age, and the ADC mission made sense once the Soviet Union acquired the capability to strike the United States with nuclear weapons. Tactical Air Command seemed adrift however, supporting a conventional army in a nuclear world. General Otto P. Weyland, commander of Tactical Air Command envisioned TAC as a highly mobile strike force armed with nuclear weapons. He downplayed the city-busting approach of SAC, arguing that tactical nuclear weapons were not indiscriminate, but could strike precise military targets. Weyland successfully separated the missions of SAC and TAC, as he defined SAC as a deterrent force and TAC as a mobile strike force.[51]

Many believe that Weyland's ideas were introduced to the Air Staff through an Air War College research study headed by Colonel Richard P. Klocko in 1954.[52] Soon, the General's thoughts were commonly accepted as facts throughout TAC. An AWC student research paper by Colonel Levi Chase in 1956 lamented the fact that TAC was essentially a training command, supplying aircrew for theater commanders in Europe and the Far East. In the author's eyes, these theater commanders were soldiers who were given control of a weapon they did not understand, violating the principle of unity of command. The paper advocated making TAC a global strike force, ready to deploy tactical nuclear weapons to hot-spots anywhere in the world at a moment's

[50] Gunston, *Encyclopaedia,* 127, Norman E. Borden, Jr., *Jet-Engine Fundamentals* (New York: Hayden Book Company, Inc., 1967), 126-127.
[51] Futrell, *Ideas, Concepts, Doctrine,* 437-448; Paul D. Gelpi,Jr., "Forging the Sword: Tactical Air Power and the US Military Experience, 1950-1961," (Ph.D dissertation, The University of Alabama, 2002), 302.9-10.
[52] Ibid., 449.

notice. Colonel Chase no doubt reflected concerns from higher levels about command and control of air assets.[53]

Probably more typical of thinking among younger officers is an Air Command and Staff College research paper by Major Buford C. Blount. It is filled with statements that most airmen accepted as truth, such as:

> It was clearly demonstrated [after World War II] that our political leaders, when dealing with the Russians would have to negotiate from positions of strength. The strength most readily recognized by the Russians was military power.

The author's conception of the Korean War was that "history has proved" that despite possessing overwhelming force, the United States "had to accept a prestige losing compromise." The author then advocated creating a mobile strike force within TAC that could deploy anywhere in the world with tactical nuclear weapons. Clearly, at all echelons of the Air Force, airmen believed tactical nuclear weapons could and would be used effectively in the next conflict.[54]

As the new tactical nuclear bombers entered the Air Force inventory, thinking concerning limited war began to change. The French defeat in Southeast Asia in 1954 and the Taiwan Straits crisis of 1955 alerted the U.S. military that limited war was indeed still a possibility in the nuclear age, and should have warned them that Korea was not an aberration. Yet, airmen clung to the belief that aggression could be deterred by the threat of nuclear weapons. As SAC focused on general war against the Soviet Union, airmen in the Tactical Air Command believed it was precisely such conflicts which gave them relevance. Fast jets, such as the nuclear capable F-84s and the F-100s then entering the inventory seemed tailored for such conflicts. "Indochina" began to appear in Air Force writings as a hot-spot where the tactical nuclear threat could be

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[53] Colonel Levi R. Chase, *A Global Mission for TAC* (Maxwell AFB, AL: Air War College Research Study, April 1956), 22-42.
[54] Major Buford C. Blount, *TAC's Mobile Atomic Strike Force* (Maxwell AFB, AL: Air Command and Staff College Research Study, 1955), p. 15.

employed. Undoubtedly, there was a certain amount of hubris in the belief that non-industrialized nations would be overawed with the arrival of the USAF, armed with the ultimate weapon.[55]

There were, however, some within the Air Force who questioned the New Look and massive retaliation as a viable strategy in limited war. A 1954 Air War College study questioned "the acceptance of atomic weapons as having virtually achieved conventional status…" in the national security policy. The study group offered no answers to the questions they posed, but they wondered if the doctrine of massive retaliation moved the United States closer to initiating a preventative war, and they were uncertain as to whether allies would back the policy.[56] Concerning limited war, the study group asked if the doctrine of massive retaliation would be applied in the case of a communist insurgency "such as Indo-China." They also asked if the United States risked starting a general war by broadening a local conflict with a nuclear retaliation. Clearly, they were concerned that the New Look did not allow enough flexibility of response.[57]

Civilian strategist Bernard Brodie questioned the USAF conception of modern war and the reliance on strategic bombardment in a 1955 article. He accused airmen of slavishly following the ideas of Douhet, without a careful consideration of von Clausewitz. Brodie argued that a rigorous examination of the strategic bombardment campaigns of World War II might have yielded different lessons without the advent of the atomic bomb. He said the bomb was "unquestionably a triumph for Douhet that he was able to create a framework of strategic thought

[55] Futrell, *Ideas, Concepts, Doctrine,* 447-452; Blount, 3.
[56] Graduate Study Group Research Project No. 8, Some Pertinent Questions Concerning the So-Called "New Look" Concept, 1 April 1954, AFHRA Call No. K239.0422-8, IRISNUM 00479983, 6.
[57] Ibid, 13.

which is considered by many responsible airmen to fit the atomic age astonishingly well."[58] Brodie contends that the days of nuclear monopoly created within much of the defense establishment the idea that modern war was total, and that war had become an end in itself. He advocated a return to the work of von Clausewitz, who said the object of war must be tied to the desired political outcome.[59]

Yet airmen continued to trumpet the benefits of strategic bombardment like a modern day Cato, calling at every opportunity for the destruction of the Soviet Union. In 1956, the Air Force officially suggested that the nation make nuclear war the primary method to wage limited war.[60] Ironically, President Eisenhower implemented his massive retaliation policy with aircraft primarily developed during the Truman Administration and in the shadow of the Korean War. Both bombers and fighters had become nuclear bombers, designed to outrun enemy air defenses and deliver their atomic ordnance. American aircraft technology had changed rapidly, and new aircraft were considered obsolescent when they entered the inventory because the next aircraft boasted increased speed and greater capability. By the end of Eisenhower's term in office however, the strategic environment had changed. Not only had domestic budget considerations become a factor, but Soviet technology had advanced as well.

The U.S. national security establishment was shocked when the Soviet Union launched Sputnik, the first artificial earth satellite, into orbit on October 4, 1957. While American scientists had been exploring ballistic missile technology since the end of World War II, missiles had always taken second place to the development of manned bombers. Initially, bombers were a more reliable bet than missiles since the technology was proven, and was easily improved

[58] Bernard Brodie, "Some Notes on the Evolution of Air Doctrine" in *World Politics* 7, No. 3 (April 1955), 366.
[59] Brodie, "Evolution of Air Doctrine," 366-370.
[60] Futrell, *Ideas, Concepts, Doctrine,* 458.

upon. A rocket would have to be very large to produce enough thrust to launch a version of the 10,000 pound Mark III bomb into space. Another challenge with missiles was the accuracy and weapon yield problem. The best accuracy in the immediate postwar years was still obtained with the notoriously inaccurate Norden bombsight. The yield of the Mark III was in the 20 KT range, and assuming a guidance system equal to the Norden bombsight, a ballistic missile launched from the United States to the Soviet Union could miss the target by more than 75 miles.[61]

The miniaturization of warheads with increased yields, thermonuclear warheads, and the advent of self-contained navigation systems all combined to make missile technology more feasible. Smaller warheads with larger yields helped to solve one of the accuracy problems. Some early attempts at guidance used a celestial tracker to guide missiles, but it was the inertial navigation system (INS) that gave intercontinental ballistic missiles viability. The INS operates by using gyros stabilized along the three axes of motion to track acceleration, then feeds the information to an accelerometer. Once the initial position of the device is known, a computer can update the position based on the raw information obtained from the accelerometer. The computer can also compute a course to a destination, and can drive a guidance system to steer the device to that destination, which in the case of a missile is the target. Inertial systems are very accurate, and do not require any outside input.[62]

Even though the intelligence community had warned the administration by 1955 that the Soviets were making good progress in their missile programs, DoD was stunned when faced with the reality of Sputnik. The specter of a nuclear holocaust seemed more real than ever, because the ability to put a satellite into orbit meant that the U.S.S.R. now had the ability to launch

[61] Ibid, 477-481.
[62] Ibid, 485; Samuel B. Fishbein, *Flight Management Systems: The Evolution of Avionics and Navigation Technology* (Westport, CT: Praeger Publishers, 1995), 66-67.

nuclear warheads at the United States. The speeds at which ballistic missiles travelled meant that even with the installation of early warning radars, the nation would only have about fifteen minutes' notice before an attack. It was perhaps enough time to launch a retaliatory strike if aircraft were on alert with pre-planned targets, and maybe alert people to take some sort of cover.[63]

Sputnik caused the Air Force to allocate more of its budget to missile development. This reprioritization came at the expense of manned aircraft programs. The YF-107A Ultra Sabre was an innovative design that first flew in 1956, but fell victim to the budget axe the next year. Based on the F-100 Super Sabre, the plane was redesigned to incorporate area rule. Originally conceived to fill either the day fighter, interceptor, or fighter bomber roles, the intake was positioned above the cockpit, freeing space in the nose for a radar and other avionics. After considering other aircraft in production to fill various roles and missions, and no doubt recognizing that money was flowing into nuclear bombers, North American decided to abandon all roles other than air-to-ground for the YF-107. The plane was designed to carry its nuclear weapon in a depression under the aircraft centerline rather than in a weapons bay. The Air Force actually preferred the YF-107 to the F-105, which was then undergoing development problems. The cancellation decision was based on the fact that even with its problems the F-105 would be available sooner, and also the desire to keep troubled Republic Aviation in business.[64]

Another casualty of the budget reprioritization was the North American XF-108 Rapier. Proposed in 1955, the Rapier was a response to changing technology and the changing strategic environment. The threat of Soviet bombers launching stand-off missiles with thermonuclear warheads drove a requirement to intercept the attackers hundreds of miles away from the U.S.

[63] Futrell, *Ideas, Concepts, Doctrine,* 502.
[64] Knaack, *Volume I: Post World War II Fighters,* 329-330; Spitzmiller, 207-213

borders. The XF-108 was envisaged as a two-seat, twin engine, long-range interceptor, with twice the range of the F-106. It was to fly above 70,000 feet, be able to achieve Mach 3, and be capable of supersonic cruise, all of which required more fuel efficient engines. The Rapier was to incorporate a large, powerful radar, and radar designers were beginning to consider a look-down capability since land-based radars were driving bombers to low altitude to avoid detection. It was no simple task to build radars that could discriminate an airplane from ground clutter, so this was a new technological frontier. Interestingly, North American had the contracts for the Mach 3 XB-70 bomber and the Navaho cruise missile. The similarities in the designs are obvious.[65]

The XF-108 was cancelled in 1959, before the aircraft ever flew. In another example of technology changing the strategic environment, the Central Intelligence Agency's (CIA) U-2 reconnaissance overflights of the USSR revealed that the Soviets did not possess the bombers that jittery airmen imagined. The research completed for the Rapier was transferrable to the XB-70 project, which did fly, but that project was subsequently cancelled as well. Much as in the case of the XF-103, the characteristics envisioned for the XF-108 would be incorporated in the SR-71. A fighter version of the SR-71, known as the YF-12, embodied the characteristics of the XF-108. The YF-12 flew once before it was cancelled.[66]

The Bell F-109 was an early attempt to field a vertical take-off and landing (VTOL) fighter. It was a complex design that utilized six jet engines. Two engines were conventionally housed within the fuselage, two were mounted in nacelles on the wingtips that rotated 100 degrees from horizontal to 10 degrees past the vertical. The final two engines were mounted vertically behind the cockpit. The F-109 was designed to operate from short or unimproved

[65] Knaack, *Volume I: Post World War II Fighters,* 330-331; Spitzmiller, 214-216.
[66] Ibid., 217

runways, but was capable of Mach 2 speed once airborne. It was literally an idea which did not get off the ground, as it was cancelled in 1961 before any prototypes were built for testing. Without doubt, aircraft designers had since the end of World War II constantly explored the frontiers of technology to develop innovative solutions to the problems the changing strategic environment presented.[67]

The Air Force Vice-Chief of Staff, General Thomas White, made a speech to the Air Command and Staff College Class of 1957 about a week before their graduation. They had spent the last ten months studying military history, foreign policy, and operational forces. It was the point at which some of these mid-career officers would go off to command operational units, but most would go to various staffs, either at major commands around the world, or at the Pentagon. The Class of '57 was about to become the nameless, faceless staff officers who turn senior officer's directives into regulations, policies and procedures. They would develop plans for the next war and advise senior officers on courses of action when contingencies arose around the world. General White that day told the assembled officers "We see all too few examples of really creative, logical, far-sighted thinking in the Air Force these days." Perhaps the General thought of the technological and strategic change he had witnessed during his own career when he urged them to avoid four pitfalls he had identified in how airmen thought about problems.[68]

White's four pitfalls are far less important than the substance of his comments on nuclear and limited wars. White acknowledged that the atomic bombs had been dropped on an already defeated enemy and that the United States still knew "practically nothing about atomic war."[69] He said airmen had not considered the "utter chaos" that a nuclear attack would bring and were

[67] Ibid., 218-222.
[68] General Thomas D. White, Speech by General White to the Air Command and Staff College, AFHRA, Call #K239.716257-54, IRISNUM 00918411, 2; 4.
[69] Ibid., 3.

"too optimistic" about the nation's ability to survive and retaliate.[70] White pointed to the French failure in Indochina and their troubles in North Africa to suggest that force does not always work to achieve national goals. He told the assembled officers that nuclear weapons were not the solution to every military problem, since in some instances the political situation might make them unusable. He also warned them that Korea was not an aberration, and that for political considerations airpower might not be able to attack enemy sanctuaries. It seems the General understood the relationship between war, politics and change.[71]

White summarized his speech by telling the audience that Air Force doctrine was "not a prayer that we must learn by heart and repeat hopefully every time we are troubled." He urged the young officers to study doctrine to gain "understanding and guidance," but urged them to "add to and revise" as well.[72] The next year, the Air Force began a revision of the Air Force basic doctrine manual, AFM 1-2. In the wake of Sputnik, Indochina, and the overall changed strategic environment, revision seems reasonable. The new Air Force Manual 1-2, dated 1 December 1959, provides a glimpse into the type of thinking about which White warned the ACSC class. While the new document acknowledges the need to consider space, it is mostly unchanged from the 1955 manual it superseded. In fact, it simply introduced the term "aerospace" to define the air and space as a continuum above the Earth and claimed 'the aerospace" as the domain of the Air Force.[73]

The USAF did become more serious about intercontinental ballistic missile acquisition after Sputnik, but for several years the U.S. space program remained behind the Soviets. The USAF commitment to manned bombers and nuclear deterrence is evidenced in a project known

[70] Ibid., 15.
[71] Ibid., 6; 17.
[72] Ibid., 19.
[73] AFM 1-2 United States Air Force Basic Doctrine, 1 December 1959, FRIC Special Collections, i.

as the Dynamic Soarer, or Dyna-Soar. This was a space vehicle that was boosted into orbit on a rocket, then glided through space. The Air Force planned one version for strategic reconnaissance and a second for strategic bombardment. Of interest was a plan to arm the Dyna-Soar with three nuclear bombs and place the vehicle on nuclear alert in space. The plan called to rotate the vehicles and crews monthly. To avoid sensitivities to an American orbital vehicle with armed nuclear weapons overflying the Soviet Union, an equatorial orbit was proposed. This plan, which never progressed beyond a memo, must have assumed that nations along the equator would have no objections to American H-bombs orbiting overhead. The Dyna-Soar program was cancelled in the early 1960s, but the idea of a space glider resurfaced in the 1980s with the space shuttle.[74]

Unlike the period following World War II, after the Korean Conflict airmen had time to consider the implications of new technology on doctrine and strategy. Some lessons that airmen might have learned from the Korean experience quickly faded into irrelevance during the Eisenhower Administration. The President's New Look strategy, which threatened to inflict massive nuclear retaliation upon aggressor nations, fit nicely with the Air Force strategic bombardment doctrine. The miniaturization of nuclear warheads gave the New Look teeth, as even tactical aircraft became nuclear bombers and interceptors became nuclear missile platforms. Even though some were beginning by the mid-1950s to question the wisdom of threatening the use of nuclear weapons in every situation, airmen continued to maintain that they had the perfect weapon and continued to procure aircraft optimized for nuclear delivery. The only substantive change to Air Force basic doctrine was to claim space as the domain of the USAF. They could

[74] Nicholas Michael Sambaluk, "US Policymakers Confront Aerospace Doctrine, 1957-59" in *Cold War History,* 2014, Vol 14, No 1, 91-107, http://dx.doi.org/10.1080/14682745.2013.782536 [accessed 12/18/15]

not know that the next President would require a flexible response to crises, and what the implications might be for the hardware they acquired and the doctrine they had failed to develop.

CHAPTER 4

A VERSATILE PLANE FOR A FLEXIBLE RESPONSE

The John F. Kennedy Administration entered office in 1961 with a new strategy called Flexible Response, designed to revitalize the conventional warfare option. The idea actually arose during Eisenhower's first term, and seems to have been a different reaction to the lessons of the Korean Conflict and nuclear proliferation. General Maxwell D. Taylor is credited with coining the term "flexible response" in 1955 when he became the Army Chief of Staff. Taylor argued the Communists would continue aggressively to promote their world view, but he also viewed the Soviets as rational actors who would not risk nuclear destruction to achieve their goals. He arrived at the premise that the Soviets would continue to support revolutions and small wars of liberation, and that the U.S. military needed to be prepared to meet this sort of threat. Taylor did not totally eschew preparation for general war, but he believed the armed forces needed to be ready to fight a limited war. He called for the Army to acquire increased intratheater airlift capability, and he sought Army control of tactical air support in the battle area.[1]

The idea of flexible response quickly gained favor among civilian strategists. Having had time to consider the Korean War independent of interservice rivalries, budget battles, and planning for the next war, many of these thinkers came to the conclusion that modern war need not necessarily be total. Yet, they understood that nuclear weapons had changed the international dynamics, and indeed the definition of limited war. It had become clear to them

[1] Futrell, *Ideas, Concepts, Doctrine, V.1, 454*-457.

that nations armed with nuclear weapons needed to deter both conventional and nuclear aggression. Bernard Brodie argued that one of the problems with "the doctrine of massive retaliation, where it has been meant as a response to less than massive aggression, is that the enemy with a nuclear capability of his own cannot believe that we mean it."[2] Henry Kissinger admitted that his thinking had changed and that "the conventional capability of the free world should be of such a size that a nuclear defense becomes the *last* and not the *only* recourse" [italics in original].[3] Yet despite the growing chorus of voices in opposition, the Eisenhower Administration continued to base its strategy on massive nuclear retaliation.

President Kennedy was very much influenced by these civilian strategists, and entered office convinced that the United States needed a strong conventional deterrent in addition to a strong nuclear deterrent. As a candidate in 1960, Senator Kennedy criticized the massive retaliation strategy, and promised to increase conventional forces. He did not maintain that deficit spending on the conventional military buildup while simultaneously building up nuclear forces would hurt the economy. While in office, President Kennedy never signed a national security policy paper such as NSC-162/2 that committed the nation to any sort of response to Soviet aggression, so the administration's position has to be discerned from public statements. These statements clearly show that while flexible response was never the administration's stated policy, it was the course they followed.[4] Freed from commitment to any one course of action, the President's policy "reflected the basic insight of the civilian strategists that it was uncertainty that made nuclear threats work in circumstances of mutual vulnerability."[5]

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[2] Bernard Brodie, "The Anatomy of Deterrence" in *World Politics* 11, No. 2 (January 1959), 176.
[3] Henry A. Kissinger, "Limited War: Conventional or Nuclear? A Reappraisal" in *Daedalus* 89, No. 4 Arms Control (Fall 1960), 809.
[4] Futrell, *Ideas, Concepts, Doctrine, V.2, 1-2;* Wenger, 181-196.
[5] Ibid., 196.

New Air Force Secretary Eugene M. Zuckert administered an organization in which doctrine flowed from the USAF conception of military strategy, not from national security strategy, as he believed doctrine should. The Air Force had, in the years preceding Zuckert's appointment, not changed its basic strategic outlook since the 1930s. Other than claiming "the aerospace" for the Air Force, the 1959 edition of AFM 1-2 was little changed from the 1955 edition.[6] The Air University, which was meant to be a place where new ideas were formed and debated, made a noticeable shift away from student research in 1957. Facing budget cuts, the AU Commander decided to make all of the required reductions in research, not military education.[7] The idea of massive retaliation seemed a more efficient form of strategic bombardment, and airmen were convinced that war with a peer competitor was necessarily total in the nuclear age, and that a nuclear onslaught at the outset of hostilities was inevitable. They also maintained that the threat of massive retaliation deterred limited conflict, the Korean experience notwithstanding. Zuckert would later say of his time as Air Force secretary, "adjusting to new hardware still seems easier than adjusting to new ideas and new methods."[8]

Some within the Air Force were beginning to understand the relationship between doctrine and national security policy that Zuckert advanced. AFM 1-1, United States Air Force Basic Doctrine was published in August 1964, and it truly superseded the December 1959 doctrine manual AFM 1-2. The 1964 manual is important because it represents the first break in Air Force thinking in over thirty years. The new manual dropped the notion that airpower alone could win wars, and acknowledged the need for cooperation with all of the services. AFM 1-1 subordinates victory to political objectives, which is precisely how Zuckert said doctrine should

[6] Futrell, *Ideas, Concepts, Doctrine, V.2,* 230-231.
[7] Ibid., 160-161.
[8] Ibid., 230-231.

work. The new manual's authors also recognized that all wars are not necessarily total, and suggested that total victory "in even a conventional war might not be possible."[9] It contains sections on aerospace employment in general war, tactical nuclear operations, conventional air operations, and counterinsurgency. The use of the term "tactical versatility" for the first time suggested that airmen understood the goals of the flexible response policy, and goes along nicely with the idea of selective target destruction, or accuracy rather than larger yields to assure target destruction. Unfortunately, there is little evidence that the manual was understood or followed outside of the select few who wrote it.[10]

The Kennedy Administration's first test of the flexible response policy was the Cuban Missile Crisis of October 1962. The crisis began when American reconnaissance aircraft observed offensive medium range ballistic missiles in Cuba. Although the United States had missiles in Turkey that posed a similar threat to the Soviet Union, Kennedy insisted the Soviets withdraw their missiles. The Soviets backed down, averting a dangerous escalation of the situation, which is now generally acknowledged to have been the closest the antagonists ever came to a nuclear exchange. While the administration believed the threat of invasion of Cuba had caused the Soviets to reconsider their course, General LeMay claimed that it was the threat of airpower, particularly strategic airpower as evidenced by SAC's around-the-clock airborne alert, that had carried the day. While the administration and the USAF disagreed on the overall lesson of the crisis, they did agree that the nation needed more tactical fighters. It had been necessary for TAC to cancel planned rotations to Europe, and redeploying fighters to the southeastern U.S. for the crisis had stripped the rest of the nation of tactical aircraft.[11]

[9] Mowbray, 32.
[10] AFM 1-1 United States Air Force Basic Doctrine, 14 August 1964, FRIC Special Collections, 1-1 – 7-1.
[11] Futrell, *Ideas, Concepts, Doctrine, V.2,* 84-86.

Tactical Air Command believed the perfect tactical fighter to meet any future challenge was already in the pipeline. In 1959, General Frank F. Everest, Commander of TAC, had an idea for the aircraft that eventually became the F-111. He was responding to Air Force General Operational Requirements (GOR) for Weapon System 649C, the follow-on to the F-105 Thunderchief, which was just entering the inventory in 1958 after multiple delays. Any new aircraft would need to meet the requirements of TAC's missions, which were air superiority, interdiction and close air support for the Army, at least on paper. But by 1959 TAC was primarily interested in tactical nuclear bombers, which is what Everest really wanted. To improve upon the F-105s capabilities Everest envisioned an airplane with a maximum speed of Mach 2.5, which was capable of crossing the Atlantic unrefueled, then make a low altitude penetration at Mach 1.2 to deliver its nuclear weapon. Aerodynamically, these are mutually exclusive goals because the long ferry requires long, relatively straight wings while the supersonic dash suggests a short, delta wing design.[12]

John Stack, a National Aeronautics and Space Administration (NASA) engineer, informed Everest that a variable wing sweep geometry aircraft, known as swing-wing, would solve his aerodynamic dilemma and that it was technologically feasible. The idea of variable wing sweep was not new in the US, and dated to the exploitation of German technology after World War II. Operation LUSTY scavengers captured an experimental variable wing geometry plane, the Messerschmitt P1101, and Project Paperclip operatives co-opted Dr. Adolf Busemann, the engineer behind the idea. The German plane had three fixed wing positions that had to be set before flight. Building on the German technology, both Bell Aircraft and Grumman Aircraft designed planes that could vary the wing sweep in flight, which were the X-5 and the XF-10-F

[12] Knaack, *Volume I: Post World War II Fighters,* 191-193; Robert J. Art, *The TFX Decision: McNamara and the Military* (Boston: Little, Brown, and Company, Inc., 1968), 15-20.

respectively. Neither design was successful, because each used a single pivot in the fuselage at the wing root. In this configuration, the center of gravity and the center of lift moved apart as the wing angle shifted, making the aircraft unstable. NASA engineers proposed a dual pivot outside the fuselage in a fixed portion of the wing, which solved the stability problem. So, the idea of a new tactical fighter incorporating this radical new technology was born.[13]

The Air Force would, in February 1960, issue a System Development Requirement (SDR) for the new, variable wing geometry fighter, which was now known as Weapon System (WS) 324A. The SDR called for an innovative engine technology, the afterburning turbofan engine, in addition to the variable geometry wings. Turbofan engines were a new technology just coming into use on commercial jets, because they are more fuel efficient than turbojet engines. The idea of using a turbofan engine was driven by the exceptionally long range requirements of the new aircraft. The turbofan incorporates blades that are similar to compressor blades, only much larger. These fan blades act somewhat like propellers, producing thrust from intake air that completely bypasses the combustion chamber of the engine. The afterburner section of the engine works just like the afterburner on a turbojet, producing extra thrust from the excess air passing through the combustion chamber. While the afterburner consumes fuel rapidly, its use allows the plane to climb to a given altitude more quickly, saving fuel in the long run. The whole operation of an afterburning turbofan made for a more efficient use of fuel to produce thrust, and burning less fuel per minute equates to a longer time airborne, which means a longer range overall.[14]

[13] Knaack, *Volume I: Post World War II Fighters,* 223; Art, 20-24.
[14] Borden, 47-50; Peter E. Davies and Anthony M. Thornborough, *F-111 Aardvark* (Ramsbury, UK: The Crown Press Limited, 1997), 14; Knaack, *Volume I: Post World War II Fighters,* 223.

While the Air Force was proceeding with its requirements for a new fighter, the US Navy was beginning to develop its own. The Navy's primary concern was fleet defense; ground attack remained a secondary role. In the changed strategic environment, the USN needed to intercept Soviet long range aircraft equipped with air-to-surface missiles before they reached their launch position. It wanted a plane able to stay airborne for long periods of time, equipped with long range air-to-air missiles and a sophisticated radar for guiding them to their target. The Navy had an internal debate about the need for their new fighter to have supersonic capability. Some argued that the plane needed to be supersonic in order to intercept Soviet aircraft before they reached their launch points. Their opponents argued that supersonic capability was unnecessary because the Navy had recently acquired the supersonic F-4 Phantom II. They contended the high speed missile would actually accomplish the intercept, and that a sub-sonic plane would be less costly. Those favoring the subsonic plane won out in the era of Eisenhower's limited budgets. They avowed that the cost savings on a subsonic airframe could be used to offset the cost of the sophisticated avionics required for the new jet. The debate ended and the Navy awarded the Douglas Aircraft Company a design contract for the F-6D Missileer.[15]

This was the state of new fighter aircraft development in 1961 when the Kennedy Administration entered office. The new Secretary of Defense, Robert S. McNamara, was a man with a reputation for efficiency in industry and he was determined to bring efficiency to the DOD. A graduate of and former professor at the Harvard Graduate School of Business, McNamara had been a Statistical Control Officer during World War II. He was one of a group of young officers who analyzed mission data for the Army Air Forces. He was one of ten statistical control officers who as a group sold their skills to the struggling Ford Motor Company

[15] Robert F. Coulam, *Illusions of Choice: The F-111 and the Problem of Weapons Acquisition Reform* (Princeton: Princeton University Press, 1977), 43-45.

after the war. Known as the "Whiz Kids," McNamara and his fellow analysts helped bring profitability to the automaker again. McNamara rose quickly through the bureaucracy at Ford, and became the first company president that was not a member of the Ford Family the day after Kennedy was elected in 1960. He only held that position for a month before the President-Elect tapped him to serve as Secretary of Defense. Friends and acquaintances expected McNamara to have the same sort of success in Washington as he had had in his other ventures.[16]

The new Defense Secretary claimed he could use the same methods that had been successful at Ford to make the government more efficient. He certainly must have considered his time in the Army Air Forces and the changes his group had been able to effect by analyzing mission data. Using statistical analysis, his group had helped to reduce the mission abort rate in Eighth Air Force by showing that the problem was not aircraft maintenance, but rather aircrew fear.[17] In a 1995 retrospective, McNamara explained his thinking when he entered government service:

> I had no patience with the myth that the defense department could not be managed. It was an extraordinarily large organization, but the notion that it was some ungovernable force was absurd. I had spent fifteen years as a manager identifying problems and forcing organizations – often against their will – to think deeply and realistically about alternative courses of action and their consequences. My team and I were determined to guide the department in such a way as to achieve the objective the president had set: security for the nation at the lowest possible cost.[18]

It was a candid admission that McNamara thought his methods were universal, and that he could change the Pentagon for the better.

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[16] Staff, "Six for the Kennedy Cabinet" in *Time* 76, No. 26 (December 26, 1960), 12; George M. Watson, Jr. and Herman S Wolk, "'Whiz Kid:' Robert S. McNamara's World War II Service" in *Air Power History* 50, No. 4 (Winter 2003), 6-8.
[17] Ibid., 6-8.
[18] Robert S. McNamara, *In Retrospect: The Tragedy and Lessons of Vietnam* (New York: Times Books, 1995), 22-23

Armed with a mandate from President Kennedy to defend the nation while cutting costs, McNamara and his team set out to eliminate needless duplication in the Pentagon procurement process. Coulam points out that the Secretary identified not only interservice, but also intraservice duplication. Some examples were the Air Force's F-107, which performed the same mission as the F-105, and the Navy's F-4 and F-8 programs. Reflecting the new administration's focus on revitalizing conventional warfare options, McNamara cancelled the Air Force's F-105 program. He replaced it with the Navy's F-4, which he saw as a more flexible option for conventional missions than the F-105, which had been designed to carry a nuclear weapon very fast in a straight line. A panel McNamara had convened in February 1961 to consider limited war suggested development of a multi-service aircraft. Some observers thought this would mean the death of the Air Force WS324A, which had now acquired the designation Tactical Fighter Experimental (TFX). McNamara decided, after surveying the available options, that the TFX with its swing-wing multi-role capability and afterburning turbofan engines best fit the bill. So he cancelled the F-6 Missileer and ordered the Air Force and the Navy to proceed with a joint development to meet their requirements.[19]

Secretary McNamara envisioned the TFX as an airplane that would be able to undertake a variety of missions, which fit nicely with the administration's flexible response strategy. In McNamara's mind, the variable geometry wing was the key. The Air Force had conceived the airplane as a fast delta wing nuclear bomber, but the large fuel capacity and long ferry range seemed to indicate that with the wings swept forward, the plane could loiter for long hours to perform the Navy's fleet defense mission. The high altitude top end speed suggested that as a fleet defense plane the TFX would be capable of intercepting incoming bombers far distant from

[19] Coulam, 45-52.

the fleet, which was the same characteristic Air Defense Command needed to intercept bombers inbound for the United States. The plane was also required to carry a conventional ordnance load of over 15,000 pounds, which indicated that it could perform the battlefield interdiction mission, and when combined with the long loiter time, the TFX seemed perfect for orbiting over the battlefield to perform the CAS mission for both the Army and Marine Corps. Furthermore, the Air Force had already planned a reconnaissance version. The Secretary believed he could achieve significant cost savings if all of the services acquired the TFX.[20]

The Navy, and to a lesser extent the Air Force, protested the Secretary's decision. The Navy initially argued that the plane the Air Force desired was not suitable for aircraft carrier operations. Without doubt, the Navy had the more strict requirements. A carrier plane had to be light enough for the catapults and arresting gear to handle, had to fit in the existing hanger space below deck, and had to fit on the elevators that moved the planes back and forth between the deck and hanger. Each service initially tried to end the joint development program by arguing extreme specifications that they knew would be unacceptable to the other service. At one point the Navy called for a plane not more than fifty-six feet long and weighing no more than 55,000 pounds, while the Air Force called for a plane eighty-five feet long and weighing over 80,000 pounds. McNamara solved the impasse by informing the services that if they could not come to an agreement, he would make a decision for them. Fearing what McNamara would give them, the services agreed on specifications and proposals were solicited from the aircraft industry.[21]

Requests for proposals were sent to ten aircraft companies at the end of September 1961. The TFX would go through an unprecedented four development phases before a contract was awarded, and in the midst of the competition would pick up a new designation. The Air Force

[20] Futrell, *Ideas, Concepts, Doctrine, V.2,* 113-121.
[21] Art, 33-51.

version would be known as the F-111A, the Navy version the F-111B. The first round of the contract search brought six proposals; three individual proposals by Lockheed, North American, and Boeing, and three team proposals by Republic and Chance Vought, General Dynamics and Grumman, and McDonnell and Douglas. The team approach paired companies with experience designing planes for the Air Force with companies that had experience designing Navy planes, since the TFX would need to meet the requirements of both services. A joint Air Force-Navy evaluation group decided that none of the proposals submitted were suitable, but that the Boeing and the General Dynamics-Grumman designs were the best offered. The Boeing submission exceeded the design specifications by adding thrust reversers and over-wing intakes which would allow the plane to operate from unprepared airfields. The next level of the military bureaucracy, the Source Selection Board, recommended a contract be awarded to Boeing.[22]

The Air Force Council, which sat above the Source Selection Board suggested a twelve week run-off competition between the two contractors. They could not concur with the earlier decision because Boeing had selected the General Electric MF-295 turbofan engine, which was still in the design phase, to power the F-111. Selecting Boeing with the MF-295 would have caused a delay in meeting the scheduled operational date. General Dynamics-Grumman had selected the Pratt and Whitney TF-30 turbofan which was much farther along in development. The Air Force preferred the MF-295, because it promised to be smaller and lighter than the TF-30. But the Air Force Council directed Boeing to use the TF-30 engine in their new proposal, which required an extensive redesign of their plane. At the end of the second round, the Boeing design was considered best and was recommended by the Source Selection Board. Normally, Boeing would have been awarded a contract, but since neither company fully satisfied either

[22] Knaack, *Volume I: Post World War II Fighters,* 225; Leon Booth, Robert Chepolis and George Howard, *TFX* (Cambridge: Harvard University. Graduate School of Business, 1966), 6; Art, 62-66.

service's requirements, Air Force Secretary Eugene M. Zuckert and Navy Secretary Frederick H. Korth suggested to McNamara that each company be allowed another three weeks to improve upon their designs, and that they be allowed a small amount of divergence in the Air Force and Navy versions. Convinced by their argument, the Defense Secretary directed an unprecedented three week extension of the competition, essentially a third round, and he relaxed his requirement for one plane to fill both roles.[23]

Both aircraft companies were frustrated. Boeing submitted a completely new airplane while General Dynamics resubmitted its last proposal to meet the Air Force requirements, and submitted six different Navy configurations, asking the services to choose one. Among the General Dynamics proposal for the Navy were one pairing of the Air Force fuselage with a new Navy wing, and one that paired the Air Force wing with a brand new Navy fuselage. The Navy liked the new Boeing design, which had a larger wing area, making it more capable of operating from a carrier. The larger wing decreased the top end speed the Air Force desired, but they said it was acceptable because it increased the ferry range and ordnance-carrying capacity. The military again favored Boeing, but both the Source Selection Board and the Air Force Council realized that neither company had been realistically allowed enough time to improve upon its design. They also realized that they had not had enough time to review the designs thoroughly. They recommended that the companies be given at least forty-five more days. The civilian secretaries concurred, and ordered a 60 day fourth design round for the contractors, and an additional 45 days for the military to review the designs.[24]

The final round was conducted under different rules. This time, Air Force Colonel Charles A Gayle was allowed to work with each competitor as if it had been selected as the

[23] Booth, Chepolis and Howard, 8-9; Art, 67-72.
[24] Booth, Chepolis and Howard, 9; Art, 72-74.

prime contractor. Previously unable to point out deficiencies, he was now able to tell them what the military found wrong with their designs and to suggest corrections. The fourth round yielded designs that were rated essentially equal. For the first time since the competition began, there was unanimous agreement up the military chain of command that they wanted the Boeing aircraft. Throughout the competition, the Boeing design was the more technologically innovative of the two, while the General Dynamics-Grumman design was considered the more feasible based on existing technology. The military favored the cutting edge technology. Secretary McNamara, however, believed that Boeing's cost estimates were too low and that the company was too inexperienced with supersonic fighters and naval aviation. He overruled the uniformed decision makers and awarded a contract to the General Dynamics-Grumman team. This decision was made without the benefit of prototypes and a fly-off competition as is expected in today's procurement environment. The award of a contract moved the F-111 out of the Pentagon and into the public eye.[25]

Secretary McNamara's decision generated quite a bit of public controversy over the aircraft. Art stated, "the TFX made the front page of the *New York Times* on and off for almost six months."[26] The original estimates were that between 1,700 and 2,000 planes would be purchased, and the many believed that this would be the only fighter purchase for a decade. Obviously, both General Dynamics and Grumman stood to make a huge profit, while other aircraft manufacturers scrambled for business. In 1963, the plane generated ten months of Senate subcommittee hearings, with several noted Senators charging bias. These charges were based on the fact that General Dynamics would build the airplane in Texas – the home state of Vice-President Lyndon B. Johnson, and that Air Force Secretary Eugene M. Zuckert was from

[25] Booth, Chepolis and Howard, 9-10; Art, 75-78.
[26] Ibid., 2.

New York, the home of the Grumman Corporation. These charges were flatly denied by all of the principals who testified, and no misconduct was ever proven.[27] Undeniably, the decision to award the TFX contract to the General Dynamics-Grumman team was controversial. The service secretaries had chosen a more conservative approach, overruling the military which was leaning forward with several new technologies. In the end, McNamara's decision set the controversial F-111 on a collision course with a war that was heating up in Southeast Asia.

The Vietnam War found its seeds in the independence movement that occurred after the defeat of the French colonial rulers by the Nazis and the subsequent humiliation of the Western Powers by the Japanese in the beginning months of World War II. Leader of the communist Viet Minh, Ho Chi Minh, tapped the nationalism in his country and led a successful insurgency against the French when they attempted to reestablish their colonial rule in Indochina after the war. The United States, which was settling into a strategy of containing communism and desired French cooperation in NATO, became involved in Indochina by supporting the French colonial claim. One historian said that in so doing, "the United States attached itself to a losing cause."[28] France fought the insurgents and kept a tenuous hold on Vietnam until the 1954 defeat at Diem Bien Phu ousted them from the region. The Geneva Accords of the same year partitioned the country at the seventeenth parallel. Ho established the communist Democratic Republic of Vietnam north of the seventeenth parallel with a capitol at Hanoi. Emperor Bao Dai, who had abdicated in 1945, was restored in the south at the traditional capitol in Saigon. He selected Ngo Dinh Diem as prime minister of the nominally democratic Republic of Vietnam.[29]

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[27] Ibid., 3-6.
[28] George C. Herring, *America's Longest War: The United States and Vietnam, 1950-1975, 3rd Edition* (New York: McGraw Hill, 1996), 19.
[29] Stanley Karnow, *Vietnam: A History, 2nd Edition* (New York: Penguin Books, 1997), 215-221.

The Geneva Accords had called for elections in 1956 to unify Vietnam, but they were blocked by the United States government, which feared Ho's popularity and an almost certain communist election victory. Even so, the situation in Vietnam was relatively stable from the French withdrawal until the early 1960s. US military involvement consisted primarily of advisors to the Republic of Vietnam. Continued unrest and dissatisfaction with the South's government during this period spawned another insurgency movement with a corresponding growth in the numbers of American advisors. The discontent led to a military coup and the assassination of Ngo Dinh Diem in early November 1963, a scant three weeks before President Kennedy would fall to an assassin's bullets. Ho, who had never given up the goal of unifying his country, believed the time was right to escalate the insurgency by sending regular army units into the south to topple the government. His troops met stiff resistance from the Army of the Republic of Vietnam. Vowing not to lose Vietnam to the communists as he believed Harry Truman had lost China in 1949, new president Lyndon B. Johnson increased the number of American advisors.[30]

For the USAF, increased involvement in Vietnam meant deploying a detachment of the 4400th Combat Crew Training Squadron (CCTS). In response to President Kennedy's interest in expanding counterinsurgency capability, the Air Force had created the 4400th CCTS in April 1961 to prepare USAF personnel to train foreign aircrews and maintenance crews for counterinsurgency operations. The training squadron initially consisted of 352 Air Force personnel, equipped with sixteen C-47 cargo planes, eight B-26 bombers in various configurations, and eight T-28 attack aircraft. Their mission was primarily to train the South Vietnamese Air Force, although they trained other nations as well. Their planes were all World

[30] Herring, 47-132, Karnow, 293-327.

War II vintage, but they were rugged and relatively simple to operate. All were modified with armor plating and provisions to carry more bombs and rockets. In October 1961 a small detachment of the 4400th CCTS, known as Farm Gate, and consisting of 151 trainers with four C-47s, four RB-26 reconnaissance aircraft, and eight T-28s deployed to Vietnam. While these planes bore Vietnamese markings, by December USAF crews were authorized to fly combat missions as long as at least one Vietnamese crew member was on board.[31]

The nature of American involvement in the war changed in 1964 with what is known as the Gulf of Tonkin Incident. In August, North Vietnamese patrol boats attacked US Navy destroyers collecting intelligence near the coast. One boat was damaged and the other boats were driven off, but President Johnson ordered retaliatory air strikes against North Vietnamese naval bases in an attempt to signal US resolve. Within days of the incident, Congress passed the Gulf of Tonkin Resolution, which gave the President carte blanche to conduct military operations in Vietnam short of a declaration of war. Despite Johnson's efforts to keep from escalating the war, attacks on American advisors led to more retaliatory air strikes. By March 1965, two battalions of US Marines stationed on Okinawa became the first U.S. ground combat troops officially committed to the conflict. With both sides claiming that they wanted to negotiate, but neither willing to compromise, the war began to escalate and the United States committed more and more ground troops until by 1967 they numbered about half a million.[32]

An invasion of the North was ruled out of the strategic options due to memories of the Chinese intervention in Korea, so the United States relied heavily on air power to achieve its objectives in Southeast Asia. The ROLLING THUNDER air campaign was born during this

[31] James S. Corum and Wray R. Johnson, *Airpower in Small Wars: Fighting Insurgents and Terrorists* (Lawrence: University Press of Kansas, 2003), 238-246.
[32] Herring, 133-145; Alan Millet and Peter Maslowski, *For the Common Defense: a Military History of the United States of America* (New York: Free Press, 1984), 576-577.

period. The Joint Chiefs of Staff (JCS) conceived and Secretary McNamara approved ROLLING THUNDER as a massive air campaign directed at not only North Vietnam's war effort, but also their will to continue the fight. Apparently they did not remember that attacks on enemy morale yielded dubious results during World War II. The JCS nominated 94 targets of strategic significance that they believed would bring the Communists to their knees. Desiring to do something, yet fearing a possible Chinese or Soviet intervention, Johnson approved ROLLING THUNDER in a diluted form. This air campaign would continue for years, with intermittent bombing halts to signal a willingness to negotiate and subsequent escalation to demonstrate US resolve. The President tightly controlled the targeting process the entire time at his infamous Tuesday lunches, trusting the advice of his civilian advisors more than that of his senior military advisors.[33]

Two incidents in January 1968 caused a major turning point in the American involvement in Vietnam. The first of these was the Tet Offensive. In conjunction with the celebration of the lunar New Year, the North Vietnamese launched attacks against all of the major population centers in the South. The insurgents were handily defeated across the country, yet the great tactical victory for the United States became a great strategic victory for North Vietnam. News footage portraying fighting in the streets of Saigon appeared to contradict the government's claim that the situation was under control. A still photo of a street execution of a suspected Viet Cong without benefit of a trial caused more and more Americans to question the nation's involvement in Vietnam and the nature of the government the United States supported. The second incident of early 1968 was the seizure of a US Navy intelligence ship, the *USS Pueblo,* by the communist government of North Korea. The *Pueblo* incident provoked the only reserve

[33] Ibid., 577-584; Jacob Van Staaveren, *Gradual Failure:The Air War Over North Vietnam, 1965-1966* (Washington: Office of Air Force History, 2002), 52-53.

call-up of the Southeast Asia conflict, which Johnson, desperately wanting to focus on his domestic agenda, had sought to avoid.[34] Senator Joseph Clark, after a fact finding mission to Vietnam in early 1968, said that "we are in a stalemated war of attrition, with neither side capable of attaining its objectives by military means."[35] Even as many in the U.S. were turning against the war, the military establishment sought ways to win it.

Most senior military officers asserted that the North Vietnamese would not be able to continue the war in the face of superior American technology. Admiral U.S.G. Sharp, Commander in Chief, Pacific from June 1964 until July 1968, captured this sentiment in his memoirs. Writing about the political restraints placed on the bombing campaign, he said the United States had denied "ourselves the advantage of our immensely superior firepower and technology, fighting a war with one hand tied behind our backs." Additionally, Sharp said, "What a difference had we been allowed to utilize fully our military-technological power!"[36] This view, however, was by no means limited to senior military leaders. As early as 1963, company grade officers were complaining that the T-28s and B-26s then being used in the counterinsurgency war were dangerously vulnerable to antiaircraft fire, and were inferior weapons delivery platforms when compared to more modern F-100s and B-57s. One field grade officer quipped, "A squadron of F-100s over here could puncture the balloon of skeptics."[37] The F-111A, which first flew in December 1964, certainly represented the culmination of this unrelenting belief in superior technology.

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[34] Millet and Maslowski, 203-211.
[35] Joseph S. Clark, *Stalemate in Vietnam. Report to the Committee on Foreign Relations, United States Senate* (Washington D.C.: U.S. Government Printing Office, 1968), 5.
[36] U.S.G. Sharp, *Strategy for Defeat: Vietnam in Retrospect* (Novato, CA: Presidio Press, 1998), 96.
[37] Earl H. Tilford, Jr., *Setup: What the Air Force Did in Vietnam and Why* (Maxwell AFB, AL: Air University Press, 1991), 79.

After the selection of General Dynamics as the primary contractor, the Air Force amended the second competitive design contract on 21 December 1962 to build twenty-three research, development, testing and evaluation (RDT&E) aircraft. This procedure allowed General Dynamics to start work before the actual contract was signed. Eighteen of these were built as Air Force F-111A models, the other five were built to the Navy F-111B configuration. The contract called for the first flight in 25 months, and the first flight was on 21 December 1964, two years to the day after the RDT&E contract was signed and a month ahead of schedule. Unforeseen compressor stall problems manifested with the TF-30 engine, which required a redesign of the engine intakes. The wing sweep worked as advertised, the full range from 16 degrees to 72 degrees was tested on the second flight. The Air Force was not happy with the side by side seating arrangement that accommodated Navy requirements, preferring tandem seating so the pilot could see out both sides of the aircraft. The plane was heavier than expected, with the final combat loaded weight coming in at 92,000 pounds. Despite the extra weight, it was able to attain the design speeds of Mach 1.2 at sea level, and Mach 2.2 at high altitude. Despite the problems, the USAF was satisfied with the F-111A as delivered. The new fighter seemed a good fit for the administration's flexible response strategy.[38]

The Navy was not as satisfied with the F-111B as the Air Force was with the A model. Secretary McNamara's goal had been to use exactly the same plane for both services, but he discovered during the design phase that some divergence had to be allowed due to operational requirements on an aircraft carrier. The B version had a shorter radome to aid pilot visibility during carrier approaches and landings, which made it six and a half feet shorter than the A. The wings of the F-111B were also two and a half feet longer than the standard A model, and the

[38] Knaack, *Volume I: Post World War II Fighters,* 225-228; Anthony M. Thornborough and Peter E. Davies, F-111: *Success in Action* (London: Arms & Armour Press, Ltd., 1989), 12-18.

pilot's seat was raised slightly higher than the Intercept Control Officer's seat, again to aid visibility. Even so, the two models were over eighty percent congruent. The B model suffered from the same compressor stall problems as the A, as the test models used the same version of the TF-30 engine. Additionally, the Navy had problems integrating the long range AIM-54 Phoenix missile it had designed the F-6 Missileer to carry. The biggest problem for the Navy, however, was that the F-111B was much heavier than it expected, or desired. The Navy originally wanted a 50,000 pound jet, but compromised with the Air Force on a 55,000 pound maximum weight. The F-111B, as built, weighed about 65,000 pounds. It was much lighter than the F-111A, but too heavy to operate from any but the Navy's largest aircraft carriers.[39]

As the war in Southeast Asia continued to escalate, the Air Force had to address several tactical problems. It needed an improved ability to penetrate enemy defenses, increased weapons delivery accuracy, and the ability to conduct night and adverse weather operations. [40] A typical bombing mission required the support of a strike package, consisting of fighter cover, air defense suppression aircraft, and electronic jamming aircraft, not to mention pre- and post-strike reconnaissance and KC-135 tankers to keep all of the short range aircraft airborne. The spring and fall monsoons often grounded USAF aircraft, or obscured the target from those who made it into the air. In early 1965, the only plane in theater capable of striking targets at night and in bad weather was the Navy's A-6A. The F-105 had a ground mapping radar with a terrain avoidance mode, but like everything else about the Thunderchief, the terrain avoidance feature was meant to be used in the most extreme of circumstances: nuclear weapon delivery. Possibly concerned

[39] Don Logan, *General Dynamics F-111 Aardvark* (Atglen, PA: Schiffer Military History, 1998), 252-254; Thornborough and Davies, 46-47; Trevor Armbrister, "Is this Plane a Billion-Dollar Blunder?" in *The Saturday Evening Post* 240, Iss. 12 (June 17, 1967), 23-42.
[40] Lt Col Edward O. Stillie,"Tactical Air Employment – Current Status and Future Effectiveness, *Air University Review*, November-December 1967, 53

that the Navy was prosecuting what should be an Air Force mission, the Air Force modified its F-105s for all weather, conventional radar deliveries. The bombing results that the F-105s achieved using these new delivery systems under optimal conditions were almost 900 feet in one mode, and over 1300 in another. In combat the results were "usually worse, and their 750-pound and 3,000-pound bombs seldom damaged their intended target.[41]

The USAF publicly stated that the F-111A incorporated "significant advancements." Much had already been said about the variable geometry wings, afterburning turbofan engines, and crew escape module. The advancements that seemed to solve the tactical problems aircrews faced in Southeast Asia were the automatic terrain following radar, a high resolution attack radar, a sophisticated bombing and navigation computer unit, and an internal electronic countermeasures suite. While the airframe itself was indeed radical, it was primarily the advances in the field of avionics that made the Air Force believe that the F-111 was the answer to its needs in Southeast Asia in 1968. Theoretically, the F-111 should be able to fly at night and in bad weather without tanker or electronic defense suppression support, identify the target, and bomb it accurately.[42]

The USAF *Fighter Weapons Newsletter* called the terrain following radar "one of the most highly publicized (and least understood) systems of the F111A aircraft." The integrated air defense system in North Vietnam had effectively denied the Air Force use of the airspace below 1500 feet and at night. The TFR was a two-channel radar system designed to "hug" the terrain at low altitude by maintaining a selected altitude above the ground. The radar scanned vertically in front of the aircraft, and when it detected terrain or obstacles above the flight path, it generated a

[41] W. Howard Plunkett, "Radar Bombing during Rolling Thunder – Part 1: Ryan's Raiders," *Air Power History* 53, Iss. 1, (Spring 2006), 6- 7; Spitzmiller, 178.
[42] Brigadier General A.L. Esposito, "The F-111 Today," *AF Policy Letter for Commanders: Sup No 8,* August 1969, 25-26.

command to climb above it. Once the terrain or obstacle was cleared, the TFR commanded the aircraft to dive, always seeking to maintain the preselected altitude. The two-man crew could manually select set clearance planes of 200', 300' 400', 500', 750', or 1000'. What was truly unique about the TFR was that the pilot could manually follow the climb and dive commands as displayed in the cockpit, or he could couple the TFR to the autopilot and allow the airplane to automatically follow the commands in the AUTO TF mode. The Air Force believed that this capability would allow the F-111 to fly to the target undetected at treetop level, below enemy radar coverage and eliminating the need for support aircraft to suppress surface to air missiles (SAMs) or to fly escort to defend against MiG fighters.[43]

Further enhancing the F-111's ability to reach its target were the sophisticated penetration aids (penaids) incorporated into the design. The F-111 boasted a radar homing and warning set designed to detect and display the position of enemy threat radars. These radars were displayed on a compass rose, so that the crew could determine the relative position of the threat. The countermeasures receiver set alerted the crew of air-to-air missile launches from the rear hemisphere of the jet. An electronic countermeasures system transmitted signals designed to break, or jam, the track of the threat radars. The system was actually a deception system, which would transmit false target information to the threat radar, causing it to fire at a false target. Finally, the F-111 included a countermeasures dispenser set, which allowed the crew to drop chaff to confuse enemy radars and flares designed to draw off heat seeking missiles. Each part of the system could be operated automatically or manually, however, flares were always used in the manual mode to keep an inadvertent launch from disclosing the aircraft position. No other tactical aircraft flying in Southeast Asia was designed with such self-protective equipment. The

[43] Major John Phillips, "F-111 Terrain Following Radar," *USAF Fighter Weapons Newsletter* March 1969.

others required external radar jamming pods and escort aircraft to suppress enemy defenses. The F-111 was unique in its ability to protect itself.[44]

Once the target area has been reached, the ability to put ordnance on the desired point of impact has been an airpower quest since the first use of airplanes in combat during World War I. One author said that as early as 1962, "it was clear that precise targeting was required by the nature of the conflict."[45] President Johnson was terribly concerned about accuracy and collateral damage, fearing that an errant bomb could provoke a Chinese or Russian intervention. His concern over accuracy was not wholly unfounded, as F-105s and F-4s dive bombing under optimum conditions could put about 75% of their bombs within 400 feet of the target. This circular error could easily expand to as much as 2000 feet when the situation was less than perfect, and in combat conditions are rarely perfect.[46] Consequently, restricted zones were placed around the center of Hanoi and Haiphong of 30 and 10 miles respectively, and within 30 miles of the Chinese border in order to avoid killing civilians or provoking the Chinese. Admiral Sharp recalled that "severe limitations" were placed on attacks within these restricted areas. Additionally, prohibited zones of ten and four miles within the centers of Hanoi and Haiphong were instituted. Sharp says that attacks within these zones were seldom approved. Naturally, many of the high value targets that the JCS wanted to strike were within these areas, and they became sanctuaries that the North Vietnamese exploited to their own advantage.[47]

The Mark I bombing-navigation (bomb-nav) system incorporated into the F-111A helped to solve many of the aerodynamic problems associated with accurately putting bombs on the

[44] Captain Henry A. Rivers, "F-111A Weapons Systems Training, "*Navigator,"* Spring 1968, 32-33; Davies and Thornborough, 37.
[45] Corum and Johnson, *Airpower in Small Wars,* 258.
[46] Tilford, 111.
[47] Sharp, 102.

desired target. Billed as being able to "attack a target… and have excellent bomb placement regardless of wind, airspeed or other factors," the bomb-nav system was built around an analog inertial navigation system (INS) which fed position and velocity information to a navigational computer unit (NCU) and a ballistics computer unit (BCU). The bomb-nav system computed a wind corrected release point, and automatically steered the aircraft to this point for accurate radar bombing. It also allowed the right seat Weapon System Officer (WSO) to program waypoints into the computer, which, when coupled with the autopilot, would automatically fly the mission. Finally, the Mk I bomb-nav system improved visual bombing accuracy with a constantly computed impact point (CCIP) displayed in a lead computing optical sight (LCOS). The bombing system incorporated in the F-111A represented a significant technological advance over any aircraft the Air Force was then using in Vietnam.[48] And plans were already in progress for an even more sophisticated (and accurate) digital INS and a true Heads Up Display (HUD), to be incorporated in the F-111D model.[49]

Another concern for the military leadership was the ability to bomb targets at night and in adverse weather. Night operations negated the MiG threat, and the weather was often rainy in Southeast Asia during the winter monsoon season. General William W. Momyer, Commander of 7th Air Force in Vietnam, shed light on this problem in a letter to the Air Force Chief of Staff, General John P. McConnell. He informed his boss of a recent success using F-105s at low altitude with high drag bombs during a "drizzle" with less than 1000-foot ceilings and 3 miles visibility.[50] This weather was typical during the monsoon. Night bombing missions in either the

[48] Lieutenant Colonel Al Parks, "F-111 Bomb-Nav System," *USAF Fighter Weapons Newsletter,* December 1968; Captain Max L. Pettijohn, "Heads up and the F-111A," *Fighter Weapons Newsletter,* September 1965; Davies and Thornborough, 50.
[49] "F-111D Mark II Avionics," *Fighter Weapons Newsletter,* December 1969.
[50] General John P. McConnell Personal Papers (Letter from Momyer), AFHRA, Document #168.7041-125.

F-4 or the F-105 were accomplished as either a visual drop with the target area illuminated by flares or when the weather was too poor to drop visually, the aircraft were vectored at an altitude of 19,000 feet by ground controllers to a bomb release. One F-4 pilot said he doubts these bombs ever landed closer that a half mile from the desired point of impact.[51]

Boasting "a scope presentation like 3D," the USAF concluded that the F-111 Attack Radar Set (ARS) could do better than the "considerably less than desirable" results achieved by F-4s and F-105s attempting radar bombing. The ARS scanned 45 degrees either side of the nose of the aircraft, and presented returns in ranges from 5nm out to 160nm. While the ARS had an air-to-air mode, it was usually used in the air-to-ground mode. Linked to the MK I bomb-nav system, the NCU generated cross hairs on the radar scope at the coordinates of the selected turnpoint or target. If the target was radar-significant, meaning that it produced a distinct radar return, the cursors could be moved to the proper impact point by the WSO using a tracking handle in the cockpit. Targets that did not produce discernable radar returns, known to the crews as "no-show" targets, could still be bombed by aiming on a radar-significant offset. The range and bearing from the target to the offset were preset into the bomb-nav computer. Once the target was identified on radar using either method, and the bomb-nav system updated, the aircraft was automatically steered to a wind-corrected bomb release point.[52] General Momyer claimed the F-111A was "a revolutionary breakthrough in an all-weather delivery system." The capability of the attack radar was no doubt the technological advance that elicited this comment.[53]

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[51] Barry D. Watts, "Unreported History and Unit Effectiveness" in *The Journal of Strategic Studies* 12, Iss 1 (March 1989), 92.
[52] Lieutenant Colonel Al Parks, "F-111 Attack Radar," *USAF Fighter Weapons Newsletter*, June 1969; Davies and Thornborough, 50.
[53] William W. Momyer, *Airpower in Three Wars* (Washington: The Department of the Air Force, 1978), 181.

The Air Force was pleased with its new jet and confident of its abilities, and consistently defended the plane. Speaking at an Air Force Association Meeting in 1965 and obviously addressing the controversy surrounding the F-111, one general said:

> We have confidence that it will come into the operational inventory as just what it was intended to be, an extremely versatile aircraft, easy to maintain, and giving us combat capability under a wide variety of conditions which we have never previously had.[54]

In one of its early defenses of the F-111, the Air Force issued a statement in September 1966 refuting charges made by *Barron's* magazine in its 15 August issue, that the airplane was overweight, grossly overpriced, and should be operational by now, among other things. The F-111B, the Navy's version, was heavier than had been specified, and this certainly helped fuel the controversy. But the Air Force flatly denied that the aircraft was overpriced, and ridiculed the *Barron's* writer by saying that he had expressed his "own private assessment," but that the airplane had not been planned to be operational before mid-1967, and that its development was on schedule.[55]

As the F-111A began to enter the operational inventory in October 1967, it seemed the Air Force was entering a new era. The fighter seemed to be on the leading edge of technology, boasting many firsts such as the variable geometry wing, the afterburning turbofan engine, the auto TFR function, and the sophisticated penetration aids, to name a few. The USAF appeared to be a new frontier of thought as well. Futrell called it the end of an era when General LeMay retired in February 1965. LeMay was "the last major commander of World War II to retire from active duty," and when AFM 1-1 was published in August 1964 it "manifested an intention to

[54] Lieutenant General T.P. Gerrity, "Increase in Southeast Asia Support: F-111 Progress," *AF Policy Letter for Commanders: Sup No 1*, January 1966, 30.
[55] "The F-111: DOD Speaks at Last," *Flight International*, 22 September 1966.

look forward."[56] Yet, the F-111 had been conceived in the 1950s, during the time of massive retaliation. It was first and foremost a very fast, long range, tactical nuclear bomber. Every system that the Air Force had specified in SOR 183 was meant to support the tactical nuclear mission. The plane was a result of old thinking about strategy that LeMay's generation had passed down to those entering the Air Force in the 1960s. Although Secretary McNamara tried to make it the versatile fighter for the flexible response of the next decade, many would wonder over the next few years if the plane was the right tool for the job in Vietnam. The thinking about the proper prosecution of a war had not changed among those who would wield that tool.

[56] Futrell, *Ideas, Concepts, Doctrine, V.2*, 235.

CHAPTER 5

A BETTER BOMBER?

The F-111A entered operational service with the USAF on 16 October 1967, when Colonel Ivan H. "Ike" Dethman and Major Roger P. Nunemaker picked up a brand new "F-111A jet fighter aircraft geared for combat use" from the General Dynamics factory in Fort Worth, Texas.[1] They flew the plane to Nellis AFB, Nevada, where Dethman commanded Detachment 1 (Det. 1) of the 4481st Tactical Fighter Squadron, which was charged with training the initial cadre of F-111A pilots. Pre-production aircraft had been arriving at Nellis since July 1967 for use as trainers, but a Pentagon spokesperson described this as the first "operationally configured production model."[2] Six operational jets were assigned to the 4481st TFS, others were assigned to the 474th TFW at Cannon AFB, NM as they rolled off the assembly line. The *Los Angeles Times* article that announced the arrival at Nellis AFB noted that Dethman and Nunemaker flew the jet over one thousand miles of low level flight with the TFR coupled to the autopilot, and that it was capable of speeds in the neighborhood of 1,600 miles per hour, yet still referred to its controversial beginning as the TFX.[3]

The pilots initially selected to fly the F-111 were all experienced in other weapon systems. This is a common practice, as it does not take as long to train an experienced tactical pilot as it does to train a new one. The pilot flying in the left seat was the Aircraft Commander (AC), and his duties, while specific to the F-111, were analogous to AC duties in other aircraft.

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[1] AP, "Combat-Ready F-111A Jets to Nevada Base," *Los Angeles Times*, 17 October 1967, 5.
[2] Ibid., 5.
[3] Ibid.; Knaack, *Volume I: Post World War II Fighters,* 228-229; Bill Gunston, *F-111* (New York: Charles Scribner's Sons, 1978), 47; Thornborough and Davies, 23.

Although the Air Force would eventually assign navigators to the right seat Weapon System Officer (WSO) position around 1970, initially, pilots were assigned to the right seat and trained to operate the attack radar and other systems. Generally, these pilots were not pleased with their assignments to the F-111 right seat. They flew as integrated crews, meaning that an AC was paired with a WSO and, with the exception of an occasional left seat flight, the WSO normally flew in his assigned position. A qualified F-4 Aircraft Commander selected to fly the F-111 related that of the twenty pilots originally chosen, he was one of nine assigned to the right seat. He recalled that the nine considered this assignment a demotion, and that all filed paperwork to separate from the Air Force. Their requests were denied, and they were trained in the F-111A.[4]

The F-111 introduced complex new equipment, requiring the initial cadre of pilots to develop methods and procedures during training. A program known as Harvest Reaper was instituted to identify post production problems, but it also completed a timeline analysis which studied crew workload in the low level environment. In addition to monitoring the normal aircraft instruments, the study found it was imperative that the AC monitor the TFR scope during auto TFR operations. The TFR scope presented a vertical picture of the terrain directly in front of the aircraft, and was commonly known by the crews as the E-Scope, because the presentation of the vertical scan was known as an E-scan. The timeline found that in addition to operating the bomb-nav system, the WSO would be busy most of the time operating the attack radar, and that it was essential for the WSO to provide the AC with a running commentary of the terrain presented on the attack radar scope. By comparing what the WSO saw with what he could see on the TFR scope, it was possible for the AC to identify anomalies with the Auto TFR system.

[4] Davies and Thornborough, 36.

One pilot said that they treated the flights as instrument flights, only occasionally looking outside the aircraft.[5]

The F-111 pilots at Nellis AFB were familiar with the findings of the timeline analysis, since they gave input to the report as they trained with the new jets. After three weeks of ground training on the aircraft systems at Cannon AFB, NM, the initial cadre pilots went to Edwards AFB, CA, where they practiced takeoffs and landings with test pilots. After completing their instrument flight checks, the group went to Nellis where they designed their own mission training. Their goal was night, single-ship, low level missions on TFR, which mirrored the mission profile they expected to fly in Vietnam. The crews began their training in daylight, which allowed them to become familiar with the systems and to build confidence in them before trying them at night. A typical training profile was takeoff and climb to a Minimum Enroute Altitude (MEA), followed by an auto-TFR letdown into the low-level environment. The mission continued on TFR to the bombing range, where the crew made multiple passes to practice various weapon deliveries, although emphasis was placed on the first pass across the range since multiple passes over the target in combat could be hazardous to one's health. Bombing practice was followed by a low altitude egress from the target area, climb to MEA for approach and landing back at Nellis.[6]

By mid-1967, the Air Force was busy planning to send the F-111A to combat in Southeast Asia. Sending a new aircraft into combat at the earliest opportunity was a discernable expression of USAF thought. As LeMay told Congress in 1961, the Air Force "must push the state of the art right up to the limit" and "we cannot go into battle with anything less."[7]

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[5] Conrad C. Bishop, *F-111A Aircraft Time-Line Analysis for Low-Level, High-Speed Penetrations* (Eglin AFB, FL: Armament Development and Test Center, October 1968), 4-5; Thornborough and Davies, 23.
[6] Ibid., 23-24.
[7] Futrell, *Ideas, Concepts, Doctrine, V.2,* 196.

Consistent with Air Force thinking, General McConnell directed the air staff to complete planning "for the deployment of six (6) F-111A aircraft to SEA with a readiness date of 15 January 1968" in a secret document dated 6 May 1967. [8] Apparently, this was an open secret, as it was common knowledge by September 1967 that the Air Force had decided to send its controversial new fighter to Southeast Asia. *The Air Force Almanac* for 1967 acknowledged that a "combat test of the F-111A against targets in North Vietnam is being planned for early 1968."[9] This deployment decision reached the highest levels of the Pentagon, as Secretary of Defense McNamara gave his qualified approval on 19 December 1967, pending "the assurance of the Joint Chiefs of Staff and the Secretary of the Air Force that the aircraft are ready for the combat test program."[10] Given McNamara's involvement in the procurement of the F-111, it seems reasonable to assume that he followed the deployment planning carefully.

The combat test to which Secretary McNamara referred was not a snap judgment, but rather the result of a series of tests that the Air Force conducted under conditions simulating combat. These tests validated the F-111A's weapons delivery systems and their accuracy, and that of the penaids, while operating on the TFR at low level and at night. General McConnell reported to Secretary McNamara on 28 February 1968 that The F-111s bombing accuracy of 180 feet against radar reflectors was better than the design specification of 187 feet. The tests also disclosed that the Air Force could expect accuracy to drop against more complex targets, as the design specifications called for 500 feet, but the F-111 registered 580 feet in the tests. McConnell's report suggests that there was no attempt to cook the evidence, but rather that he

[8] Memorandum, General John P. McConnell to Staff Agencies, 6 May 1967, F-111 SEA Deployment History of Actions/Decisions, AFHRA, Document #K168.03-260.
[9] "Air Force Almanac", *Air Force and Space Digest,* September 1967.
[10] Letter, Secretary Robert S. McNamara to SECAF and JCS, 19 December 1967, F-111 SEA Deployment History of Actions/Decisions.

truthfully reported the test results. Significantly, he said the test indicated that the F-111 performed better than the other Air Force aircraft currently employed in Vietnam, the F-4 and the F-105. These tests evaluated the three tactical problems that the USAF believed that it needed to solve in Southeast Asia, which were increased weapons accuracy, improved ability to penetrate to the target, and the ability to bomb at night and in bad weather. The report also demonstrated the confidence the USAF had in its new jet was based on empirical evidence, not blind faith. General McConnell recommended that the F-111A and its support package deploy to Southeast Asia on 15 March 1968.[11]

The 474th TFW, which had previously flown the F-100 aircraft, moved from Cannon AFB, NM to Nellis AFB, NV in January 1968 without planes or personnel. Det. 1 of the 4481st TFS was deactivated, and its planes and personnel were immediately activated as the 428th TFS, the first of three planned operational F-111A squadrons comprising the reconstituted 474th TFW. The 429th TFS would be activated in May, and the 430th TFS would follow in September, as more planes arrived from the factory. Colonel Dethman assumed command of the 428th, and began preparations to take a detachment of 6 aircraft to Southeast Asia under the code name COMBAT LANCER.[12] Guided by a Pacific Air Forces (PACAF) Programmed Action Directive, Dethman expected a "179 day operational test…to determine the night, all-weather level radar attack capability" of the F-111A in combat conditions. The long term goal of the test was to determine if the F-111 could provide night attack coverage on a permanent basis.[13]

The COMBAT LANCER crews completed their operational training on 6 March 1968, a mere nine days before the scheduled deployment. After flying a total of 500 bombing sorties and

[11] Memorandum, SECAF to SECDEF, 6 May 1967, F-111 SEA Deployment History of Actions/Decisions, AFHRA, Call #168.03-260, IRISNUM 01130116.
[12] Thornborough and Davies, 227-28; Logan, 33; Knaack, *Volume I: Post World War II Fighters,* 229
[13] PACAF Programmed Action Directive 68-3, 25 August 1967, AFHRA, Call #K717.054-1, IRISNUM 00517519.

logging over 2000 flying hours, the crews scheduled to fly the F-111 in Vietnam were convinced that the plane truly represented a technological leap. This was not idle chatter, as all of the men scheduled for the deployment were highly experienced combat veterans, having flown F-84s, F-86s, F-104s, F-105s, or F-4s in either Korea or Vietnam. They all agreed that the avionics and radar were the best they had ever seen. They also extolled the bombing systems, claiming that the accuracy was twice that achievable with the F-105 or the F-4. Brigadier General Ralph G. Taylor, Jr., who commanded the Tactical Fighter Weapons Center at Nellis AFB said, "Nobody is qualified to pass judgement on the F-111A until he has flown it." One of the pilots said the same thing less eloquently when he quipped, "The guys who bad-mouth this airplane are the guys who never got in the cockpit."[14] The pilots of the 428th TFS were certainly confident in the ability of the new jet.[15]

The confidence that not only the F-111 pilots, but also the Air Force leadership had in the aircraft seems to have infected the media as well. The tone of the 9 March 1968 *New York Times* article announcing that the long-awaited deployment was imminent is positive. The article actually divulged Takhli Royal Thai Air Base, Thailand as the deployment destination, some general characteristics of the aircraft and the mission profile the Air Force expected it to perform. The journalist reported that the Air Force considered the F-111 "by far the best tactical bomber in the world." The *Times* announced the arrival of the 428th TFS, Det 1, consisting of the six COMBAT LANCER aircraft, at Takhli RTAB on 17 March, stating that if "the F-111 proves it can do the job, it will probably take over the role of the F-105 Thunderchief in the air war." The first combat sorties were flown on 18 March against truck parks, bivouacs, and storage areas, all

[14] Claude Witze, "F-111A: The Men Who Fly It Like It" in *Air Force and Space Digest* 50, Num. 12 (December 1967), 45-47.
[15] Knaack, *Volume I: Post World War II Fighters,* 229.

in the Route Pack I area just north of the demilitarized zone. A 25 March news report about the first sorties alluded to the F-111's unique capabilities, stating that it was flown in "darkness and overcast" and "under radar controls." While the term "radar control" actually means with assistance from an air traffic controller, most assuredly the newsman referred to the automatic terrain following capability of the F-111.[16]

Just when it appeared that the controversy surrounding the plane was ending, on 28 March an F-111 disappeared without a trace, amid North Vietnamese claims that the plane had been shot down. Internal memoranda suggest that the Air Force anticipated intense media scrutiny of the first lost aircraft. In a 7 March 1968 memo, Secretary of Defense Public Affairs guidance said that "since the F-111 is highly newsworthy, interest will be greater than normal… after the announcement is made." The same guidance stated that since the COMBAT LANCER deployment was a six month temporary duty assignment, that "newsmen may claim that this deployment is merely to provide a test of an untried aircraft." Ultimately, the initial news release after the first combat loss followed existing protocol for reporting any plane lost in action. Colonel L.J. Churchville, 7th Air Force Director of Public Affairs recognized that any attempt to cover up the loss would "result in a long and drawn out affair with daily stories".[17]

The first combat loss was rapidly followed by a second a mere two nights later, on 30 March. Despite North Vietnamese claims of another F-111 shot down, the Air Force knew that the crew experienced an in-flight emergency caused by a mechanical problem. They ejected over friendly territory in Laos, the wreckage was recovered, and both crewmembers were

[16] William Beecher, "First Combat Duty For F-111's Is Due In Next Few Days," *The New York Times,* 9 March 1968, 1; AP, "6 F-111's In Thailand for Tests in Airwar," *The New York Times,* 18 March 1968, 3; AP, "F-111 Flies First Raid Against North Vietnam," *The New York Times,* 25 March 1968, 2; F-111A Aircraft, Southeast Asia Conflict Combat Lancer, AFHRA, Call #K-SQ-FI-428-HI, IRISNUM 00420876.
[17] Message, SECDEF to Several Staff Agencies, 7 March 1968, and Message, 7th AF to Subordinate Units, in 7th AF Miscellaneous Msgs, Memos, and Ltrs, 1966-1968, AFHRA Document #K740.951-3,1966-1968.

rescued. The COMBAT LANCER aircraft were grounded for almost two weeks while the USAF examined the causes and reviewed procedures. Two aircraft left Nellis AFB for Takhli RTAB on 1 April to replace the two aircraft lost in combat, arriving on 5 April.

The Air Force found itself in a no-win public relations situation, because reporting the mechanical problem led to speculation that the plane was untried, and somehow defective. At the same time, if the plane had been shot down as the North Vietnamese claimed, it suggested that the sophisticated, and expensive, equipment designed to make the plane more survivable did not work as advertised. One article argued that the lost plane could be a "technological gold mine" if such equipment as the TFR or bomb-nav computers fell into the hands of the "Reds." With the loss of two F-111s during the first week of combat operations, the controversy surrounding the plane began to heat up again. Ironically, the same issue of the *Times* that reported the second loss carried an article quoting the pilot who had flown the first combat mission as saying that the airplane's performance was "outstanding."[18]

The next evening, 31 March, President Johnson addressed the nation in what most observers thought would be a routine speech during an election year. The speech will forever be remembered, however, for its ending, when Johnson told the nation that he would not seek reelection. Unrelated to the recent F-111 losses, but germane to the COMBAT LANCER deployment, was the President's announcement of a unilateral bombing halt in an effort to bring the Hanoi government to peace negotiations. It was not a total prohibition on bombing the North, but applied to all of the nation except the portion of Vietnam just north of the DMZ, in Route Pack I. Internal Air Force memoranda show that the plan was to introduce the F-111 in the

[18] "Second F-111 Jet Fighter Down in Southeast Asia," *The New York Times,* 31 March 1968, 1; AP, "Pilot Praises F-111 After Raid in North," *The New York Times,* 31 March 1968, 4; George C. Wilson, "Lost F-111 Could Be Technological gold Mine for Reds," *The Washington Post,* 30 March 1968, A14.

"more permissive areas of RP I" and, as the crews gained more experience, "move to the high threat areas of Route Packages V and VI." Johnson's announcement, while not removing the F-111 from combat, assured that the plane would not be used against the targets it was designed to strike.[19]

Just eleven days after returning to combat, a third F-111A went down in Southeast Asia on 22 April, and like the first, without a trace. There was a notable shift in the mood of news articles, typified by a 24 April piece on the third loss. Gone was the media confidence in the capabilities of this new aircraft, replaced by the familiar old language of controversy. Yet, in the midst of the debate, Air Force Secretary Harold Brown said that he was "satisfied" with the F-111.[20] Despite Brown's confidence, the Air Force found itself increasingly on the defensive concerning its new technological marvel. The *Times* reported after the third loss that the Air Force was:

> Mystified about the cause of two of the three losses, but top officials swore on a stack of test reports and pilot evaluations that their ardor for the swing-wing fighter-bomber was undiminished.[21]

After the losses, many claimed that the aircraft was mechanically defective and therefore unsafe. Some prominent Senators even called it "a suicide plane."[22] The Air Force quickly published statistics comparing the F-111's first 10,000 flight hours to the other Century Series aircraft. The F-111's five major accidents compared favorably against the F-106 with 8 losses at the same stage of development, and was significantly better than the F-105 with twelve crashes in its first

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[19] President Lyndon B. Johnson's Address to the Nation, March 31, 1968, http://www.lbjlib.utexas.edu/johnson/archives.hom/speeches.hom/680331.asp , accessed 3 March 2016; Message, General Ryan to General McConnell, 20 July 1968, in Deployment of First F-111 Squadron to SEA, AFHRA Document #K168.03-261, 8 Feb 1968-23 Jul 1968.
[20] Douglas Robinson, "3D F-111 Crashes; Testing Program Being Reassessed," *The New York Times,* 24 April 1968, 43; UPI, "Brown ends Thailand Tour; He Is Satisfied with F-111A," *The New York Times,* 22 April 1968, 1.
[21] "F-111: Is There Something Wrong?" *The New York Times,* 28 April 1968, E12.
[22] UPI, "2 In Senate Score Use of F-111A Jet," *The New York Times,* 29 April 1968, 43.

10,000 hours. Many people still believe that the TFR was at fault, or that the aircraft were shot down as the North Vietnamese claimed, despite evidence to the contrary which was readily available at the time.[23]

The second COMBAT LANCER crash site was located in friendly territory, so the USAF was able to perform a routine safety investigation. The cause of the mishap was originally blamed on a tube of sealant, inadvertently left in the tail assembly during the manufacturing process, which became lodged in the flight controls. However, this assessment was revised after a crash that occurred at Nellis AFB, Nevada on 8 May 1968. This crew also survived, and reported almost identical circumstances to those experienced by the crew that had survived the crash in Laos. This accident investigation determined the cause was a failed weld in the horizontal stabilizer assembly. Forty-two aircraft, including the five remaining COMBAT LANCER jets were grounded and only released to fly after the problem had been corrected. This represented most of the fleet, although twelve early models were built without this part, so were not restricted. Once the problem was corrected across the fleet, no other F-111s were ever again lost under the same mysterious circumstances. No aircraft was sent to Takhli to replace the third loss, and the five remaining jets returned to the United States in November 1968, having flown fifty-five combat missions in Southeast Asia. The USAF considered fifty-two of these missions successful.[24]

Even so, the controversy surrounding the combat losses began to overshadow the combat performance of the COMBAT LANCER aircraft. Even General Momyer, who called the F-111s bombing "excellent," mistakenly attributed the three losses to the TFR in his memoirs. As the commanding officer of 7th Air Force, he would have reviewed the accident reports and should

[23] "F-111 Crash Cause Found?" *Flight International,* 20 June 1968, 934-935.
[24] Ibid., 934-935; AP, "F111 Jets Grounded," *The Hartford Courant,* 22 May 1968, 1A; Logan, 222.

have known the true cause.[25] *Air Force Magazine* called the combat performance "outstanding," pointing out that all missions were flown at night and most in bad weather. Air Force Secretary Brown wanted to declassify parts of the record on the F-111's combat performance, so that the true story of the fifty-two successful combat missions could be told. Some Congressmen who were familiar with the record agreed with the Secretary. However, for security reasons the Air Force had to be content with generic statements that bomb damage assessment showed that the results were "acceptable" and "surpassed" the F-105 and the F-4. So, despite information that the airplanes had performed well, the Air Force found itself constantly battling misinformation emanating from unsympathetic sources. Senator Stuart Symington, the F-111's most outspoken foe on Capitol Hill, called for the cancellation of the program.[26]

Lieutenant Colonel Robert Belli, an F-105 pilot at Tahkli, recalled a conversation he had with an unnamed defense contractor during the COMBAT LANCER deployment. The contractor talked about the F-111's bad publicity and said that the Air Force wanted to get the airplane into combat as soon as possible in order to "take the heat off." The contractor's opinion was that the airplane would have done a good job a year later, but that it had been rushed into combat prematurely.[27] This belief has become a part of the folk wisdom surrounding the aircraft. Yet, Air Force leaders never said that they had sent the airplane into combat too soon. The Air Force consistently backed the jet, never wavering in its conviction that the F-111 was the answer to the challenges presented by the air war in Vietnam. The cynic would argue that the military

[25] Momyer, 87; 181.
[26] Richard Witkin, "Symington Suggests Terminating F-111 Program," *the New York Times,* 25 September 1968, 18; "The F-111A's Real Struggle," *Air Force Magazine,* July 1968, 14.
[27] Lieutenant Colonel Robert E. Belli, End of Tour Report, United States Air Force Historical Research Agency (AFHRA), Document # K 239.0512-645, 92.

establishment refused to admit that it was wrong, but the evidence suggests that the airmen were confident in their aircraft.

A retired Air Force general, Ira C. Eaker, offers a glimpse into the Air Force decision-making process in an article written for the *Air Force Times.* He wrote about the factors that the Pentagon used in coming to a decision to send the F-111A to combat. He mentions the tactical tests, which suggested the plane was "a considerable advance" over other aircraft prosecuting the war at that time. In what amounts to an official statement, and in agreement with Belli's unofficial assertion, Eaker admited that the Air Force considered "taking the heat off." He said:

> Successful performance in Vietnam could diminish the criticism of the decision to buy this model. This might also stop the congressional investigation of the F-111 and its naval sister, the F-111B.

In answering why the Air Force sent its newest fighter to combat, he quoted an anonymous Pentagon official as saying, "With a dirty war on our hands, would you have us hold out of combat the most advanced air weapon we have?" He closed the article by again extolling the F-111's greater bombing accuracy, superior payload and all weather capability, and by stating the belief that it should be sent against "important targets, vital to enemy war-making potential."[28]

As concerns about the F-111's cost began to mount, the Pentagon began to study lower cost alternatives. These including reopening the F-105 production line and producing an advanced, all weather version of that plane, or possibly an increased buy of the A-7D, a close air support plane that Secretary McNamara had ordered all of the services to adopt. In the final analysis, however, the Air Force continued to express confidence in the F-111. Airmen talked of developing the planned reconnaissance version and proceeded with the purchase of the F-111D, which incorporated state-of-the-art digital avionics, the F-111E which was essentially an A-

[28] 'War Loss Heats Up F-111 Debate," *The Air Force Times,* 1 May 1968, 13.

model with some post-production problems fixed, and a bomber version for Strategic Air Command – the FB-111A. Another proposal, which was eventually adopted, was the F-111F, which incorporated the best features of the planned F-111D, but was less costly because it retained many tried-and-true features of the F-111E. Not only was the USAF still interested in acquiring more F-111s, but so were the Royal Australian Air Force (RAAF) and Great Britain's Royal Air Force. Twenty-four F-111Cs, which were essentially F-111As, were purchased by the RAAF. The RAF had ordered fifty F-111Ks, which were again similar to the F-111A. The program was cancelled by Parliament in 1968, and the RAF never took delivery of any F-111Ks.[29]

The Navy, never satisfied with the F-111, suffered through many more development challenges than did the Air Force. Some problems were common between the versions, such as the shortcomings of the TF-30 engine, but others were unique to the Navy and its mission. One serious problem the Navy faced was with mating the AIM-54 Phoenix missile to the F-111B airframe. But the most egregious problem the Navy faced was the ever-increasing weight of the aircraft, despite efforts to keep it down. The first prototype of the F-111B weighed 69,000 pounds, which was 14,000 more than the 55,000 pounds to which the Navy had grudgingly agreed during the TFX competition. The first production model weighed 75,000 pounds, which was 20,000 pounds heavier than expected. One author suggested that the Navy was more politically savvy than the Air Force, and scuttled the program by insisting on equipment that drove the weight up. Congress finally cut funding for the F-111B in fiscal year 1969. The Navy did accomplish some valuable research during the program, which paid off when Grumman, a

[29] "Pentagon Seeks Alternative to 'Gold Plated F-111s," *Armed Forces Journal,* 26 October 1968 and "Air Force Studying Less Expensive F-111," *Armed Forces Journal,* 28 June 1969; Knaack, *Volume I: Post World War II Fighters,* 234-235; Logan, 278-279.

subcontractor on the F-111, developed the F-14 Tomcat, a swing-wing Phoenix missile platform specifically designed to meet Navy requirements.[30]

As 1969 ended, more trouble accrued to the controversial F-111 program. On 22 December, another F-111 crashed, this time due to a failure of the wing pivot. The next day, the entire fleet was grounded.[31] The crash garnered quite a bit of attention, as the failure was catastrophic, and both crewmembers were killed. As one eyewitness described it, "the right wing snapped clean off."[32] The grounding of the fleet reignited the debate in Congress, with advocates calling the F-111 the best attack aircraft in the world. Some opponents questioned the basic structural safety of the aircraft, while others attacked it as not meeting the performance specifications required of a fighter. The USAF continued to stand behind the F-111, and pointed to its safety record, which surpassed all other fighters, both USAF and USN. Air Force spokespersons pointed out that the F-111 safety record was 40% better than the F-106, which was the next best in the inventory. They also pointed to the fact that the F-111 flew many hours in the low level environment, which is inherently more dangerous than flying at high altitude where the crew has a better chance of successfully bailing out. The grounding lasted seven months, until 31 July 1970, and the USAF arguments were lost on critics.[33]

Undeterred, the USAF pressed forward with planned upgrades to the F-111. Just as the F-111A had been considered a revolutionary step forward in aerodynamics, the Mark II avionics system slated for the F-111D was supposed to be a revolutionary step forward in avionics. The Mark II featured a digital computer, which was state of the art in the mid-1960s. The F-111D

[30] Knaack, *Volume I: Post World War II Fighters,* 235-238; Gunston, 28-35.
[31] Knaack, *Volume I: Post World War II Fighters,* 230-231;
[32] Davies and Thornborough, 44.
[33] Knaack, *Volume I: Post World War II Fighters,* 230-231; Richard Witken, "F-111s to Stay Grounded until Intensive New Safety Tests Are Passed," *New York Times,* March 5, 1970, 1; Richard Witken, "F-111 is Defended As Best of Type," *New York Times,* April 10, 1970, 60.

cockpit looked totally different than those of the other models, as it featured new displays known as the Integrated Display Set (IDS). The IDS included true Head-Up Displays (HUDs) for each side of the aircraft, which allowed visual bombing from either seat. Instead of the round dial instruments common to all aircraft at the time, the aircraft commander had a 7 inch TV screen called the Vertical Situation Display (VSD), which displayed flight information. The WSO had an 11 inch Multi-Sensor Display (MSD), which displayed the radar and other information on a TV screen. Another new feature was the Horizontal Situation Display (HSD), which presented the aircraft's position on a moving map. Similar to the delays the F-111B encountered integrating the Phoenix missile, F-111D development ran into delays integrating all of the new systems. As the cost of the Mark II avionics system rose, the number of F-111Ds the USAF bought was decreased until finally, only 96 were built, enough to equip one wing, the 27 TFW at Cannon AFB, New Mexico.[34]

The Air Force was also beginning to think about its next generation fighters. A small group of younger officers, who one author called "reformers," fought against the trend away from air superiority fighters like the F-86 toward tactical nuclear bombers like the F-105 and F-111. An analysis of U.S. and Soviet fighters showed that for air superiority, maneuverability was a better characteristic than higher speeds and higher altitudes, and that the latest Soviet fighters were superior to the latest U.S. fighters in this regard. Specifications for the F-X, a replacement for the F-4, were drafted in 1965 and gave the first indication that the new fighter was to be primarily an air superiority fighter. The F-X program was delayed for several years, primarily due to budget constraints and war requirements, but the aircraft that emerged around 1969 was a large, twin engine, single seat fighter capable of carrying eight air-to-air missiles, and

[34] Knaack, *Volume I: Post World War II Fighters,* 249-254; Davies and Thornborough, 95-100.

equipped with a 20mm cannon. While the designers included an air-to-ground capability, it was considered secondary in this jet. Built by McDonnell-Douglas and known as the YF-15, the plane was built around a very large radar antenna which allowed it to fill the interceptor role. Even though it weighed about half what the F-111 weighed, it was still too large and complicated for the reformers, so they agitated for an even smaller, simpler fighter after the F-15 decision had been made, which would eventually become the F-16.[35]

In response to Army requirements for a suitable CAS airplane, the Air Force began working on a replacement for the A-7D then in use in Southeast Asia, which initiated the A-X program in 1966. The criteria for the new plane was the capacity to carry a heavy ordnance load while retaining the ability to maneuver at low speeds to deliver weapons accurately. Other required qualities were the ability to loiter in the target area, and to deliver weapons accurately since targets were often near friendly troops. Survivability was important, as the airplane was expected to absorb hits from ground fire and return to base. The A-7 had proven too vulnerable to ground fire. Finally, it was expected to be simple to operate and maintain so that it could fly at a high sortie rate. Two companies provided prototypes, so there was a fly-off competition between the Northrop YA-9 and the Fairchild-Republic YA-10. The competition was close and the two prototypes were essentially equal. After the YA-10 was selected as the winner, it faced another fly-off against the A-7, which one author argued was motivated by Congressional lobbyists on behalf of Douglas Aircraft. The second competition was not close, as the A-7 had been rushed into service as a stopgap measure while the A-10 had been designed to fill the CAS role.[36]

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[35] Kenneth P. Werrell, *Chasing the Silver Bullet: U.S. Air Force Weapons Development from Vietnam to Desert Storm* (Washington: Smithsonian Books, 2003), 59-65; Knaack, *Volume I: Post World War II Fighters*, 334-335.
[36] Peter C. Smith, *Fairchild-Republic A-10 Thunderbolt II* (Ramsbury, UK: The Crowood Press Ltd., 2000), 21-31.

The Air Force was not only interested in upgraded airframe technology, but also in acquiring new weapons technology as well. Even as the Air Force extolled the virtues of the F-111's navigation and bombing systems, weapons accuracy was still a problem as the F-111 could only be trusted to get bombs within several hundred feet of the target. Early experiments with radio-controlled guided weapons had produced mixed results, but by the early 1960s technology had reached a point where smart weapons were indeed feasible. The first precision guided munition the Air Force used in Southeast Asia was the AGM-62 Walleye, a Navy-developed weapon that featured electro-optical television guidance. The elongated fins on the weapon gave it glide capability, so the weapon could be dropped five or six miles from the target as the gyro-stabilized TV camera in the nose of the weapon guided it in. F-4 Phantoms were retrofitted to carry the Walleye, which was first used in combat in 1967 and produced "spectacular results." The weapon was not without problems, as complex targets did not always provide enough contrast for the guidance system to work properly, but the Air Force was satisfied enough that in 1969 it began a program to replace the Walleye, which became the AGM-65 Maverick.[37]

By the time the Air Force was using the Walleye in combat, it considered semiactive laser guidance the most promising smart weapon technology. Laser-guided bombs require an illuminator that projects a beam of infrared light on the desired aimpoint, and a guidance system that picks up the reflected laser energy to home on the target. The laser illuminator was small enough that it could be hand held, or it could be mounted on a wide variety of aircraft, from slow-moving forward air control planes to fast-moving fighter aircraft. Once again, the F-4 was chosen as the platform to carry to illuminator. The system was initially tested with M-117 750 pound bombs, but installation of the guidance kit on the World War II vintage bomb proved to be

[37] Paul G. Gillespie, *Weapons of Choice: The Development of Precision Guided Munitions* (Tuscaloosa: The University of Alabama Press, 2006); 103-112.

difficult, and its rounded shape was not very aerodynamic. Laser-guided bomb technology found success once mated with 2,000 pound Mark 84 general purpose bombs. The Mark 84 is a longer, slimmer, low drag weapon that is much more aerodynamic than the M-117. With a guidance kit attached to the front of the Mark 84, the weapon had a standoff range of over five miles, and produced a CEP of twenty feet with twenty-five percent of the bombs registering direct hits. The laser guidance package was less expensive than TV guided weapons, quickly making laser guided bombs the precision weapon of choice.[38]

The year 1969 also brought in a new President, Richard M. Nixon, and ushered in "the most sweeping changes in foreign policy since the idea of containment had first evolved two decades earlier."[39] Nixon's general approach to foreign policy was détente, or a relaxing of tensions with the communist world. The world political situation had changed by 1969, as the Soviets approached nuclear parity with the United States. The President was reportedly appalled when he received his first briefing on the Single Integrated Operating Plan (SIOP), which was the plan for a general nuclear exchange with the Soviet Union. Nixon was enough of a pragmatist to realize that no rational actor would subject his own nation to a full out nuclear exchange. Nixon and his National Security Advisor, Henry Kissinger, also recognized the growing rift between the Soviet Union and the People's Republic of China, evidenced by an undeclared border war between the two in 1969. Nixon and Kissinger were quick to exploit that divide, hoping to play the two communist giants against each other to receive concessions in the way of trade deals, arms reductions and finally, pressure on North Vietnam to end American involvement in the war on favorable terms. One historian suggests that Nixon had such a strong

[38] Ibid., 106-111.
[39] Gaddis, 274.

record as an anticommunist that his willingness to negotiate looked like statesmanship, not weakness.[40]

Nixon's election also signaled a new phase in the conduct of the Vietnam War. Nixon gave insights into his thinking in a 1967 *Foreign Affairs* article, but most historians point to remarks the new president made in Guam on 25 July 1969 as the introduction of what became known as the Nixon Doctrine. His policy toward Vietnam, called Vietnamization, was built on a gradual withdrawal of American troops, while increasing the capability of the South Vietnamese to defend themselves. Nixon had campaigned on ending U.S. involvement in the war, and beginning in late 1969 he began a slow but steady withdrawal of American troops from Vietnam. While the pace of withdrawal was too fast for the hawks and too slow for the doves, troops were removed at approximately the rate they had been introduced. Yet, his strategy was not to simply abandon Asia, as he believed the European colonial powers had, but to remain engaged. To reassure nominally democratic capitalist governments in other Asian nations battling their own communist insurgencies, Nixon pledged to honor treaty obligations, extend the American nuclear shield if necessary, and provide economic and military assistance short of direct US military involvement. [41]

Despite a willingness to negotiate with the communists, Nixon remained a staunch anticommunist, and he never gave up his desire to win the war. For him, winning meant a secure, stable, non-communist government in Saigon. Like many within the military, Nixon's stance was that the Kennedy and Johnson administrations had been too limited in their use of military power. Early in 1969, he devised a plan called DUCK HOOK to deliver a knockout

[40] Ibid., 274-276; William Burr, "The Nixon Administration, the 'Horror Strategy,' and the Search for Limited Nuclear Options, 1969-1972" in *Journal of Cold War Studies,* Vol. 7, No. 3 (Summer 2005), 34-35.
[41] Jeffrey Kimball, "The Nixon Doctrine: A Saga of Misunderstanding" in *Presidential Studies Quarterly* 36, No. 1 (March 2006), 59-62; Futrell, *Ideas, Concepts, Doctrine, V.2,* 263-264; Gaddis, 299.

blow to the North Vietnamese, designed to bring about fruitful negotiations and end the war. The major components of DUCK HOOK were a blockade of North Vietnamese ports, an assault on major cities, and he even considered the use of tactical nuclear weapons. The plan was leaked to the press with the hope of coercing the North Vietnamese government to engage in serious negotiations. Hanoi, however, was not cowed and remained intransigent. Nixon wanted to order the assault, but was convinced by high level advisors that opposition from the American public would be too fierce.[42]

DUCK HOOK was abandoned later that year, but Nixon continued with other plans to increase the pressure on North Vietnam to negotiate. He continued to withdraw troops, but simultaneously escalated the fighting. The Joint Chiefs wanted to end Johnson's bombing halt above the 19th parallel and resume bombing up to the 20th parallel. Nixon was not willing to resume bombing in the North, but he was willing to expand the war into the neighboring countries of Cambodia in 1970, and Laos in 1971, in order to deny these sanctuary areas to enemy troops. The North Vietnamese supply line, known as the Ho Chi Minh Trail, ran through both nations. Once the North realized that the United States would not violate the borders, these became sanctuary areas through which men and supplies were moved to the South. The Army of the Republic of Vietnam (ARVN) shouldered most of the burden, but American soldiers participated in the invasion of these neutral countries as well. The President ordered B-52 strikes on supply areas, and air support for ARVN troops invading the area. Nixon justified his actions by saying the presence of the North Vietnamese Army in the sanctuary areas jeopardized the U.S. withdrawal.[43]

[42] Herring, 247-251.
[43] Futrell, *Ideas, Concepts, Doctrine, V.2,* 264-266, Herring, 257-271.

It was during the Nixon Administration that the Air Force next revised its basic doctrine. AFM 1-1, dated 28 September 1971, was not an attempt to reflect the Nixon Doctrine, but rather the first serious attempt within the Air Force to understand and to codify the conduct of limited war. The August 1964 version of AFM 1-1 had paid lip service to the concept of limited war while explaining away or simply ignoring Korea. There seems to have been a realization among airmen that Air Force doctrine did not match reality by early 1967, when the first efforts to revise the 1964 doctrine manual began. The draft manual reflected comments from senior officers, staff agencies and even the RAND Corporation. The review process prompted a Colonel on the Air Staff, who was chief of the Aerospace Doctrine Division, to quip that it was the extensive coordination process that forced some senior officers at least to consider Air Force doctrine. Almost implied is the idea that these senior officers had never truly thought about basic doctrine. While many of the old adages remained, the new doctrine manual reflects an understanding that all war is not total and that nuclear weapons are not a credible threat in every situation, a basic truth that the USAF sorely needed to acknowledge.[44]

The overall impression the 1971 Air Force basic doctrine manual conveys is more Clausewitzian than its predecessors, in that it viewed peace and a general nuclear exchange as extremes, and recognized that there are many factors that limit escalation along the continuum between peace and total war. Since the 1964 manual was published before the official introduction of combat troops in Vietnam in 1965, in many ways it still represents the World War II conception of total war. The 1971 manual affirmed that experience should inform doctrine, and reflects Air Force thought after more than five years of limited conflict, and the lessons airmen took away are reflected throughout. The document conveyed frustration with the

[44] AFM 1-1 United States Air Force Basic Doctrine, 28 September 1971, FRIC Special Collections, 1-1 – 6-2; Futrell, *Ideas, Concepts, Doctrine, V.2,* 719-721.

national command authority, saying the enemy "must be convinced that US power exists," and, "that the national will exists to use it against him." In other cases, however, it expressed more mature ideas, such as recognition that there are "degrees of enemy response to any deterrent posture," and that deterrence may work not to halt enemy action, but to limit it to "a lower level of conflict than his capabilities and objectives would dictate."[45]

As the new Air Force basic doctrine manual was distributed to the force, the USAF was tested by a new enemy response in March 1972. Intelligence had detected a buildup of North Vietnamese forces, and expected an assault in conjunction with the Tet holiday, as had occurred in 1968. Tet came and went, but the long awaited attack did not come until March 30, three days before Easter. This Easter Offensive was a massive conventional attack into three different regions of South Vietnam. Certainly timed to coincide with the 1972 election cycle in the United States, Hanoi certainly sought to create the same sort of response from the peace movement as it had in 1968. Less than 100,000 US soldiers remained in Vietnam, approximately 6,000 of whom were combat troops. The attacks were initially very successful, sending ARVN forces into retreat on all three fronts. President Nixon was incensed, and immediately ordered B-52 strikes on the invading troops. Since it was a conventional attack spearheaded by Soviet supplied tanks and trucks, Nixon also ordered attacks on fuel storage areas in the vicinity of Hanoi and Haiphong. A week into the attack, General Creighton Abrams, the commander of all American forces in Vietnam, called the offensive "a big mistake." By July, Hanoi's attack was deemed a failure.[46]

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[45] AFM 1-1, 28 Sep 71, 1-2.
[46] Peter Osmos, "N. Viet Offensive Mounts: 3 Divisions Attack Bases Below DMZ," *The Washington Post,* 2 April 1972, A1; Herring, 272-273; George C. Wilson, "Offensive Is Called A 'Mistake," *The Washington Post,* 8 April 1972, A1; Peter Braestrup, "Foe's Generals Fail: Tactics Fall Short of Weaponry," *The Washington Post,* 8 July 1972, A1.

On 8 May 1972, General Abrams asked the President for permission to escalate the bombing of the North and to mine the port of Haiphong. President Nixon called a special meeting of the National Security Council, and on the night of 8 May in the US, in a televised speech, Nixon announced to the nation that he was escalating the bombing of the North and mining the harbors. Surely the President reflected on his Duck Hook plan, thinking that he should have enacted it in 1969. His televised speech conveys his disappointment that after over three years of negotiating with Hanoi, no progress had been made. The measures Nixon outlined in his speech certainly reflect the operational measures of DUCK HOOK: mining of ports, cutting rail and road lines, and strikes against military targets in the North. The goals of Duck Hook were evident as well, which were to stem the flow of supplies into the South, and to raise the level of violence enough to pressure the North Vietnamese government into serious negotiations. The Air Force had maintained contingency plans for precisely such an action for years, so was able to go immediately to work.[47]

The escalation of aerial bombardment was called OPERATION LINEBACKER, allegedly because President Nixon had a penchant for sports analogies. Secretary of Defense Melvin Laird explained the operation to newsmen by saying the linebackers "stop the progress of an opposing ballcarrier who has penetrated the first line of defense."[48] These metaphorical linebackers, however, seemed to attack the opposing team's bench, as the initial penetration had been largely halted by May. Airmen immediately drew comparisons to the ROLLING THUNDER campaign of 1965-1968, which they said was conducted under "severe, often

[47] Herring, 273; President Richard M. Nixon's Address to the Nation, May 8, 1972, http://millercenter.org/president/nixon/speeches/speech-3880, accessed 7 March 2016; M.F. Porter, *Project CHECO Report: LINEBACKER: Overview of the First 120 Days*, (Hickam AFB, HI: Directorate of Operations Analyses, 1973), 14.
[48] Staff, "Laird Puts Point Over With Sports Phrases," *the New York Times,* 11 May 1972, 18.

crippling, restraints."[49] They were pleased to attack the enemy bench, and hailed the first sustained air operations over North Vietnam since 1968. The Joint Chiefs of Staff (JCS) signaled their intention to change the rules of engagement in Southeast Asia, and solicited recommendations from subordinate units on what measures would have the greatest impact upon the enemy on 4 April. By 7 April, Admiral John S. McCain, Jr., the Commander in Chief Pacific (CINCPAC) forwarded recommendations from the field to the JCS which included mining harbors, naval gunfire, and "more aggressive action against MiGs." Airmen could scarcely contain their glee, as they believed the message "left little doubt that an integrated plan for a 'hard' war was being implemented in Washington."[50]

The USAF viewed LINEBACKER as a chance to bring its superior technology to bear against the North. Aircraft technology had not changed since 1968, as no new fighters or bombers had entered the inventory during the preceding four years. Airmen argued, however, that their planes had been misused in the past and that employed properly, they could bring a rapid end to the war. Although the Air Force did not have new aircraft, it was able to mate new guided bomb technology with existing F-4 Phantom IIs to obtain new results. Paveway laser guided bombs and Walleye TV guided bombs returned spectacular results. Airmen pointed proudly to their success in dropping the Thanh Hoa Bridge during LINEBACKER. During the first attack on the bridge in 1965, a strike package including seventy-nine F-105s, escorted by F-100s, dropped over 240 tons of bombs on the bridge, but caused only minor damage. In 1972, twelve F-4s armed with twenty-four tons of laser guided bombs were able to render the bridge unusable. After the war, however, the US military would find that the low-tech enemy was very

[49] Porter, 2.
[50] Ibid., 14-15.

good at camouflage, even constructing bridges just below the surface of rivers, hiding them from American reconnaissance aircraft.[51]

President Nixon did not authorize an increase in ground troops to meet the challenges posed by the Easter Offensive, but he did authorize an increase in air strength. The 474th TFW received orders in the middle of August to return to Takhli RTAB in the fall under the project name CONSTANT GUARD V. This was the first return to combat for the F-111 since the deployment of 1968, primarily because the bombing halt had put off-limits the targets deemed suitable to the F-111's capabilities. Instead of sending just six aircraft for a combat test as had been the case in 1968, forty-eight aircraft comprising two entire squadrons were sent to replace seventy-two F-4s distributed among four squadrons. As the winter monsoon approached, the Pentagon was very interested in the F-111's ability to bomb targets at night and in bad weather. News articles about the deployment were generally positive, although they generally mentioned the F111's controversial beginning as the TFX, subsequent mechanical woes, and the two planes that disappeared without a trace in 1968. Pentagon spokesmen announcing the pending deployment highlighted the low altitude, all weather capabilities, along with improved weapons accuracy, and said that the F-111 was "more reliable" now that it had been in 1968.[52]

A flight of twelve F-111s from the 429th TFS departed Nellis AFB on 27 September, flying directly to Anderson Air Force Base, Guam. Using prepositioned, rested crews, the planes were refueled and continued on to Takhli. In an elaborate plan to send the F-111 immediately into combat, upon their arrival at Takhli on 28 September six of the planes were fueled, armed,

[51] John L. Frisbee, "The Air War in Vietnam" in *Air Force Magazine* 55, No. 9, (September 1972), 49; Porter, 24.
[52] John S. Schlight, "A War Too Long: Part II" in *Air Power History* 62, Iss. 3 (Fall 2015), 26; A.A. Picinich, *Project CHECO Report: The F-111 in Southeast Asia, Septermber 1972-January 1973* (Hickam AFB, HI: Directorate of Operations Analyses, 1974), 15-17; Richard Witkin, "48 F-111's Going to Vietnam Area," *The New York Times,* 27 September 1972, 16; Charles W. Cordray, "A 'more reliable' F-111 Is Going Back to War," *The Baltimore Sun,* 27 September 1972, A4.

and launched on combat missions against targets in Route Pack V. This was less than twenty-four hours after the planes had left Nellis AFB. The plan again called for using prepositioned crews who had been resting and planning their missions since their arrival in Thailand. The Air Force probably hoped to showcase the abilities of the F-111, once again hoping to take the heat off the controversial weapon system. The plan only served to stir the controversy, however, as only two of the six aircraft reached their targets, and one of the aircraft was lost, once again without a trace. The Air Force did not speculate on the cause of the crash, although some members of the squadron have in later years suggested that because the planes were launched during a heavy monsoon, spatial disorientation in the weather may have been the cause.[53]

Still expressing confidence in the F-111A, the Air Force did not ground the fleet, but rather scaled back operations for five days. The aircrew reviewed tactics while the aircraft were given thorough maintenance inspections. Then, the crews were given theater orientation flights in Thailand to familiarize them with the environment in Southeast Asia. Their first missions upon returning to combat were in Route Pack I. Newsmen began to call the aircraft "jinxed," but the aircrew who flew the F-111 did not lose confidence in their weapon system. One pilot called it "the greatest piece of machinery" one could fly in combat.[54] When a second F-111 disappeared less than a month later, with a third combat loss about two weeks later, the Air Force seemed to take the losses in stride. The planes were not grounded, and while tactics and procedures were reviewed, there were no intensive maintenance inspections. Replacement aircraft and crews were sent to Thailand, and the F-111s continued to prosecute the air war over

[53] Picinich, 23-24; Davies and Thornborough, 47-49, Staff, "Pentagon Can't Explain Disappearance of F-111," *Los Angeles Times*, 4 October 1972, A5.
[54] Staff, "Pilots Still Like the 'Jinxed" F-111," *New York Times*, 15 October 1972, 14.

North Vietnam.[55] One F-111 pilot very simply said that "if you're gonna fly combat missions, you're going to lose airplanes. Flying is inherently dangerous."[56] After the third loss the Air Force issued a statement expressing its satisfaction with the F-111's combat performance and its continued confidence in the jet.[57]

On 23 October President Nixon halted bombing north of the 20th parallel, as each side inched toward a peace agreement that allowed the United States to withdraw from Vietnam. F-111 missions shifted from Route Packs V and VI to strikes in Route Pack I and in Laos. The missions in Laos were very different from the low altitude single ship penetrator missions the F-111 usually flew, and showed the tactical versatility of the aircraft. In Laos, the planes flew in at medium altitude and dropped their bombs using a radar beacon. The beacon was a broadcast station on the ground that was capable of displaying a symbol on the aircraft radar. This beacon was used as an offset, and a beacon controller would give the aircrew a range and bearing from the beacon to the target. The WSO would set the range and bearing into the bomb-nav computer, line the radar crosshairs up on the beacon symbol presented on the radar, and let the computer systems in the airplane do the rest. In another demonstration of flexibility, the navigation system allowed the F-111 to act as a pathfinder for A-7 and F-4 aircraft on these missions when the weather would have precluded them flying.[58]

After his re-election and another breakdown in the peace negotiations, President Nixon ordered a new bombing campaign of the North, known as LINEBACKER II. Officially, Nixon sought to coerce Hanoi into serious negotiations, although Herring claims the move "reflected

[55] Staff, "Second F-111 Lost Over North Vietnam but Flights Go On," *Los Angeles Times,* 18 October 1972; Staff, "Another AF F-111 Lost in N. Vietnam," *Los Angeles Times,* 8 November 1972, A9; Picinich, 26-28.
[56] Staff, "Pilots Still Like the 'Jinxed" F-111," *New York Times,* 15 October 1972, 14.
[57] Staff, "U.S. Won't Ground F-111 Despite Vietnam Losses," *The Washington Post,* 10 November 1972, A2.
[58] Picinich, 31-33; Davies and Thornborough, 52-53.

the accumulated anger and frustration of four years" and that it may have been an attempt "to weaken North Vietnam to the point where it would be incapable of threatening South Vietnam."[59] Whatever the reason, the Hanoi area was subjected to eleven days and nights of the most intense bombing of the war. Over one thousand fighters and bombers participated, but LINEBACER II is probably best remembered for the B-52 strikes in and around Hanoi. The F-111 played a significant role in enabling the B-52s, as they went into the area before the heavy bombers and provided defense suppression. Initially, the F-111s attacked airfields to keep the MiGs from attacking the big, slow bombers, but in the second half of the campaign a significant number of F-111 sorties were dedicated to suppressing SA-2 missile sites. Other targets for the F-111s during LINEBACKER II included railroads, storage areas, and communications facilities.[60]

Military lore asserts that the Christmas Bombings, as the LINEBACKER II campaign is often called, finally brought the North Vietnamese to the bargaining table in earnest. This line of reasoning argues that had the same measures been adopted in 1965, that the war could have been ended then. It supports its argument with examples of the restraint and political control exercised from Washington. This argument ignores the historical context of the Vietnamese independence movement. Other observers counter argue that knowledgeable observers knew that the United States only wanted out of Vietnam by 1972 and that the brutal attacks did nothing to alter Hanoi's negotiating position. In any event, a peace agreement was signed in January 1973 that left the North Vietnamese Army in the South, returned American prisoners of war, and allowed the United States to withdraw from Vietnam. Nixon could claim that he had achieved "peace,

[59] Herring, 280.
[60] Picinich, 33-35; Schlight, 29-30; John W. Finney, "Hanoi Is Blamed," *New York Times,* 21 December 1972, 73; Michael Getler, "North Hit By Heaviest Raids of War," *The Washington Post,* 20 December 1972, A1; Jack Foisie, U.S. Threw 1,400 Planes Into Attack," *Los Angeles Times,* 28 December 1972, A1.

with honor." After the fighting ended for the US, the F-111s remained in Thailand until August 1974.[61]

The Air Force was generally pleased with the F-111 as a weapon system after the CONSTANT GUARD V deployment. The long range of the aircraft assured that it could reach its targets without aerial refueling, although there was always an emergency tanker orbiting during the missions just in case someone needed more fuel to return to base. Another positive factor was that the F-111 did not need a support package. Flying at night and low altitude using the TFR negated the MiG threat, so there was no need of F-4s to provide defensive counter air. Additionally, the low altitude tactics and the plane's internal radar jammers obviated the need for defense suppression aircraft like EB-66 electronic jammers, or F-105 Wild Weasel aircraft to launch antiradiation missiles at the SAM radars. Planners contended that since there was no need to send support aircraft into the target area before the strike aircraft, that the F-111 retained the element of surprise. The Air Force did, however, restrict the F-111 from dropping low drag 2000 pound Mk 84 bombs at low altitude, as they believed the weapon fragmentation pattern may have led to at least one of the six aircraft losses.[62]

Two of the three tactical problems that the Air Force sought to solve with the F-111 were the ability to strike targets at night and in bad weather, and the ability to penetrate to the target. Subsequent evaluations of the single ship penetrator tactics employed during the 1972 deployment suggest that the F-111 was generally able to reach the target unscathed. Missions were launched at night during the monsoon season, and most reached their targets and returned successfully. A total of six aircraft were lost during LINEBACKER I and II, a loss rate similar

[61] Herring, 279-283;
[62] Major Calvin R. Johnson, *Project CHECO Report: LINEBACKER Operations: September-December 1972* (Hickam AFB, HI: Headquarters Pacific Air Forces, CHECO Division, 1978), 34-36.

to the A-6 and the F-105F, both of which also flew at night using TFR. The first aircraft lost, on 28 September, did suggest that abnormally heavy rain could overcome the ability of the TFR to keep the crew safe. Four of the six lost aircraft went down in the target area, suggesting that they may have been shot down. Generally, F-111 crews reported AAA bursts behind the aircraft, which suggests that gunners were not able to use radar guidance, but were firing at the sound of the aircraft. SAMS rarely engaged the F-111, and only one aircraft was ever damaged by a SAM, which is usually attributed to the low altitude tactics and the penaids. Overall, the Air Force expressed satisfaction with the ability of the F-111 to reach its targets at night and in weather that would keep other aircraft from flying.[63]

The third tactical problem the Air Force needed to solve was improved weapons delivery accuracy. In statements expressing confidence in the F-111s performance, airmen often referred to its delivery accuracy. Weapons accuracy, however, is a difficult metric to assess. The F-111 missions directed against targets in RP I and Laos often dropped into triple canopy jungle, making it difficult to ascertain whether the ordnance expended struck anything other than the ground. Aircrew post-strike reports have always been suspect, as the crews always thought their bombs more accurate than they actually were. Aircrew could sometimes judge the effectiveness of a strike by observing secondary explosions, and they might on a clear night see a bomb strike a target, but such incidents were rare. At 540 knots, an airplane is travelling 929 feet per second, meaning that two seconds after bomb release, the plane is already a quarter mile away from the target. Post-strike reconnaissance was often limited by cloud cover, and of the 85 missions that did yield aerial photography, only twenty-three could be positively identified with F-111 strikes.

[63] Picinich, 46-59; Johnson, 35-36.

From this sample, a Circular Error Probable (CEP) of 656 feet was calculated, which is better than the other aircraft then in use, but otherwise unimpressive.[64]

Privately, airmen admitted the F-111 was "not likely to produce spectacular results in terms of physical damage alone with conventional weapons." The USAF chose to evaluate the effectiveness of the F-111 on its ability not only to destroy targets, but also on its ability to harass enemy forces in the target area.[65] Reminiscent of attacks on enemy morale during World War II, airmen thought harassment had a "formidable" psychological effect on the enemy. They pointed to the F-111's presence, that is, the ability to suddenly appear without warning. They maintained this had a psychological effect on the enemy, even though they had no evidence that the enemy worried that the F-111 might show up at any time. Of more value, they recognized that even a strike that caused limited damage, when conducted at night, inhibited the ability to make repairs to damaged facilities. Mission effectiveness was often inferred from observations such as less MiG activity after an F-111 attack on an airfield, or fewer SAM launches after an F-111 strike on a SAM site.[66]

The official Air Force assessment of the CONSTANT GUARD V deployment is that the F-111 was initially employed cautiously, therefore it "did not really have the opportunity to prove the full range of its combat capabilities." The report goes on to say, however, that the F-111's "subsequent performance during the LINEBACKER II operations demonstrated that it was capable of doing what it was designed to do."[67] In his end-of-tour report, Lieutenant General William G. Moore, the 13th Air Force Commander based in the Philippines during the deployment, summarized the Air Force position on the F-111:

[64] Davies and Thornborough, 52; Picinich, 64-65.
[65] Picinich, 60.
[66] Johnson, 36-37.
[67] Picinich, 63-64.

> Other than a six-aircraft test force (Combat Lancer)… the 474TFW had no combat experience with the F-111. Therefore, the F-111 with its single aircraft night penetrator tactics represented a relatively unknown asset. The performance of aircrews and aircraft during the December 1972 campaign… proved the soundness of both the aircraft and the decision to deploy the wing.[68]

For a moment in time, the Air Force avowed it had found a tactical bomber that was able to bring superior technology to bear upon an enemy, and that the F-111 was able to bring about both the desired military, and political results.

[68] Lieutenant General William G. Moore, End of Tour Report, 28 December 1973, AFHRA, Document #K717.131 (Moore, William G.), IRISNUM 00517603.

EPILOGUE

Production of the F-111 in its various models continued until the last F-111F was delivered in 1976. The F-111A returned from Thailand in 1974, and assumed a peacetime routine. The 474th TFW moved to Mountain Home AFB, Idaho and began training for deployment, keeping their combat skills honed for the next conflict. In the early 1980s, 40 F-111As were converted to EF-111As, an electronic jammer aircraft, capable of either high speed low altitude penetration or long loiter times on station. The F-111E entered the Air Force inventory and was stationed at RAF Upper Heyford, UK, where they joined the NATO nuclear alert force. The F-111D, due to problems with the Mark II avionics system, entered the inventory after the E-model. The avionics system theoretically made the F-111D the most capable version of the plane, but due to reliability problems, the D-model assumed a peacetime deployment training routine at Cannon AFB, NM. The F-111F was probably the most successful of the variants delivered to TAC, as it incorporated a scaled down version of the Mark II avionics system, along with the best components of the A and E models. The F-111F was stationed at RAF Lakenheath, UK, and joined the NATO nuclear alert force as well. The planned RF-111 reconnaissance platform was never built.[1]

The F-111F began to receive the Pave Tack laser/infrared detection set in 1981, which gave it the ability to deliver precision guided munitions (PGMs). This upgrade made the F-111F the most capable of the variants. Because the F-model could deliver PGMs it was selected for

[1] Davies and Thornborough, 35-117.

Operation EL DORADO CANYON, a 1986 strike on Libya in response to several terrorist attacks against American interests. Flying from RAF Lakenheath, the mission is probably best known for the fourteen hour flight around the Iberian Peninsula because France denied overflight permission to the strike force. The Navy's carrier-based A-6 Intruders, which also possessed PGM capability, participated as well, along with five of RAF Upper Heyford's EF-111As. Of the eighteen plane F-111F strike force, one plane and crew were lost, probably shot down by a SAM while egressing the target area. Very few of the flights actually struck their targets, but the mission showcased the F-111's long range and PGM capability, and generally painted the aircraft in a positive light.[2]

In 1990, the F-111 was called upon again to participate in Operations DESERT SHIELD and DESERT STORM, the mission to protect Saudi Arabia and to eject the Iraqi army from Kuwait. Flying from Taif Air Base in Saudi Arabia, the F-111F, with its Pave Tack infrared targeting and weapon guidance pod and precision weapons capability, was employed against tough targets that could not be destroyed with free fall bombs. The F-model performed a variety of missions with its PGMs, to include destroying half the bridges that the coalition targeted, forty percent of the hardened aircraft shelters, and over fifteen percent of the tanks and armored vehicles in the Iraqi arsenal. The aircrews developed new techniques for targeting tanks one at a time with laser guided bombs when purpose built anti-tank munitions did not work as advertised. Tthe F-111F was credited with halting the environmental damage caused when retreating Iraqi troops opened valves that dumped oil into the Persian Gulf. Armed with the GBU-15 TV guided bomb, a flight of four destroyed the manifolds that may have stopped the spill, although

[2] Ibid., 118-124

there is some speculation that Kuwati oil workers may have covertly shut the valves. Other versions of the F-111 were well represented in the air order of battle as F-111Es flew from Turkey, and EF-111As flew from both Saudi Arabia and Turkey.[3]

By the time the last F-111F was retired in 1996, the Air Force had developed new aircraft and a new way of thinking about fighter aircraft. The F-15 was the USAF's first air superiority fighter built to dogfight with enemy fighters since the F-86, as the F-100 was quickly converted into an air-to-ground machine. During the 1950s, missile development and Air Force assumptions about war in the nuclear age led airmen to insist that long range air-to-air missiles would shoot down Soviet bombers beyond visual range. This led to the development of interceptors like the F-102 and the F-106 that were large and fast, but not very maneuverable. It was the reality of aerial combat in Vietnam, including rules of engagement that required visual identification of enemy aircraft that led a small, vocal group within the Air Force, backed by World War II and Korean War aces, to push for an interceptor that retained the ability to mix it up in a dogfight. The F-16, which began with the 1972 lightweight fighter program, was also developed as a highly maneuverable fighter that could be used in both the air-to-air and air-to-ground roles. Cost was also a factor in the procurement of the F-16, as the pricetag on an airplane is directly related to the weight.[4]

While the Air Force revitalized the air superiority mission, there was still a recognition that the aerial bombardment mission needed to continue. The F-111F, with its PGM capability, became the baseline for TAC's next fighter-bomber. The F-15B two seat trainer became the test

[3] Ibid., 125-136
[4] James Perry Stevenson, *McDonnell Douglas F-15 Eagle* (Fallbrook, CA: Aero Publishers, Inc., 1978), 8-10; William G. Holder and William D. Siuru, Jr., PhD, *General Dynamics F-16* (Fallbrook, CA: Aero Publishers, Inc., 1976), 20-21.

bed for the F-111 replacement aircraft, which would eventually be known as the F-15E Strike Eagle. Like the F-111, the two person crew included a WSO, who operated the targeting systems. The F-15E was equipped with the APG-70 radar, which retained all of the air-to air functionality of the F-15A/C radar. The APG-70 also used a computer technique called synthetic aperture radar, which measured the Doppler shift of the radar returns, ran the data through the computer, and presented a radar map of the target. This new technique greatly increased the accuracy of radar deliveries. The F-15E also included the LANTIRN (Low Altitude Navigation and Targeting Infrared for Night) pods, one of which gave the Strike Eagle TFR capability similar to the F-111's, the other pod contained a laser designator giving the jet LGB capability. Finally, it was equipped with conformal fuel tanks that did not add much drag, yet increased the range almost to that of the F-111.[5]

A more innovative approach to the fighter bomber concept was the development of the F-117A Nighthawk, which introduced stealth technology. Learning from the Vietnam Conflict that its aircraft were extremely susceptible to radar-guided SAMs and AAA, the Air Force began work on reducing the radar signature of its planes. Lockheed developed a plane that was almost invisible to radar, by using a faceted shape that reflected radar returns away from the receiver, and by developing special radar absorbing materials with which to coat the jet. Instead of using radar, which could expose the aircraft location with its emissions, the F-117 used a passive infrared system for navigation and target acquisition. The ordnance load on the F-117 was small, generally two GBU-27 2,000 pound laser guided bombs. The advent of PGMs had caused a move away from the idea that a plane needed to carry more bombs, because the guidance

[5] Steve Davies, *Boeing F-15E Strike Eagle: All-Weather Attack Aircraft* (Ramsbury, UK: Airlife Publishing, 2003), 10-39.

systems directed one or two bombs to the designated point of impact. The plane was given a century series designation as a cover to hide its secret state-of-the-art technologies, but the radical design belonged to a new era. The F-111 remains truly the last of the century series fighters.[6]

The influence of the F-111 was seen not only in the mission it performed, but also in aircraft design. Two more variable wing geometry aircraft entered US military service, the Navy's F-14 Tomcat and the USAF's B-1. Grumman had been the primary subcontractor to General Dynamics and was responsible for building the F-111B. It had become apparent by 1967 that the F-111B would never meet the Navy's needs, yet Grumman considered the basic concept sound. It approached the Navy with a proposal to redesign a smaller, lighter, swing-wing airframe utilizing the F-111B's avionics and engines. In early 1969, Grumman was awarded a contract for the F-14A, eleven feet shorter and about 15,000 pounds lighter than the F-111B. The Air Force's B-1 bomber grew from attempts to replace the B-52, the most well-known of which was the high altitude, Mach 3 capable XB-70 project. Once the USAF determined that radar guided surface-to-air missiles negated the advantages of high altitude, high speed penetrators, SAC decided that its follow-on bomber needed to ingress at low altitude, which was essentially the F-111 mission. The B-1 airframe mirrors the F-111 design, it used the same TFR system for low altitude flight, and even the avionics and cockpit design are similar to that of the F-111D.[7]

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[6] Paul F. Crickmore and Allison J. Crickmore, *F-117 Nighthawk* (Osceola, WI: MBI Publishing Company, 1999), 8-45.

[7] James Perry Stevenson, *Grumman F-14 "Tomcat"* (Fallbrook CA: Aero Publishers, Inc., 1975), 12-24; William G. Holder, *The B-1 Bomber*, Second Edition (Blue Ridge Summit, PA: TAB Books, 1988), 13-30.

The Air Force rewrote its doctrine in the immediate wake of the Southeast Asia Conflict, publishing a new version of AFM 1-1 in January 1975. While this version of the basic doctrine manual is more succinct that its predecessor, it does not offer much new in the way of strategic thought. The section on deterrence still contains a reference to the nation's "will" to use superior force.[8] By the 1977-78 academic year, the Department of Military Doctrine and Strategy at the Air War College was assigning students case studies of tactical air in World War II, Korea, and Vietnam, with a fourth case study covering LINEBACKER II alone. The treatment of LINEBACKER I called it the "most effective interdiction operation" of the war, and said that when coupled with the "strategic attacks during Linebacker II, the pressure on the North Vietnamese government became sufficient to achieve the political objective of serious negotiations."[9] In an echo from the 1930s, the Air Force narrative became that airpower, once the oppressive political restrictions were eased, had ended the war. The new doctrine manual and the AWC curriculum, taken as a whole, reflect the old ideas that were passed to a new generation of airmen: faith in superior technology and a belief in the efficacy of strategic bombardment.

The superior technology theme is as old as the airplane itself, and certainly predates the U.S. Air Force. When considering the lessons of World War I, John Morrow concluded "the airplane established itself as the ideal weapon for western man, who regards his technical mastery as proof of his superiority over others."[10] During the interwar years, airmen in the United States pursued new aircraft technologies that accorded with their theory of future war.

[8] AFM 1-1 United States Air Force Basic Doctrine, 15 January 1975, FRIC Special Collections, 1-1 – 3-6.
[9] Air War College Curriculum History Class 1977 to 1978, AFHRA Document #K239.0423178-3 V.3, Table of Contents-1.
[10] Morrow, 366.

The idea of an offensive strike against enemy industry drove the procurement process, and the technology that resulted were the B-17 and B-29 bombers, equipped with the Norden bombsight. The advent of nuclear weapons did not change the idea of strike against enemy industry, but led to the procurement of longer range bombers. The influx of German aerospace technology after the war suggested many paths along which the U.S. aircraft industry could progress. However, the miniaturization of nuclear weapons led to only slight changes in doctrine which allowed small fighter aircraft to be employed in a tactical nuclear role. This in turn led to the procurement of the Century Series fighters, each of which was increasingly optimized for a nuclear mission, and equipped with more sophisticated avionics to deliver nuclear weapons more accurately. At each step, the USAF committed to acquiring the most current and sophisticated technology available.

The institutional belief in superior technology is inextricably intertwined with the belief in the efficacy of strategic bombardment. Once again, it was during the interwar years that American airmen developed the Industrial Web theory, or the idea that the key to destroying the opposing military was to destroy the industry that supplied the fielded forces. The European Strategic Bombing Survey contained indications that strategic bombardment had not been as effective as prewar suppositions suggested it would, but the advent of nuclear weapons changed the calculus. No longer did one need to be incredibly accurate to insure the destruction of enemy industry. This idea so affected early Cold War planners that in the absence of specific targets, they planned to destroy Soviet cities on the assumption that any industry within the blast radius would be destroyed. Strategic bombardment theory drove procurement decisions, placing a premium on technologically advanced bombers able to penetrate to the target. The Air Force initially sought high altitude, high speed bombers that could elude enemy interceptors. The

advent of effective radar guided surface to air missiles, however, placed a premium on aircraft that could elude radar at low altitude, and use electronic countermeasures to confuse radar homing.

By the late 1950s, most airmen placed an almost religious faith in superior technology and an unbridled belief in the efficacy of strategic bombardment. Earl Tilford stated that "institutionally, the Air Force committed to flying and fighting with weapons that incorporated unparalleled technological sophistication" and that "most of the officers were fascinated with technology."[11] His words demonstrate that these ideas had become a part of the organizational culture, and that they formed each individual airman's operational code. As John Lewis Gaddis suggested, early in each airman's career, these ideas became the lens through which he viewed problems and which informed his decisions. Additionally, as Wayne Lee proposed, these are the ideas that were passed on to subsequent generations of airmen through doctrine, training, and even myth. In this context, myth means the informal stories, repeated at the bar or shared during the mission debrief. These are what airmen refer to as "there I was…" stories, based in fact, although one suspects that some of the memories grow with the telling. When the TFX project was proposed in 1959, it certainly represented the culmination of Air Force thinking concerning technology and doctrine.

An oft repeated military truism is that "the first casualty of every war is the plan." In the early 1960s, the USAF found itself found itself embroiled in a war for which it had not planned, equipped with hardware not optimized for the task at hand. Yet, the institutional culture predisposed airmen to believe that superior technology directed against the proper targets would

[11] Earl H. Tilford, Jr., *Setup: What the Air Force Did in Vietnam and Why* (Maxwell AFB, AL: Air University Press, 1991), 95-96.

bring victory. In 1965, when the ROLLING THUNDER campaign began, airmen confidently sent their F-105 aircraft, which had been optimized for a nuclear strike in Europe, against targets in North Vietnam using conventional weapons. While they blamed political restraints for their lack of victory, airmen realized that their plane was not up to the challenge. Despite being the newest, most sophisticated tactical bomber in the inventory, the F-105, was not able to penetrate to the target without high losses, and required a huge support package for protection. It was not able to attack at night or in bad weather, and once it reached the target was not accurate enough to assure destruction. They placed their hope in the next technological advance.

By 1968, the new F-111A certainly represented the culmination of superior technology. Like the F-105, it had been designed for nuclear strike in Europe, but the technology employed held out hope that it could answer the tactical problems the USAF faced in Southeast Asia. Its terrain following radar and self-contained electronic penetration aids suggested that the plane could reach the target without unacceptable losses, and without a large support package. The attack radar and superior avionics suite promised that ordnance delivery would be accurate. The controversy surrounding the loss of three aircraft and political restrictions caused by the bombing halt assured that the F-111 would not prove its worth in 1968. Air Force thinking, however, did not change regarding the qualities an aircraft needed to be effective in the war, so the F-111 returned to Southeast Asia in 1972. This time, the plane was sent against high value targets near Hanoi and Haiphong. Even though evidence readily available at the time suggests that bombing accuracy was suspect, the F-111's performance reaffirmed the myth that relatively unrestricted bombing of high value targets ended the war.

The F-111 served in the Air Force inventory for nearly thirty years, and assessing the plane's worth is a nearly impossible task. Fortunately, it never actually performed the nuclear

mission it was designed to accomplish, so it will never be known if the plane was a success on that count. On the other hand, it is impossible to quantify how much its known capabilities played into the nation's nuclear deterrent posture, so perhaps in that sense the F-111 was successful. There is no doubt that by the end of its operational career, the F-111F had become an extremely accurate conventional bomber, but only through the adoption of another technological advance, the precision guided munition. It was not uncommon, however, for the USAF to employ a weapon system in a role for which it was not designed. For example, the B-52 was designed as a nuclear bomber, yet performed conventional interdiction missions in several wars. Suffice it to say that the F-111 represented the culmination of Air Force thinking concerning superior technology and strategic bombardment in 1959, and once in the inventory, the mission was adjusted to fit the situation. Officially, the USAF always expressed satisfaction with the plane's performance.

Airmen will always measure success in terms of targets destroyed. While Air Force thinking has changed around the margin over the years, superior technology and strategic bombardment still dominate both doctrine and procurement decisions. John Warden's 1988 book, *The Air Campaign,* is viewed as one of the most influential expressions of air doctrine in the last fifty years. His advocacy of the enemy as a system, and the destruction of his centers of gravity, is not much different than the critical nodes in the enemy's industrial web that airmen sought to destroy in the 1940s. The effort to destroy enemy centers of gravity still drives procurement. Yet, as the price of new aircraft rises, seemingly exponentially, it is important that these planes can do a variety of missions efficiently. New aircraft must have stealth technology to penetrate enemy defenses unescorted, accurate navigation systems allowing for all weather operations, and precision guided munitions to ensure accuracy and target destruction. The basic

mission remains as it was in 1968 when the F-111A deployed to Southeast Asia. Using the F-111 as a case study allows a glimpse into the process of Air Force thinking in the past, and suggests ways that airmen will solve problems in the future.[12]

[12] John A. Warden III, *The Air Campaign* (New York: toExcel, 1998).

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