

UNDERSTANDING CHANGE:
AN INTELLECTUAL AND PRACTICAL STUDY OF MILITARY INNOVATION
U.S. ARMY ANTI-AIRCRAFT ARTILLERY AND THE BATTLE FOR
LEGITIMACY, 1917-1945

DISSERTATION

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ABSTRACT

Military organizations are normally quite resistant to change the way they operate. For a number of complex reasons militaries have failed on occasion to anticipate, learn, and adapt to changes in the conduct of warfare. This work examines the anatomy of change and argues that achieving successful organizational change in the military results from garnering external support and winning internal consensus. It counters recent scholarship that maintains the Interwar Army was a hidebound organization, unable to overcome internal power struggles and achieve necessary reforms. It begins with an intellectual analysis of how and why organizational change occurs, examines the nature of revolutionary and evolutionary change, and offers one approach toward achieving lasting, meaningful modernization and innovation in the military.

This work then examines the development of American antiaircraft artillery as a case study to illuminate the earlier discussion of theory as it relates to organizational and institutional change. Beginning in World War I and tracing the evolution of antiaircraft artillery through the Interwar Period and World War II, this study highlights the non-linear nature of change and the influence of technology, strategy, resources, and organizational politics on efforts to improve the American Army's ability to defend against air attack. It also provides valuable insight into the ability of the Army to learn from its mistakes and adapt to changing combat situations. From the Interwar

development of doctrine to the prewar production of new weapons, the antiaircraft artillery establishment accepted limited, incremental success and did not sacrifice its overall development on the altar of sweeping reform. National military policy, strategy, operations, and tactics are analyzed as the expanding antiaircraft establishment defended the Panama Canal, Pearl Harbor, and the Philippines from Japanese attack, and fought through stubborn German resistance at Kasserine Pass, on Normandy, and at the Remagen Bridge. Battles against the V-1 cruise missile, the V-2 ballistic missile, and Japanese *kamikaze* pilots tested antiaircraft units' training and adaptability, while fire support missions to assist infantry and armor units brought the antiaircraft artillery independence from the Coast Artillery Corps and acceptance as a member of the family of arms.

I dedicate this dissertation to my parents, Edward and Marion Greenwald, in recognition of their love and support.

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CHAPTER 1

INTRODUCTION

On 10 October 1917, General John J. Pershing, commander of the American Expeditionary Forces, authorized the creation of an Antiaircraft and Trench Mortar School at Langres, France. By the time World War I ended thirteen months later, the men of the American Antiaircraft Service had shot down a total of 58 enemy airplanes.¹ In their short time at the front, these men downed more planes in less time and with less ammunition than either their French or British counterparts. By February 1919, however, the Antiaircraft Service ceased to exist, its personnel and equipment victims of the rapid demobilization that followed the Armistice. Another twenty-three years would pass before world events again required American antiaircraft artillerymen to demonstrate their skills.²

In his post-World War I report, Secretary of War Newton D. Baker commented that as wartime aviation developed there "naturally grew up a system of anti-aircraft defense. . .to either drive off or destroy bomb-carrying enemy planes."³ Following the war, however, a dichotomy developed between the evolution of military aviation and the wartime system designed to defend against it. In the period between the wars, while the development of military aircraft flourished with the help of the civilian aviation industry,

antiaircraft artillery--one of the many military specialties without direct civilian application--floundered.

During World War II, the effect of this dichotomy became painfully apparent. Perhaps no one understood this better than General of the Army George C. Marshall. Commenting in his 1945 "Biennial Report of the Chief of Staff," Marshall stated that antiaircraft weapons were one of the types of weapons that had been grossly neglected in peacetime because they had no commercial counterpart. He continued:

[t]he highly efficient antiaircraft of today did not materialize until long after the fighting began. The consequent cost in time, life, and money of this failure to spend the necessary sums on such activity in peacetime has been appalling.⁴

Marshall understood that a reliable defense against air attack was necessary for waging successful land combat and that the shortage of antiaircraft artillery equipment had significantly hindered early military operations. For the most part, the War Department completed equipment standardization and production too late in the war to influence its initial combat operations. The Army needed fully equipped antiaircraft units early in the conflict in order to protect forward bases and lines of communications from hostile air attack.

More importantly, General Marshall's comment describes the difficulty in recognizing changes in the conduct of warfare and adapting a military organization to new, nascent forms of combat. This study examines the nature of change in military organizations, focusing on the period between the First and Second World Wars and analyzing the process of Interwar military development as it relates to the United States Army. It concentrates on the development of an emerging combat arm within the Army,

the antiaircraft artillery, as a microcosm of the larger Army yet subjected to the same external and internal pressures that affected change across the broader, more diverse force.

The Army, along with the other services, struggled for its institutional legitimacy in the two decades following World War I. Faced with legislation that reduced its size, budget decreases that halved its authorized strength, isolationist policies that brooked no support for military readiness, and a national economic disaster that retarded any improvements in force structure, the Army sunk to eighteenth in size among the world's militaries before beginning to rearm in 1938. Subsumed within the Army's larger struggle was the battle fought by the antiaircraft artillery for legitimacy within the Army. A child of World War I, the antiaircraft artillery fought against both external and internal pressures to emerge as an accepted member of the family of arms by 1941. Like the Army, it too fought poorly against the Germans at Kasserine Pass, raising several questions about the process of Interwar development and how it may have contributed to the defeat of American ground forces in their first great land battle since World War I. Equally telling is the process of adaptation following the battles in North Africa. The conclusions drawn and the speed and skill with which the Army and the antiaircraft artillery establishment adapted to the new realities of modern, industrialized warfare are strong indications of the intellectual quality and the institutional flexibility of both organizations.

To a great degree this work is a parallel study of nested organizations. Each organization is part of a larger whole and each changes and adapts the way it acts with respect to itself and its parent organization. During the Interwar period, the Army reflected some of

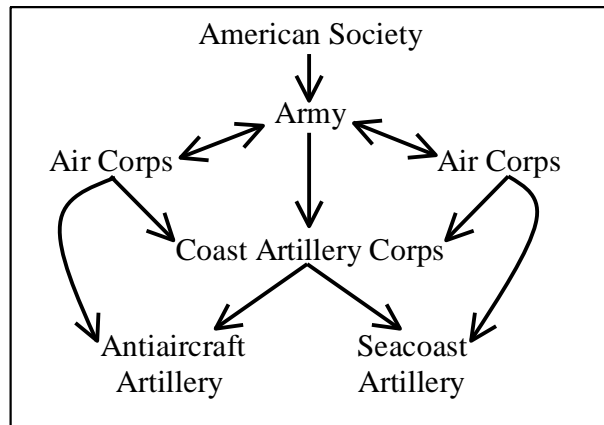


Figure 1.1 - Nested Organizations

the values of American society. With no perceived national threat, the Army suffered the attendant peaks and valleys of popular and political support characteristic of most interwar periods. How the Army dealt with these challenges is instructive and may offer some insight into similar challenges in the future.

During the same period, the Coast Artillery Corps, one of the Army's several combat arms, experienced an organizational dilemma. The growth of military aviation during World War I created a need for antiaircraft artillery organizations and weapons. The emergence of the antiaircraft artillery establishment, however, represented a shift within the Coast Artillery Corps away, somewhat begrudgingly, from the traditional mission of seacoast defense. Over the course of this shift, the antiaircraft artillery community fought not only against the purveyors of the status quo in the seacoast artillery who sought to shield their organization from technical and political obsolescence, but also the other combat arms within the Army. In particular the Air Corps, which sought to establish itself as an independent service charged with defending America from air and sea attack, disagreed with the Coast Artillery over the need for

either seacoast or antiaircraft artillery. This conflict placed the antiaircraft artillery establishment squarely in the middle of an organizational and institutional debate. On the one hand, the antiaircraft establishment grew out of the World War I requirement to protect friendly forces from air attack and saw itself as responsible for countering the potential threat represented by the revolutionary advances in air power. On the other hand, as a subordinate element of the Coast Artillery Corps, it took direction and received organizational support from a hidebound headquarters that one scholar called the most conservative and resistant to change of the Interwar period.⁵ To make matters worse, as both aircraft and antiaircraft technology advanced during the Interwar period, the complex interplay of strategic or fixed-site antiaircraft artillery (designed to defend against high altitude bombers) and tactical, mobile antiaircraft artillery (focused on protecting maneuver forces from attack aircraft) required senior antiaircraft leaders to make tough decisions concerning the investment of meager resources. The antiaircraft artillery establishment's struggle for institutional survival and warfighting legitimacy reflects the dynamics of change in the military and may serve to enlighten and inspire any military organization currently attempting to change the way it operates.

As such, this work argues that achieving successful organizational change in the military results from garnering external support and winning internal consensus. With respect to the development of U.S. Army antiaircraft artillery, it is a secondary thesis of this work that the antiaircraft artillery establishment fought both internal and external forces to emerge as an accepted member of the combat arms. The struggle for legitimacy, however, cost the organization valuable time and limited its effectiveness at the beginning of World War II. In terms of manning and equipment, the consequent

reaction to under-preparedness was to devote more men and resources to the antiaircraft artillery than subsequent tactical operations justified. The Army corrected this condition during the course of the war by shifting antiaircraft artillerymen to heavy field artillery battalions and infantry replacements. By the end of World War II, a new equilibrium obtained when the Army granted its imprimatur and incorporated antiaircraft artillery units into the design of its fighting divisions, the sine qua non of legitimacy and status in the Army.

Both theses strike a middle ground between the two points of view regarding American military development during the Interwar period. The first point of view contends that the external environment as represented by a parsimonious Congress and an isolationist public starved the military of resources, which led to its systemic unpreparedness prior to and during the first phase of World War II. This position dominates much military history writing and is reflected in the U.S. Army's official military history.⁶ The competing point of view, championed recently by David Johnson in *Fast Tanks and Heavy Bombers* (1998), looks inward and argues that internal barriers to change and single-issue constituencies within the service were the predominant reasons for the Army's unpreparedness prior to World War II.⁷ The truth lies somewhere between these competing points of view, in the balance of their interaction. It is a major theme of this work that both external and internal forces react to shape the direction of change in the military. Succeeding parts of this work discuss this theme both from a historically informed theoretical perspective and by example through the history of antiaircraft artillery development between the First and Second World Wars.

The Limited Historical Record of American Antiaircraft Development

The impetus behind this examination of antiaircraft artillery development comes from the pursuit of two equally challenging professions. As an air defense artillery officer in the U.S. Army, I am naturally drawn to the history of my military specialty. As a historian, I am educated to examine any history critically and search for depth, breadth and context. As both an officer and a historian, I am not only appalled by the grave imbalance that exists in the historiography of air defense, but also disturbed by the limited quality of what history does exist. Even the most cursory examination of bibliographical sources yields many references on air power, airplanes, and the evolution of the United States Air Force, but virtually nothing on the development of antiaircraft artillery, especially during the Interwar period.⁸ If the emergence of antiaircraft artillery as a legitimate combat arm was indeed a struggle against the status quo, then the lack of associated history of that battle, when compared to the volumes written about air power, clearly validates the adage that “the history of warfare is written by the victors.”

Three texts which touch briefly on the development of Interwar American antiaircraft artillery are *Anti-Aircraft Artillery: A History of Air Defence* (1978) by Ian V. Hogg; *Archie, Flak, AAA, and SAM: A Short Operational History of Ground-Based Air Defense* (1988) by Kenneth P. Werrell; and *On Air Defense* (1994) by James Crabtree. Hogg offers a largely antiquarian view of antiaircraft artillery with a decidedly European slant, while Werrell ignores all American development up to 1942. Of the three, Crabtree offers a broad survey of global antiaircraft or air defense development from World War I to the Persian Gulf War, but it is that broad scope that prevents him from probing any of his topics deeply.⁹ By way of comparison, there are several comprehensive volumes on

the development German antiaircraft defenses, including Edward B. Westermann's recent *Flak: German Anti-Aircraft Defenses, 1914-1945* (2001), the sum of which only serve to highlight the aforementioned disparity in literature on American antiaircraft artillery.¹⁰

One early attempt by the military to study the development of antiaircraft artillery was the United States Army Air Defense School's four-volume history published in 1965. Although the bibliography contains a number of useful primary sources on the subject, the volume on Interwar development only focuses on the technological evolution of antiaircraft artillery weapons.¹¹ Since people, not machines prepare for and fight wars, the Army's study only informs the reader about technological developments as they pertain to the art and science of engaging aircraft and missiles from the ground. This focus on technology and the belief that it exerts a greater influence on the direction of change than any other factor is one-sided and does not educate the reader on the often competing social component of change in the military.¹²

Although he concentrates on seacoast defense, a study by Kenneth Hamburger on the technology, doctrine, and politics of the United States coast defenses from 1880-1945 offers a small window into some of the difficulties facing Interwar antiaircraft artillery development.¹³ Hamburger contends that the Coast Artillery Corps--the parent Army organization for the antiaircraft artillery--never fully accepted its responsibility to develop the antiaircraft element and continued to focus its Interwar attention on the seacoast artillery portion of the branch in a failing attempt to defend against a fading threat.¹⁴ The advent of naval aviation in the late 1930s and early 1940s made the seacoast artillery technically obsolete against all forms of attack save localized

amphibious assaults. The vestiges of coastal defense politics, however, prevented its immediate demise until after World War II.

Even the most complete collection of scholarly works on the United States Army during the war, the seventy-eight volumes of the “U.S. Army in World War II” series, fails to address in any comprehensive manner the history of antiaircraft artillery prior to or during that war. Instead, the subject is covered in varying degrees in five major sub-series--“The Army Ground Forces”, “The Western Hemisphere”, “The War in the Pacific”, the “Mediterranean Theater of Operations”, and the “European Theater of Operations”—with most of the organized discussion occurring in the two volumes of “The Army Ground Forces.” During World War II, the Army Ground Forces (AGF) Historical Section produced several studies of specialized units to include one on “The Antiaircraft Command and Center.” Several of the studies written by the Historical Section were subsequently incorporated in the two volumes of AGF history, *The Organization of Ground Combat Troops* and *The Procurement and Training of Ground Combat Troops*. “The Antiaircraft Command and Center” study and others on similarly specialized units and topics (the Airborne Command, the Armored Force, the Amphibious Training Center, and the Tank Destroyers) were not reprinted as distinct sections of these two volumes, but incorporated into portions of the two volumes as their subjects warranted.

Another wartime effort by the Army Service Forces originally intended to produce ten volumes of Ordnance Department history covering “the development, use, and procurement of various types of weapons,” including antiaircraft artillery.¹⁵ This effort fell short with the Ordnance Department producing two volumes, *Planning*

Munitions for War and Procurement and Supply. The only academic work devoted to the study of American antiaircraft artillery, albeit during World War I, is Charles Kirkpatrick's *Archie and the A.E.F.: The Creation of the Antiaircraft Service of the United States Army, 1917-1918* (1984).

Why So Little Attention?

There are several potential explanations for why so little attention has been paid to the history of American antiaircraft artillery prior to and during World War II. In *Flak*, Edward Westermann cites three reasons German antiaircraft artillery has been ignored. These reasons may apply to the American case as well. The first explanation is the perception that American antiaircraft artillery defenses achieved limited success against enemy fighters and bombers, in particular when compared with the efforts of Allied aircraft to win the war. The second possible reason for the lack of attention paid to American antiaircraft artillery is the belief that antiaircraft artillery equipment was too expensive and required too many personnel, making its limited effectiveness all the more burdensome. The third reason is similar to the second argument and postulates that, given its limited effectiveness, the materiel resources needed to manufacture antiaircraft equipment could have been better used to build airplanes or field artillery. As related to the ground-based air defense of the Luftwaffe, Westermann demonstrates that the opportunity cost argument has some merit, but is limited in scope and fails to examine events in their complete context. With respect to the U.S. Army antiaircraft artillery establishment, all of these arguments are equally faulty.¹⁶

Limited Effectiveness

The first argument concerning the limited effectiveness of American antiaircraft artillery during World War II ignores the facts. Available records indicate that American antiaircraft artillery destroyed at least 3,675 enemy aircraft and severely damaged another 1,514 for a total of 5,189 aircraft. By comparison, the U.S. Army Air Forces received credit for 15,811 aerial victories during World War II. To look at it another way, the efforts of Army antiaircraft artilleryman accounted for just under 25 percent of the approximately 21,000 enemy aircraft destroyed or rendered inoperable by the entire U.S. Army and Army Air Forces during the war.¹⁷ This number does not include the additional 236 enemy aircraft trailing smoke or pieces of fuselage, but that observers deemed able to return to base safely.¹⁸ If included, the total enemy aircraft damaged or destroyed by Army antiaircraft artillery jumps to over 25 percent. Nor does this total

Theater of Operations	Planes Destroyed	Planes Probably Destroyed	Planes Damaged	Theater Total
European (6 Jun 44 - 8 May 45)	2138	1013	Incomplete records	3151
SWPA (to 15 Mar 45)	402	244	236	882
North Africa (Nov 42 – 2 Dec 43)	526	Incomplete records	Incomplete records	526
Sicily (9 Jul – 12 Oct 43)	120	“ “	“ “	120
Italy (to 15 Mar 45)	473	246	“ “	719
Corsica & Sardinia	8	4	“ “	12
Southern France	8	7	“ “	15
Grand Total	3675	1514	236	5425

Source: LTC Alvin M. Cibula, “The Antiaircraft Command and Center (Army Ground Forces Study no. 26),” (Washington, DC: Army Ground Forces Historical Section, 1946), 209-211.

Table 1.1 - Summary of AAA Operations in World War II

include the large number of V-1 pilotless aircraft destroyed by Army antiaircraft artillery. The V-1 was the first of the “Vengeance” weapons launched by the Germans at London, Antwerp, and other cities during the latter portion of World War II. While creating a moderate amount of physical damage, the V-1, along with the V-2 ballistic missile, caused a significant number of deaths and injuries as well as immense psychological dislocation of the civilian populace. In England, the V-1 and V-2 attacks were responsible for 31,966 casualties. On the Continent, they caused another 14,758 casualties, for a total of 46,724 military or civilian personnel killed or wounded as a result of the attacks.¹⁹ Without antiaircraft defense, however, the numbers would have been much higher. The defense of Antwerp offers an excellent example of the contribution of American antiaircraft artillery to protection from V-1 attacks. Of the 4,883 V-1 “buzz bombs” launched at Antwerp, 2,356 or 48 percent were destroyed by U.S. Army antiaircraft artillery. Many others flew outside of the target area of the shipping docks and were not engaged. Of the 4,883 bombs launched, only 211 or 4.3 percent landed within a five-kilometer radius of the target area.²⁰ In fact, antiaircraft artillery gunners perfected their skills to the point that during one week, 22-30 March 1945, units from the IX U.S. Army Air Defense Command shot down 96 percent or 87 of 91 V-1 cruise missiles.²¹ Arguments concerning the limited effectiveness of antiaircraft artillery also disregard the impact antiaircraft defenses had on enemy pilots as they attempted to conduct their missions. Fear of being hit forced pilots to dodge upcoming flak making their strafing and bombing runs less accurate. It drove pilots to fly higher to avoid being hit and made them release their bombs earlier and miles off target. Also,

those aircraft damaged by antiaircraft artillery and limping back to base made easy targets for Allied fighter aircraft.

Too Costly and Diverts Manpower?

The second explanation possible for dismissing antiaircraft artillery is that it was too expensive and took too many soldiers away from front line combat duty. This reasoning is partially correct, but must be put in context. While personnel distribution became a problem, cost was not a factor. Once the United States reached full mobilization in 1943, its financial and material wealth proved robust enough to field an immense American Army, Navy, and Air Force as well as offer significant material support to Britain, Russia, and China. The monetary cost of such an undertaking was never an issue. Neither was the priority placed on aircraft or antiaircraft artillery. President Franklin Roosevelt made this clear in a meeting held with his top advisors on November 14, 1938, a month and a half after the Munich Agreement and the German annexation of the Sudetenland. According to notes taken by then Major General Henry H. Arnold, the new Chief of the Army Air Corps, the President expressed the opinion that one of the main reasons Britain and France had to accede to Hitler's wishes at Munich was due to their lack of air power. Concerned about German air power, Roosevelt emphasized that the Army Air Corps was the weakest of all the armed forces, followed closely by the Army antiaircraft units. While he stressed the need for a rapid build up of both, he clearly placed priority on aircraft, initially proposing to build between 10,000 – 20,000 planes per year and later increasing that number to 50,000 planes following Germany's victory over France in 1940.²² On the issue of money to purchase aircraft, General Arnold recalls being told by Senator Henry Cabot Lodge of the Senate

Appropriations Committee in June of 1940, “all you have to do is ask for it.” As Arnold later stated: “In forty-five minutes I was given \$1,500,000,000 and told to get an air force.”²³ Money or priorities of work were never an issue and as such one cannot use them as reasons to explain the disinterest in antiaircraft artillery.

The problem of personnel distribution is only partially correct. Peter Mansoor, in his award-winning examination of American infantry divisions in Europe, *The GI Offensive in Europe*, claims one reason American divisions experienced a chronic shortage of infantrymen was that the Army “expended too much of its manpower on certain types of units, such as...antiaircraft artillery.” He continues that since air supremacy was a precondition for launching a cross-Channel invasion, “one wonders if the need for antiaircraft units was not overstated.”²⁴ Both portions of this statement oversell the issue, are technically incorrect, and ignore the context of the times. The Army may have misallocated or distributed too many men to antiaircraft units, but it did not “expend” too much of its manpower on antiaircraft artillery. While some men did become casualties, the bulk of them did not disappear. In fact, between July and October 1943, the Army recognized it had assigned too many men to antiaircraft units and reduced its proposed strength for antiaircraft personnel by 174,000, from around 601,000 to 427,000. By the end of 1944, the Army further reduced its target endstrength for antiaircraft artillery units to 405,535.²⁵ The Army redistributed the majority of these allocations to other Army Ground Forces units, primarily to the infantry.

These numbers, however, were planning figures or staff projections and only tell part of the story. In terms of actual strength in the field, the Coast Artillery Corps (which included the antiaircraft artillery establishment) was the only major branch or

element of the Army to decline as an overall percentage of the force. The true growth occurred in both the Air Corps and the Service Troops, which increased in raw numbers over six and seven fold. While the Coast Artillery Corps began the war in December 1941 with 177,379 personnel or 10.7 percent of the Army's total manpower, antiaircraft strength peaked in December 1943 at approximately 431,000 soldiers or 5.7 percent before declining to about 246,000 or 3.0 percent of the force by March 1945. During the same period, the USAAF grew from 270,535 or 16.3 percent to 1,831,091 or 22.4 by end of the war. The size of Service Troops, however, exceeded both the USAAF and the antiaircraft artillery throughout the war.²⁶ Since both the antiaircraft artillery force and the USAAF were responsible for destroying enemy aircraft in the air, at about 12 percent of the total air defense force structure, the antiaircraft artillery forces did 25 percent of the killing.²⁷

Branch	31 December 1941		31 December 1942		31 December 1943		31 March 1945	
	Strength	Percent	Strength	Percent	Strength	Percent	Strength	Percent
Ground Arms (less AAA)	690,083	41.7	1,512,730	28.0	1,960,068	24.9	2,423,075	29.7
Coast Artillery Corps (incl AAA)	177,379	10.7	425,187 (297,000)	7.9 (5.5)	590,939 (431,000)	7.9 (5.7)	330,442 (246,000)	4.1 (3.0)
US Army Air Forces	270,535	16.3	1,270,677	23.5	1,810,900	24.2	1,831,091	22.4
Service Troops	435,769	26.3	1,857,042	34.4	2,735,076	36.5	3,095,020	37.9
Other (WACs, Warrant and Flight Officers, and those w/no branch assigned)	83,391	5.0	333,252	6.2	485,451	6.5	477,758	5.9
Total	1,657,157	100.0	5,400,888	100.0	7,482,434	100.0	8,157,386	100.0

Source: Kent Roberts Greenfield, Robert R. Palmer, and Bell I. Wiley, *The Organization of Ground Combat Troops*, United States Army in World War II, The Army Ground Forces, (Washington, DC: Center of Military History, 1987), 161 and 203.

**Table 1.2 - Growth of the Army, 1941-1945
(Comparing Combat Arms and Air Corps with Antiaircraft Artillery)**

It is important to note that comparing strength figures with the numbers of aircraft destroyed by the USAAF and the antiaircraft artillery establishment is a little inaccurate,

but nonetheless informative. Not all air force personnel were involved in air defense activities. Besides fighter pilots and bomber crews that shot enemy aircraft over both friendly and hostile territory, fighters and bombers also destroyed approximately 12,040 enemy aircraft on the ground, contributing overwhelmingly to the accomplishment of Allied air superiority.²⁸ Other personnel maintained aircraft and planned and controlled air operations. Similar activities occurred in the anti-aircraft arena, though not to the same degree. The primary mission of all anti-aircraft activity was to destroy enemy aircraft whereas the air forces devoted only a portion of the aircraft and overall endstrength to that task. As such, it is not entirely accurate to compare the two. Conceptually, however, the comparison does highlight the significant level of contribution to the war effort made by the anti-aircraft artillery establishment given its fairly limited size.

It is also faulty logic to state, as Mansoor does, that since the Allies made air supremacy a precondition for invasion and the invasion occurred, that the Army must have overstated its need for anti-aircraft artillerymen. That is like saying that General Dwight D. Eisenhower, the Supreme Allied Commander in Europe, overstated the need for good weather in early June 1944. Indeed, the Allies had barely enough good weather or air superiority to make a go of the Normandy landings and the subsequent breakout. As reports from Europe indicate, from D-Day to 8 May 1945, Army anti-aircraft artillerymen destroyed or severely damaged 3151 Axis aircraft, including over 2200 in the First and Third Army areas. During the Normandy campaign (7-30 June 1944), Army anti-aircraft units destroyed 96 of the 682 sorties launched by the Germans against the First Army.²⁹ As the chapter on anti-aircraft artillery activities in Europe will demonstrate, air supremacy in Normandy and in other operations in Europe was a close

run thing. As one general officer stated of the antiaircraft artillery on D-Day, their work “was largely instrumental in our existence on Omaha Beach.”³⁰

While Mansoor is correct--the Army did assign too many men to the antiaircraft artillery—it did so for what were sound reasons at the time. When one understands the context within which the Army made its initial manpower decisions, the logic behind the decisions becomes clear. One of the major underlying themes of this volume is that defining the future condition of warfare and creating a military force to meet the needs of that future condition is a daunting and many times unsuccessful endeavor. Often a nation and its military can only hope to get its force structure about right and adjust it once the war starts. From the 1939 through the middle of World War II, the Army attempted to comprehend and react to the incredible events unfolding across the world. In Europe and the Pacific, America faced potential enemies with immense military capabilities. One of the emerging lessons the American Army drew from observations and reports in the late 1930s and early into 1940 concerned the increased efficacy of air power as a weapon of war. One lesson the American public drew from the massacre of innocent non-combatants at Guernica in 1937 during the Spanish Civil War, the bombardment of civilians in Warsaw in 1939, the attack on London during the Battle of Britain in 1940, and the Japanese attack on Nanking in 1941 was the increasing use of air power as weapon of terror. The President, Congress, and the Army all recognized the need for airplanes *and* antiaircraft artillery to protect critical American infrastructure at home and quite possibly American forces abroad. On more than one occasion, President Roosevelt asked the War Department specifically about the status of antiaircraft equipment.³¹ No matter how fanciful it may seem today, the concern in the United States about air attack

of the homeland was quite real beginning in 1940. After Pearl Harbor in December 1941, this fear grew even more, causing the Army to surround Washington, D.C. and other cities with AAA batteries. That the predictions of military planners did not come completely true and their preparations overshot exactly what the Army needed on the battlefield is understandable. The prewar theories on strategic bombing espoused by Giulio Douhet, Billy Mitchell and others also proved not entirely correct, but no one argues that there were too many airmen or airplanes in the Army Air Forces and that America would have been better served had those resources been converted to infantrymen and rifles.

To put this growing concern about air attack both at home and on deployed forces into perspective, consider that during rearmament from December 1940 to December 1943 the Army expanded significantly, enlarging the Infantry by 600 percent and the Artillery by 500 percent. Worries about air defense, however, drove the size of the antiaircraft artillery to explode exponentially. After scratching out a meager existence during the Interwar period, the antiaircraft artillery establishment grew by 1,750 percent during the same three years and would have increased to over 2,400 percent its pre-war size had the Army not adjusted its needs.³² This expansion, which highlights the nation's emphasis on hemispheric base defense as a first priority, only looks overstated in hindsight. Given the concern of the time, it seems a responsible and appropriate course of action. While it did contribute in part to the ultimate shortage of infantrymen in Europe, there were other causes as well, including a flawed personnel system.³³ To its credit, the Army recognized its mistake and adjusted accordingly. A less flexible organization may not have been as able to react. As Eisenhower stated when discussing a

devastating German air attack on the port of Bari, Italy in December 1943, which destroyed sixteen ships and some “extremely valuable cargo,” “war is always conducted in the realm of the possible and of the estimated rather than of the certainly known.”³⁴

Diversion of Resources?

The third reason given for the lack of attention paid to antiaircraft artillery in the post-war years holds that the material resources needed to provide antiaircraft equipment during World War II could have been better used to build more airplanes. This argument assumes too much, ignores the fact that the United States Army was the best equipped and supplied of all the combatants, and is not helpful in explaining the lack of historical analysis. It assumes that the United States had a material resource problem which it did not, certainly not to the extent faced by the Germans or Japanese and not to the extent that it limited production of either aircraft or antiaircraft weapons. America did have problems converting its industrial might from a peacetime to a wartime footing. Early during the transition the lack of a central controlling authority, combined with the misallocation of existing production capacity and inaccurate scheduling, limited industrial output more than any individual resource shortage.³⁵ Once the government worked through these problems, however, the American industrial colossus manufactured sufficient stocks of trucks, tanks, rifles, and rations to arm the forces of the free world.

In the end, both the Army Air Forces and the antiaircraft artillery establishment had enough equipment. From January 1940 – December 1945, the Army Air Forces took delivery of 231,099 total aircraft, including 68,712 fighters and 69,082 bombers of all types. By 7 December 1941, the United States had become the world’s leader in aircraft production.³⁶ During the same period, the Ordnance Department accepted delivery of

49,775 anti-aircraft guns of all types and 79,698 anti-aircraft machine guns. Machine gun production was one of the most successful programs of the war, largely because standardized models had been selected well before the war and a sizeable production capacity already existed. Anti-aircraft machine guns represented only a small portion of the 2,679,819 total machine guns produced. The majority of the guns (1,634,765) made went to the Army Air Forces.³⁷ Conversely, a host of problems confounded the production of artillery tubes, aircraft guns, anti-aircraft guns, and tank and anti-tank guns, most notably the lack of existing production capacity and continuing changes in design. Anti-aircraft guns, especially high altitude 90-mm guns, were the initial main priority. While problems existed in the program, they did not conflict with the production of aircraft-mounted guns, which was able to keep pace with aircraft production almost from the beginning.³⁸ In late 1940 a problem did exist with competition for machine tools among three seemingly non-competitive areas: British airplanes, Navy cruisers, and Army anti-aircraft artillery and ammunition. The requirements of all three entities placed ever-increasing demands on the hard-pressed machine tool industry whose output they needed to produce their armaments. After much discussion, President Roosevelt settled the issue in favor of the Army.³⁹

In addition to arguing that anti-aircraft production caused a diversion of critical resources away from building aircraft, this argument also wrongly assumes that one method of destroying enemy aircraft is inherently better than the other. To the contrary, from an air defense perspective, aircraft and anti-aircraft artillery represent complementary systems. One is an area system that can fly rapidly across miles of open sky searching for enemy aircraft to attack. The other is a point system that protects

critical assets the enemy is expected to bomb or strafe. One searches for the enemy, the other lies in wait. Both destroy enemy planes and kill enemy pilots. The Army realized the benefits of this division of labor early in its rearmament efforts when it sought a balanced force. In May 1940, when testifying before the Senate Appropriations Committee, General George C. Marshall responded to two senators who were concerned about air attack and trying to decide which weapon, the airplane or the antiaircraft artillery system, was preferable. According to Marshall, “The whole thing is interwoven....All these matters have to be given proper weight to get a well integrated and balanced whole.”⁴⁰

It's an “Anti”-Weapon

Perhaps the most compelling reason for the lack of attention given to antiaircraft artillery is one not discussed by Westerman or others. It concerns the “negative” nature of antiaircraft artillery. In terms of Clausewitzian theory, antiaircraft or air defense artillery is a “negative” weapon with a “passive” purpose. Its weapons are designed to *stop* aircraft that are attacking friendly forces, not to seek out and destroy the enemy. Though not true of the soldiers who man them or the tactical operations they support, antiaircraft artillery weapons connote a defensive mindset. Although Carl von Clausewitz determined that defense was the stronger form of war, no war was ever won entirely on the defense.⁴¹ In the Jacksonian tradition, “defense” is un-American.⁴² While on occasion necessary, Americans view defensive forms of war as temporary conditions. Professor Russell Weigley, in his history of American military strategy and policy, argues that based on the nation’s Civil War experience “the American Way of War” relies on the wealth of the nation, has unlimited war aims, “seeks the complete overthrow of the

enemy, the destruction of his military power,” and for most of its history is best characterized by a “strategy of annihilation.”⁴³ American warfare is *offensive* warfare that takes the fight *to the enemy* and is waged to the hilt. The only way to do that is through aggressive *attack* on the ground and in the air. Hence, defending against an air attack with antiaircraft artillery weapons may be necessary both tactically and operationally, but it will never be preferable to attacking an enemy air force in the sky or bombing an enemy’s airfields, factories, cities, or soldiers on the ground.⁴⁴ While present throughout most of American military history, this psychology, as it involved antiaircraft artillery, was evident during the Army’s planning and preparation for World War II. The Army Ground Forces history states that in 1942, Lieutenant General Lesley J. McNair, Chief of the Army Ground Forces and the man responsible for building the World War II Army, argued against strong demands by General Eisenhower and others to include antiaircraft weapons in the infantry and armored divisions. He did so primarily because filling “the division with defensive ‘*anti*’-weapons went counter to [his] desire to encourage aggressive tactics and psychology in the divisions and to avoid diversion of resources to the production of mere countermeasures.”⁴⁵ While there can be no doubt regarding the contribution of antiaircraft artillery to the American war effort, historians and their readers have preferred to write and read about airplanes and the men who flew with them, and not the efforts of the units whose mission it was to shoot them down with “*anti*”-weapons.⁴⁶

The Study of Interwar Military Organizations

Until recently, the study of Interwar military organizations has not fared much better than the study of American antiaircraft artillery. Heretofore, historians and social

scientists have focused most of their efforts on examining either the conduct of the military during a conflict or a portion of the sociology of the military profession. As Peter Paret points out, however, the "strategy and operations of any war can be understood only in the light of conditions of the ten or twenty years before its beginning."⁴⁷ The foundation of all action in war springs from the organization, technology, doctrine, training, and leadership of the force during the period preceding the first battle.

In *On War*, Clausewitz offered a more exacting dichotomy of the art of war. He saw the "activities characteristic of war...split into two main categories: those *that are merely preparations for war*, and *war proper*." For Clausewitz, focused as he was on discovering the essence of the duel that describes warfare in its basic form, the "preparations for war" involved the "creation, training and maintenance,...and organization and administration of the fighting forces." "War proper" concerned only the "use of the means, once they have been developed, for the purposes of the war."⁴⁸ If alive today and faced with the rapid pace of technical development, the increased lethality of modern weapons, the immense expansion of the battlefield, the absolute tyranny of logistics, and the deterrent value of national defense, Clausewitz might reconsider his choice of words, delete the term *merely* from his definition, and place both categories of warfare on near equal footing. For given contemporary conditions, war is no longer the refuge of the minuteman, *poilu*, or short-service conscript armed with the handcrafted, mantle-piece weapons of the past. The speed, complexity, lethality, industrialization, and cost of modern war test the validity of pre-war preparations and compel an army to adapt rapidly to new realities or suffer defeat.⁴⁹

For all of the apparent reasons to study interwar military development, historians have sometimes tended to neglect this area of military history and focused instead on military history as the history of wars. The primary cause of this neglect stems from a decision by the individual historian regarding the purpose of military history. If used to acculturate members to the military, military history tends to focus on the actions of individuals, units, branches, or services in battle. When used to teach officership, combat leadership and battle analysis are examined for timeless principles. If its purpose is to influence civilian policy makers, then history is organized often selectively in an attempt to affect decisions about force structure, materiel acquisition, and national defense. This type of work draws heavily on the history of battles and is not so much about an interwar period as it is *for* a specific interwar period. Emory Upton's *The Military Policy of the United States of America*, Alfred Thayer Mahan's *The Influence of Seapower Upon History*, and Billy Mitchell's *Winged Victory* are examples of histories written to influence civilian policy elites. Of all the uses for military history, civil utilitarian military history—often referred to as “war and society” or the “new military history”—comes closest to focusing on the periods of peace between wars as well as the wars themselves. Unless the author restricts his topic, however, the study of overall interwar development may become lost in the effort to relate the history of the primary subject.⁵⁰

Another reason that historians may shy away from writing interwar history is that it is often much more difficult to conduct adequate study of an interwar period than it is a war. The sources are more diverse and demand an interdisciplinary approach employing the history of social, technological, and institutional change as well as healthy dose of

biography, politics, and social science. This approach places greater demands on the scholar and requires a broader range of research and interpretation.⁵¹

When it does occur, the study of interwar armies appears on three distinct levels. The first level occurs in general survey works. These are works dealing largely with organizational and institutional history and by their very nature offer broad interpretations of interwar militaries. They routinely devote more print to fighting the war than to preparing for it. For this reason, general surveys may highlight key events and developments that occur during an interwar period, but they do not examine interwar issues in great detail. Some notable exceptions include: *War in the Modern World*, by Theodore Ropp; *The Pursuit of Power* by William H. McNeill; *Against All Enemies: Interpretations of American Military History from Colonial Times to the Present* edited by Kenneth Hagan and William Roberts; *History of the United States Army* by Russell Weigley; *Arms and Men: A Study in American Military History* by Walter Millis; *Semper Fidelis: The History of the United States Marine Corps* by Allan R. Millett; and *For the Common Defense: A Military History of the United States of America* by Allan R. Millett and Peter Maslowski.

The second level of analysis occurs in biographies of officers whose careers coincide with the development of their institution during one or more interwar periods. Limited somewhat to the activities of their subjects, these works give perhaps the best mixture of general interwar history and specific developmental detail. Among the best works are: Martin Blumenson, *The Patton Papers, Volume 1: 1885-1940*; D. Clayton James, *The Years of MacArthur, Volume I: 1880-1941*; Allan R. Millett, *The General: Robert L. Bullard and Officership in the United States Army, 1881-1925* and *In Many a*

Strife: General Gerald C. Thomas and the United States Marine Corps, 1917-1956; Frank Vandiver, *Black Jack: The Life and Times of John J. Pershing*; and the first two volumes of Forrest Pogue's biography of Marshall, *George C. Marshall: Education of a General, 1880-1939* and *Ordeal and Hope, 1939-1942*.

The third level of interwar history focuses on the development of specific doctrines, equipment, or military organizations. These histories offer great detail into the development of their subject, but at the occasional risk of neglecting the larger civil-military context within which their subjects develop. The best in this genre include: John Ellis, *The Social History of the Machine Gun*; David Armstrong, *Bullets and Bureaucrats: The Machine Gun and the United States Army, 1861-1916*; Tim Nenninger's four part history of "The Development of American Armor 1917-1940" in *Armor*; Mildred Gillie, *Forging the Thunderbolt: A History of the Development of the Armored Force*; James Huston, *The Sinews of War: Army Logistics, 1775-1953*; David Johnson, *Fast Tanks and Heavy Bombers*, and Maurer Maurer, *Aviation in the U.S. Army, 1919-1939*.

Of course, there are exceptions to every rule. Most notable among these exceptions are those works that focus exclusively on interwar armies. Several important works come to mind. The first is volume two of the three volume *Military Effectiveness* series edited by Allan R. Millett and Williamson Murray, which analyzes the development of all the major powers between the world wars. The second is *Military Innovation in the Interwar Period*, also edited by Allan R. Millett and Williamson Murray. Serious students of Interwar military innovation should consider this a companion volume to the *Military Effectiveness* series. The third is Robert A. Doughty's

The Seeds of Disaster: The Development of French Army Doctrine, 1919-1939. The fourth is Bruce W. Menning's *Bayonets Before Bullets: The Imperial Russian Army, 1861-1914*. The fifth is William McBride's *Technological Change and the United States Navy, 1865-1945*. Finally, there are works, like Edward M. Coffman's *The Old Army: A Portrait of the American Army in Peacetime, 1784-1898*, that are of such scope and detail that they rise above all characterization.

The Interwar Process

The study of the American Interwar Army is really a study of the interaction between the Army and society—in particular, the relationship between the War Department and Congress—and how that interaction affected the development of the Army during the Interwar period. Conceptually, the interwar process or cycle that most armies go through begins following the last battle of the previous war and ends with the first battle of the next war. It consists of five phases: demobilization, recruitment and retention, modernization, pre-war mobilization, and finally, the first battle. The attitude of society and the government toward the military determines the level of interest in military readiness and the level of defense spending throughout all phases of the interwar period. Naturally, as these levels change they have a corresponding effect on the Army's ability to meet its responsibilities. While external support and financial investment are critical, the Army must also be a learning organization, questioning its doctrine, force structure, weapons, and training and seeking to adapt to emerging trends if it is to prepare properly for its first battle. The Army's success in these interwar phases conditions its ability to excel in two additional phases that occur following the first battle: adjustment and last battle.⁵²

During demobilization, the Army historically returns most of its postwar soldiers and what equipment it deems necessary for continued operations to various outposts across the United States, leaving only a portion of its wartime force to perform occupation duty as appropriate in the enemy's territory. The tendency throughout American history has been toward rapid, if somewhat disorderly, post-war demobilization. The demobilizations after each World War offer good examples of this trend. When the war ended on November 11, 1918 there were 3,685,458 men in federal service. By 1920, the Army retained only 201,918 men in uniform, a 94% drop in strength. On 31 March 1945, the Army (excluding the Army Air Forces) strength totaled 6,326,295. By June 1947, the total was a mere 684,000, an 89% reduction in manpower.⁵³

While the Army completes demobilization soon after the last war ends, recruitment and retention continue throughout the Interwar period. The attitude of the general public toward the military, the current national economic situation, and the defense budget as it translates into salaries and incentives all affect the Army's ability to recruit new members into the ranks and retain those it has spent time and money training. In the Army, recruiting and retention suffered greatly from the national retrenchment that followed World War I. Conversely, the Great Depression was a boon to both recruiting and retention. Fewer men were leaving the Army, leaving fewer spots for recruiters to fill. Increasing unemployment, peaking at 25 percent of the work force by 1933, ensured there were plenty of applicants for each spot. Beginning in 1933, however, New Deal programs established by Franklin D. Roosevelt started to compete with the Army for men. These programs cut Army pay and created jobs at better than Army wages. The

Civilian Conservation Corps (CCC), approved by Congress in March 1933, fed and housed enrollees and paid them \$30 per month, while Army privates received only \$17.85. Ironically, the Army was responsible for the initial organization and administration of the 1,315 CCC camps. By 1936, the effects of the New Deal combined with an improving economy to hamper recruiting and retention. Only with the onset of war in Europe in 1939 and the Selective Service Act of 1940 did recruiting and retention problems end.⁵⁴

Modernization of doctrine and equipment also occurs throughout an interwar period. Equipment, particularly in times of rapid technical advancement as in the 1920s and 1930s, is heavily dependent on financial support from Congress. Conversely, doctrinal modernization is not as dependent on money as it is on forecasting the conditions under which the next war will be fought and adjusting the structure of the organization and the manner in which it fights to the perceived future conditions. For these reasons, modernization is the product of both the internal military environment and the external conditions placed on the Army. As argued throughout this study, various internal and external factors shape the process of modernization and affect the identification of operational requirements for change, the technical feasibility of the change, and the fiscal capacity to fund the change. Linked to modernization is the requirement to train the Army to use its new equipment and fight with its improved doctrine. Without adequate funding for training and maintenance, the Army quickly falls into disrepair. Thus, for a host of reasons, modernization is easily the most difficult phase of the process and the most important phase to the future battlefield success of the Army.⁵⁵

To a large extent, the success of modernization creates the conditions for the success of the pre-war mobilization and the first battle. If the hard thinking needed to define and justify the operational requirement occurs in peacetime, it makes pre-war mobilization less encumbered by hasty calculations and thus, more purposeful. In essence, the more thinking about future warfare that occurs before mobilization begins, the less confused the mobilization. Perhaps the best example of a lack of forethought in peacetime and subsequent confusion during mobilization occurred during the Army's build-up for the Spanish-American War in 1898. In that war, personnel mobilization occurred at a much faster and larger rate than pre-war planners expected. The speed of personnel mobilization far outstripped the ability of the existing arsenals and factories to supply the growing force. As a result of the mobilization debacle, the Army instituted reforms under Secretary of War Elihu Root that reduced the chances of the confusion experienced in 1898.

During the period between the World Wars, the War Department General Staff developed several personnel mobilization plans for wartime contingencies. None of the plans, however, anticipated the 3500 percent increase in personnel that occurred during the eventual mobilization. Industrial planning occurred under the auspices of the Office of the Assistant Secretary of War, but lost most of its vitality to a President careful to avoid any unnecessary over-centralization of power below his level. This limited effectiveness, combined with a dramatic change in the technology of war and the impact of Roosevelt's Lend Lease Program, created a huge gap between the type and quantity of war materiel needed and what industry was willing and able to produce. While equipment was still a problem, the Army between 1939-1941 at least had the opportunity

to reorganize and test portions of its fighting doctrine under the guise of the Protective Mobilization Plan and the Louisiana Maneuvers. These activities enabled the Army to codify its mobilization and training policies, begin construction of production facilities that led to an extremely well supported Army, and educate a generation of future senior World War II leaders. Despite these advances, time was short and the lag in industrial mobilization contributed to the American Army's failures in the early stages of the war.⁵⁶

A first battle, as defined by the U.S. Army Combat Studies Institute in 1986, is quite simply the first combat experience of the Army following a period of peace.⁵⁷ It is not normally a battle between equal forces. Usually one side is qualitatively or quantitatively better than the other. In the case of the American Army's first battle at Kasserine Pass in early 1943, the German Army not only had a better doctrine for air-ground coordination, but it outclassed the American Army in equipment, manpower, and training. Perhaps most importantly, Kasserine Pass was not the German Army's first battle.⁵⁸

In addition to facilitating pre-war mobilization and improving the prospect for victory during the initial battle, the success of Interwar modernization contributes immeasurably to an army's ability to adjust to the results of its first battle. More specifically, the intellectual mobilization of the officer corps that accompanies the debate over the future vision of the army fosters the honesty and mental agility necessary for an army to discern the causes of success or failure and change its methods and doctrine accordingly. Interestingly, successful armies adjust to changing circumstances regardless of the outcome of their first battle. In other words, armies that are victorious in their first battle are often as ruthless in self-criticism as are those who lose their opening

engagements. The German Army followed its victory in Poland in 1939 with a period of exacting self-examination. It used its experience and combat after action reports not to justify existing doctrine, but to "improve doctrine and military standards throughout the army."⁵⁹ This effort helped produce an ignominious defeat for France and a resounding victory for Germany in 1940. Similarly, the American Army was quick to learn from its mistakes at Kasserine Pass and elsewhere. It demoted poor leaders, elevated effective ones, and corrected its doctrine where needed. Unfortunately, personnel and force structure decisions made early in the war limited the Army's ability to attain tactical superiority over the Germans. In the Pacific, where Army and Marine units had time between amphibious assaults to retrain troops and correct tactical deficiencies, military effectiveness improved greatly.⁶⁰

To paraphrase from Correlli Barnett's *The Swordbearers*, the last battle is the great auditor of armies.⁶¹ Conceptually, the last battle tests whether an army has the physical, intellectual, and psychological wherewithal to adjust to the conditions of its first battle, correct the asymmetry that previously existed between forces, and eventually defeat the enemy. Success or failure in the last battle indicates the degree to which an army comprehends the conditions of the first battle; can adapt its doctrine, equipment, and training to the new conditions; and achieve success on the battlefield. In the case of the French Army, the first and last battles occurred almost simultaneously. Although it is doubtful that a mechanism existed in the French Army to implement rapid doctrinal change, the speed of its collapse did not allow for any period of adjustment and correction. Conversely, the German Army demonstrated a remarkable ability to adapt tactically, but abdicated its strategic and operational direction to Hitler. The Army's

deference to Hitler prevented it from adjusting to the war's changing conditions and standing any realistic chance of defeating the Allies. Not surprisingly, the Russian and American armies fared much better. The Russian Army traded space for time in 1941, modified the way it fought, and destroyed the Germans on the Eastern Front. Similarly, the American Army accepted the bloody nose it received at Kasserine Pass, altered the way it fought, introduced new weapons, and, with the hearty assistance of the British and Russians, defeated the Germans and the Japanese.⁶²

An Organizational, Social, and Technological Riddle

This history of the U.S. Army's process of Interwar change and specifically the emergence and integration of the antiaircraft artillery organization as an appropriate and useful addition to the force is a complex tale. It is as much an organizational history as it is a social and technological history, describing the way a very hierarchical organization adapted or failed to adapt to the social forces and new technologies that emerged between World War I and World War II and reshaped its mission. It begins in Part One with an examination of the process of change as it applies to military organizations and offers some insight as to how successful innovation occurs. Only students at War Colleges and others who study war from afar, however, possess the luxury of theory. Others closer to the point of the spear bear the duty of decision-making and are more interested in the theory's practical application. Therefore, in Part Two this study traces the birth of antiaircraft artillery in the United States Army during World War I and follows the antiaircraft establishment through the 1920s and 1930s as it sought to grow into a full-fledged member of the combined arms team. It then analyzes the Army's development of Continental and Hemispheric Defense and its preparedness to defend the Panama

Canal—an area declared before the war to be one of the “most strategic” locations outside the United States—Hawaii, and the Philippines from air attack as well as fight a mobile war against the Germans in North Africa. This study concludes with an examination of the antiaircraft establishment’s ability to learn from its first battles, make the necessary institutional, technical, and tactical adjustments, and succeed in its “last” battles in Europe and the Pacific.

On one level, this work is a history of the Army’s antiaircraft artillery organization, how it responded to advances in air power during the Interwar period, and how successful it was in shooting down airplanes and missiles in World War II. While interesting, important, and essential to filling the gap of historical knowledge on that subject, there is more to the story. Any history purporting to examine the process of change must first define it. That is no easy task. On a second, deeper level, this work is a history of the multidimensional change of an emerging subordinate element (the antiaircraft artillery) of an organization (the coast artillery) contained within a larger institution (the United States Army) that was itself undergoing rapid and diverse change. This history of the U.S. Army antiaircraft artillery establishment is, to paraphrase Winston Churchill’s 1939 statement regarding Soviet actions in Poland, much like “a riddle wrapped in a mystery inside an enigma....” But, as Churchill continued, “...perhaps there is a key.”⁶³ The key to this riddle is to understand the anatomy of change and how military organizations react to change, using the development of the Army’s antiaircraft artillery establishment as a guide.

PART ONE

THEORY

CHAPTER 2

THE ANATOMY OF CHANGE

Terms of Reference

Military modernization is an oft invoked, but ill-understood phrase. Before beginning down the complex path to understanding the nature of change, it is important to establish some terms of reference. Within the context of this analysis, the terms innovation, modernization, and reform are synonymous. Each connotes an action that represents a new and improved method or procedure for doing business as related to the mission, implies a major change and clear break with the practices of the past, is acceptable to at least part of an organization, and is valued by someone outside the organization. To avoid confusion, when used in a military context these terms characterize actions that result in one or more of the following: a change in the way an arm of the service fights; the creation of a new arm; a change in relative worth between arms of a service; the reduction or disuse of an older concept or formerly dominant weapon, or the addition of a new weapon.¹ The doctrinal and organizational changes necessitated by the inclusion of antiaircraft artillery weapons in Coast Artillery units, the creation of the Air Corps, the emergence of armored warfare, the demise of horse cavalry, and the addition of the tank and airplane are all examples of military innovation. For the purpose of this analysis, the terms military innovation, modernization, and reform do not refer to smaller changes in organizations or weapons such as the addition of a man

to an infantry squad or a new telescope to a rifle. These represent smaller evolutionary changes that are often imperceptible to others in the organization and normally do not run counter to the institutional status quo.

Peacetime Modernization, Innovation, and Reform

At its most basic level, the effectiveness of peacetime modernization is central to the future success of the military in battle. Battles are won or lost, soldiers live or die, in part, based on how well the military learns from its past wars and prepares for its next conflict. Understanding the anatomy and process of peacetime change is critical to implementing successful modernization in the military. Without mastering this process, efforts at modernization, innovation, and reform will often go awry. Knowledge of this process is also essential to understanding the struggle for legitimacy faced by the antiaircraft artillery establishment as it sought to emerge from the shadow of the Coast Artillery Corps following World War I. As theory informs practice, so too does the past inform the present.

Unfortunately for those seeking to effect change, achieving military innovation is never easy and never cheap. Military organizations are normally quite resistant to change the way they operate. For a number of complex reasons, as Eliot A. Cohen and John Gooch note in *Military Misfortunes*, militaries have failed on occasion to anticipate, learn, and adapt to changes in the conduct of warfare.² Indeed, as Allan R. Millett highlights, prior to World War II all of the major naval powers had incorporated aviation platforms into their war plans with Japan, Britain and the United States already possessing aircraft carriers. Moreover, all of the seven major powers (Germany, Italy, Japan, Britain, France, the Soviet Union, and the United States) had trucks and tanks of

various capabilities in their inventories in differing organizations. All these nations were on the verge of breakthroughs in military effectiveness, but only a few got it right when they were employed against an enemy.³ The experience of these nations causes the military practitioner and the civilian analyst to wonder, if winning the next war is better than losing it, if the stakes are indeed so high, then why is it so hard for nations and their military and civilian leaders to comprehend the changing conduct of warfare and implement actions to prepare their force to prevail when the next cannon sounds?

The answer to such a question is complex. To begin with, analyzing the past and predicting the future of military conflict is much more of an art than it is a science. The fog and friction of war, the impact of loss and suffering, the psychology of the time, and the lingering emotions and misperceptions about the war continue to resonate decades after the fighting has stopped. These circumstances combine to cloud the ability of the historian and the military analyst to divine exactly what happened during the war and what it means for the future. With few exceptions, it has taken military experts almost seventy years to begin to discern the complexities and dynamics that befuddled the warring armies on the Western Front in World War I.⁴ More recently, America's war in Vietnam has received a great deal of attention, particularly at the political and strategic level, but arguments still exist as to whether the United States could have actually won the war and the peace that followed at an acceptable cost.⁵

Even when general agreement exists on the lessons of past conflicts, attempts at innovation and change often run afoul of bureaucratic prerogatives both inside and out of the military. Two types of factors inhibit change—external and internal. External factors that impede change are derived from a complex set of interrelated strategic determinants

that include geography, threat perception, history, ideology, culture, and economics. These determinants all affect the level of popular and political support given to the military as represented by the nation's willingness to pay for and employ its armed forces. Historically, most modernization efforts cost more than a peacetime society has deemed appropriate to spend when not threatened or aroused to some passionate cause. This penurious predicament has forced decision makers inside the military to choose between dedicating funds to maintain current readiness or proceeding with plans to modernize the force for the future.

The internal factors affecting the ability of the military to change are equally complex. They include aspects of historical experience, a conservative outlook toward change, an inability to evaluate adequately new ideas, an acute awareness of the tremendous cost of defeat, and a desire by some within the organization to preserve the status quo for fear of losing either personal or professional power and prestige within the organization. At times, any combination of these factors may prevent meaningful change from occurring in a military organization in time to prepare the force to win the next war.

Finally, even after navigating through the shoals and sandbars of professional, political, and popular opinion, the possibility exists that the proponents of reform are all wet. As in the case of the French Army prior to World War II, occasionally those advocating reform misdiagnose the conditions of the next war and prescribe changes to force structure, doctrine, and equipment that exacerbate the potential for future asymmetry between forces.

This chapter establishes the intellectual foundation for the examination of change in the military and for understanding the development of antiaircraft artillery in the

United States Army during the Interwar period. It creates a complex model for understanding how change has occurred in the past, what innovations were attempted, and why they did or did not succeed. It begins with a discussion of the Hegelian dialectic—thesis, antithesis, and synthesis--as a model to analyze and even predict change. This discussion is followed by an explanation of the related concepts of “military revolution” and “revolution in military affairs” as well as an examination of “revolutionary” and “evolutionary change.” After providing a framework for comprehending the scope and speed with which change may occur, this chapter then analyzes how “revolutions in science” happen as a way to discern further the process by which organizations and individuals recognize problems and find solutions. These concepts form the theoretical structure guiding how large organizations recognize and accept change. The model employs the theory of punctuated equilibrium to draw all the earlier concepts together and establishes the relationship between technical, operational, and technological innovation. To flesh out this skeletal conceptual structure, the chapter concludes by highlighting how the growth and development of antiaircraft artillery during the Interwar period fits this model.

For those readers interested in developing their own conceptual framework for understanding how and why changes occur within military organizations, this chapter provides good intellectual fodder. Those readers more interested in the history of the Interwar period and who long for the whirl of propellers, the grinding of tank treads, and the smell of cordite will have to wait a few pages. For members of both groups, what is important about this chapter and important for a general understanding of innovation and change in the military is that each must construct his or her own concept of the patterns

that exist in warfare and how they mutate and change over time. To understand the continuous change that occurs in the conduct of warfare one must develop skills at pattern recognition and trend analysis. To borrow a term from Clausewitz, the reader and student of change must develop *coup d'oeil* or the inward eye capable of “quick recognition of a truth that the mind would ordinarily miss or would perceive only after long study and reflection.”⁶ Clausewitz used the term with reference to the elements of time and space as they applied to tactics and strategy, but an insightful student can apply it to understanding how change takes place as well. As Clausewitz remarked:

What this task requires in the way of higher intellectual gifts is a sense of unity and a power of judgment raised to a marvelous pitch of vision, which easily grasps and dismisses a thousand remote possibilities which an ordinary mind would labor to identify and wear itself out in so doing.⁷

In sum, this chapter provides the reader with concepts with which to develop the necessary “power of judgment” to begin to understand the patterns of change and innovation in military history and the history of the Interwar period. After a period of reflection, one might hope that the student of military innovation could look at the tableau of history and see patterns emerge just as the infantryman can look at a flat map and discern the flow of the terrain over which he will one day fight.

A Theoretical Framework for Understanding Change

In a general sense, any changes that occur in doctrine, technology, and force structure during an interwar period are driven by a desire on the part of the military to perfect its ability to defend the nation and defeat the enemy on the next battlefield. Unfortunately, warfare is not a one-sided affair, but as Clausewitz remarked, “the collision of two living forces.”⁸ This competition increases the difficulty of correctly

identifying future operational requirements on which to base changes in military doctrine, technology, or organization. Hardly ever does the enemy conform to the friendly plan or sit idly by while one side enhances its capability to defeat the other. On the contrary, military innovation in both peace and war resembles a tennis match where the opponents engage in a deadly game of serve and volley, each side seeking to overpower the other through a series of technological, doctrinal, and organizational actions and reactions.

Within the realm of science, Isaac Newton defined this phenomenon in his third law of motion: "every action has an equal and opposite reaction." Philosopher Georg Wilhelm Friedrich Hegel expressed it in terms of the action-reaction dialectic, thesis acted upon by antithesis and resulting in synthesis. In war and on the field of battle, Clausewitz classified this process as an activity directed "against a living and reacting force."⁹ The confluence of these descriptions yields a process where each action--be it a technical advancement, doctrinal adaptation, or contextual change--causes a reaction. The reaction then becomes the catalyst for another reaction. This dialectic continues unabated until friction (both Clausewitzian and scientific) retards the action-reaction cycle and eventually wears the forces down until motion ceases, ideas and technology cannot progress any further, or one side defeats the other.

While the development of nuclear weapons and nuclear strategy during the Cold War is perhaps the most technologically deterministic manifestation of this phenomenon, important social and political dimensions also influence the development of weapons, doctrine, and organizations. This dialectic relationship between thesis, antithesis, and synthesis (or action, reaction, and counter-reaction) has been a recurrent theme throughout the history of warfare.¹⁰ Several notable historical works--including *From*

Crossbow to H-Bomb by Bernard and Fawn Brodie; *Technology and War* by Martin van Creveld; *Of Arms and Men* by Robert O'Connell; *The Pursuit of Power*, by William H. McNeill; *Guns, Sails, and Empires* by Carlo Cipolla; *Gunpowder and Galleys* by John F. Guilmartin; and *Technological Change and the United States Navy, 1865-1945* by William McBride--discuss various aspects of this ongoing relationship.

Military Revolutions and Revolutions in Military Affairs

Almost as a subset of this dialectic process, some scholars contend that certain changes in warfare are so dramatic from one period to the next as to constitute a "military revolution." The concept of a "military revolution" first appeared in 1955 during a lecture by historian Michael Roberts on the impact of the military reforms of Swedish King Gustavus Adolphus on seventeenth century warfare. Roberts' ideas went relatively unchallenged until 1976 when another historian of the Early Modern period, Geoffrey Parker, questioned several aspects of his thesis.¹¹ Since then several books and articles have used this concept to explain the dialectic character of warfare during several periods of history. Of these, the most noteworthy works are: Geoffrey Parker, *The Military Revolution: Military Innovation and the Rise of the West, 1500-1800*; Jeremy Black, *A Military Revolution? Military Change and European Society, 1550-1800*; Andrew F. Krepinevich, "Cavalry to Computer: The Pattern of Military Revolutions," and Clifford J. Rogers, "The Military Revolutions of the Hundred Years War" and *The Military Revolution Debate, Readings on the Military Transformation of Early Modern Europe*.¹²

In his classic *The Anatomy of Revolution*, however, Crane Brinton notes that revolution "is one of the looser words."¹³ Like earlier references to innovation, modernization, and reform, the term "revolution" has been employed by many, but

understood by few. Brinton, who analyzed the British, American, French, and Russian revolutions, opts for a definition rooted in a drastic, sudden, and violent substitution of one group for another--a fundamental and dramatic governmental, economic, or societal change obtained through the use of power and usually violence. While causing dramatic and fundamental changes in the structure and employment of armed forces, military revolutions, however, are rarely violent when they are undertaken within a nation's own military. They only become violent when employed against an unprepared foe.¹⁴

One may also question whether revolutions are truly sudden. History has shown that some changes can take years, decades, or even centuries to occur. Indeed, the underlying conditions that spawn revolutions, be they social, technological, political or economic, often exist for long periods of time. Brinton borrows from medical science, specifically the outline of a "fever chart," to underscore this concept. He contends that signs of the coming disturbance occur in the generation or two before the outbreak of revolution. These signs are not quite symptoms, as those would indicate the presence of a disease for which others would have to notice and take action. He describes these early signals as "*prodromal*" signs, "indications to the very keen diagnostician" that a disease is on the way. Once fully developed, these signs become symptoms and a "fever of revolution" begins. This development occurs not in an orderly fashion, but with fits and starts until a "crisis" occurs. Following the crisis is a period of convalescence marked by occasional relapses. Finally, the "fever" is over and the patient is well again, perhaps even strengthened or immunized by the experience, but "certainly not wholly made over into a new man."¹⁵ Concerning societal revolution, Brinton contends that as societies undergo the full cycle of revolution as he describes it they may emerge stronger, but are

often not remade. Nor are they immune from another subsequent revolution. In other words, the process—the dialectic—continues.¹⁶

Finally, one may even question whether “revolution” is the appropriate term to describe at least some of the changes that do occur over time in the conduct of warfare. Allan R. Millett, one of the foremost scholars of military innovation, considers it “reckless” to make “absolute claims for special periods of military innovation....” Millett points out that the “Military Revolution of Sixteenth Century” now “covers enough centuries to qualify as several revolutions.”¹⁷ As such, it is not the purpose of this chapter to discern if the term “military revolution” or the related phrase “revolution in military affairs” is a correct label for the manifold changes that all agree have occurred throughout the history of warfare. This study of innovation employs these terms and concepts only to identify initial intellectual patterns from which the reader is free to deviate and roam.

One certainty exists, however. Unlike the dialectic, which Hegel defined over a century ago, the term “military revolution” or its conceptual cousin, “revolution in military affairs” has been variously defined, depending on who one reads. The term “military revolution” draws its pedigree from Roberts’ 1955 essay, but quickly shifted from an academic phrase to one employed by military theorists more focused on its conceptual utility to the military than on its historical applications. In the 1970s and 1980s, Soviet Marshal Nikolai V. Ogarkov, Chief of the Soviet General Staff from 1977-1984, published a series of papers analyzing the revolutionary potential of new military technologies. American defense analysts, more comfortable with scientific revolutions than the theories of Hegel and Marx, also focused initially on technology, specifically the

concept of a “military technical revolution,” but soon found that idea too limiting. What evolved was a more holistic, complete concept of a “revolution in military affairs.”¹⁸

While these conceptual cousins – “military revolution” and “revolution in military affairs” -- may be related, they do not have the same meaning. Scholars and analysts often view them as synonymous when, in fact, they are not. Military revolutions are more inclusive and encompassing, invoke a greater array of change, and are less mediated by human intervention than revolutions in military affairs. Conversely, revolutions in military affairs, while offering profound change, are less broad, more cyclic, and more open to the vicissitudes of organizational politics and decision-making.¹⁹ Indeed, one or more revolutions in military affairs may occur within an ongoing military revolution. Using these terms interchangeably blurs important distinctions, confuses dialog and debate on the direction of change, and creates divergence of purpose along the path to discerning and implementing meaningful change in military institutions.

The most perceptive definition of military revolution comes not from theorists, but from historians Williamson Murray and MacGregor Knox, who analyzed the major periods of change over the last seven hundred years in rigorous detail. They contend that military revolutions bring “fundamental changes to the framework of war . . . recasting society and the state as well as military organizations.”²⁰ Military revolutions are often “uncontrollable, unpredictable, and unforeseeable” and bring “systemic changes in politics and society.” While not inevitable, the effects of military revolutions are additive. Nations that skipped or “missed earlier revolutions cannot easily leap-frog to success in war by adopting the trappings” of a previous revolution. Murray and Knox

liken these military revolutions to earthquakes. As such, they bring with them significant seismic changes to the existing structure. During these periods of upheaval, military organizations and the societies and governments they serve can at best hang on and hope to survive.²¹

Murray and Knox delineate five military revolutions in Western history. The first military revolution occurred in the Seventeenth Century along with the creation of the modern nation-state, which brought with it the large-scale organization of disciplined military power. The second was the French Revolution of the late Eighteenth Century, which merged mass politics and warfare. The third was the Industrial Revolution beginning in the late Eighteenth Century, which made it possible to equip, supply, and pay the masses created by the French Revolution and move them quickly to the battlefield. The fourth revolution came during and as a result of the First World War. It built on the French and Industrial Revolutions and set the pattern for war in the Twentieth Century. The fifth military revolution came with the advent of nuclear weapons, which kept the Cold War between the nuclear powers and their allies *cold* despite earlier indications to the contrary.²²

Within the span of a military revolution, one or several lesser expansive revolutions in military affairs may occur. Even that term, however, has been defined and refined over much of the late Twentieth Century.²³ The two most useful definitions come from author and noted military analyst, Andrew Krepinevich, and Andrew Marshall, Director of the Pentagon's Office of Net Assessment.²⁴ Krepinevich argues that a revolution in military affairs occurs when

... the application of new technologies into a significant number of military systems combines with innovative operational concepts and

organizational adaptations in a way that fundamentally alters the character and conduct of conflict. It does so by producing a dramatic increase—often an order of magnitude or greater—in the combat potential and military effectiveness of armed forces.²⁵

Marshall adds depth, breadth, and context to that definition and demonstrates a degree of correlation with Brinton’s concept of underlying conditions. In testimony before the Senate Armed Services Committee Acquisition and Technology Subcommittee in 1995, he offered the following analysis:

The term “revolution” is not meant to insist that change will be rapid – indeed past revolutions have unfolded over a period of decades – but only that the change will be profound, that the new methods of warfare will be far more powerful than the old. Innovations in technology make a military revolution possible, but the revolution itself takes place only when new concepts of operations develop and, in many cases, new military organizations are created. Making these organizational and doctrinal changes is a long process.²⁶

In sum, revolutions in military affairs occur when military organizations capture the essence of changes in the political and social fabric and technology of their time and create new, innovative conceptual approaches to warfare that integrate tactical, doctrinal, organizational, and technical advances. These conceptual approaches require time. They should follow the direction set by national strategy and policy and occur most frequently and profitably in cultures free from dogma and open to experimentation. Finally, these revolutions in military affairs ride the wave of previous and current military revolutions to produce military organizations with a vastly improved capability to wage war.²⁷ To continue the previous metaphor, if military revolutions are earthquakes of sufficient magnitude to wreck existing structures, then revolutions in military affairs are aftershocks strong enough to rearrange the furniture and shatter the china.

Bringing the two concepts – military revolutions and revolutions in military affairs – together helps highlight a pattern of change in the military and brings order to the discussion of innovation, modernization, and reform. For without an adequate understanding of the conceptual foundation for the nature of change in past military organizations, all discussion concerning the future direction of change risks failure. The table below outlines the five military revolutions and their associated and resultant revolutions in military affairs as determined by Murray and Knox.

Military Revolutions and their Revolutions in Military Affairs (RMAs)

Anticipatory RMAs of the Middle Ages and early modern era

- longbow, offensive-defensive strategy, gunpowder, new fortress architecture

Military Revolution #1: *the seventeenth-century creation of the modern state and of modern military institutions*

Associated and resultant RMAs:

- Dutch and Swedish tactical reforms, French tactical and organizational reforms, naval revolution, Britain's financial revolution
- French military reforms following the Seven Years' War

Military Revolutions #2 and #3: *the French and Industrial Revolutions*

Associated and resultant RMAs:

- national political and economic mobilization, Napoleonic warfare (battlefield annihilation of opponents)
- financial and economic power based on industrialization (Britain)
- technological revolution in land warfare and transport (telegraph, railroads, steamships, quick-firing smokeless powder, small arms and artillery, automatic weapons)
- the Fisher revolution in naval warfare: the all-big-gun battleship and battlefleet (1905-1914)

Military Revolution #4: *the First World War irrevocably combines its three predecessors*

Associated and resultant RMAs:

- combined-arms tactics and operations, Blitzkrieg operations, strategic bombing, carrier warfare, submarine warfare, amphibious warfare, radar, and signals intelligence

Military Revolution #5: *nuclear weapons and ballistic missile delivery systems*

Associated and resultant RMAs:

- precision reconnaissance and strike, stealth, computerization and computer networking of command and control, massively increased lethality of "conventional" munitions

Source: Williamson Murray and MacGregor Knox, "Thinking about Revolutions in Warfare," in MacGregor Knox and Williamson Murray eds. *The Dynamics of Military Revolution 1300-2050*, (Cambridge, UK: Cambridge University Press, 2001), 13.

Table 2.1 – Military Revolutions and their Revolutions in Military Affairs

Much of the current debate within the American defense establishment concerns the military potential of an “information revolution” and how best to organize and equip the American armed forces to take advantage of this revolution in military affairs. Perhaps the more appropriate question is whether the world is in the midst of another larger, more encompassing military revolution, which will reorder the existing context of warfare. “Globalization” with its far reaching and deeply pervasive ability to affect societies around the world may be such a phenomenon.²⁸ Information “globalization”, riding on the power of the microprocessor, has created zones of technological and social progress as well as provided previously isolated, mass societies with the ability to see and communicate beyond their borders. In a positive sense, it has opened markets and enriched mankind. In a negative sense, “globalization” has enabled the post-colonial era “revolutions of rising expectations” so prevalent in the 1960s and 1970s to become more than merely localized civil wars or tribal conflicts. “Globalization” permits the easy migration of ideas and ideologies, problems and plagues, back and forth from the Third World to the First World. From a Western or developed point of view, it has made the problems of the Third World “ours” to solve. If “globalization” is the sixth military revolution, then it falls to the American civilian and military leadership to determine what resultant revolutions in military affairs will emerge from this upheaval. Certainly, an “information revolution” will be one of the RMAs to emerge from “globalization.” While much work is ongoing, its exact form and how it evolves into battlefield effectiveness is unknown.²⁹ There will be other RMAs to emerge, which are currently unforeseen. The lack of a peer competitor able to challenge America’s conventional military capability will no doubt drive enemies to look for asymmetrical and idiosyncratic

ways to combat her power. The globalization of terrorism is the first sign of this phenomenon occurring. How the United States redefines and redesigns its military force to defeat this enemy may result in another revolution in military affairs. How long it takes or how pervasive its impact on the conduct of warfare in the future remains to be seen.

In war, Clausewitz warned that “the first, the supreme, the most far-reaching act of judgment that a statesman and commander have to make is to ... establish the kind of war on which they are embarking, neither mistaking it for, nor trying to turn it into, something that is alien to its nature.”³⁰ The same must be said for discerning the future condition of battle and being intellectually alert and bureaucratically savvy enough to change one’s military organization to take advantage of what the future holds. To use a tactical military metaphor, navigating over difficult terrain or the open sea is hard enough for the soldier or sailor who knows the ultimate destination. Navigating without a known start point to advance from, however, is nearly impossible. A soldier or sailor who doesn’t know the starting location or the final destination is directionless and liable to end up anywhere.

Recognition and Acceptance

The concepts of the dialectic and military revolution/revolution in military affairs are central to understanding change within the continuum of history. They provide the broad background, the philosophical underpinning, and the historical periodization for past changes. These concepts inform *what* happened, but do not provide an explanation as to the process of effecting change or *why* some military organizations seize upon opportunities to improve their warfighting capability, while others reject efforts at

peacetime modernization. Assuming that a change does occur to alter the way wars are fought--the development of rifled weapons or the emergence of the airplane are two technical examples--the issue then becomes one of recognition and acceptance. If a military organization identifies the nature of the change, then it must decide if adopting elements of the new way of warfare will improve its military effectiveness. Often, however, military organizations neither perceive the nature of the change nor accept the need to change despite ample evidence to the contrary. If a change in warfare does occur, but goes unnoticed by the organization, then the chances are strong that the organization will not undertake any meaningful modernization prior to the next war starting. A similar outcome may result if the military or the government recognizes that a change has occurred, but chooses for whatever reason--political, bureaucratic, or economic--not to pursue it. The danger, of course, is that an adversary may recognize and accept the change in warfare, modify its existing military organization, and capitalize on this new way of fighting when the next war starts.

Revolutions in Science

An analysis of the nature of revolutions in scientific thought may help explain why some military organizations fail to recognize or subsequently accept changes in the conduct of warfare. While the environments within which scientific and military thought operate vary dramatically, an examination of the progression of revolutions in science offers a worthwhile starting point for further discussion concerning the process of military innovation. Thomas S. Kuhn and I. Bernard Cohen propose two models of scientific revolution that mirror the dialectical nature of warfare and highlight how the scientific community recognizes and adapts to changing conditions.

Kuhn, in his seminal work, *The Structure of Scientific Revolutions*, used the term "paradigm shift" to characterize what historians and experts on military affairs have labeled a revolution in military affairs. According to Kuhn, paradigms are the "entire constellation of beliefs, values, techniques and so on shared by members of a given community." Kuhn contends that a paradigm represents a set of "concrete puzzle solutions" which the associated community employs as "models or examples" to "replace explicit rules as a basis for solutions of the remaining puzzles of normal science."³¹ Refining Kuhn's somewhat obtuse definition, military historian and theorist James J. Schneider suggests that a paradigm is simply a set of "shared professional beliefs that aid in the solution of problems and, therefore, guide action."³² Stated another way, a paradigm is a bounded domain of thought and behavior related empirically to solving a set of recurring human, communal problems.³³

As Schneider explains in *The Structure of Strategic Revolution*, however, a paradigm is not a theory, but a conceptual framework around which scientists of all types organize the data from their experiments and observations.³⁴ "A theory is a coherent statement about reality. Theories rely on the content and structure of paradigms." Theories provide scientists with a "reliable blueprint of reality" to guide engagement with it. "When theories no longer accord with reality," a "paradigm shift" has occurred.³⁵ A truly valid theory is timeless and expansive enough to accommodate changes in the underlying reality. It provides the framework for a coherent critique of its associated discipline. Finally, it offers a "guiding vision to change reality to the advantage of the ... practitioner."³⁶

In military affairs, Kuhn's concept of paradigm equates to military doctrine and its associated ability to provide organization and method for units and weapons in battle. Among its many functions, military doctrine provides a guide for actions on the battlefield. It facilitates communication between officers, defines terms, and provides concepts that enable the various branches and military services to employ their martial instruments and to act in concert. Given this definition it is not surprising that the French Army during the Interwar period used the term "harmony" to explain the purpose of its doctrine. As Robert Doughty writes:

the analogy of harmony within an orchestra seems particularly appropriate. In the symphonic form, it represents everyone playing his instrument differently but still following the directions of the conductor.... Without the direction of the conductor, without the unity of doctrine, the variety of instruments being played differently can only result in a harsh cacophony of noise.³⁷

Doctrine, as published in field manuals and training circulars, is not considered a *vade mecum* requiring strict adherence and forbidding initiative or individual thought. On the contrary, doctrine constitutes the common conceptual framework and language by which an army conducts warfare. It provides the broad guidelines within which the individual initiative and intellect of the soldier are free to operate. Finally, doctrine establishes the foundation and functional criteria for the design of weapon systems and military organizations. Thus, given its impact on military affairs, one can see that a change in doctrine amounts to a shift in the military paradigm.

Although Kuhn wrote *The Structure of Scientific Revolutions* to educate scientists about the history of scientific discovery, his four-stage model of scientific revolution--Crisis, Adaptation, Solution, and Instability--is an excellent point of departure for further

examination of the theoretical nature of change in military organizations.³⁸ According to Kuhn, the process of change begins when the underlying reality no longer agrees with the conceptual paradigm. At the point where old methods and doctrine fail to explain current observations and experiences, a paradigm crisis occurs. As anomalies arise to question the acceptability of the current paradigm, scientists increasingly recognize the paradigm crisis and seek new ways to adapt their model to the new data. Once they arrive at a solution, the scientists employ the new paradigm as a guide for solving other problems. For a while, stability returns to their scientific world. Like Hegel's dialectic, however, new anomalies eventually occur to call the established model into question. These new anomalies create instability, a subsequent crisis, and the reinitiating of Kuhn's cycle.³⁹ To a great degree, Kuhn's model is similar to Brinton's "fever" concept except that Brinton includes a "*prodromal*" or premonitory phase where warning signs or symptoms precede the crisis stage. A revised cycle of change incorporating the expectation of anomalies-- call it the Kuhn-Brinton model--is as follows: Symptomization-Crisis-Adaptation-Solution-Instability.

Finally, a subset of the Solution phase, unidentified by Kuhn, exists involving the "diffusion" of the "solution" throughout the community where the "crisis" has occurred. Innovation or "adaptation" provides a new method to resolve the "crisis." Formalizing the "adaptation" into a "solution" represents the institutional acceptance of the "adaptation" as the bonafide corrective or the new "best practice." "Diffusion" represents the spread of the new "best practice" throughout the force until it becomes the "average practice." In the military, the proliferation of a new fighting technique or doctrine, perhaps slightly modified from the textbook answer to meet the differing

realities of each combat environment, is one example of the diffusion of a “best practice” solution into an “average practice.” This migration from “adaptation” to “solution” and from identification of the “best practice” to employment of the more common “average practice” is a subtle, but important difference.⁴⁰

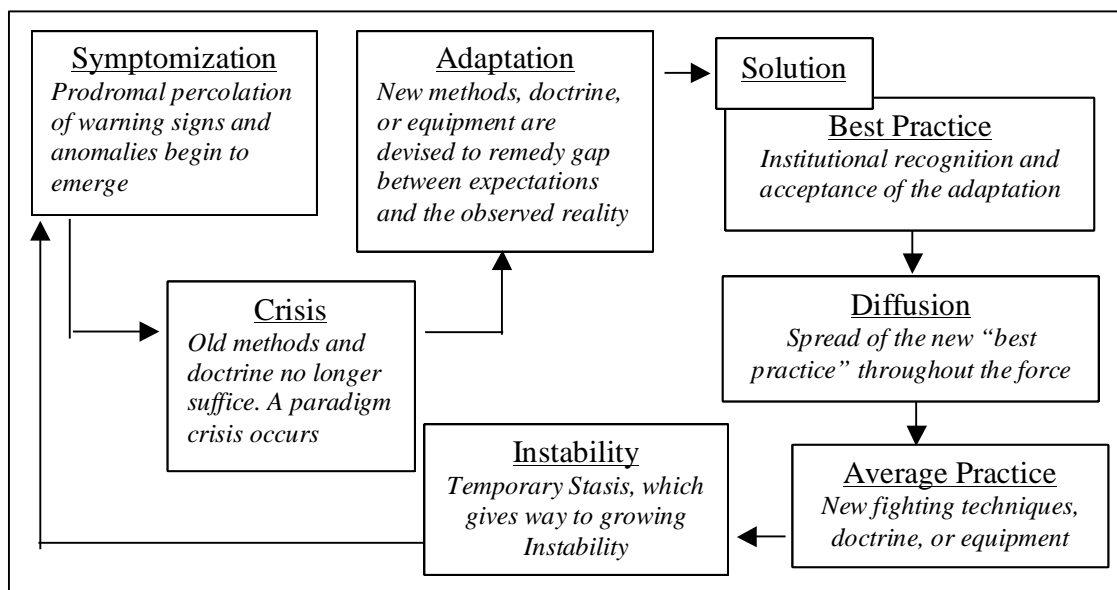


Figure 2.1 Kuhn – Brinton Model (adapted to include Diffusion)

In his 1985 work, *Revolution in Science*, I. Bernard Cohen offered a four-stage progression for revolutions in scientific thought that complements the Crisis-Adaptation-Solution phases of the Kuhn-Brinton model. The first stage involves an "intellectual revolution" or "revolution-in-itself." This “intellectual revolution” occurs when a scientist develops a radical solution to a major problem, introduces a new method or framework for using information that leads to unexpected predictions, or proposes a theory or set of concepts that changes the character of existing relationships.⁴¹

In the second stage, the scientist affirms his or her commitment to the revolutionary idea by recording key observations in a diary, notebook, letter, report, or a draft of an article for publication. This action denotes privately an individual break with the old paradigm and a point of no return for the researcher.⁴² The third stage, a "revolution on paper," moves the personal intellectual revolution into a public forum. During this stage, the scientist's ideas enter into general circulation among other members of the scientific community through the publication of a scientific paper or book. Often it is only during the process of preparing logic for public scrutiny that a scientist transforms conceptual thoughts into a formal theory.⁴³ Carl von Clausewitz's writing of *On War* conforms with Cohen's contention. While revising his *magnum opus* in 1827, Clausewitz wrote that he regarded "...the first six books...merely as a rather formless mass that must be thoroughly reworked once more."⁴⁴

The last of Cohen's four stages is one of acceptance and practice. While a revolution in science may fail at any point during the first three stages, Cohen emphasizes the decisive nature of the fourth stage. Once the community of scientists accepts the new paradigm and alters its actions to operate according to the new precepts, a revolution in science has occurred.⁴⁵

Although the character of revolutions in scientific thought differ from revolutions in military affairs, in a general sense the broad outlines of Cohen's model mirror changes in military thought. One example is the progression of Alfred Thayer Mahan's ideas on sea power. Mahan met Cohen's stage one and two criteria with the early intellectual development of his concept of sea power and his lectures to students at the Naval War College. With the 1890 publication of *The Influence of Sea Power upon History, 1660-*

1783, Mahan stepped into stage three. As the British, German, and American naval communities sequentially embraced his ideas, Mahan's concepts of sea power advanced through the Cohen's fourth stage.⁴⁶

Differences between Revolutions in Science and Revolutions in Military Affairs

Throughout the history of human conflict, scientists and soldiers have had much in common. Indeed, scientists have advanced the technology of war for almost as long as soldiers have fought in battle.⁴⁷ But as closely as the development and subsequent apotheosis of Mahan's concept of sea power parallels Cohen's four stages of scientific revolution, revolutions in science are different from revolutions in warfare in three important ways. First, military revolutions contribute greatly to changes in military thought while simultaneously complicating human decision-making to a much greater degree than in revolutions in science. Second, the rate, scope, and non-linear nature of change in the military often overwhelm the ability of those charged with understanding it. Third, obtaining feedback on the efficacy of "new solutions" to problems or "crises" takes longer and is more difficult in the military domain than in the world of science.

The first difference between revolutions in science and those in military affairs is that the latter contain a critical "zeroeth" stage. Prior to the initial stage in either the Kuhn or Cohen models, a qualitative, revolutionary change in the underlying reality must occur-- "The revolution in war entails a revolution in military thought."⁴⁸ As Schneider points out, the Galilean and Copernican revolutions only looked at the universe differently; they did not restructure it. Contrary to revolutions in science, "military and political revolutions are historically mediated, that is, qualitative changes in the underlying reality are induced by man himself."⁴⁹ The concept of a "zeroeth" stage

accords well with the thoughts of Murray and Knox as they pertain to military revolutions setting new conditions for subordinate or lesser-included revolutions in military affairs. For instance, with the advent of the Industrial Revolution, commanders adopted certain technical devices--the railroad, telegraph, and mass production techniques--to transform qualitatively the very substance of their military reality.⁵⁰ During the Interwar period, Germany applied advances in tank, aircraft, and radio technology in a synergistic fashion to create a new concept for maneuver warfare. France, for geographical, economic, and political reasons, used the same technologies in a less complementary manner. In these examples, the various changes in communication and transportation technology constituted a "zeroeth" stage and, in turn, established the initial conditions for military theorists to grapple with while attempting to integrate the new advances into their methods of warfare.

The second difference between the scientific and military revolutions concerns the nature of change in military affairs. While revolutions in science are often linear, revolutions in military affairs occur faster, are of greater scope, and are non-linear.⁵¹ These characteristics exacerbate the difficulty military reformers have in perceiving emerging trends, understanding their military applicability, developing appropriate doctrine and technology to capitalize on these trends, and convincing others to support envisioned reforms.

An excellent example of this difficulty existed at the end of the Nineteenth Century when civilian leaders and military professionals in Europe and America confronted the pace, enormity, and diverse nature of technological change. During this period, "revolutionary inventions like the typewriter, the phonograph, the motion-picture

camera, the telephone, the wireless, the transoceanic cable, the bicycle, the automobile, the airplane, the electric street car, and the subway irreversibly changed” Western society.⁵² The greatest civilian example of this rapid rate of change came in the ten-fold increase in automobile manufacturing from 1908-1913. Within the military, Western armies attempted to adapt to these changes, expanding testing facilities, organizing management bureaus, and revising fighting doctrines, but the scope and pace of technological change outstripped the emerging process of integration and “created nearly unbridgeable gaps between theory and practice.”⁵³ In hindsight, these advances represented *prodromal* signs or early symptomization of the coming military crisis in World War I.

To make matters worse, the technological changes that inundated European and American societies and their militaries developed in an uneven and unpredictable, non-linear fashion. The birth of weapons as “systems” emerged. The success or viability of these weapons “systems” relied on several diverse factors and multiple strains of development all coming together to work as one. The development of the machinegun brought increased firepower to the battlefield, but small changes in traverse-and-elevation mechanisms, cleaner-firing ammunition, and better field glasses all combined to make the machinegun more lethal than originally anticipated.⁵⁴

The same phenomenon would occur with the development of antiaircraft artillery in during the Interwar period. In that case, the antiaircraft “system” only became viable with the advent of technologies such as radar and the proximity fuze, improved training regimens, and organizational doctrines designed to maximize the effectiveness of the entire “system.” Far from being deterministic, this process illuminates the obvious role

that chance or fortune has to play in the non-linear way in which nations developed their military weapon "systems."

The third difference between revolutions in science and military affairs concerns the "period of incubation between thought and action, theory and practice."⁵⁵ In the natural sciences, scientists can test many of their theories in their laboratories almost immediately. As Kuhn notes, the rejection of one paradigm occurs nearly simultaneously with the acceptance of another.⁵⁶ Theories of warfare, however, are much harder to replicate in wargames or simulations and therefore must wait until the appropriate conditions--usually warfare--occur.⁵⁷ In peacetime, military organizations have a very difficult time gaining "feedback" on their efforts at innovation. In essence, they operate in a void. As British historian Sir Michael Howard commented in his essay "Military Science in an Age of Peace," an army, in trying to identify the conditions of the next war:

...is like a sailor navigating by dead reckoning. You have the terra firma of the last war and are extrapolating from the experiences of that war. The greater the distance from the last war, the greater become the chances of error in this extrapolation...For the most part you have to sail on in a fog of peace until at the last moment. Then, probably when it is too late, the clouds lift and there is land immediately ahead...Then you find out ... whether your calculations have been right or not.⁵⁸

Given these preconditions, the real task of an army, or any military organization, is to not get the interwar process of modernization "too badly wrong." For if it is only slightly off, an effective military organization can recognize its key deficiencies, adjust its way of fighting and, in the course of the war, defeat the enemy.⁵⁹ Unfortunately, the inability to replicate or prove their theories in peacetime may leave military reformers in a tenuous position and greatly handicap their chances of successfully modernizing their military forces.

Bringing it all Together - Punctuated Equilibrium and a Theory of Change

Both the military revolution theories of Murray and Knox and the Kuhn and Cohen models of scientific revolution dovetail nicely into what paleontologists Niles Eldredge of the American Museum of Natural History and the late Stephen Jay Gould of Harvard University called the punctuated equilibrium theory of evolution. In 1972, Eldredge and Gould postulated that biological evolution was characterized not by a slow, gradual division and creation of species, but rather by species formed relatively quickly by rapid bursts of evolutionary change interspersed with long periods of near stasis. Although not all-inclusive--indeed, Eldredge and Gould did not initially address the possibility of incremental change--their theory has gained measured acceptance. While still generating a great deal of controversy, many scientists have agreed that "much, though not all, evolutionary change occurs during short periods of rapid development."⁶⁰ As Clifford Rogers comments in his study of military revolutions during the Hundred Year's War, "this newer conception of punctuated equilibrium evolution, combining both incremental and 'revolutionary' change, seems to describe the process of military innovation extraordinarily well."⁶¹ Andrew Krepinevich makes the same argument implicitly in his article concerning the pattern of ten military revolutions since the Fourteenth Century.⁶² After a period of near stasis, a rapid change occurs in the conduct of warfare that alters the way wars are fought. This change dominates warfare, albeit undergoing and giving way to incremental change, until supplanted by another rapidly emerging method of warfare.

Thus, on one level, it seems that the conduct of warfare has evolved over time and been punctuated by broad-based social, economic, technical, and military revolutions.

These revolutions changed the underlying conditions of warfare and provided the basis for altering the dialectic relationships between offense and defense, and missile weapons and shock warfare. On another level, however, the theory of punctuated equilibrium may also characterize what occurs within a longer evolutionary cycle. In that regard, the theory of punctuated equilibrium equates to the percolation of anomalies described by Brinton and Kuhn and the rapid focus on developing solutions to the new problems explained by both Kuhn and Cohen. To put it another way, within the concept of punctuated equilibrium, the military revolution as outlined by Murray and Knox provides the basis for a subsequent revolution in military affairs.

The journey from the initial emergence of an anomaly questioning the viability of the existing method of warfare to the complete discovery, creation, and implementation of a solution that becomes the subsequent revolution in military affairs is a long and circuitous one. Along the way, the vagaries of human decision-making combine with the overwhelming rate, scope, and non-linearity of change and the difficulty in testing solutions and obtaining feedback to alter the direction of change in the military. Instead of the relatively straightforward scientific process of Symptomization-Crisis-Adaptation-Solution-Instability articulated in the Kuhn-Brinton model, along with Cohen's four-stage progression for revolutions in scientific thought, military analysts and leaders of change face differing national strategic imperatives, varied external conditions, and conflicting internal organizational dynamics. These differences modulate and redirect strategic, operational, and tactical outcomes and ensure that regardless of the commonality of the underlying reality that fostered the innovation, virtually every nation and significant civilian or military leader will interpret the need for change and the ultimate solution

differently. This phenomenon explains conceptually *why* the Germans in World War I adopted a solution to the stalemate of the Western Front before the British, French, and Americans did, albeit in a losing cause. It underscores why Germany defeated France in 1940, despite both nations having two decades to study the lessons of World War I. It also helps explain why Britain and America developed carrier aviation and long-range fighters and bombers while Germany did not.

Within in this theory of change, there are two important characterizations that inform the pace, direction, and impact of innovation. First, while a matter of degree, there is a difference between revolutionary and evolutionary change. Indeed, some elements of a revolution in military affairs are actually evolutionary developments that take place over an extended period of time. Others are more rapid and immediate. Second, change and innovation in the military occurs at different levels and in different forms. Understanding the evolutionary or revolutionary aspect of a proposed change and its expected impact on improved warfighting effectiveness is critical to a military organization as it calculates the fiscal and political viability and organizational energy necessary to achieve planned reforms. To misdiagnose the impact of impending changes risks wasting time, money, and ultimately lives.

Revolutionary vs Evolutionary Change within an RMA

Rapid, dramatic revolutionary change within a revolution in military affairs is more the exception than the rule. Revolutionary innovation appears largely the product of top-down leadership. Only strong, savvy leaders who are “well-informed about the technical *as well as conceptual* aspects of possible innovation” are positioned to initiate and carry through revolutionary changes to completion.⁶³ A recent study of seven areas

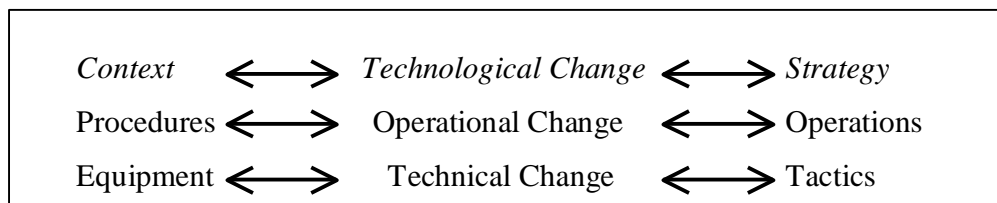
of innovation during the Interwar period – armored warfare, amphibious warfare, strategic bombing, close air support, carrier aviation, submarine warfare, and air defense – considered only the establishment of a complete air defense “system” including radar stations, command and control networks, and fighter aircraft by British Air Marshal Sir Hugh Dowding as an example of revolutionary change.⁶⁴ The selection of Dowding and the development of the British air defense system as revolutionary among a field of other, more evolutionary, innovations strikes an important note of caution. First, the element of chance and the unpredictable nature of human decision-making played a key role in Dowding’s selection as the organizational leader of Fighter Command. For “without Dowding the British would not have created a *system* of air defense.”⁶⁵ Second, top-down leadership only proves effective in creating a revolutionary innovation when the leadership accurately discerns the emerging changes in warfare and drives the organization to take advantage of them. In the hands of a bad or unenlightened leader, misplaced innovation can turn potential advantage into probable defeat. Such was the case of the French, who maintained top-down control over Interwar army doctrine and encouraged a singular belief in the superiority of the “methodical battle.” As Williamson Murray asserts, “if you are right, top-down leadership will allow you to get it very, very right. If you are wrong, however, you will get it very, very wrong.”⁶⁶

The majority of innovations, however, are evolutionary, not revolutionary. They evolve over a long period of time and involve navigating between strategic imperatives, national and organizational cultures, and bureaucratic idiosyncrasies. Technology, tactics, procedures, and concepts may all experience incremental change over the gradual course of evolutionary innovation.⁶⁷ Each individual improvement may have minor,

discrete significance on its own or even appear disconnected from earlier innovations, but when taken as a whole the cumulative change in warfighting effectiveness can be profound and dramatic and appear “revolutionary.” In this case, the role of senior military leadership is not to drive home specific short-term changes for those may be undone by the next series of leaders. Instead, senior leaders must set the broad direction for innovation and foster a culture that is open to both examining the lessons of the past and accepting of the potential for the future.⁶⁸

The Structural Relationships of Military Innovation

Regardless of whether military innovation is evolutionary or revolutionary, its impact derives from how well it solves a series of problems, exploits emerging advantages, or assists an organization to better perform its mission. These challenges exist at the tactical, operational, and strategic levels and may involve respective equipment, procedural, or contextual solutions. A model aligning these relationships is useful for understanding the impact of a specific change and the difficulty one might expect in implementing it.⁶⁹ The greater contextual impact a change brings, the more difficult it may be to implement.



Source: Alan Beyerchen, “From Radio To Radar: Interwar Military Adaptation to Technological Change in Germany, the United Kingdom, and the United States,” in Williamson Murray and Allan R. Millett, eds. *Military Innovation in the Interwar Period*, (Cambridge, UK: Cambridge University Press, 1996), 267-268.

Figure 2.2 – Relationships in Innovation

“Technical change” is a function of *equipment* or physical devices whose contribution lies primarily in the realm of tactics. Issuing a service a new airplane, radar set, or antiaircraft artillery gun are examples of “technical change.” When a military force adopts new *procedures* for existing equipment or new equipment combined with new procedures for their collective employment, then “operational change” has occurred. As Alan Beyerchen explains: “To envision radar as the technique of detecting targets by means of radio echoes, generating a range of devices and practices, is to focus on operational change.”⁷⁰ “Technological change” occurs when the *context* of warfare changes as the result of interaction of technical and operational change with each other and with the current operating environment. Radar working within a “system” that also included ground and fighter based air defense platforms transformed the context of air combat over the United Kingdom, helped win the Battle of Britain, and ended Hitler’s expansion westward expansion. Combined arms maneuver warfare that linked armored formations, air power, and radio communications with well-trained units, mission-type orders, and bold leadership changed the *context* of ground combat in Europe beginning in 1939.

Within the scope of this analysis, the development of American antiaircraft artillery during the Interwar period conforms with the theories outlined above. As Murray and Knox contend, World War I combined the outcomes of the three previous military revolutions (the Seventeenth-Century creation of the modern state and modern military institution, the French Revolution, and the Industrial Revolution) and cracked open the intellectual, conceptual, and physical fault lines as they pertained to the conduct of war in 1914. A conflict that began as a short war of maneuver quickly succumbed to

this seismic shift and bogged down into an extended stalemate with no decisive firepower or maneuver advantage on the Western Front. As part of the symptomization that preceded this upheaval, the development of the internal combustion engine and the invention of the airplane at the turn of the century changed what Schneider calls the underlying reality that formed part of the paradigm for warfare prior to World War I. Before the war, military aircraft underwent slow incremental development and were used primarily for observation. With the onset of war, the design and employment of military aircraft changed rapidly, adding pursuit and bombardment to the original task of observation.⁷¹ The loss of air superiority and the danger of bombardment created a paradigm crisis for all armies. In response to this crisis, each combatant established air defense techniques and antiaircraft artillery commands employing ground artillery pieces and machine guns in an anti-air mode in an attempt to prevent attack from the air. For the American Expeditionary Forces, this crisis-adaptation-solution cycle was particularly acute. Elements of the A.E.F. began air and antiaircraft planning in March and April 1917. By the end of the war in November 1918, the A.E.F. had established an antiaircraft service, assembled and trained a 12,000-man force, fielded two AAA machine gun battalions, supplied gunners to man French antiaircraft guns, and shot down 58 airplanes.⁷²

In the twenty years following World War I several revolutions in military affairs occurred as the major combatant nations endeavored to respond to the demise of the existing system of warfighting. The revolutions important to this analysis of antiaircraft artillery fall into two categories—offensive and defensive. Combined-arms warfare and strategic bombing represent RMAs whose primary purpose was offensive in nature. In

dialectic fashion, nations developed corresponding RMAs to counter the effects of those advances. Radar and the development of air defense systems to defeat strategic bombers and tactical aircraft engaged in combined-arms warfare represented the defensive response. Within this defensive category, both stationary and mobile air defense systems developed, further complicating national abilities to respond. The British air defense system, characterized by Dowding's revolutionary leadership, is the best example of a stationary air defense system designed for strategic purposes. American antiaircraft artillery, the focus of this study, best represents a forward-deployed response created to protect tactical and operational level units and critical assets.

Following World War I, the American antiaircraft artillery establishment virtually disappeared during the rapid reduction of the American armed forces. Although narrowly surviving organizational extinction and suffering from varying degrees of institutional neglect within the Coast Artillery Corps and the United States Army, the antiaircraft establishment developed its doctrine, technology, and organizational structure incrementally over the next two decades. Beginning almost immediately after World War I, a few visionaries within the Coast Artillery Corps and the Army recognized the change that the emergence of air power had brought to warfare. These individuals had experienced Cohen's "intellectual revolution" and in the ensuing years reinforced their commitment to the development of antiaircraft artillery by writing articles for professional military journals. In these works, they cited the importance of creating a credible antiaircraft establishment and the need to include an antiaircraft artillery force structure in Army organization documents. The development of antiaircraft artillery progressed through Cohen's third stage with the writing and publication of antiaircraft

artillery doctrinal manuals after 1930, and the inclusion of antiaircraft tactics and procedures into Army manuals in a substantial manner after 1939.

Unlike Dowding's creation of the British air defense system, the American system evolved slowly, at times almost imperceptibly, until the late 1930s when events in Europe and the Far East shocked the world and brought the impact of air power and the need for antiaircraft artillery to the forefront. At this point, the nagging anomalies attendant to the parallel, but asynchronous development of air power and antiaircraft artillery erupted in another paradigm crisis. Reports from military attachés in Spain and China in 1938 and Western Europe beginning in 1939 extolled the importance of air power and antiaircraft artillery. These reports raised concern over the lack of antiaircraft artillery equipment, propelling it to the top of the War Department's procurement list for the next three years and signalling a recognition and acceptance of antiaircraft artillery by the defense establishment and the Army. President Franklin D. Roosevelt's support for airplanes and antiaircraft equipment during this period demonstrated "top-down" emphasis, but that does not qualify him as attempting to revolutionize the American military nor does it make the development of American antiaircraft artillery revolutionary. Roosevelt's support was immediate, but not visionary. At best his call for airplanes and antiaircraft equipment represented the tip of the American rearmament spear. He did not revolutionize the context of air warfare like Dowding did in Britain. Instead, Roosevelt offered necessary, but belated executive support to an evolutionary effort that had struggled for legitimacy over the previous twenty years. It was more a recognition of the most immediate threat to America's national interests than it was a revolutionary event.

The development of an American antiaircraft system during the period 1918 – 1941 represents the slow, incremental evolution of ideas and concepts punctuated by a true crisis that began in 1939. Progress during that extended period was sporadic as the imperative to find a solution to the World War I problem of air attack collided with the external and internal forces that drove decision-making and affected the course and direction of peacetime change. Once the crisis became acute, however, the American defense establishment answered the call. As in World War I, the Army and defense contractors responded to the crisis by building upon the evolving system, adapting existing technology, developing new equipment, and creating new organizations and doctrine to solve the vexing problem of attack from the air. After a long evolutionary journey, the Army, the antiaircraft artillery establishment, and the defense community brought about a revolution in military affairs.

Like most solutions, however, these were only partially effective, as the soldiers of the II U.S. Corps at the Battle of Kasserine Pass found out in mid-February 1943. Similar to one of Kuhn's anomalies, the difficulties experienced in early 1943--inadequate combined arms training, lack of antiaircraft equipment suitable for a doctrine of mobile defense, a shortage of antiaircraft units, and poor air-ground coordination--spurred the Army and the newly created Antiaircraft Command to seek better solutions. While the Army was correcting the way it defended against air attack, the Army Air Forces were destroying the German and Japanese Air Forces in the air and on the ground. The combined effect of the actions resulted in Allied air superiority in Europe and the Pacific by late 1944, making many antiaircraft units superfluous. The Army deactivated

many of these units and used their soldiers to fill a critical shortage of infantrymen in the front lines.

Following this war, the Army and the antiaircraft artillery establishment reduced the size of their forces accordingly. Unlike the early period following World War I, however, the antiaircraft artillery did not disappear entirely. In a move akin to the punctuated development postulated by Eldredge and Gould, the Army in 1947 acknowledged earlier Interwar period requests by the Coast Artillery Corps, accepted the recommendations of a post-war board of general officers, and made antiaircraft artillery battalions organic to maneuver divisions. With the onset of nuclear weapons and jet propulsion--indeed, another change in the underlying military reality--antiaircraft artillery entered the missile age and moved to the forefront of the Army. During the same period, the Army, recognizing the obsolete nature of the seacoast artillery, disbanded the Coast Artillery Corps and integrated the antiaircraft establishment into the Field Artillery branch. In 1968, the Army further recognized the unique contribution of antiaircraft artillery and made it a separate branch of the United States Army.

CHAPTER 3

THE EXTERNAL AND INTERNAL DYNAMICS OF CHANGE

While the difficult and sporadic development of antiaircraft artillery that began with America's entry into World War I in 1917 and continued throughout the Interwar period fits some of the theoretical concepts, it also highlights the differences between revolutions in society and science and those in military affairs. After World War I the Army had a theoretical appreciation for the importance of antiaircraft defense, but it took another twenty years for it to incorporate the antiaircraft artillery establishment into the family of combat arms. Much of the difficulty centered on the nature of the air threat and the limited ability of antiaircraft artillery to defend against it. If the ability of antiaircraft defenses to stop attacking aircraft had been a purely scientific issue, it might have been evaluated in a controlled laboratory environment and answered with a high degree of certainty. Unfortunately, warfare is a human endeavor that largely defies attempts at high fidelity scientific analysis. The inability to produce the conditions under which antiaircraft artillery units might be expected to perform led to bureaucratic arguments about the best way to defend against air attacks. As the period between conceptualization and fielding lengthened, the issue of antiaircraft modernization fell prey to the vicissitudes of human decision-making and became increasingly influenced by external and internal factors that delayed its ultimate acceptance by the Army.¹ As the history of warfare indicates, the journey from the conception of a requirement to its successful

solution is often a long and torturous one that frequently deviates significantly from its original path. The longer the process, the more one can expect changes to performance characteristics, technology, and even mission requirements. Along the way, several external and internal factors combine to alter the direction of change. This chapter examines the influence that those factors have on the course of peacetime military innovation.

External Factors That Influence Peacetime Military Innovation

The discussion has thus far focused on theoretical models outlining how organizations find solutions to emerging problems, adapt paradigms, develop ideas, and initiate doctrinal and organizational change. Yet the process of innovation extends beyond merely identifying the future condition of the battlefield and creating a doctrine to fit the new condition. In fact, one noted scholar of innovation maintains that the role of doctrine generated by service schools in instigating institutional reform is oversold.² While extremely difficult to get right, it is not enough to identify future requirements and develop doctrine to meet those requirements. The doctrine must be technically feasible--if not immediately, then certainly at some point in the near future, perhaps reaching operational applicability five to ten years out from inception. It must also meet the political and strategic constraints of the nation. Finally, the cost of implementing the new doctrine--procuring new weapons and retraining the force while maintaining readiness--must be acceptable. In liberal democratic societies, each portion of this process is open for debate. Moreover, not only is every aspect of military modernization open for debate, in theory, by American society as a whole, but certainly by the Congress and within the military. Thus, not only must each aspect of modernization be as correct as possible with

respect to the future conditions of warfare, but it also must be technically feasible, affordable, and satisfy the external political and internal military bureaucracies as well. In light of these requirements, one wonders how effective operational innovation and modernization occurs at all.

National Strategy and the Direction of Innovation

A nation designs its military force structure to perform tasks that fit its concept of national strategy. Consequently, the operational requirements that form the foundation of a nation's military doctrine, tactics, organization, and equipment devolve from its concept of strategy. National defense strategy, however, constantly evolves and adapts to "shifting conditions and circumstances in a world where chance, uncertainty, and ambiguity dominate."³ While political objectives and diplomatic, economic, and military resources all play a role in determining a nation's strategy, national geography, history, ideology, and culture also exert influence on the direction of strategy formulation and by extension the shape of military doctrine and force structure.⁴

Geography

Several aspects of a nation's geography, particularly its location, shape the way it views its security requirements. As Williamson Murray and Mark Grimsley point out in the introduction to *The Making of Strategy*, a nation like the United States was for most of its history so removed from external threats that it ignored and rejected balance of power politics and involvement in overseas disputes.⁵ Even after World War I, America's separation from Europe and Asia continued to influence her attitude toward national defense. The inability of foreign powers to attack the continental United States was one of the factors that led American policy makers to limit defense expenditures. When

Major General Frank W. Coe, Chief of the Coast Artillery Corps in the early 1920s, tried to use popular concerns about aerial bombardment as a springboard for increased funding for antiaircraft artillery, he was ignored because none of the professionals involved could envision an air threat capable of attacking America in the near future.⁶ Indeed, for most of the Interwar period, the nation relied on the Fleet, the Army's Coast Artillery Corps, and Air Corps bombers to protect the coastline. Only in the late 1930s did policy makers become concerned with possible German economic and military penetration of South America and begin reinforcing the air, ground, and sea defense of the Panama Canal and the Caribbean region.

Conversely, Great Britain's proximity to the European continent forced it to remain concerned with defense against invasion. Historically, Britain based its security on the strength of the Royal Navy and control of the Low Countries. After World War I, Sir Basil Henry Liddell Hart even offered a concept of defense based on "limited liability" and involvement in land warfare in Western Europe.⁷ Despite the protection offered by its naval shield, however, Britain could not neglect the emergence of air power as a weapon of warfare. Fearing a "knock out blow" by German bombers, Britain for much of the 1930s followed a dual-track policy. On the one hand, Britain tried to "secure international conventions which would provide for limitations on aircraft production, the abolition of the bomber, prohibitions of the act of bombing, a guarantee against air attack and a convention regulating the conduct of air warfare."⁸ On the other hand, the British government increased defense spending for aircraft and antiaircraft artillery.⁹ Interestingly, Britain's focus on the possibility of aerial attack drove her to develop technologies suitable for antiaircraft defense (radar) far ahead of the United States. The

transfer of these technologies proved a significant help to American antiaircraft efforts throughout the war.¹⁰

Beyond mere threat-identification, geography also shapes the formation of military doctrine and procurement of specific types of weapons. As Murray and Grimsley assert, throughout the Interwar period both British and American airmen emphasized the belief that air power could win wars independent of offensive action by ground or naval forces. This emphasis led both nations to devote a large portion of their defense expenditures to purchasing aircraft, particularly bomber aircraft.¹¹

Faced with the threat of ground attack, Germany took the opposite approach. Instead of relying heavily on "strategic" bombing, which implied some degree of sanctuary from direct land invasion, German air doctrine focused primarily on supporting the ground forces. To do otherwise might result in having eastern and northern German airfields, industry, and countryside overrun. Conversely, given the Channel and North Sea obstacles to direct invasion, the British could afford the loss of Belgium, the Netherlands, or France and still keep fighting. Ironically, the *Luftwaffe's* focus on relatively short-range fighter aircraft designed to support the *Wehrmacht* or for air defense undermined German prospects for victory during the Battle of Britain.¹²

In the American antiaircraft artillery establishment, the focus on strategic bombing drove a corresponding effort toward the procurement of high altitude, fixed antiaircraft guns to defend against urban and fixed-base air attack and away from consideration of antiaircraft defense for its mobile forces. This fixation on defense against strategic bombing had an equally negative impact on antiaircraft training and tactical displacement early in World War II. In some cases, antiaircraft battalions did not

train with Army divisions despite being located on the same installations. In North Africa, the operational implications of this emphasis became clear, as the vast majority of antiaircraft units were deployed to protect relatively fixed rear-area assets vulnerable to high altitude bombing instead of being forward defending front-line soldiers.

History

Along with geography, history also plays a large role in coloring the development of national strategy. While national experience influences strategic decisions almost as much as geography, the effect of historic periods on decision-making is just as profound. During the Interwar period, the memory of the millions of dead, wounded, and missing soldiers seared the national psyche of the Western democracies and left both their governments and populations largely paralyzed by the resurgence of German power. In Britain, the memory of World War I drove the adoption of the "Ten Year Rule"--a defense budget and procurement program that assumed that Britain would fight no major conflict for the next ten years. The ten-year date rolled forward every year until the early 1930's and enabled the "government to evade any responsibility for providing a minimum base from which rearmament might begin."¹³

Across the Atlantic, the historical experience of World War I drove Americans to call for a "return to normalcy" despite President Woodrow Wilson's contention that "there can be no question of our ceasing to be a world power."¹⁴ For the American Army, "normalcy" meant a rapid reduction in forces, a return to prewar constabulary duties, and protection of the limited American interests in China, the Philippines, Hawaii, and Panama. It also meant severely reduced funding for research and procurement of weapons and equipment.

Ideology and Culture

Historical experience often accords closely with national ideology and culture. In Germany following World War I, the misuse of history gave rise to the "stab-in-the-back" or *Dolchstoß* myth, which subsequently reinforced the National Socialist propaganda program and spurred Hitler's rise and consolidation of power. In America, an indigenous belief exists that the United States stands alone in the world as the unique "embodiment and protector of liberal democracy."¹⁵ This "Exceptionalist" view, combined with America's ideological, cultural, and social abhorrence for large standing armies, has perpetuated the Minuteman myth and the Jacksonian notion of the citizen-soldier and led to precipitous peacetime declines in military preparedness.

The Level of External Support and the Open Mind

All of these influences on strategy also affect decisions within the military about force structure, equipment, and doctrine. When the external pressures of geography, history, ideology, and culture drive decisions on strategy that diminish the need for military preparedness, the likelihood that the military will attempt to innovate on its own is also limited. Indeed, the military works in a social environment that "is at best indifferent and at worst hostile to [its] activities."¹⁶ In a majority of Western liberal democracies, the degree to which the public perceives a threat to its survival or well-being dictates the level of external support for the military.¹⁷ Typically, during interwar periods, the public does not perceive a threat to its existence. Thus, it does not find great utility in peacetime military forces. Unfortunately, the level of peacetime external support for the military has a direct effect on the ability of the military to achieve internal innovation. In other words, the less intellectual, psychological, economic, political, and

personal support the military receives, the less likely it will be to accept new ideas. If the military perceives it has little or no margin for error, then it will find intellectual, psychological, political, and physical sanctuary in maintaining the status quo. The less external support the military receives, the more it focuses inward and the more it fails to recognize emerging national and international political, social, and technological trends that may affect the way it should operate in the future.¹⁸ Thus, a lack of external support may drive the military to resist innovation or to miss important opportunities to identify correctly the future conditions of battle.¹⁹

The Military as an Ocean Liner

The military, particularly in the United States, is a large bureaucratic organization and like a large ocean going vessel, it changes direction very slowly. To carry the analogy further, internal efforts to change direction are a function of the azimuth established by the captain and the propulsion created by the workers in the engine room. External efforts that force a change in the direction of the ship manifest themselves in the winds and tide emanating from the will of the people embodied in the Congress. By virtue of the Constitution, the Congress of the United States has great power to "raise and support," "maintain," and "regulate" the military. The Congress exercises this prerogative formally through hearings and legislation that affect the intellectual and physical development of interwar operational requirements. The Congress enforces its will through military budget appropriations and other legislation, as is its Constitutional duty.

Curiously, some scholars dismiss the impact of Congress on the process of military innovation as "at best, limited and indirect...."²⁰ One only has to read General

Omar N. Bradley's testimony as Army Chief of Staff before the House Committee on Appropriations to appreciate the high level of Congressional influence over military innovation. Bradley commented that

in [its] calculations of what we shall spend for armed security and how we shall spend these funds ... this committee is actually recommending to the Congress a military policy ... for the long-run military plans must be reshaped within the budget allowed.²¹

Bradley went on to emphasize that due to Congressional control of appropriations "the military policy of the United States [was] shaped by the Congress and not the armed forces...."²² In addition to enforcing its will upon the military through budget appropriations, Congress also dictates reform to the military through specific legislation. The impact of the 1986 Goldwater-Nichols Act on the military's attitude toward joint warfare is one example of many on how Congress can foster innovation.

The Effect of Social and Technological Currents

While the winds and tides of popular and political opinion exert a strong force on the direction of innovation in a military organization, they are fickle and subject to change. A few more stable forces influencing the direction of military innovation are the social currents and technological trends that can speed innovation, but just as often can carry military organizations in directions they do not intend to go. The history of the Interwar period offers several examples of external trends influencing change within the military. The popular disdain for attrition warfare that emerged in Britain after World War I drove military theorists and reformers like J.F.C. Fuller and B.H. Liddell Hart to seek technological and doctrinal solutions to the stalemate that plagued the Western Front. Fuller and Liddell Hart proposed mechanization and combined arms warfare at a

time when the Ten Year Rule prevented even moderate modernization and many in the British Army discounted the value of mechanized warfare.

Similarly, the popular enthusiasm for the automobile that gripped America in the 1920s and 1930s came at a time when some Army officers still regarded the cavalry as truly a horse-powered force, particularly in roadless areas like West Texas. Nonetheless, the force of motorization proved unstoppable, driving the Army to put its mounts out to pasture and make the internal combustion engine the new workhorse of the Army. Likewise, the civilian air industry provided the Army Air Corps with both a public following and a technical foundation that allowed it to grow and prosper during a period when the development of equipment for the rest of the Army, including anti-aircraft artillery equipment, languished because it had no civilian application. Particularly in non-totalitarian states, a portion of professional military knowledge and growth germinates from the seeds of ideas transplanted from the civilian world. Thus, it benefits the military to understand the trends, absorb the ideas, and translate the advances found in the civilian community into something with military utility.²³ The initial development of airplanes, nuclear power, radar, and nanotechnology are but a few examples of civilian initiatives that found their way into military research and development programs.

Lest one put too much faith in the application of science to warfare, several qualifications and limitations exist concerning the impact of technology on innovation. First, advances in civilian technology do not always translate into increased military effectiveness. An army cannot merely superimpose technological trends upon its institution without seriously risking combat readiness. Simply possessing a superior weapon is not enough.²⁴ It is essential that the military assimilate the tactical,

operational, and strategic effects of innovations in weaponry. Consider for a moment the example of European forces in the latter half of the Nineteenth Century. As Maurice Pearton points out, at Sadowa in 1866, the Prussian needle gun was less important to the outcome of the battle than the faulty tactics and organizational defects of the Austrian command. Moreover, close integration of doctrine and technology made the Prussian artillery more effective even though it was technically inferior to that of the Austrians. The trend continued four years later against France. There again German superiority rested as much on the tactical employment of the new Krupp cannon as on its technical quality. In both wars, the "opponents of the Prussian Army failed to assert their superiority in weaponry--the Austrian cannon at Sadowa and the Chassepôt rifle and mitrailleuse during the Franco-Prussian War."²⁵

Second, while advances in technology certainly influence military innovation, they do not create it. There is no "technological imperative" that drives militaries to revamp the way they operate or to undertake wholesale organizational changes.²⁶ Organizations, both civilian and military, are made up of people who make decisions about which technologies to introduce and how to best integrate them. As evidenced by the different Interwar air power doctrine and force structure developments in Germany, Britain and the United States, strategic assessments about a nation's specific military requirements modulate attempts to insert advances in technology uniformly into different military organizations. Moreover, better civilian technology does not confer directly improved tools of war upon the military. Civilian scientists and engineers understand the technology involved, but only political and military leaders can answer institutional force structure questions about which type of weapons and how many of them the military will

need. Often, civilian advances in technology do not fit military needs directly. In many cases, as America began rearmament in the late 1930s, the “state-of-the-art technology would not support operational concepts developed by military visionaries.”²⁷ The Chrysler Royal with its Spitfire engine and “fluid drive” Simplimatic transmission may have been one of the most sophisticated cars of 1941, but it was the \$900 low-tech, rugged Ford and Willys Jeeps that carried soldiers into battle in 1942.

One exception lies in areas where dual-use technology benefited both military and commercial applications. In this case, civilian led enterprises and technical developments tended to advance more rapidly than government-run programs that followed the “‘arsenal model’ in which research and engineering development remained the domain of military managers and technicians.”²⁸ Transportation and communications are two examples where civilian-managed programs advanced rapidly and benefited both civilian and military interests. Military-run programs in ordnance and munitions were not as successful.²⁹

Third, to translate technological improvements into increased military effectiveness requires political support and an adaptable military organization—one that is able and willing to change. In discussing the impact of technology on World War II, Allan R. Millett cautions that “the key to technological exploitation became not so much the revolutionary character of inventions and processes, but the creation of a management and logistical system that made the *application* of technological advantage possible.”³⁰ The professional management of American logistics kept Allied aircraft, ships, tanks, and submarines full of fuel and ammunition and at high operational ready rates long after the Axis well had run dry.

Fourth, to alter doctrine or force structure for the sake of technological change creates needless turbulence and reduces military effectiveness. Such was the case with the Pentomic Army of the 1950s, when the Army attempted to stave off institutional irrelevance by reequipping and reorganizing to meet the perceived needs of the nuclear battlefield. In doing so, it rushed off in pell-mell pursuit of nuclear technology only to build an Army that was, in the words of General George H. Decker, Army Chief of Staff from 1960-62, "a jack-of-all-trades-and-master-of-none."³¹

Fifth, it is important to evaluate advances in military technology fully before embarking on changes in equipment, organization, or doctrine. In some cases inadequate technical development can lead civilian and military decision-makers to make erroneous choices regarding the effectiveness of specific weapons systems, on occasion with potentially disastrous results. One example of this phenomenon occurred with the development of British naval aviation and the quite correct concern about how the fleet would defend itself against enemy aircraft. In this case, British naval authorities based equipment, doctrinal, and even wartime tactical decisions on conclusions drawn largely from inadequate testing and underdeveloped technical means. In the 1920s, the majority of British naval opinion viewed land-based defensive fighters operating near the fleet as the best defense against air attack. Naval antiaircraft gunnery would fill the gaps in fighter coverage and merely mop up the few enemy aircraft that penetrated the defensive air coverage. By the mid-1930s, however, an amazing turnabout had occurred. Antiaircraft gunnery became the main defense, with fighter aircraft designated to pick off surviving enemy planes. Indeed, the Royal Navy's lack of faith in its defensive fighters

caused it to pioneer several defensive initiatives including building armored aircraft carriers capable of absorbing heavy damage.³²

This belief carried over into tactical operations at sea during World War II. Three weeks into the war, four German JU-88 aircraft attacked Britain's *Ark Royal*, the first British ship designed as a "flat top" carrier. The commander of the 23,000-ton Fleet Carrier was so convinced of the ability of naval antiaircraft to protect the carrier that he placed his fighters below deck, drained them of fuel, and relied entirely on antiaircraft gunnery to defend the ship. The dive-bombers narrowly missed, as did the return fire from group's antiaircraft gunners.³³ Despite indications to the contrary, the Royal Navy's confidence in antiaircraft gunnery grew so strong that in Feb 1940, Admiral G.C.C. Royle, the Fifth Sea Lord and Chief of the Naval Air Service, proclaimed that "the Fleet at sea with its destroyer screen" presented "the most formidable target a formation of aircraft could attack" and defensive fighters were by "no means a necessity."³⁴

This over reliance on antiaircraft gunnery came from faith in its assumed lethality as developed to meet the misplaced fears of a potential French air attack in the 1920s. It grew, in part, due to a lack of confidence in the ability of early generation defensive fighters to do the job. As Geoffrey Till points out, the self-fulfilling prophecy occurred largely as the result of several small decisions, many of them the product of inadequate technical development. Based on the limited number of aircraft a carrier could hold, a preference existed for general-purpose, versatile aircraft instead of planes designed specifically for naval air defense. The resultant lack of naval air defense fighters further reduced the opportunity to find a viable alternative or complement to antiaircraft guns. Additionally, delays in catapult design and concomitant difficulties in executing carrier

operations undercut confidence in the fighting potential of naval aircraft. Also, prior to the development of radar, numerous fleet exercises indicated that fighters had extreme difficulty locating and intercepting attacking aircraft. Finally, the lack of remote control drones to use as targets prevented testing the actual accuracy naval antiaircraft fire. Therefore, there was no way to disprove the unfounded belief that antiaircraft gunnery could defend the fleet either with or without fighter support. In the case of British naval air defense, better research, development, and testing combined with a complementary approach that paired defensive fighters with naval antiaircraft gunnery would have served the Royal Navy better.³⁵

Sixth, innovators must plan for countermeasures and not fall prey to Utopian beliefs in a superweapon. Military history is replete with examples of technological asymmetry and temporary advantage being countered by other means. The mounted knight fell to the longbow and pike. Surface ships suffered from subsurface torpedo attacks until the adoption of the convoy system, anti-submarine warfare (ASW) escorts, and the invention of sonar. Soviet Hind helicopters ruled the skies over Afghanistan until the Mujahadeen used shoulder-fired, American-made Stinger missiles to challenge their air superiority. These examples highlight the importance of understanding the applicability of military force within the context of its time and the need to integrate closely the development and use of new doctrine and technology. Failure to do so will result in the use of the extremely powerful, but proverbial, elephant gun to hunt fleas.³⁶

This discussion concerning the impact of technology on the course of military innovation highlights many lessons for those attempting to change their organizations. Perhaps the most compelling lesson to draw regarding technology is that organizations

must engage in the hard thinking that defines the direction of reform prior to the beginning of modernization. "With inadequate thinking about operational requirements, the best technology and the biggest budget in the world will only produce vast quantities of obsolete equipment."³⁷ As officials now engaged in studying the effect of technology on World War II indicate, some military organizations did "a much better job of thinking through the appropriate concepts of operation" and "made the necessary organizational changes [to gain] a dramatic advantage until other military establishments [could] emulate them or make adjustments."³⁸ In discussing the implications of Hegelian action-reaction dialectic and the competition between nations for greater military effectiveness, Dr. Andrew W. Marshall, Director of the Department of Defense Office of Net Assessment believes:

... that the most important competition is not the technological competition, although one would clearly want to have superior technology if one can have it. The most important goal is...to be the best in the intellectual task of finding the most appropriate innovations in concepts of operations and making organizational changes to fully exploit the technologies already available and those that will be available in the course of the next decade or so.³⁹

If Marshall's challenge was easy, anyone could do it. But understanding the current and future conditions of warfare, designing appropriate operational concepts, and instituting organizational changes is extremely difficult to do. It is made doubly hard because military organizations and the governments they serve are social entities where strategic calculation, technical reasoning, and cold hard facts often give way to internal conflicts, institutional enmity, and bureaucratic politics. Frequently, the most pitched competition is not about solving the problem of future warfare, but over defining the problem in the first place.⁴⁰ Winning the intellectual battle to define the problem gives

the victor a head start toward securing institutional solvency and primacy in the distribution of money and other spoils of the bureaucratic system. In an environment where internal factors often affect modernization and reform in a disproportionate manner, only a great deal of forethought about the direction of innovation can help the Army to not get "it too badly wrong" when the next cannon sounds.

Internal Factors that Influence Peacetime Military Innovation

No effort to engender external support for innovation or any attempt to integrate emerging social and technological trends will succeed, however, unless the desired reforms pass internal military muster. Without support from within the military, most attempts at innovation will at the very least lose their effectiveness, if not fail completely. Unfortunately for proponents of modernization, the military, for reasons of organizational structure and professional culture, is largely resistant to change.

Military Conservatism

Military bureaucracies take a custodial approach toward their institutions and a conservative outlook to change. Their rigid, hierarchical organizational structure impedes the progress of new ideas. Formal information flows down the chain of command through orders and regulations and upward via reports from subordinates to superiors. In most organizations there is a tendency to protect the chief executive from undue disturbance. In the military, because formal rank and hierarchy are so clear-cut, informal access to senior leaders is cut off almost entirely. As a result, those in a position to support innovation within the organization only hear (or read) a small portion of the new ideas that exist at any moment. Moreover, because rank and seniority are the dominant characteristics of the organization, the military has great difficulty accepting

outstanding original thinkers, particularly when these thinkers are young and have not "earned their spurs."⁴¹

Commenting on the relative difficulty between integrating changes in technology and those in tactics, Alfred Thayer Mahan wrote that "improvements of weapons [are] due to the energy of one or two men, while changes in tactics (or in this case the entire direction of modernization) have to overcome the inertia of a conservative class..."⁴² Mahan's critique notwithstanding, there are valid reasons why the military as an institution hedges toward conservatism. In defense of its organizational rigidity and conservatism, the military differs from all other organizations in that its "business" is the employment of violence in support of national policy objectives. Therefore, the dangerous nature of the military profession counsels against incorporating unverified innovations into the organization. The cost of failure to the Army and the nation is so great that it warrants a conservative approach to new ideas.

The Military: A Pluralistic Community

Although the military's rigid, hierarchical structure differs greatly from the structure of most organizations, it still reflects to some degree the pluralistic nature of the society it serves. In democratic nations, the military, like society, is not monolithic, but is a political community consisting of sub-units each with different views on how the Army or the military establishment as a whole should prepare to fight the next war. Just like other political communities, the various sub-units within the Army--branches such as Infantry, Cavalry, Engineers, Artillery, Coast Artillery, and the Air Service during the Interwar period--debate which branch should dominate and how the "citizens" of their community--the soldiers--should function. Therefore, military modernization does not

simply occur from a transfer of resources, but is the result of an ideological struggle that redefines the way the "citizens" function or in this case, the way the Army fights.⁴³

The Interwar period is replete with examples of such doctrinal debates. Following World War I, the military organizations in each of the major powers fought over the direction their military development should take.⁴⁴ Commenting on the German Army's ideological struggle over doctrine, Matthew Cooper concludes that not only did the German Army not wholeheartedly embrace what has since been called *Blitzkrieg* warfare, but that the entire

... history of the German Army from the 1930s to the middle years of the Second World War [was] essentially the record of unresolved conflict between the protagonists of a new strategy founded on the revolutionary use of armoured, motorised and air forces engaged in a mission of paralysis, and the adherents of the traditional strategy based on mass infantry armies, with the new arms at best treated only as equal partners, the cutting edge of the old decisive manoeuvre of encirclement and annihilation.⁴⁵

In the United States, a similar debate ensued over the development of aviation, its relationship to the Army and Navy, and the ability of antiaircraft artillery to defend against it. On one side of the debate were elements calling for military aviation to remain integrated within the Army and Navy. On the other side of the issue were those supporting the unification of all air elements into an independent service. A key point in the debate concerned the utility of aircraft in military operations. Part of the Army's position to Congress against separating the Air Service from the Army rested on the argument that air power could not win wars alone and that antiaircraft artillery was a viable means to defend against air attack. In February 1925, Army Assistant Chief of Staff, Brigadier General Hugh Drum, testified before the House Select Committee of

Inquiry on the Operations of the United States Air Services that with twelve 3-inch antiaircraft artillery guns he could stop "any bomber from doing serious destruction."⁴⁶

Conversely, Brigadier General William "Billy" Mitchell, testifying before the same committee, stated that with respect to stopping incoming aircraft "the problem of antiaircraft ... is almost an impossible one to solve." He commented that the United States had lost only "one-tenth of one percent of all missions" flown during World War I to German antiaircraft fire and that the "method of firing [had] not improved perceptibly" since then.⁴⁷ Fiorello H. LaGuardia, a World War I pilot and a Congressional Representative from New York, however, captured the tenor of this ideological struggle. In testimony before the House of Representatives Committee on Military Affairs in 1926, LaGuardia charged the Army General Staff with being "either hopelessly stupid or unpardonably guilty" in refusing to recognize the need for a separate air service. During his testimony, LaGuardia singled out the Coast Artillery Corps as an illustration of what he called "standpatism" or the failure to yield to the logic of air power. He rebuked military authorities for having the "audacity" to ask Congress to fund coast defenses at a time when he believed coastal surface guns were outranged by their naval counterparts and antiaircraft batteries were only capable of hitting attacking aircraft during rigged firing tests.⁴⁸

The Difficulty of Achieving Consensus

If the plurality of the military community exists, then it follows that for innovation to succeed, agreement on the new "ideology" must occur between the major parties involved. In short, the senior leadership must forge, through force of will and strength of ideas, a consensus on the future direction of the military. For a number of

reasons, however, innovation in the military has usually met with strong resistance, making consensus as difficult to create there as in the civilian political community.

Uncertainty vs Romanticism

Innovation is difficult to achieve because of the uncertainty created by the method of evaluation and by the need for confidence in the existing equipment and doctrine. The military is naturally reluctant to discard historically reliable equipment and doctrine before the battlefield advantages of innovations have received a full, complete, and objective test. As stated earlier, the cost is too great if the innovators are wrong. One student of military organizations has observed that part of the rigor and realism demanded by the military in field-testing innovations arises from the historical romanticism infused in the profession.⁴⁹ The utility of military history as a vehicle for inculcating soldiers with the military's professional ethic breeds a romantic attachment to the equipment and doctrine of its history. Thus, part of the military's resistance to change may stem from its efforts to instill pride, foster unit cohesion, and improve military effectiveness. This line of reasoning assumes, of course, that soldiers and officers actually *read* military history or use it for instruction in other than specialized staff colleges. Tradition, reputation, and folk history also play a role in developing this attachment. The author is probably more accurate when he states that a soldier's faith in his weapons and doctrine is essential to the maintenance of *esprit de corps* and morale. Without such faith, no soldier will venture forth in battle. As a result, soldiers are reluctant to exchange proven battlefield equipment and techniques for innovative replacements unless they are convinced of their worth. This reluctance makes the need

for open, objective, and reliable field-testing essential to building the consensus necessary to support changing the current doctrine or equipment.⁵⁰

A poignant historical example of such resistance lies in the efforts of Twentieth Century armies to hold on to their horse cavalry despite indications for well over fifty years that there was no place for cavalry on a battlefield dominated by breech-loading rifles and machine guns. As early as 1870, when Prussian riflemen decimated the ranks of charging French cuirassiers the evidence was clear--horse cavalry served no purpose as an attacking force on the modern battlefield. Evidence of the collapse of cavalry appeared again in World War I as machine guns and quick firing artillery stopped cavalry charges in their tracks. The reluctance to abolish cavalry units continued, however, until it was swept aside by the onset of peacetime motorization in society and the wartime destruction of Polish horse cavalry in 1939.⁵¹

Protectors of the Status Quo

Resistance to modernization also comes from those who have a vested interest in maintaining the status quo. "Often leaders who see their particular weapon becoming obsolete, and who see no approach to regaining their organizational dominance, are the most ritualistic and compulsive about the older forms of military command."⁵² This phenomenon occurs in most military organizations regardless of the nature of the regime they serve. The father of German armored warfare theory, General Heinz Guderian, commented in *Panzer Leader* that neither the establishment of an independent air force or the development of armored doctrine was adequately studied or appreciated by the General Staff because it was feared it might result "in the one case, in a decrease in the

importance of the Army as a whole and, in the other, in a lessening of the prestige of the older arms of that service."⁵³

With respect to the development of antiaircraft artillery during the Interwar period, the issue of antiaircraft protection for the Army division offers an excellent opportunity to study this internecine struggle for functional supremacy. One of the enduring lessons that the Infantry drew from World War I was its vulnerability to strafing and bombing attacks by airplanes. Mindful of the increased potential for air attack in the next war, the War Department recognized the need to improve the division's antiaircraft capability and altered its tactical doctrine in its *Field Service Regulations, 1923* to address the problem. Unfortunately, the Army did not allocate any additional force structure or create any additional antiaircraft units to protect divisional assets and front line commanders. The limited amount of antiaircraft artillery available to the corps commander (one battalion of 3-inch antiaircraft guns and one battalion of machine guns) dictated that he use these assets to defend higher priority targets, many of which existed in the Corps rear area and not near the troops. The Infantry was left to defend itself. The obvious solution to this problem was to add an organic antiaircraft artillery unit, most likely a battalion, to the division structure. As arguments raged between the Infantry, Cavalry, and Coast Artillery, each of whom saw protection from air attack as one of their mission areas, the option of adding an antiaircraft battalion to the division structure ran into opposition on numerous fronts because it threatened to increase the size of the division and reduce its overall mobility on the battlefield.⁵⁴ This problem remained unresolved throughout the Interwar period. It reemerged as America prepared for battle in World War II and pitted Lieutenant General Lesley J. McNair, Chief of the Army

Ground Forces and an ardent supporter of streamlining the division structure and pooling antiaircraft units at corps level, against a series of influential Army leaders who wanted antiaircraft battalions dedicated to maneuver divisions. In 1941, Major Alfred C. Wedemeyer, the author of the "Victory Plan", advocated adding the antiaircraft battalion.⁵⁵ Then in 1942, with soldiers in combat in North Africa, Undersecretary of War Robert Patterson; Lieutenant General Jacob L. Devers, Chief of the Armored Force; and then Lieutenant General Dwight D. Eisenhower, commander of the Allied Expeditionary Force in North Africa, all petitioned McNair to for more antiaircraft support.⁵⁶ After much argument, McNair prevailed and was able to keep antiaircraft units out of the divisional structure throughout the war.⁵⁷

Age, Rank, and Reluctance to Accept Change

Military sociologist Morris Janowitz contends that the tendency to resist organizational change rests in the middle officer ranks. At the bottom of the military hierarchy, the realities of combat force leaders to adapt. At the very top, leaders are selected because of their inclination to innovate. Moreover, they are susceptible to external pressure to innovate. Janowitz believes that in the middle ranks the pressures to innovate are absent. Additionally, mid-ranking officers are often aware that their prospects for advancement are declining. Thus, these officers adopt a defensive stance. "Instead of constructive problem solving, these officers are concerned with maintaining the formal prerogatives of their rank" and position. These concerns, in turn, lead "to organizational rigidity, ceremonialism, and a retreat from administrative responsibility."⁵⁸

Janowitz's conclusions are that of a military sociologist, not a historian, and may reflect more than anything else his study of the United States military in 1965. No

definitive evidence exists to suggest that middle grade officers are more or less innovative than senior officers or subalterns. While there may be some question as to how he defines the "middle officer ranks," however, his characterization of resistance is nonetheless accurate.

Students of military innovation understand that resistance to change can occur at all echelons, including the highest levels of military service. One has only to read of Secretary of War Elihu Root's reforms and the decade long fight against them by Major General Fred C. Ainsworth to appreciate the level at which opposition can occur. As the chief of the Army's Office of Record and Pension in 1903 and later as the Adjutant General, Ainsworth stood to lose a great deal of personal and professional prestige if the War Department centralized administrative control of the bureaus and functional control of the various arms under the office of the Chief of Staff. In an attempt to prevent this change from occurring, Ainsworth fought a bureaucratic battle within the War Department until forced by General Leonard Wood and Secretary of War Henry Stimson to retire in lieu of being court martialed for insubordination. He subsequently renewed his fight from Capitol Hill as an unofficial advisor to a sympathetic congressman. Only when the congressman retired and the nation entered World War I did the resistance cease.⁵⁹

Norman Dixon, in his polemic *On the Psychology of Military Incompetence*, attributes the failure of senior leaders to innovate to "extremely weak egos" which result in schizophrenic behavior typified by an "insatiable desire for admiration" and the avoidance of criticism on the one hand and an equally "devouring urge for power and positions of dominance" on the other. Dixon concludes that in trying to avoid criticism,

status quo leaders shy away from innovation and delude themselves and others that current methods are adequate for the situation. This delusion is reinforced by their personal and positional power within the organization which ensures that their vision, be it right or wrong, remains unchallenged.⁶⁰

Dixon may be more accurate in his contention that resistance to innovation is often borne of ignorance or mental stultification. Although he applies it solely to senior officers, his theory works for all those who reach for and attain positions for which they are truly unqualified to hold. According to Dixon, pontification follows as nature abhors a vacuum and the ignorant move to fill the vacuum by pontificating to conceal their lack of knowledge or because they are too ignorant of the facts to feel any concern about expressing ideas to the contrary.⁶¹ In the military realm, this condition often leads to oversimplification or assumptions about the future that contradict emerging trends. British Field Marshal Archibald Montgomery-Massingberd, Chief of the Imperial General Staff from 1927 to 1933, is a perfect case in point. At one point during his tenure, Montgomery-Massingberd ridiculed J.F.C. Fuller's works on tank warfare while simultaneously admitting that he had never actually read any of them.⁶²

Conversely, attempts to foster change in military organizations may occur as a result of the combined efforts of several individuals of varying rank and responsibility. The early history of the antiaircraft establishment during the Interwar period is an excellent example of this phenomenon. As the Army demobilized following World War I, a group of junior officers at the Coast Artillery School began writing in the *Coast Artillery Journal* about the impact air power had on that war. They urged the leadership of the Coast Artillery Corps to take the initiative and lead the way in preparing a credible

defense against the airplane.⁶³ As this movement began to gain momentum, it received support from local commanders and eventually, the Chief of the Coast Artillery, General Coe.⁶⁴ With Coe's support, the Coast Artillery School published doctrinal flyers or primers on antiaircraft artillery throughout the decade.⁶⁵ By 1930, the combined effect of these publications, together with continued education at the Coast Artillery School and the fielding of equipment, propelled the antiaircraft artillery establishment to a position of equality with, if not primacy over, its seacoast artillery counterpart. Seacoast artillery officers feared abuse from "ruthless antiaircraft-minded authorities" and Major General John W. Gulick, the new Chief of the Coast Artillery Corps, was forced to issue a statement denying the superiority of the antiaircraft artillery and telling seacoast artillery officers that their neither their careers nor their sub-discipline within the Corps were in jeopardy of becoming obsolete.⁶⁶ Such was the impact of a small, but varied group of visionaries on the psychology of the institution.

Mavericks as Agents of Change

Reluctance to change the status quo also manifests itself in hostility toward the agents of change. This situation is particularly evident when the agents become mavericks and operate outside of the normal channels of communication. During the Interwar period, three well-known mavericks sought to modernize their militaries and alter the status quo. In England, Basil H. Liddell Hart and John Frederick Charles Fuller argued that mechanized warfare and combined arms formations would restore mobility on the battlefield and return the offensive to the dominant place in warfare. In America, Billy Mitchell argued fiercely for an independent air service to replace the Navy as the nation's first line of defense. While all began their efforts as mavericks railing against the

established vision of their services, only Liddell Hart softened his rhetoric and endeavored to work within the system to achieve the changes he believed necessary. Conversely, Fuller retired in disgust and joined with Britain's Fascist Party, while Mitchell was court-martialed for insubordination and left the US Army in 1926.

Interestingly, some scholars theorize that military mavericks lend expertise to civilians who then push the military toward innovation.⁶⁷ In reality, these mavericks often do more harm than good to the cause of innovation. By going outside of the military, the mavericks alienate those within the organization who subsequently dig in their heels. Insulted and seething with indignation, the orthodox military becomes intransigent, defying or retarding civilian efforts to force innovation on the military.⁶⁸

Strategic Logic and Military Innovation—A Difficult Calculus

To the degree that a logical and rational assessment of the nation's strategic needs ever drives the design of its military, Americans should consider themselves lucky. For rarely has there been a more difficult calculus to solve. First, one must recognize that the underlying reality that established the current military structure may have changed, prompting a reassessment of the nation's defense requirements. Second, one must win the battle to define the nature of the changing reality. Third, one must determine if the changing reality requires a corresponding innovation in response, what the optimum response ought to be, and whether it is feasible and affordable. Fourth, one must run that response past the gauntlet of external variables, each the product of a diverse set of geographic, historical, and cultural factors, technological trends, and social attitudes. Finally, one must expose the derivative response to the politics of change internal to the military, validating the solution in the eyes of the servicemen whose lives will ultimately

depend on it and convincing conservative colonels and corporals to change their way of fighting. Much like a mathematical equation that contains factors derived from an incongruous and competing set of ever-changing set of variables, solving the nation's strategic logic and successfully implementing military innovation can be a vexing problem.

CHAPTER 4

A THEORY TOWARD ATTAINING SUCCESSFUL CHANGE

Given the numerous external and internal impediments to innovation, one may wonder how any modernization occurs within the military. Yet, on those occasions when successful innovation does occur, it is usually the product of several important elements brought together in a single process for change. Determining those elements is one of the hallmarks of success. For if some uncertainty surrounds the probability of attaining successful change, there is no shortage of recommendations on how achieve it. Several senior military officers and noted scholars have offered their views on how best to achieve peacetime military innovation. This chapter outlines those views, condensing a wide body of literature and incorporating these different viewpoints into a holistic, yet concise list of key characteristics of successful change.

The Body of Literature

The body of literature on the subject of military innovation is both wide and deep. Topics range from sweeping ideas on defense reform to pesky details of about how to fix broken personnel systems. The range of authors is just as diverse, running from unbiased savants to service apologists. The following separates the noteworthy comments and recommendations from the field of not-so-worthy commentary and summarizes the views of several noted authorities on innovation and change. The criteria used to select these works for review emphasized the authors' *experience with* and *understanding of* the

problems associated with achieving change in the military. Long association with the military through a combination of uniformed and civilian service and extensive study of the subject ensured the authors chosen possessed a deep and thorough knowledge of the unique character of the military. Additional experience in leading military organizations through periods of change further credentialed some of the authors. Finally, to ensure the validity of the authors' opinions, their works had to be relevant, concise, and well documented. Relevancy to the subject of military innovation eliminated several texts on organizational theory and bureaucratic politics.¹ The need for a treatment of the subject that was both full in scope, yet succinct, disqualified other works.² Finally, poor research and overly broad and unsupported generalizations about military reform invalidated many others.

The qualifications and background of the authors selected exceeds the criteria required. Most are both soldiers and scholars in that they have military experience, some in combat, as well as a wealth of academic credentials. Several have taught at military institutions. Sir Michael Howard, MC (WWII), I. B. Holley (WWII), Allan R. Millett, and Williamson Murray (Vietnam) were all decorated for their service in the military, but are better known for their contributions to military thought. Dennis Showalter is equally renown as a historian, visiting professor at several U.S. military colleges, and author of several volumes of military history. Timothy Lupfer and Richard Swain earned advanced degrees while in the Army and led soldiers in combat. So did retired Brigadier General Huba Wass de Czege, who also went on to found the U.S. Army's premier school to train officers in the art of operational warfare. Harold Winton, a retired Army colonel,

Vietnam veteran, and noted academic, went on to help create a similar institution in the U.S. Air Force.

This summary is not a full representation of the body of literature, only a sampling of the most thoughtful and well-argued positions on the subject of military innovation. Some are broad in scope, while others offer specific recommendations for attaining meaningful change. Based on this summary, a few general principles and key characteristics will emerge that can serve as a comprehensive guide to attaining successful military innovation.

Of all the writing on military innovation Sir Michael Howard and Brigadier General Huba Wass de Czege offer two of the most broad, yet penetrating opinions of the conditions necessary for success. Howard, an eminent military historian and strategic thinker who served with the Coldstream Guards during World War II, defined three conditions that underwrite any military innovation, particularly in peacetime--technical feasibility, operational requirement, and financial capability.³ Wass de Czege, founder of the U.S. Army School of Advanced Military Studies at Fort Leavenworth, suggests, "successful military reform comes from developing a harmony among the three elements of soldiers, ideas, and weapons."⁴ Combined, these ideas meld operational necessity, technological imperative, and fiscal responsibility with the human dimension of warfare and lay the foundation for establishing a worthwhile body of thought on the subject.

As fundamental as the comments of Howard and Wass de Czege are to understanding the requirements for successful innovation, Allan R. Millett takes these requirements a step further by delving into the process and patterns of innovation. Having studied and written extensively on the development of American military strategy

and policy in the Twentieth Century, Millett contends that successful military innovation results from a combination of accurate strategic vision, supportive organizational factors, the selection of key leaders and disciples, and necessary technological developments. None of these factors alone can account for the success or failure of individual reforms. He offers four characteristics common to those innovations that had the most impact in World War II. First, a “commitment that equated organizational survival with the performance of an important wartime mission that might make the difference between victory or defeat” is necessary to motivate the target institution to reform. In other words, challenging the organization to “put up or shut up” in a critical field of endeavor has a marvelous way of clearing away disagreement and focusing the organization’s energies. The U.S. Marine Corps’ development of amphibious doctrine and force structure during the Interwar period is one oft-cited example where institutional well-being was linked to a bonafide wartime requirement that was critical to mission success. Second, given the internecine squabbling that occurs over roles and missions, Millett argues “the less the role of interservice cooperation [is necessary for innovation to occur], the more likely it [is] to prosper.” Third, to gain momentum toward consensus, organizations need some amount of “bureaucratic (general staff) representation.” Fourth, successful innovations require an “operational expression (armored division, amphibious brigade) that could be exercised and tested” in order to prove their validity. Conceptual doctrine, field manuals, and staff studies were useful, but they will not convince military leaders to give up battle-tested tactical methods and weapon systems.⁵

Williamson Murray, an incisive critic of military organizations, consultant to the Defense Secretary’s Office of Net Assessment, and co-author with Allan R. Millett of

several important volumes on military effectiveness and innovation, offers characteristics of both successful and failed attempts at change. With respect to successful efforts to innovate, Murray maintains that specificity or the presence of a concrete military problem that military organizations have a vital interest in solving goes a long way toward harnessing the energies of the institutions involved. At first glance, one might expect that defending against air attack would be problem enough to propel the development of American antiaircraft artillery further during the Interwar period. That the development of antiaircraft artillery stalled for most of the 1920s and 1930s and only began in earnest in 1938 does not invalidate Murray's theory. On the contrary, antiaircraft development suffered for most of the Interwar period because solving the problem of attack from the air did not become of *vital interest* until 1938. Moreover, significant disagreement existed over the *definition* of the problem and which organization--the Air Corps, the Coast Artillery, or the individual arms of Infantry, Cavalry, and Artillery--was responsible for developing the solution. Murray also contends that developing a military culture that is open to self-examination and fosters an aggressive attitude toward problem solving is a second critical component in attaining meaningful change the military. In this regard, he cautions against two attributes that characterize failed attempts at innovation--the ignorance or misuse of history and the intellectual and organizational rigidity that closes minds and institutions to the obvious need to reform.⁶

General Donn A. Starry, former commander of the United States Army Training and Doctrine Command and an architect of the Army's 1982 edition of *FM 100-5: Operations*, lists seven broad requirements for successful military innovation: 1) select or create an institution or mechanism to identify the need for change, draw up parameters

for change, describe what must be done and how it differs from past practice; 2) invest in the rigorous educational background of officers responsible for change to produce a common cultural bias toward solving problems; 3) create a spokesman for change; it can be an institution or an individual; 4) build consensus and gain converts; 5) maintain continuity among the architects of change; 6) attain support at or near the top of the organization; and 7) conduct field trials to test the validity of the proposed change.⁷ Coming from a practitioner who created and brokered doctrinal change throughout the United States Army, these recommendations, written in 1983, offer a solid beginning toward establishing the framework for successful innovation. In 1999, while writing about the history of American armored forces, Starry reiterated the need to build consensus for change, a key ingredient for success. He also highlighted the need for an intimate and cooperative relationship between those responsible for creating battle fighting concepts and those charged with the development of military technology. He lamented that each wants to drive the development of the other's domain and complained that the "historic inability to achieve such a symbiotic relationship in the United States has been, and remains, a persistent problem aggravated by the accelerating pace of technological change."⁸ Without this dynamic relationship, each group will continue to "talk past each other" and achieve nothing of value.⁹

Harold Winton, a former Army officer and one of the founders of the United States Air Force School for Advanced Airpower Studies at Maxwell Air Force Base, has written often on military innovation. In *To Change An Army*, his 1988 history of General Sir John Burnett-Stuart and the development of British armored doctrine, Winton offered six requirements for changing military institutions that dovetail well into the points made

by Starry. Winton argues for: 1) a close and dynamic relationship between the purposes of military institutions and the forms those institutions take; 2) the need for senior leaders to articulate continuously the vision for the future; 3) intellectual mastery of the nature of war and development of doctrine on how future wars should be waged; 4) the validation of doctrine through field testing to check it and form the basis for changing organizations, weapons, equipment, and training methods; 5) high level support and consensus to overcome ingrained habits and branch or service parochialism; and 6) the need for reformers to remain accepted by their service and not become alienated or marginalized by the mainstream of the institution.¹⁰ In a recently published volume analyzing selected innovations undertaken during the Interwar period, Winton reiterated several of his earlier points, highlighting the role of doctrine, experimentation, and senior leadership. Further, he observed that military innovation constituted its own version of the Clausewitzian trinity with reform suspended between the poles of strategic and technical uncertainty, the political and social values of the state, and the characteristics of the military service undertaking the reform.¹¹

Professor I. B. Holley, in *Ideas and Weapons*, his study of the relationship between technological advancements, military doctrine, and weapons development, contends that military organizations fail to discover and apply the best weapons and techniques in war because they fail to: 1) adopt, actively and positively, the thesis that superior arms favor victory; 2) recognize the importance of establishing a doctrine regarding the use of weapons; and 3) devise effective techniques for recognizing and evaluating potential weapons in the advances of science and technology.¹² While more technologically deterministic than Starry, Holley nonetheless recognizes the need for

interaction between the developers of weapons and the creators of future warfighting concepts. In developing doctrine, Holley offers a three-phase process of "assembling objective information, formulating doctrinal generalities, and disseminating the doctrine to the field."¹³ While accurate and adequate, these generalities belie the difficulty military organizations actually have in "assembling, formulating, and disseminating" information when confronted with a plurality of opinions and attitudes.

Professor Dennis Showalter, former president of the Society for Military History and noted author of several works on various aspects of European military history, offers four general conclusions about military innovation. First, he reminds students of the subject and would-be reformers that all change is contextual. Those looking to the past must evaluate earlier attempts to innovate objectively and within the context of their times. Like Murray, Showalter believes it is dangerous to oversubscribe lessons to victors on the basis of broad generalizations about performance. In short, one must do the homework before holding up the past as a direct model for the future. Second, armies reflect the core dynamics and anxieties of the societies they serve much more than navies or air forces do. Armies are less wedded to technology than the other services and they operate on the ground among the population. As such, Showalter contends they are political institutions as well as instruments of policy. If accurate, this condition suggests that military innovation undertaken by an army may be more susceptible to the external forces discussed in Chapter Two. Third, the direction of change relies a great deal on the nature of the army's internal interest groups, highlighting the need for an internal organizational strategy to win support. Fourth, testing and validating new equipment and

methods of warfighting is often difficult to conduct, but critical to the process of innovation.¹⁴

Finally, Showalter offers a counterproposal to the standard Marxist-industrial model of change in which “systems are identifiable, stable, and controllable”--what he calls the “Whig” perspective. He contends that given the complexity of military innovation, the “chaotic” or “third wave” model represents a better structural organization for reform. In the “chaotic” model, “specific innovations...are less significant than the creation of a positive synergy among material and doctrine, ‘service cultures,’ and the wider social and political systems to which those cultures belong.”¹⁵ In this approach, he echoes Starry’s concern for a dynamic relationship between technology and doctrine as well as Harold Winton’s ideas about external systems and internal cultures.

Dr. Richard Swain, a retired colonel of artillery and former director of the United States Army Combat Studies Institute at Fort Leavenworth, Kansas, takes the approach that a rational strategic assessment drives the design of the future military force structure. In his recommendations for a capable spokesman, however, he highlights the belief that pure strategic logic must be simple enough for non-converts to understand, yet powerful enough to withstand criticism and win the argument. Swain lists five attributes a military force needs to keep pace with changing military developments in times of peace: 1) a correct strategic rationale; 2) a concept of military operations; 3) investment in research and development and procurement proportional to the likelihood of immediate employment; 4) an open-minded proponent for the whole; and 5) a convincing

spokesman capable of explaining military requirements to government decision makers and, ultimately, the public.¹⁶

Lieutenant Colonel Timothy Lupfer, a veteran of Operation Desert Storm and the author of a minor military classic on the development of German tactical doctrine during World War I, lists nine steps as a guide to achieving successful change: 1) perceive a need for change; 2) solicit ideas, especially from battlefield units; 3) define the change; 4) disseminate the change; 5) enforce the change throughout the Army; 6) modify organizations and equipment to accommodate the change; 7) train thoroughly; 8) evaluate the effectiveness of the change; and 9) make subsequent refinements. Lupfer inferred these steps from his World War I research on Germany's adoption of *stormtrooper* tactics as a response to the stalemate on the Western Front. As such they reflect more a process for wartime adaptation than a method for navigating between peacetime external and internal influences that, like the minefields in No Man's Land, seek to alter the course of one's reform or stop a worthwhile concept in its tracks.¹⁷

The Way Ahead -- Key Characteristics for Successful Change

Given this wealth of insight, the military reformer and architect of change may still face difficulty in discerning the path to successful innovation. For much like the doughboy preparing to cross No Man's Land, all this insight is like echelons of artillery providing much needed intellectual fire support. They provide both general suppressive fires on the objective as well as pinpoint attack on specific problems and obstacles ahead. But they also chum up the ground making progress precarious even when the enemy is neutralized. Moreover, the dust and debris created may cloud one's vision and often obscures the way ahead. What follows represents an intellectual and practical Very light

to illuminate the way for the eager reformer preparing to leap forward from his entrenched position and assault the bastions of bureaucratic lethargy that would otherwise defeat his efforts at military innovation.

Timing

Assuming that a bonafide need for change exists, that the change in question is appropriate for the organization's future success, and that plans to initiate the change already exist, the first element of successful modernization is timing. Poor timing can prevent even the most patent innovations from happening. While there is no optimal time to begin innovation, there are three periods that have served as stimuli for change in the past. Some authors contend that the period immediately following a defeat offers the best chance to initiate modernization. Capitalizing on the weakened preconceptions of senior leaders, the demonstrated fallibility of traditional methods, and the lack of confidence of the established order, innovators in these armies use their recent defeat as a lever with which to press for reform.¹⁸ In this sense, defeat represents the greatest, most visible collection of anomalies to the current military paradigm and serves as a ready example of a paradigm crisis. The impact of Prussia's loss to Napoleon in 1806 on the military reform movement led by Scharnhorst and Gneisenau is a case in point.¹⁹ Not all armies, however, recognize the need to reform following a defeat. Andrew F. Krepinevich, in his trenchant study, *The Army and Vietnam*, considers the Army derelict in its duty because after its defeat in that low-intensity conflict "the Army made little effort to preserve the learning that had occurred during the war; rather, it expunged the experience from the service's consciousness."²⁰ In *The Limits of Air Power*, Mark Clodfelter offers a similar criticism of the post-Vietnam U.S. Air Force for adopting a "one-size-fits-all" belief in

strategic bombing as the solution to all types of wars—unlimited, limited, conventional, and guerrilla--despite overwhelming evidence that such a doctrine only became effective in 1972 after the political and military conditions of the war had changed.²¹

Although less frequently observed, another period when history indicates innovation has occurred is following a major victory. Far from resting on their laurels, successful armies have used this occasion to modernize their doctrine and equipment both to deter potential aggression by an adversary and to ensure future battlefield readiness. Napoleon's development of *La Grande Armée* during the relative period of peace between 1802 and 1805 is one example of a army introducing a new doctrine and organization after a major victory--in this case Marengo.²² Again, however, not all armies feel compelled to attempt innovation during the period following a major victory. As discussed earlier, war weariness and isolationism prevented modernization from occurring in the British and American armies for over a decade after their victorious conclusion of World War I.

A third point in the life of an interwar army when conditions may support successful modernization occurs during the period immediately prior to a potential conflict. This situation occurs when leaders perceive the conduct of war has changed and their force is not capable of meeting the new challenges ahead. As a result, these leaders attempt to alter their organizations to cope with a recognized crisis in their military paradigm. As Friedrich von Decken, a Hanoverian staff officer, who later distinguished himself under Wellington in Spain, wrote in 1800:

Change encounters less obstacles shortly before the outbreak of a war... A danger sensed by all muffles the voice of intrigue, and the innovation appears as a smaller evil that must be accepted to avoid a greater.²³

Such was the case in both the United States and Great Britain in the mid-1930s as storm clouds formed over Europe. Of course, the danger in waiting until the period immediately prior to a new conflict to modernize is that the army may get caught in a doctrinal, organizational, or technological "Midway," having completed only a portion of the planned change and operating with a mix of old and new methods when the next war starts. Shortly before its defeat in 1806, the Prussian Army reorganized along the divisional lines. While desirable, the reform came before anyone learned how to operate the new system.²⁴

What all of these time frames have in common is that they occurred when there was a period of what one author has called organizational slack or organizational distress in the life of the institution. Slack occurs when an organization possesses resources (money, personnel, time, political support) in excess of what it needs to meet its daily mission requirements. Slack supports innovation because it allows the organization to divert resources to develop, test, and implement new ideas. Of the examples above, perhaps only Napoleon enjoyed the overabundance of resources necessary to foster modernization. More recently, the increase in defense budgets during Ronald Reagan's presidency is another example of increase resources spurring reform.²⁵ Conversely, distress occurs when an organization faces budget decrements, a diminishing threat, and an uncertain operational future. Under these pressures the organization must look for innovative methods to preserve its institutional vitality. It sets new goals, adopts new values, and creates new supporting power structures. The U.S. Marine Corps is one example of a military organization changing as a result of distress. Until rearmament

began in the mid-1930s, the Marine Corps was under acute organizational stress. It adapted to the conditions of the time, developed innovative ideas concerning amphibious warfare, and sustained its organizations in the face of overwhelming pressure. The Coast Artillery Corps, its adoption of the antiaircraft artillery mission, and development of supporting doctrine, organization, and technology is another example of an institution adapting in times of distress to meet changing operational needs.²⁶ In this regard, expanding an organization's professional jurisdiction into new emerging areas of warfare, while simultaneously relinquishing responsibility for lesser critical functions, is one method of gaining external support, maintaining internal vitality, and creating the necessary organizational slack to remain viable as an institution.²⁷

Continuity and Protection for Agents of Change

The second element of successful modernization concerns the architects of change. "The reform of any military organization...requires multiple paternity, a coalition of senior and junior officers who share a common vision" of both the past and the future.²⁸ Moreover, these officers must possess the intellectual and political staying power to see the innovation through to implementation. Frequently, military innovations take a long time to complete. They represent more than anything else great campaigns against the status quo. Unfortunately, in the modern military, personnel turbulence virtually guarantees a rapid turnover of the individuals charged with stewardship of the innovation. At a minimum, career progression dictates the departure of key people before the changes are complete. Thus, it is essential that senior leaders establish continuity among the agents of change.²⁹

Equally important is the need for the current leaders to ensure the succession of like-minded officers into senior leadership positions within the military. If the intellectual and political chain of authority supporting the innovation is broken, then modernization will fall victim to traditional beliefs--the long threads that tether institutions to the past--and fail. Without a patron to shield the innovation from attack and shepherd both it and the innovators through hard times, the effort will collapse. Similarly, modernization will require a spokesman to sell the innovative ideas to the Army at large. While the spokesman should not be a "maverick," he or she should be either an individual with credibility both inside and out of the Army or, as General Donn Starry contends, an institution such as a staff college like the US Army Command and General Staff College or a staff agency like the Training and Doctrine Command that can carry the innovation forward from within the bureaucracy.³⁰

Consensus, Incrementalism, and Distributed Action

The third and most important ingredient to successful modernization is the creation of a consensus in support of the change. The architects of change must build support within the Army using the irrefutable logic of their ideas backed by empirical evidence obtained through realistic, objective trials. Only when the field Army accepts the benefits of change and believes it has a stake in the modernization will the rank and file tear down the bureaucratic barriers impeding the progress of innovation and support the change.³¹ In part, the non-linear or "chaotic" nature of military innovation assists in consensus-building. Friedrich von Decken offered the following analysis:

Such a close relationship exists among the separate components of the military estate...that in order to achieve anything many wheels must be set in motion that often seem far removed from one another.³²

Thus, several groups of innovators can work independently to build consensus for various elements of a planned modernization that, if combined, would alarm the purveyors of the status quo. By taking an incremental, distributed approach to modernization, innovators can avoid the kind of all-out ideological struggle that polarizes the military and retards reform.

Intellectual Surf Rider or Irrelevant Institution

Combined, these elements of successful modernization--good timing; continuity, patronage, and salesmanship; and non-linearity and consensus building--give the agents of change a fighting chance to defeat the traditional elements of resistance and see their modernization reach fruition. As demonstrated by the development of the antiaircraft artillery during the Interwar period as well as other examples, successful innovation is the product of a diverse set of external and internal factors that continually intervene to alter the nature of any long-range modernization as well as the path taken to achieve it. Given the broad similarities between the Interwar period and today, the lessons of past attempts at innovation bear consideration for the future. To return to the analogy of the ocean liner, the United States Army can no longer see itself as a large, lethargic vessel, fighting against the currents and winds of change and turning ever so slowly at the direction of the captain. Instead, to borrow from Sir Michael Howard, the Army must see itself as an "intellectual surf rider spotting the essential currents on which to ride" the crest of the breaking wave of social, political, and technological trends that would dash a less flexible, versatile, and adaptable organization on the rocks of irrelevance, or beach it in the shallow waters of impotence.³³

PART TWO

PRACTICE

CHAPTER 5

WORLD WAR I and the BIRTH OF AMERICAN ANTI-AIRCRAFT ARTILLERY

Perhaps no epoch in the history of the army has been so fraught with innovations.... If any comparison were instituted with ten years ago the change between the old and new Army would ... indicate what a revolution we are going through.

*Brigadier General Joseph C. Breckinridge
Inspector General of the U.S. Army, 1891*

The actual bringing down of enemy planes. . . can be regarded only as a fortunate incident.

*Colonel Jay P. Hopkins
Chief of the Antiaircraft Service, 1918*

The battle for control of the sky began over a hundred years before Orville and Wilbur Wright initiated heavier-than-air flight at Kitty Hawk, North Carolina in 1903. Ever since man took to the sky in the late Eighteenth Century, those in the air and those on the ground have fought over dominance of the third dimension. The pendulum of progress has oscillated between the two forces as each side endeavors to surpass the other in a cycle of action, reaction, and counteraction. Pitting balloons, biplanes, bombers, and ballistic missiles against elevated field artillery, anti-aircraft guns, anti-bomber missiles,

and anti-ballistic missile systems—the battle for control of the sky has been going on for over two hundred years and shows no sign of ending soon.

Early Battles and “Revolutionary” Advances

During the French Revolution, Jean Marie-Joseph Coutelle, a French chemist, received a commission in the French Army as the commander of the *Compagnie d’Aerostiers*. At Maubeuge, Belgium in 1793 during the War of the First Coalition, Captain Coutelle went aloft in his hydrogen balloon and sent down intelligence reports on Austrian positions. Concerned as much about the psychological effect the balloon was having on their soldiers, who had never seen a balloon before, as they were with the information it provided the French, Austrian commanders ordered two 17-pound howitzers to place their trail-pieces in a ditch and fire on the balloon. The Austrians almost hit it, just missing the airbag and grazing the gondola.¹

In America, the first battle for control of the third dimension occurred in the Civil War. It started in 1861 when Thaddeus S. C. Lowe, a circus balloonist, convinced the War Department to hire him to build and operate balloons for the Union Army. Soon after his June 1861 trial flight, Lowe began constructing balloons out of the “best Indian silk and linen cordage,” charging the War Department \$1,200 to \$1,500 per balloon depending on size.² In July 1861, shortly after the Battle of First Bull Run, Lowe ascended and used a telegraph to wire his reports of Confederate troop movements and unit dispositions to Union commanders on the ground. Their usefulness as elevated reconnaissance platform proven, Lowe’s balloons were a hit with the Union Army, which used them throughout the war in both the Eastern and Western theaters.

If Union commanders valued it (General Joseph Hooker went aloft on several occasions), Confederates, like General Joseph E. Johnston, hated the “infernal balloon.”³ Perceptive Confederate commanders quickly took measures to offset the value offered by the Union balloons. To cover a withdrawal of his soldiers at night, General P.G.T. Beauregard ordered a detail of soldiers to light camp fires to deceive Union balloon scouts as to actual Confederate troop locations and intentions.⁴ Some commanders took to camouflaging their positions to avoid aerial observation and constructed dummy positions, complete with “Quaker guns” made of painted logs, to deceive Union observers.⁵ Other commanders preferred to handle the problem more directly by elevating their artillery barrels and firing on the balloons. In August 1861, the battle was joined when Confederate Captain Edward Porter Alexander, West Point Class of 1857, opened fire on a Union balloon, causing it to descend “as rapidly as gravity would permit.”⁶ At times the fire could be withering. As Lowe recalled, he had just cleared the tree line during a flight in May 1862 when the rebel forces “opened [up with] all of their batteries ... and the whole atmosphere was literally filled with bursting shell and shot, one passing through the cordage that connects the car with the balloon.”⁷ Not only were Confederates engaging airborne targets, but soon they too were flying their own balloons, albeit on a more limited basis than did Union forces.⁸

In August 1861, the same month that Captain Alexander took aim at a Union balloon, Brevet First Lieutenant Joseph C. Breckinridge joined the Union artillery. Almost thirty years later, Brigadier General Breckinridge would become the Inspector General of the United States Army. In his 1891 Annual Report to the War Department, Breckinridge marveled at how “fraught with innovation” the Army had become and

boasted that it was in the midst of a “revolution.”⁹ With the defeat Sioux dissidents at the Battle of Wounded Knee in December 1890, the American Army ceased to be a frontier constabulary force and accelerated the process of reorganization.¹⁰ Given the rapid physical consolidation of the Army—it closed twenty-five percent of its frontier garrisons between 1889 and 1891--Breckinridge’s view reflected the reality of his time. Advances in garrison living conditions, field training, artillery practice, uniforms and equipage, pay and benefits, wireless communications, magazine rifles, breech loading cannon, bicycle troops, and ammunition further reinforced his opinion that the Army had undergone revolutionary change over the last decade. While proclaiming that, “our little Army has never been better in all that pertains to a soldier and his trade,” Breckinridge urged his superiors to prepare “with all zeal to meet the new and more exacting demands of the future.”¹¹ He cautioned: “There is no choice. The door is open; we must enter and conform our thoughts and practice to the military requirements of the times.”¹²

His admonition notwithstanding, Breckinridge had no idea what the future held. It is a common condition that those in the midst of change feel awash in it. Occasionally, leaders of an organization will claim to be ahead of the pace of change or argue that for one reason or another a specific change does not apply to them. Rarely does an organization admit that it is lagging behind. A witness to the rapidity of institutional change, Breckinridge believed the Army was keeping pace with the dynamic social, technological, and national security factors that were driving his service’s future direction. He viewed the Army as innovative and revolutionary, when it was actually only evolving and improving at the margins. The intellectual and institutional dislocation experienced by the United States Army in the late Nineteenth Century was a natural

condition given its limited organizational development. Up to this point in its history, neither the Army nor the nation had an internal mechanism established to study, design, and implement radical change in the military. In combat, the period of greatest risk occurs during the transition from one phase of the battle to another—from the offense to the defense, ship to shore, deliberate attack to pursuit and exploitation. Battles are won and lost based on how well the force in question masters the transition. In 1891, the Army, like most organizations in the midst of transition from one stage of development to another, thought it was keeping up with the pace of change when in reality it was about to be overwhelmed. Although perceptive and progressive, Breckinridge and the Army's leadership in the 1890s could not have possibly predicted the massive changes that would alter the conduct of war so dramatically over the next thirty years.¹³

For Breckinridge and his generation of frontiersmen, the changes that occurred over the ensuing three decades could not have been more striking. A veteran of the Civil War and Indian Wars, Breckinridge would have recognized the opening of the Army War College in 1901 and the creation of the Army General Staff in 1903 as continuations of the military's professionalization that began in 1881 with the founding of the Infantry and Cavalry School at Fort Leavenworth, Kansas.¹⁴ Familiar with the Gatling Gun, Breckinridge might have understood the technical advancements made by Maxim, Browning, and Lewis that led to the machine gun in World War I, but he would have stood dumbfounded at its ultimate ubiquity and technological dominance on the Western Front. As an artilleryman, Breckinridge knew that the M1857 12-pound Napoleon smoothbore, one of the more common artillery pieces used in the Civil War, had a range of approximately 1,600 yards. He may even have known that during the battle of

Gettysburg, Union and Confederate forces fired a total of 52,781 rounds of artillery in three days.¹⁵ He would have been impressed by the technological improvements that enabled the French 75-mm artillery piece to range out to 9,000 yards by World War I, but awed by the destructiveness and the vast quantities of artillery ammunition fired during the war—over 1.6 million rounds during the week-long Allied preparation preceding the Battle of the Somme and over 81 million rounds by the French just in 1918.¹⁶

A Slow Start for Airplanes and Antiaircraft Artillery

Of all the advances of modern warfare, however, nothing would have likely awed the frontiersmen more than the airplane. Awkward and dangerous, airplanes caused both fascination and worry. Described both as a “mechanical messiah whose coming would transform life and society” and as a “bird of hell” whose power would turn New York City into “a furnace of crimson flames” and leave “all at the mercy of a few hundred bird men,” the technological potential of the airplane seemed at once both boundless and ominous.¹⁷ Ironically, the United States pioneered the development of powered flight in 1903, but by the beginning of World War I had lost its potential preeminence in military aviation. An examination of national investment in aircraft procurement demonstrates just how far America had fallen behind Europe in aviation development. In 1891, the War Department had made a bad investment in the experiments of Dr. Samuel P. Langley, whose aerial efforts “dropped ‘like a hand full of mortar’ into the Potomac River.”¹⁸ As a result, the War Department’s Board of Ordnance and Fortifications declined to fund heavier-than-air flight even after the Wright brothers’ success in 1903, focusing instead on the military potential of the dirigible.

In 1907, with President Theodore Roosevelt's support, the Signal Corps created an aeronautical division.¹⁹ In 1908, the Army placed its first order for military aircraft—delivered by the Wrights in 1909--but in the ensuing five years only spent \$430,000 on the development of an "aerial fleet."²⁰ Although enterprising officers rigged crude bombs and machine guns to early planes, Signal Corps sponsorship steered the design and mission of the "fleet" toward reconnaissance and communications. By 1913, the American air force consisted largely of the eight Curtiss biplanes belonging to the 1st Aero Squadron in Texas. The squadron accompanied Brigadier General John J. Pershing on the 1916 Punitive Expedition into Mexico, serving as aerial scouts and messengers. This American air effort paled in comparison to what the Europeans achieved as they marched toward war in 1914. During the same period in which America, unencumbered by concern for war and protected by vast oceans, tinkered with the airplane and invested less than \$500,000 to build an "aerial fleet," both France and Germany spent close to \$22 million, Russia about \$12 million, and tiny Belgium almost \$2 million on military aviation.²¹

If the Army had only a handful of airplanes when the United States entered World War I in April 1917, it possessed virtually none of the assets necessary to cope with the rigors of European trench warfare. Having returned from expeditions to Cuba and the Philippines, the Army reverted back to a largely constabulary force designed to protect the nation's border with Mexico and defend its new insular holdings. In 1917, the Regular Army numbered a mere 127,768 men. It was equipped with excellent M1903 rifles, adequate 3-inch artillery, and a collection of cars, trucks, and motorcycles tested in Mexico, but none of the heavy field artillery or machine guns that armies employed with

devastating effectiveness on the Western Front. Despite the potentially ominous impact of these shortages on the conduct of the war, the Army had some cause for satisfaction. For although it lacked the men and firepower necessary to confront a heavily armed enemy, the Army did possess a viable warfighting doctrine that stressed offensive operations and maneuver warfare, something that European armies lacked in the spring of 1917.²²

Doctrine alone, however, could not redress the shortcomings in force structure incurred by the Army as a result of its isolation from overseas conflict. Despite the salutary psychological and political effects of the Plattsburg Movement that trained 10,000 volunteers in the summer of 1916 and the legislative authority explicit in the National Defense Act of 1916, the Army's actual readiness for combat in Europe was minimal.²³ Unexposed to the latest developments in large scale, modern warfare and prevented by President Woodrow Wilson from planning for war, the Army had succeeded in defending the nation against ill-equipped Nineteenth Century invaders like Pancho Villa, but had yet to adapt its horse-powered, infantry-based forces to the technological advances that had transformed the conduct of warfare in the early Twentieth Century. Although the Army also neglected the impact that tanks and chemical weapons could have on the battlefield, its most notable oversight concerned the emerging significance of aviation and antiaircraft artillery on the conduct of warfare.²⁴

Already trailing most of the warring nations in the actual number of airplanes it possessed, America was lagging behind in its air doctrine and organization as well. Postwar reports by leading members of the American Expeditionary Forces Air Service

confirm that this situation continued through America's entry into the war. Colonel Thomas D. Milling, commander of the First Army Air Service, reported that:

at the time that we declared war on Germany few people in the United States knew about the Air Service or had any real knowledge about airplanes, types that should be employed or the use that could be made of them, either from a commercial standpoint or from the standpoint of war.²⁵

According to Brigadier General Benjamin D. Foulois, Chief of the A.E.F. Air Service (1917-1918), only six of the 65 officers and none of the 1100 enlisted men assigned to the Air Service had any experience in the organization of large numbers of men and materiel or the tactical use of aircraft. He lamented that the mission of these six officers had been to "build up a service larger than the United States Army [of 1916]" with limited support from a "pitifully inadequate aeroplane and engine industry..."²⁶

If the Army did not think seriously about the impact of air power prior to World War I, it had barely begun to consider developing a means to stop enemy airplanes from flying over friendly territory. In 1910, two Coast Artillery Corps officers, Captain Frank T. Hines and Major Franklin W. Ward, published *The Service of the Coast Artillery* in which they made "an earnest attempt to furnish an informative book for the use of the coast artillerists with special reference to militia duty in coast defense."²⁷ Hines, an honor graduate of the Coast Artillery School, and Ward, a National Guardsman from New York, spent 564 pages discussing various aspects of the coast artillery, including eleven pages on the employment of searchlights, but made no mention of aircraft or antiaircraft artillery. Even the discussion of searchlights focused on their use in detecting ships and submarines, not airplanes.²⁸ If the Coast Artillery Corps was not concerned about antiaircraft artillery in 1910, the Field Artillery made at least an initial inquiry a year later. Divorced from the Coast Artillery Corps in 1907, the Field Artillery appeared

to have considered some form of dual-purpose antiaircraft weaponry in 1911 when it purchased an Italian artillery piece with a split carriage configuration that allowed the gun tube to elevate much higher than the standard M1902 3-inch field gun.²⁹

By 1913, the concept of antiaircraft artillery advanced slightly when Congressman James Hay, Chairman of the House Committee on Military Affairs, raised the issue of defense against airplanes during a hearing in August on improvements in the Aviation Service. During the course of the hearing, the principal witness, Brigadier General George P. Scriven, the Army's Chief Signal Officer, described an air attack beyond the range of coastal artillery that might damage the Gatun Dam and thereby close the Panama Canal. While his description of the potential threat was remarkably prescient, his proposed solution—use airplanes and dirigibles to defeat the attack—conformed to the Signal Corps bureaucratic position on aviation rather than any sign of novel employment. Congressman Hay then asked if it was possible to use a gun against airplanes. Scriven responded that the German's had a Krupp Gun that “could be used against machines.” He continued: “The Ordnance Department has been experimenting, but I do not know that they have yet devised a gun.”³⁰ Unfortunately, most Artillery and Ordnance Department officers were unimpressed with the potential of the airplane as a weapon of war and focused their efforts instead on the ballistic problems involved in shooting down balloons. Much slower and less maneuverable than airplanes, balloons (or dirigibles) were easier to track and shoot down. Thus, when the Ordnance Department announced in late 1913 that the Army's 3-inch gun was sufficient for the purpose of firing against balloons, any effort to design a gun specifically for use against the more difficult airplane target ended.³¹

The Army owned only six Curtiss biplanes in August 1914, a minuscule number of modern artillery pieces--primarily 412 3-inch field guns located with units—and absolutely no antiaircraft guns.³² Given the dismal state of all types of artillery at the outbreak of the war in Europe in August 1914, the Army appointed a board of officers on April 17, 1915 to consider improvements.³³ The chairman was Colonel Charles Gould Treat (USMA 1882). Commissioned in Artillery, Treat taught artillery at West Point from 1900-1901 and was the commandant of cadets from 1901 to 1905.³⁴ The Board's 1916 report became known as the "Treat Board Report." In addition to a sizeable increase in the number of artillery pieces, the Treat Board recommended far-reaching changes in artillery including the design of a new 3-inch field gun with greater elevation, traverse, and range, a new carriage for the 4.7-inch gun, and the addition of very heavy artillery (7.6-inch, 11-inch, and 16-inch howitzers). Such heavy calibers were unknown in America and designed to operate against heavily fortified works. As such, the Board's recommendations reflected its view of the war in Europe and set the stage for the Army's potential involvement. The Board also stressed the long lead time necessary to manufacture artillery pieces, emphasizing that for the first six months of any war the Army should expect no deliveries of artillery except those already in production. Furthermore, assuming that the Ordnance Department could obtain the requisite number of skilled personnel to build these weapons, the Army should expect a delay of eighteen months for the large program recommended.³⁵

Prior to late 1916, any thought toward antiaircraft defense had been confined almost exclusively to the design of fixed units for coast defense. By April 1916, the Ordnance Department had even designed a fixed mount for the 3-inch gun for use at coastal

fortifications. As the impact of the airplane on the war in Europe grew, however, the Army began to realize the need for antiaircraft weapons to support the force in the field. On April 2, 1917, after reconvening to study antiaircraft artillery, the Treat Board recommended a program of antiaircraft artillery based on an Army of 1 million men consisting of fifteen corps and four cavalry divisions. Establishing the first official requirement for antiaircraft artillery in American history, the Board suggested the Army create 102 batteries of 3-inch mobile antiaircraft artillery guns to support a force this size. Based on reports of German bombers striking supply depots and trains away from the mobile field force, the Army added another 51 batteries to the Treat Board's recommendations. Adding 10 percent for protection of "artillery parks and training camps" brought the total number of batteries to 168 at a cost of \$100,000 per battery or a total of \$16.8 million.³⁶

The Army followed shortly with a confidential report entitled "Notes on Anti-Aircraft Guns" compiled at the Army War College and issued by the War Department on April 28, 1917. The "Notes" offer an interesting snapshot of antiaircraft artillery development in the major warring nations. Although published in late April 1917, most of the data was current as of late 1916 and indicates that the Army was at least observant, if not somewhat forward thinking. The amount of discussion given to each nation's antiaircraft weaponry indicates both that country's level of antiaircraft development and its subsequent value to American forces as Army planners attempted to cull important lessons on doctrine, technique, and weapons specifications. The twenty-eight page report spent almost ten pages discussing and illustrating German antiaircraft weapons and techniques, nearly six pages on the French weapons and methods, three pages on British

antiaircraft artillery, a half page on the Italian force, and one page on *anticipated* antiaircraft developments in the United States Army. While all nations had antiaircraft guns of various types mounted on automobiles, the French maintained semi-mobile, platform-mounted guns as well as fixed (concrete) emplacements. By far the Germans were the most advanced, with Krupp providing most of the guns in use in late 1916. The Americans had the honor of being the least developed.³⁷ The report maintained that the American 3-inch gun was the “*only weapon designed for use by our Army specifically against aircraft.*” The report then went on to confess that this gun was exactly the same “in construction and ballistics” as the M1903 3-inch gun. Indeed, what was eventually to become the M1917 3-inch antiaircraft gun was in 1917 only an Ordnance Department prototype. It may have been the “*only weapon designed*” for antiaircraft use, but it had not been *built* yet.³⁸ The tentative and underdeveloped nature of American antiaircraft artillery became obvious when the report explained that the Ordnance Department was “designing or building three different mounts for anti-aircraft artillery.” One mount was the fixed pedestal mount (designed in April 1916) for the M1903 gun. The other two mounts were for the M1902 3-inch gun—one on an automobile and the other on a semi-portable platform. Efforts fragmented further as the Engineer Department had plans to mount the gun on a standard railway car, a light flat railcar that could be pushed by hand, and on a truck.³⁹

World War I – The Army Looks for Answers

Despite ample warning and some early thinking about force structure, when America entered the war on April 6, 1917, intervention caught the Army largely unprepared. Upon receiving notice to return to Washington, D.C. where he would be

given command of an American military force bound for Europe, Pershing was disappointed when he realized “that so little had been done in the way of preparation ... that might have been done before....” According to Pershing, the lack of foresight “[did not] inspire confidence ... in the crisis that confronted us.”⁴⁰ Not surprisingly, the inattention given to the Army’s war needs carried over into its doctrine for dealing with the emerging third dimension of warfare. While it extolled the benefits of maneuver warfare and offensive action, the 1917 edition of the Army’s *Field Service Regulations* contained only two short pages on aerial reconnaissance, one paragraph on the benefits of camouflage to counter such reconnaissance, and nothing on using aircraft to attack ground troops. Given the dearth of pilots, airplanes, and aviation doctrine that existed as America began its initial mobilization for war, one could hardly expect military planners to have formulated a response to the still unarticulated threat posed to ground troops and logistics bases by attacks from the air.⁴¹

It did not take long, however, for the Army to become aware of the emergence of military aviation as a factor on the battlefield. Shortly after the United States declared war on Germany, the Allies initiated series of liaison missions designed to exchange information and speed the nation’s mobilization and active participation in the fighting. Unfortunately, this process was less straightforward than expected. Often information provided by the French and British missions contradicted each other and succeeded in confusing an already disorganized process of mobilizing the Army for war. War Department Chief of Staff Major General Tasker H. Bliss maintained that with so many varied opinions on technical matters, the missions were not even “allied among themselves.”⁴² The animus between the French (Joffre) and British (Graves) missions

was such that on more than one occasion the Chief of Staff's office would telephone the War College faculty and urge them to hasten the departure of the British mission, as members of the French mission were on their way over to discuss the war.⁴³

One way for the Army to obtain a clear view of conditions on the Western Front was to send officers over to observe operations for themselves. On one mission, the Army dispatched a group of officers, civilian engineers, and production specialists to Europe to investigate Allied air service operations and gather aircraft design and production information. This group, led by the recently commissioned civil aeronautics expert, Major Raynal C. Bolling, spent six weeks visiting factories and flying units in England, France, and Italy before returning to Paris to file its final report. As part of its findings, the Bolling Mission reported that "fighting airplanes and bombers" held significant military potential. Additionally, it highlighted the impact that anti-aircraft artillery had on limiting the effectiveness of air service operations. The report concluded that successful ground combat resulted from the use of "tremendous quantities of high explosives" in "systematic and continuous" artillery bombardments directed on "selected objectives." Understandably, Bolling deduced that "airplane bombardment" was the logical extension of the ground artillery. He predicted "definite and important results [if] ... very great numbers of airplanes carrying great ... numbers of bombs [could] be ... used continuously and systematically."⁴⁴ The report cautioned, however, that day bombing presented "greater difficulties than night bombing because it [could] not be conducted successfully ... if the enemy [had] in the air any number of fast [defensive] fighting machines or a great number of anti-aircraft guns effective at great altitudes."⁴⁵

Frustrated by the lack of a coherent picture concerning the weapons, techniques, and methods used in the war, Secretary of War Newton D. Baker sent a separate group of officers abroad to collect information that might aid the Army in organizing its expeditionary forces.⁴⁶ Departing on 28 May 1917, a board of officers led by Quartermaster Colonel Chauncey B. Baker spent six weeks visiting Allied military headquarters and frontline units. As it turned out, the selection of Baker, a former infantryman and veteran of the fighting in both Cuba and Mexico, was rather fortuitous. In addition to the combat experience and organizational skill that Baker brought to bear on the project, he and A.E.F. commander-designate Major General John J. Pershing were both members of the West Point Class of 1886. This mutual background as well as their shared experiences at Fort Leavenworth enhanced cooperation between the officers in Colonel Baker's group and those assigned to Pershing's Operations Section located in Paris.⁴⁷ As a result, the efforts of the Baker Board dovetailed smoothly into the work of the Operations Section and helped form the basis of the General Organizational Project of the American Expeditionary Forces. In one of its more significant findings, the Baker Board concluded that air power played an important role on the battlefield. Moreover, in response to the threat that the airplane posed to ground forces, the Board recommended that the Army establish antiaircraft schools and training facilities in the United States and France.⁴⁸

Antiaircraft Artillery Gets its Start

Acting on this recommendation, General Pershing directed his staff to incorporate a comprehensive system of antiaircraft defense into the General Organizational Project of the American Expeditionary Forces. The plan, as reported by Major Hugh A. Drum of

the Operations Section, called for an extensive system of antiaircraft defenses at both corps and army level. To protect the four combat and two replacement divisions allocated to each corps, Drum proposed one antiaircraft gun battalion with four batteries of three 3-inch guns each as well as one machine gun battalion of almost 800 men. To defend the troops and installations located in the army area of responsibility, Drum planned for an additional twenty antiaircraft gun platoons consisting of sixty-two men and two 3-inch guns each. To implement these plans and identify the resources available for the creation of an antiaircraft service, General Pershing sent three Coast Artillery Corps officers--Brigadier General James A. Shipton, Captain George F. Humbert, and Captain Glenn P. Anderson--to Europe in July 1917. Shortly thereafter, the A.E.F. General Headquarters established the Antiaircraft and Trench Mortar Schools at Langres, France and placed Shipton in charge of both. These actions laid the foundation for the future development of an Army antiaircraft artillery organization.⁴⁹

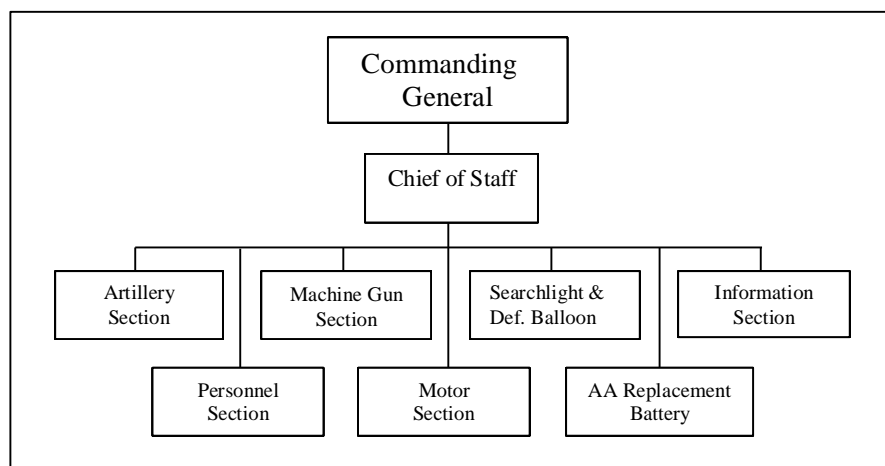
When the Army decided in spring 1917 to assign the antiaircraft mission to the Coast Artillery Corps, Shipton, Humbert, and Anderson as well as a number of underutilized seacoast artillerymen became available to Pershing to man his fledgling Antiaircraft Service. With the German Imperial Fleet confined to European waters by 1917, the Coast Artillery Corps had the freedom to release men from its traditional seacoast and harbor defense mission to undertake the emerging task of antiaircraft defense. Further reinforcing this decision was the acknowledged ability of seacoast artillerymen to fire at ships moving in two dimensions. By logical extension, this ability made them the most appropriate candidates to attempt to fire at airplanes moving in three

dimensions. It is ironic that what was an obvious and rapid decision in time of war would cause resistance among rank and file coast artillerymen in the decades after the war.⁵⁰

Regardless of how he came to be available, Shipton was an excellent choice for the job at hand. As one of the more senior Coast Artillery officers in the Army, Shipton brought twenty-five years of knowledge and experience to bear on the problems of training and organization. An Ohio native, Shipton entered the Military Academy at the age of twenty-one, graduating fifteenth in a class of sixty-two in June 1892. As a result of his relatively high finish, Shipton was able to select the second-to-last opening in the Artillery, leaving officers no less notable than John McAuley Palmer and Charles P. Summerall with commissions in the Infantry. In between tours as a Military Attaché in Brazil and Argentina, he served in the 41st and 47th Infantry Regiments, United States Volunteers, commanding troops in six engagements in Southern Luzon during the Philippine Insurrection. After attending the Submarine Defense School in 1906, Shipton changed career paths and transferred to the newly created Coast Artillery Corps in 1907. Following a series of staff and command positions, he graduated from the Army War College in 1916 and received a temporary promotion to Brigadier General shortly after the outbreak of the war.⁵¹

Upon arriving in Europe in August 1917, Shipton quickly realized that his fledgling organization was nothing more than a paper tiger. In fact, his situation rivaled that of the Air Service. He had no troops, no equipment, and only 25 officers trained at the French Antiaircraft School. Furthermore, he had to establish an American antiaircraft school and training center for troops arriving in December 1917. His first task was to give shape to the organization he now commanded. Assisted by Humbert and Anderson,

Shipton drafted plans for the headquarters under which the incoming anti-aircraft artillery units would fall. In his plan, the Headquarters, Anti-aircraft Service consisted of seven sections, three of which--the Artillery section, the Machine Gun section, and the Searchlight and Balloon section--formed the nucleus of the Anti-aircraft School and mirrored the composite nature of the Anti-aircraft Service.⁵²



Source: Charles Kirkpatrick, *Archie in the A.E.F.: The Creation of the Anti-aircraft Service in the U.S. Army, 1917-1918*, (Fort Bliss, TX: The U.S. Army Air Defense Artillery School, 1984)

Figure 5.1 -- Anti-aircraft Service Headquarters

With the organizational structure established, Shipton and his staff turned their attention to creating a school system to train the troops. Shipton's original intent was that the "anti-aircraft school ... include both anti-aircraft artillery and anti-aircraft machine gun" instruction at Langres.⁵³ While equipment shortages and limits on training areas forced him to separate the two courses, these two subjects remained at the core of the curriculum. To man the school as well as staff his headquarters, Shipton took the twenty-five officers trained by the French and divided them between the two duties. Shipton

originally assigned Humbert to supervise training at the school, but in mid-October the Army reassigned Humbert and ordered Major Jay P. Hopkins to replace him as the Director of Troop Training. Hopkins, like Shipton, was another member of the "Long Gray Line" who started his career as an artilleryman and later transferred to the newly created Coast Artillery. Commissioned in 1900, Hopkins excelled at artillery, graduating with honors from the Artillery School in 1907. Hopkins' first assignment of the war was as a railway artillery battalion commander employing his Coast Artillery weapons against ground targets. When Shipton departed in October 1918 to command the 58th Field Artillery Brigade, Hopkins replaced him as the Chief of the Antiaircraft Service.⁵⁴

Although a lack of equipment and training facilities forced Shipton to disperse the elements of the antiaircraft school, Hopkins noted in his "Final Report of the Chief of the Antiaircraft Service" that this move had some unexpected benefits. The shortage of antiaircraft artillery guns drove Shipton to relocate this portion of the antiaircraft school to Arnouville near the French school and the Paris antiaircraft defenses. The move gave the American coast artillery gunners training at the school the opportunity to train with actual guns as opposed to having to rely on purely theoretical instruction. Moreover, it provided the French, who experienced constant manpower shortages, with personnel to man the guns defending their capital. As more trained units became available, Shipton continued this policy and rotated units into the front lines to augment critically short French units. The first units sent to the front arrived on 15 April 1918 and soon sections of American "Archies" were filling French antiaircraft batteries from Verdun to Belfort.⁵⁵ Concerning the performance of these units, Hopkins later wrote that they "invariably displayed such aptitude that they were given equal opportunity with the French for

firing."⁵⁶ He also noted that in many cases French units were so shorthanded that they surrendered total control of the battery to the Americans.⁵⁷

Antiaircraft Gunnery

In addition to providing his men with equipment on which to train, Shipton had another motive for wanting to locate his gunnery course near the French school. By collaborating with the French, American officers could keep abreast of the latest developments in antiaircraft techniques. As a result, officers learned "the theory and practice of the latest fire control methods" as well as various "discarded methods where the principles involved were interesting."⁵⁸ Shipton felt this made the officers more competent and better qualified to instruct their men in antiaircraft techniques. His attitude toward "technical shooting" further reinforced his preference for French methods. He believed that the French had taken the lead in antiaircraft gunnery, while the British seemed content to rely on the unscientific and inconsistent technique of visual adjustment of the round on target.⁵⁹

This reliance on French "technical shooting" demanded a high degree of scientific skill and mathematical ability. First, it required an accurate, rapid measurement of the airplane's speed, altitude, and course in order to measure the lateral and vertical deflection to the target. When computed correctly, this information yielded a predicted flight path for the target. Second, crews had to factor in the known trajectory and velocity of the artillery round as well as the fuze setting. If everything worked properly the round exploded near the target along the predicted flight path. More normally, the round crossed behind the aircraft because crews could not make the proper adjustments fast enough to lead the target. The greatest flaw in this process, however, was the

assumption by both French and American gunners that the pilot would maintain a steady course in order to preserve his altitude as a means of escape in the event of malfunction or attack. In reality, when under fire most pilots adopted what the British called the "wobble her about a bit" method, making changes altitude and direction or "zig-zagging."⁶⁰

Adherence to French methods meant that Americans had to master two very distinct French fire control techniques--the "angle of approach" and the "tachymetric" methods. The "angle of approach" method used an "angle of approach telescope" to measure the angular velocity of the target. Crews then consulted trajectory and time of flight firing tables to compute the deflection settings required to aim the gun. The "tachymetric" method employed either an electric or mechanical instrument that measured the azimuth, elevation, and speed of the target and produced deflection data. American soldiers used two types of instruments to determine these measurements—the "Brocq Apparatus" and the "Routin mechanical tachymeter." The "Brocq Apparatus" used two coaxially mounted electric telescopes to predict the flight path of the airplane. These instruments measured the flight of the target and sent an electrical current to a rheostat mounted on the gun that indicated the proper deflection settings. It proved too frail, however, for use in the field. The "Routin mechanical tachymeter," operated on the same principle, but employed cams and gears in a mechanical speedometer to produce the proper deflection data. The gun crews then received this data over the telephone from the fire control crews. The estimated delay in using the mechanical tachymeter was approximately three seconds. When asked during a postwar lecture on antiaircraft

artillery which method he preferred, Hopkins stated that both methods were theoretically identical, but that the crewman preferred the "tachymetric" method.⁶¹

Shipton's emphasis on the technical aspects of antiaircraft artillery employment carried over to his policy regarding training standards. As Hopkins described it, Shipton based his policy on "instruction rather than elimination." Thus, when an officer failed an examination, the faculty investigated each case to determine if the "officer's previous scientific and technical training or inherent ability was such as to make him valuable to the service."⁶² If found worthy enough, the officer continued his career in the Antiaircraft Service. If not, the school recommended that he transfer to another branch.⁶³

Shipton's stress on the technical methods also influenced his opinion of the mission of the Antiaircraft Service. As he saw it:

the principle function of antiaircraft artillery [was] to prevent hostile planes from accomplishing their mission; preventing bombing planes from reaching their objectives; preventing artillery observation planes from remaining in the vicinity of the target; driving off photographing planes; [and] breaking up battle-plane formations.⁶⁴

Thus, by focusing on technical methods, the antiaircraft school discouraged the British method of random shooting that aimed at earning a kill and instead emphasized the need to reduce the aircraft's ability to perform its assigned mission. Shipton's mission statement also indicates his understanding of and balance between the moral and the physical domains of battle. Shipton understood that, given the extremely rudimentary antiaircraft equipment and technique of employment, to hit an enemy aircraft required more luck than skill. While the physical destruction of an enemy airplane was valuable, it was also rare. As Hopkins later stated, "the actual bringing down of enemy planes ... can be regarded only as a fortunate incident."⁶⁵ To dominate an enemy pilot in the moral

or psychological dimension of battle, however, was achievable. In an early example of “effects-based operations,” it did not matter if an antiaircraft battery killed an enemy pilot or merely drove him away as long as he could not bomb, strafe, or photograph friendly units.⁶⁶

“Technical shooting” and the emphasis on the moral effect of antiaircraft fire drove the Antiaircraft Service to prefer high explosive ammunition to shrapnel shells. Shrapnel shells blasted jagged bits of metal in all directions, while high explosive shells produced a large burst and concussion. Shrapnel shells had a larger, more efficient volume burst, but made relatively small holes in aircraft. They also showered those below with fragments and as such were only used on the front lines. High explosive shells were less efficient, but exploded more violently. Pilots feared them more because they *looked* more deadly.⁶⁷ As Captain Glenn Anderson of the Antiaircraft Service explained, “Consider the effect on the aviator’s nerves when a High Explosive went ‘BANG!’ ... [H]e felt a sickening feeling as his machine tilted and plunged downward, even if he was a later able to right himself.... How much value should the Boche commander attach to a man working under such circumstances?” The “true value of antiaircraft fire,” Anderson maintained, is to “make him dodge, dodge, and drive him up, up, up.”⁶⁸

Machine Gunnery

The second course taught by the Antiaircraft School dealt with machine gun training. In a process similar to what occurred with the antiaircraft gun course, the School chose an officer familiar with the equipment to teach machine gun instruction. The School initially selected Major William F. L. Simpson, an infantryman and veteran

of both the Moro and the Mexican Punitive Expeditions; but Simpson died in January 1918 from appendicitis. His replacement, Marine Major Andrew B. Drum, achieved great success in training over 4500 soldiers in the short period between 27 May-30 November 1918. Part of the reason for Drum's success was that his program did not face the same impediments to training that the gun units experienced. Unlike the antiaircraft gun course, the units attending machine gun instruction had plenty of machine guns to operate and did not have to collocate with another unit in order to train. Equally important, however, was Drum's ability to create a realistic training environment for his soldiers.⁶⁹

One of the first tasks thrust upon Drum and the staff of the Machine Gun Section involved the selection of a machine gun for use in both training and combat. While an adequate number of both the Hotchkiss and St. Etienne machine guns existed, the section discovered that the St. Etienne could not fire at all angles of elevation. As a result, the School adopted the Hotchkiss machine gun. In addition to selecting the type of machine gun, the School also experimented with various antiaircraft machine gun sights. The one found most effective was a French sight known as the "Infantry Corrector," which offset the normal ground sight and provided for superelevation.⁷⁰

Concerned about the quality of the training his troops received, Drum decided to move his School Detachment from Langres to Montaubon about eight kilometers away to take advantage of an area known as the Courcelles-en-Montage Antiaircraft Firing Ground. Through ingenuity and zeal, Drum turned the twenty-five square mile ravine into an excellent range. He conducted ground firing against the ravine walls. For aerial firing, he floated balloons over the terrain. Despite his early success at creating

challenging targets, Drum still worried that the training was not realistic. His ultimate solution to this problem proved quite ingenious. To simulate a faster moving, more realistic aerial target, Drum ordered a motorcycle driver to tow an airplane-shaped target along the ridge that ran above the ravine. With the driver protected by a stonewall, the soldiers below saw only the target and could practice live-fire traverse and elevation without endangering the rider. This type of training paid large dividends once machine gun units reached the front lines. As Hopkins noted in his "Final Report," the later success of antiaircraft machine gun units was in no small part due to the "initiative, zeal, and untiring efforts of Major Andrew B. Drum."⁷¹

Searchlights and Barrage Balloons

The final element in the Antiaircraft Service triad of weapons was the searchlight. Early in the war, the Army discovered that the limited range of field searchlights prevented their effective use on the front lines. Although their range was not sufficient to emplace them beyond the range of enemy artillery, the searchlights did possess enough power to illuminate incoming aircraft. As a result, the Antiaircraft Service incorporated searchlight training into its curriculum in June 1918. As it had with the other two legs of the triad, the Antiaircraft School dictated that the Army proponent responsible for searchlights teach the course. Thus, when searchlight classes began, the commander of the 56th Engineer Regiment (Searchlights), Lieutenant Colonel J. C. Gotwals, incurred an additional duty as the Director of the Searchlight School. In this case, not only did it make sense to have the expert teach the course, but it also made for good planning and coordination as the companies of the 56th Regiment supported the other elements of the Antiaircraft Service with searchlights once they reached the field.⁷²

Despite the heavy reliance on French "technical" methods in other areas of antiaircraft training, the use of searchlights remained the one area uninfluenced by the French. In an attempt to locate targets at night, the French did not use searchlights, but instead relied on sound detectors to provide gunners with a firing azimuth. Unconvinced that the French method was effective, the Americans followed the British example of employing both listening equipment and searchlights to find the target. The sound detectors picked up the aircraft noise and provided the searchlights with a rough initial azimuth. Once the searchlights illuminated the target, the gunners set their aiming mechanisms and fired. This procedure had numerous advantages. First, in concert with the Antiaircraft Service's more technical outlook, it saved ammunition by enabling the gunners to calculate trajectory more accurately than their French counterparts, who literally fired blind. Second, and perhaps more important, searchlights had "a great moral effect on the enemy aviator, not only because of the probable fire that will follow, but also because of the effect of the light itself."⁷³ Blinded by the light and aware of an upcoming barrage, most pilots lost either their resolve or their way to the target.

Although the Antiaircraft Service developed into a self-contained organization after the war, its wartime field organization mirrored the composite example set by the Antiaircraft School and consisted of units from three different branches of the Army. The Coast Artillery, deemed by the Army the most familiar with firing large caliber weapons at moving targets, received the mission to supply troops and training for the antiaircraft gun units. For similar reasons, the Army selected the Infantry to provide men and instruction to the antiaircraft machine gun units and the Engineers to do the same with regards to searchlights. In this case, however, the Engineer branch did not surrender

ownership of their searchlight units or equipment. Instead, the 56th Engineer Regiment distributed its ten searchlight companies throughout the Antiaircraft Service on an as-needed basis. In addition to its work with the Antiaircraft Service, the Searchlight Regiment also supported Air Service attempts to intercept enemy aircraft at night with searchlight-directed pursuit planes and provided illumination for emergency aircraft landings.⁷⁴

One worthwhile and accepted technique not employed by the Antiaircraft Service was the use of protective or barrage balloons. The French, British, German, and Italian forces all employed barrage balloons of various shapes and sizes. The leaders of the American Antiaircraft Service wanted to use them, but a shortage of manpower and bureaucratic infighting conspired to ensure they never made it into battle. Balloons, large tethered dirigibles with wires connecting them, were ideal for blocking specific avenues of approach from use by airplanes. Fearful of crashing into a wire and losing a wing or worse, pilots who spotted the balloons would fly around them only to find themselves illuminated by spotlights and targeted by antiaircraft fire. Due to a shortage of manpower, early plans to use balloons were put on hold. The Air Service wanted balloons for the protection of airfields until it learned that Air Service personnel would man the antiaircraft balloon battalions, but men from the Antiaircraft Service would command them. Upon learning of this arrangement, the threat to Air Service airfields declined and the Air Service ended its request for balloon battalions. Of the four proposed balloon battalions, none were created.⁷⁵ The issue of barrage balloons lay fallow for a number of years only to reemerge in the early 1920s as both the Army Air

Service and the Coast Artillery Corps sought to establish bureaucratic control over air defense assets.

Stateside Antiaircraft Training

Shortly after Shipton established the Antiaircraft Service and the various elements of the Antiaircraft School in France, the Army followed the advice of the Baker Board and added an antiaircraft artillery course to the Coast Artillery School at Fort Monroe, Virginia. Given the limited training area at Fort Monroe and the ever-increasing number of officers and men to train, the Army also established Camp Eustis up the James River near Newport News. Finding qualified instructors to teach antiaircraft techniques, however, proved more difficult than acquiring training land. It seemed logical for Colonel John Lundeen, the commandant of the Coast Artillery School, to request that Shipton return some of his most highly qualified officers to Fort Monroe to serve as instructors for the new cohorts of antiaircraft officers and men being trained there.⁷⁶ Shipton, however, did not see it that way and argued vehemently, “No American officers now on duty in France should be sent back to the United States.... The services of all are very important here.”⁷⁷ Shipton lost the battle and at least fourteen officers returned to Fort Monroe by September 1918.

Hopkins continued the protest and became particularly upset when he found out that two of his officers were not teaching, but conducting routine coastal defense duties.⁷⁸ Shipton and Hopkins were busy fighting the “*war proper*” and could not understand the diversion of trained men to other duties back in the United States. The immature state of the Antiaircraft Service and the immense technical difficulty involved in training its soldiers, however, mandated the *preparing* of antiaircraft forces in the United States for

deployment overseas. Shipton and Hopkins argued on principle, but their views were shortsighted. To the Antiaircraft Service the stakes were small, but the payoff was large as a series of five-week courses in antiaircraft instruction began in February 1918, each producing twenty to forty officers for the Army in France.⁷⁹

Tactical Planning Confronts Logistical Realities

Given the difficulty of integrating such a diverse organization, one comprised of French guns, Coast Artillery antiaircraft gunners, Infantry machine-gunners, and Engineer searchlight operators, the Antiaircraft Service wanted a simple plan to maximize the firepower available to the patchwork force. The plan, drafted by officers in the Headquarters of the Antiaircraft Service, divided the American sector in depth, corresponding to the alignment of forces along the front and those located in the rear with the Services of Supply. In theory, air defense at the front consisted of antiaircraft gun units (tube artillery capable of shooting at high angles) and machine gun units. The plan organized the artillery units into separate four-battery battalions with two guns in each battery. This arrangement differed slightly from the three-gun plan recommended by Major Hugh Drum of the A.E.F. Operations Section. The reduction from three guns to two per battery occurred for two reasons. First, a shortage of guns made it difficult to place three guns in each unit. Second, according to Hopkins, the Allies believed that the extra distance created by emplacing all three guns in a line outstretched the commander's ability to control his battery. Behind the first line of guns, the Allies hoped to include a second line of gun battalions to provide more robust defense in depth.⁸⁰

With respect to machine gun units, each battalion consisted of four companies of three platoons. Each platoon contained four machine guns for a total of 48 machine guns

in each battalion. The plan interspersed these battalions between the gun units, although it made no provisions for communication or fire control between the two separate units. There was no thought to establishing an “integrated” defensive system. Finally, the plan directed the Searchlight Regiment to retain its current organization of ten separate companies with five platoons of three lights each and distribute them in a band across the front. In the rear area, the organization remained virtually unchanged except that the plan grouped the antiaircraft gun batteries into sectors instead of battalions. In this manner, the plan permitted the detachment of independent batteries to guard separate point targets without incurring any incidental administrative burden.⁸¹

Despite the great strides made by the Antiaircraft Service in training and organization, poor logistics limited the Army to deploying only a small portion of the 12,000-man Antiaircraft Service eventually assembled by the A.E.F. Although the Antiaircraft Service experienced some supply problems in every sector, the greatest problem existed with the supply of antiaircraft guns. The problem of antiaircraft gun supply, however, was only a subset of the larger problem of preparedness and industrial mobilization that plagued the American war effort.

Modern warfare demands modern equipment of such complexity and quantity that a nation cannot produce it overnight. Both the War Department and Congress acknowledged this reality well before America entered the World War I. In 1916, the Chief of Ordnance, Major General William Crozier, repeatedly emphasized the time needed to design and produce equipment.⁸² In one instance, he complained that to produce enough artillery ammunition for a one million man army would take 50 to 100 times the capacity of the Frankford Arsenal, the primary agency for the production of

artillery ammunition.⁸³ Prophetically, he lamented that “my little organization would simply go down like a house of cards under such a burden as that.”⁸⁴

Crozier was right. Discouraged by President Wilson from planning for a war with Germany, the War Department was slow to act in April 1917. A series of inopportune, but defensible decisions further exacerbated this condition. In March 1917, the Ordnance Department ordered the large American steel companies to honor the existing manufacturing contracts they held with the British and French. Then, on April 28, 1917, the Counsel of National Defense gave priority to the Navy for “... such needs ... as are intended to be completed within the period of one year.”⁸⁵ These decisions resulted in the complete consumption of both the existing supply of trained workers and the majority of standing facilities, leaving the Ordnance Department to create a new work force and develop new factories. In the end, poor overall planning, bad management, and the lack of time available for industry to overcome its mistakes forced the A.E.F. to depend on the Allies for tanks, airplanes, artillery, machine guns, and antiaircraft artillery guns.⁸⁶ While this situation reduced the amount of shipping needed to speed American soldiers to Europe, it also meant that those same soldiers had to wait to arrive in France before they could begin training with their equipment.

Within the larger industrial supply problem, three factors combined to insure that the Antiaircraft Service would never receive any 3-inch antiaircraft guns during the war. First, estimated requirements for field artillery pieces surpassed the projected supply to such an extent that concern for the needs of the Antiaircraft Service lost all priority. Early in the war, General Pershing’s staff estimated that the Army required the immediate delivery of over 2,500 artillery pieces. This figure clashed with reality when the

Ordnance Department announced that it could only produce 120 guns by the end of October 1917 and none after that until June 1918. This disparity, reinforced by the apparent importance of artillery on the Western Front, guaranteed that any available artillery would go to the front for use against surface targets and not airplanes.⁸⁷

Second, when the war began the Ordnance Department planned to manufacture 3-inch artillery pieces with a modified anti-aircraft artillery mount for use by the Anti-aircraft Service. Initial progress reports from the Department appeared promising. In fact, on 15 October 1917, Major General Crozier reported, "3-inch anti-aircraft artillery guns [were] under manufacture in quantity."⁸⁸ In reality, the situation was just the opposite. What passed unnoticed by most was that in 1917 the 3-inch Anti-aircraft Gun (M1917) existed only as a prototype and would remain unfinished for months. Furthermore, these guns, when produced, may not have ever arrived in France.

In his 1916 report to the War Department, the Chief of Coast Artillery, Major General Erasmus Weaver, recommended adding a total of 159 3-inch guns to the arsenals of the coastal fortifications and the insular possessions. Over the next two years (FY1917 and FY1918), appropriations for anti-aircraft guns (exclusive of the 15 June 1917 Urgent Deficiency Bill) provided for the production of seventy-two and eighty-seven guns per year. Although no anti-aircraft guns ever reached the A.E.F., by the end of the war the Ordnance Department had produced 159 3-inch anti-aircraft guns, all in place at various coastal locations in the United States, Panama, Oahu, and Manila. A comment to the Adjutant General in a March 1920 memorandum written by Weaver's successor, Major General Frank W. Coe, confirms this conclusion. In recommending a readjustment of the nation's anti-aircraft defense, Coe stated, "the present assignment of 3-inch anti-aircraft

guns, M1917, was based on conditions which no longer exist. It was a hurried war assignment...."⁸⁹

The Urgent Deficiency Bill of 1917 also provided for the production of an additional 318 3-inch antiaircraft guns, but specified that the guns were for coast defense only. With the threat to American shores declining, the possibility existed that some of the 318 guns might eventually reach the A.E.F. In June 1917, however, after meeting with M. J. M. Ganne, Directeur des Services de Fabrications de Guerre du Haut Commissariat, and Colonel Hemond of the French Military Mission, Major General Crozier recommended that the United States adopt French caliber artillery pieces and switch production from American 3-inch and 6-inch guns to French 75-mm and 155-mm guns.⁹⁰

Several factors influenced the decision to switch calibers. First and most important, the United States possessed a very limited production capacity to manufacture its own artillery pieces. Second, Great Britain was unable to supply any armament, while the French promised to do so. Third, the nation had recently decided to fight in the French sector. Fourth, using different calibers increased the logistical burden on the Army and made the already difficult task of moving equipment and repair parts across the battlefield much harder. Therefore, ensuring compatibility between American and French forces made sense.⁹¹ Whatever the United States could not provide, the Army could get from the French. Unfortunately, this policy failed to consider the very real possibility that, despite French promises to provide 75-mm guns beginning in August and 155-mm guns starting in October 1917, the economic and industrial exigencies of the war

had pushed French production to the limit.⁹² This situation made the French supply of American forces problematic.

The decision to switch calibers also discounted the time necessary to translate French weapon diagrams and convert the nation's limited manufacturing facilities to support building French systems. The time needed to accomplish these prerequisites risked delaying production beyond the point where the Ordnance Department could achieve any meaningful output before the war ended. Indeed, when the French weapons diagrams reached America, there were multiple drawings and different specifications for the same shells and weapons. Numerous errors were discovered. Many of the drawings did not match the shell models. This situation led to intolerable delays and caused technicians in the Engineering Division of the Ordnance Department to joke that the French drawings sent to America were really intended to fall into German hands. It took until December 1917, eight months after America declared war, for the Ordnance Department to convert all of the drawings and issue them to production sources.⁹³

Although converting from 3-inch to 75-mm guns took valuable time, the Ordnance Department's greatest problems came in producing the necessary support equipment to accompany the guns. In particular, the Ordnance Department had to create design criteria and mass production techniques for the fire control mechanisms and "recoil recuperators" previously made by hand in France. The Ordnance Department also experienced problems in obtaining optical glass for telescopes and fire control equipment from Europe. Eventually, the Carnegie optics laboratory perfected the glass, but by then the end of the war overtook the production process. This series of problems partially explains why the Ordnance Department let contracts for just 3% of the \$14 billion in

orders placed by the Army and spent only \$173,782 of the \$760,000 appropriated for the purchase of anti-aircraft guns under the Urgent Deficiency Bill before Congress froze spending in November 1918.⁹⁴

In his 1919 *Report of the Chief of Staff*, General Peyton C. March lamented: “The declaration of war on April 6, 1917, found the United States from a military, industrial, and economic standpoint, thoroughly unprepared for the great task which confronted it.”⁹⁵ Underneath the umbrella of unreadiness that covered the American military prior to World War I, three factors—priority to artillery weapons, misguided concerns over homeland defense, and industrial mismanagement—combined to limit the deployment of anti-aircraft gun units to the front and forced Shipton and Hopkins to incorporate their anti-aircraft gun personnel into existing French batteries. Excluding the problems associated with anti-aircraft gun procurement, however, supply constraints did not prevent other available anti-aircraft units from entering the fray. The searchlight units, already fully equipped, deployed in accordance with the plan. Of the proposed machine gun battalions, only two had completed training and deployed to the front prior to the cessation of hostilities.

In the end, despite the early problems of organization and training and the nagging worries over the shortage of supplies, the leaders of the Anti-aircraft Service adjusted to newfound conditions and performed admirably. In less than three months at the front, both the machine gun units and the amalgamated artillery forces proved the value of solid technical training and good organization. The anti-aircraft gunners using French 75-mm guns shot down seventeen aircraft with just 10,275 rounds of ammunition, an average of 605 rounds per airplane. By comparison, British anti-aircraft gunners

expended 10,000 rounds and the French 4,500 rounds for every airplane they downed. The machine gunners achieved even more impressive results. With just 25,115 rounds, the two battalions downed 41 German aircraft. While the stated mission of the Antiaircraft Service involved preventing enemy aircraft from obtaining air superiority and endangering friendly ground troops, "comparative results in actual planes brought down give a very fair measure of the accuracy of the shooting" as well as the quality of the training and leadership provided by Brigadier General James Shipton, Colonel Jay Hopkins, and Major Andrew B. Drum.⁹⁶

In the demobilization that followed the Armistice, the Antiaircraft Service of the American Expeditionary Forces largely disappeared. Most of the men were reservists who rapidly returned to civilian life. The remaining regular Army officers and non-commissioned officers all received assignments to coast defense batteries. What little survived of their equipment was either sold for scrap or discarded in France. To the few antiaircraft artillerymen that remained, their future course remained uncharted. In a telling comment in the May 1919 edition of the *Journal of the United States Artillery*, the editor challenged the leaders of the Coast Artillery Corps to take the initiative and lead the way in preparing a credible defense against the airplane. The performance of the Antiaircraft Service in World War I had established a standard worth emulating. The Corps' actions over the next two decades would prove whether or not it was up to the challenge.⁹⁷

CHAPTER 6

THE 1920S: A STRUGGLE FOR SURVIVAL AND FOUNDATION FOR GROWTH

We place our nation in a condition of great danger through our failure to appreciate the possibility of the airplane as a new offensive weapon.... Let us guard against military conservatism and be prepared to defend ourselves against this new weapon before we have to learn our lesson through unnecessary bloodshed.

*Captain Thomas R. Phillips
Coast Artillery Corps*

All was quiet on the Western Front as the war ended at 11 o'clock in the morning on November 11, 1918. The Armistice that brought silence to the battlefields of Europe, however, spurred consternation and conflict among the soldiers training at the Coast Artillery School at Fort Monroe, Virginia. Instrumental as a training ground for Coast Artillerymen of all types during the war, Fort Monroe and the neighboring areas of Camp Eustis and Camp Stuart were home to many soldiers whose unrequited desire was to see combat in Europe. Many had been training for over a year and eagerly awaited a chance to get into the fighting. To them, the Armistice was a bitter blow only made worse by being forced to hold a victory parade in nearby Newport News that afternoon. Like bride-less grooms left jilted at the altar, the troops glumly trudged through town, ignoring as best they could the catcalls of "tin soldiers" and "home guards" coming from some of the less understanding citizenry.

Later that day, these same soldiers returned to town with an eye toward trouble. With months of pent up energy, they were going to fight somewhere even if it were not on the Western Front. In no time, they succeeded in destroying the main street in Newport News in such a manner that city and military police forces were unable to stop them. Finally, after much damage, a ruse instigated by an Army officer commanding a reserve force of military police succeed in luring the men away from downtown and into a more isolated area where they were controlled. With the close of the Battle for Newport News, World War I ended for all Coast Artillerymen.¹ The battle, however, was a harbinger of things to come. For over the next decade, Coast Artillerymen would battle among themselves, with other branches in the Army, and with others outside the Army over the legitimacy of the antiaircraft mission and just who would be responsible to defend America and its ground forces from air attack.

As the men who actually fought on the Western Front returned from Europe, military planners and elected officials in the United States began to the task of redefining the structure of America's postwar military. If any questions concerning the form or function of the postwar force still existed as Congress opened hearings on the matter, growing popular sentiment against foreign intervention and increased military spending ensured that the size of the force would remain small. While the Congress exercised its legislative duty to "raise and support" the Army, eventually reducing it to 280,000 with the National Defense Act of 1920, others within the military worked to soften the effects of the reductions.

A Struggle for Survival

For Major General Frank W. Coe, the new Chief of the Coast Artillery Corps, protecting the interests of the Corps was not a static, defensive battle that relied on justifying the branch's position and parrying the thrusts of Congressional budget knives. On the contrary, Coe intended to take the war to "the enemy" and expand the responsibility of the Coast Artillery, absorbing men, material, and political power in the process. As a result of its wartime performance, the Coast Artillery Corps had already solidified its possession of the antiaircraft artillery mission. The diverse nature of the Antiaircraft Service, however, limited the impact of this achievement. Within days of the Armistice, Coe petitioned the War Department for authority to consolidate all of the men and material drawn from the Infantry and Engineers into the Coast Artillery.²

Control de jure of the antiaircraft artillery, however, was not Coe's primary goal. A diehard artilleryman, Coe disagreed with the 1907 Act that divided the Artillery Corps into two separate branches--the Coast Artillery Corps and the Field Artillery. His wartime experience as the Commanding General of the First Army Railway Artillery Reserve convinced him of the need to reintegrate the two artillery branches. During the war, the Coast Artillery's tractor-drawn and railway-mounted guns served as the basis for the Army's heavy mobile artillery corps. Viewing this as a repudiation of the 1907 Act--indeed, the Coast Artillery's big guns did serve as the Army's long range Field Artillery--Coe hoped that the days of being relegated to harbor defense were over. In his first postwar "Annual Report," Coe argued that the developments of the war had removed the "dividing line in modern artillery" and obviated "the causes which led to the separation of the Coast Artillery and Field Artillery in 1907." Furthermore, he urged that the economic

realities of the day required the elimination of redundant administrative overhead. He proposed that the most effective way to eliminate waste and promulgate the "common artillery doctrine" used by both branches during the war was through "one chief and one main Artillery service."³

Coe received partial support for his argument from the A.E.F. Superior Board of Officers on Organization and Tactics, which convened in France to study the lessons of the war. Under the leadership of Major General J. T. Dickman, the Board reviewed numerous independent reports and concluded that the new mobility of the large guns had erased any traditional division of responsibilities between the two artillery branches. Unfortunately for General Coe, the Board did not stop there. Carrying its logic one step further, the officers reasoned that coastal defense was more of a Naval responsibility than an Army matter. Additionally, the Board saw "no good reason for making anti-aircraft artillery a separate arm by itself." As a result, the Board recommended that the War Department transfer the Coast Artillery Corps' harbor defense functions to the Navy and incorporate the Corps' heavy mobile guns and anti-aircraft units into the Field Artillery. In short, instead of removing the dividing line between the two branches and possibly gaining bureaucratic control of all of the Army's artillery, Coe might have lost everything.⁴

Fortunately for the Coast Artillery Corps, the Army had no desire to relinquish its assets to the Navy. Additionally, reintegration with the Field Artillery posed problems of personnel seniority and assignment that made the idea infeasible. Thus, when Congress, as part of the National Defense Act of 1920, retained both branches as separate entities, the Coast Artillery survived extinction. Coe's efforts at reintegration, however, had

blurred the line between the artilleries and diminished the Corps' status significantly. Moreover, the National Defense Act created new positions for the chiefs of the Cavalry, Infantry, and Field Artillery arms. These positions elevated the leaders of those branches to a status equal with the Chief of the Coast Artillery Corps and other branch chiefs, further diluting Coe's bureaucratic power.⁵

The Chief of the Coast Artillery was not alone in his pursuit of bureaucratic growth; other leaders and services also attempted to advance their own interests. Of all of the branches competing for money and prestige in the immediate postwar period, none was more conspicuous than the Air Service. Armed with the knowledge that the airplane was one of the most important, yet under-exploited, weapons of the war, air enthusiasts quickly ensured that air power became a dominant Interwar issue. As part of their campaign for recognition, Army air power champions argued that an independent air force should replace the Navy as the principal defender of the American coastline. Aside from angering Naval officers, this argument implicitly threatened the future of the Coast Artillery Corps. Since its split from the Artillery Corps in 1907, the Coast Artillery maintained the responsibility for protecting the nation's ports, harbors, and naval bases with large caliber, platform-mounted guns and submarine mine fields. With air power enthusiasts arguing that Naval coast defense was obsolete, it stood to reason that sooner or later the argument would also include the Coast Artillery Corps.

The first challenge to the Coast Artillery emerged indirectly from attempts by the Air Service to gain autonomy from the Signal Corps and the Army. In July 1919, the Senate considered a bill to create a separate, consolidated Department of Aeronautics. In part, the bill required the transfer of all Army and Navy aviation services to the new

department. The bill also called for the peacetime centralization of all "anti-aircraft defenses," including antiaircraft artillery, machine guns, and searchlights. In wartime, however, the Department planned to transfer the antiaircraft artillery and aviation assets back to the Army and Navy for use. As expected, the Chief of Coast Artillery argued against losing a portion of his domain. After numerous false starts in the Senate Armed Services Committee, the bill collapsed under the weight of its own illogic.⁶

Although the bill caused temporary concern among the leaders of the Coast Artillery, these short-term worries resulted in long-term gains for the antiaircraft artillery. By compelling the leaders of the Corps to justify their retention of the antiaircraft artillery within the branch, the bill forced them to define the part that antiaircraft artillery should play in the defense against air attacks. In a memorandum to the Chief of the Coast Artillery outlining the Corps' position on the Senate bill, a staff officer highlighted the apparent difference in roles between the antiaircraft artillery and the Air Service. The memo stated that "the essential role of the Air Service [was] offensive.... It [was] the function of the pursuit plane to fight the enemy planes wherever found...." Antiaircraft artillery, on the other hand, was a defensive weapon whose "role with respect to the Air Service [was] analogous to that of the seacoast defense with respect to the Navy."⁷ In short, the antiaircraft artillery defense of a particular area relieved the Air Service of the burden of protecting that area. This situation permitted the Air Service the freedom of maneuver to seek out and destroy hostile aircraft much the same way that the coastal guns freed the Navy to send the fleet onto the high seas.

Having survived its first institutional crisis, the Coast Artillery found that its next challenge came from the Navy over the control of the antiaircraft defense of naval shore

stations. In February 1920, after hearing the Navy's case for control of both pursuit aviation and antiaircraft assets, the Army-Navy Joint Board, consisting of the Army Chief of Staff, the Chief of Naval Operations, and their principal operations and plans officers, ruled that both tasks should remain Army responsibilities.⁸ More importantly for the Coast Artillery, the Board confirmed General Coe's earlier recommendation to the War Department that the control of all antiaircraft armament, including that providing incidental coverage to naval units located in port, belonged to the Army. By extension, this ruling meant that the control of all antiaircraft artillery armament and personnel remained with the Coast Artillery.⁹

Oddly enough, a follow-on 1920 report produced by the Joint Board entitled the "Joint Army and Navy Action in Coast Defense" did not reflect any great Army preoccupation with air attack. Far from being a "joint action," the fifty-six page report reflected more individual Service equities than any coordinated effort. The first section, the only to discuss joint concerns, outlined the forces available to each service. The Army forces, cited as the "military forces in coast defense," included the Air Service, which had responsibility for observation by airplane and balloon and attack of enemy vessels and landing parties with "bombing and pursuit planes." Antiaircraft forces, under the heading of "Harbor Defenses," were to illuminate targets with searchlights and use antiaircraft weapons to keep enemy aircraft from attacking "important targets [with] their bombs, torpedoes, and machine-gun fire."¹⁰ With respect to the Army's mobile forces, the report lumped unspecified antiaircraft forces together with several other auxiliary and corps special troops, including artillery, engineer, medical, signal, military police, and logistics forces.¹¹

The rest of the report consisted of a Navy section on coast defense, and two Army sections—one a “positive system of coast defense” and the other a section defining terms and procedures for coast defense projects. Amazingly, it was the Navy, not the Army, which focused on protecting against air attack. The report listed “aircraft attacks on seaports” as its first of “eight general forms of attack on the seacoast.” The Navy devoted five full pages of analysis to the subject, twice mentioning Army antiaircraft forces and highlighting presciently the potential for air attacks on Pearl Harbor and the Panama Canal. In its fourteen pages on “a positive system of coast defense,” the Army focused on the last of the eight potential forms of attack, the defense against landing attacks, and never once mentioned antiaircraft forces.¹² If this report offers any insight into the relative importance of air power, antiaircraft artillery, and seacoast artillery, it is that as early as 1920 the Navy viewed the airplane and the aircraft carrier as a credible threat to its interests. Conversely, the Army, which was focused more on manpower issues than on weaponry, saw the “defense against landing forces” as its only real equity in Coast Defense and the best opportunity to justify increased personnel. It also may indicate a view on the part of the Army that seacoast artillery and harbor defense were niche markets that were shrinking, not expanding. Removed from the battlefields of Europe and limited by a defense policy focused on protection of the United States and its outlying possessions, the Army had yet to acknowledge the potential threat posed by aircraft.

Institutional Support and Reorganization

The early challenges to its predominance in antiaircraft artillery had a motive effect on the attitude within the Corps toward antiaircraft development. In the two

decades following World War I, the level of interest in antiaircraft artillery gradually increased, while the overall support for coast artillery guns and fortifications declined. As the threat to the United States of invasion or naval bombardment declined, the Corps, fearing obsolescence, slowly began to envision the antiaircraft artillery as a way to retain its organizational independence as a combat arm. In the wake of the severe manpower limits imposed by the National Defense Act of 1920, the Coast Artillery leadership took a number of steps to improve the status and the organization of the antiaircraft artillery.

To enhance the prestige of the antiaircraft artillery, secure more funds for weapons development, and stave off further bureaucratic attacks, General Coe attempted to turn the air power argument to the advantage of the Coast Artillery. Trying to capitalize on popular concerns about aerial bombardment in the event of war, Coe, in his 1920 "Report of the Chief of Coast Artillery," warned that it would take \$20 million to provide Boston with the same level of antiaircraft protection afforded Paris during the war. Not surprisingly, this attempt to "scare" the War Department failed largely because none of the professionals involved could envision an air threat to Boston similar to that of Paris in 1917-1918.¹³

Despite the folly of Coe's effort at intimidation, the antiaircraft artillery did receive some regulatory support as a result of the Army reorganization

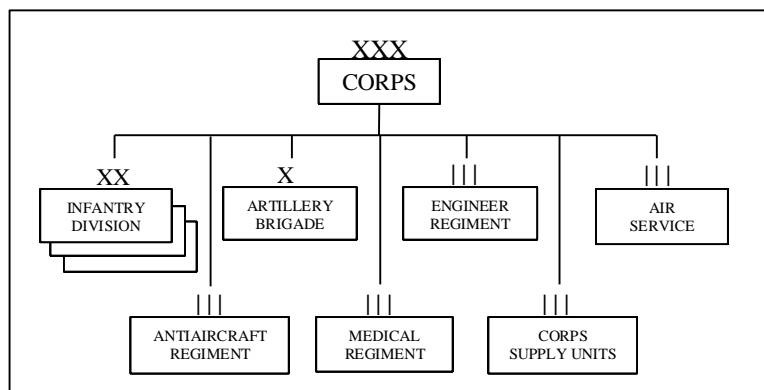


Figure 6.1 - Corps Organization (1920)

process that occurred following the passage of the National Defense Act. In mid-summer 1920, Army Chief of Staff General Peyton C. March convened a Special Committee to create an Army organization in consonance with the new Congressional guidelines.

Members of the Committee included Brigadier Generals Fox Conner and Hugh Drum, Colonel Campbell King, Lieutenant Colonel John Gulick, Majors George

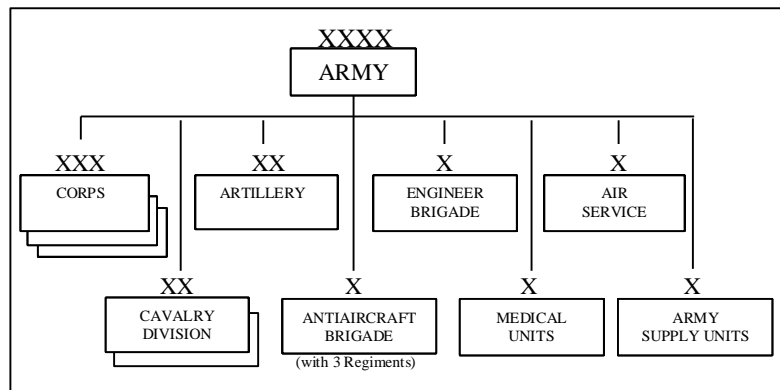


Figure 6.2 - Army Organization (1920)

C. Marshall and A.W. Lane. After studying numerous recommendations on the future shape of the Army, including those of Pershing's A.E.F. Superior Board and the War Department General Staff, the Committee developed new structures for the division, corps, and army organizations. The Committee concluded that the future standard Army division should consist of 19,385 men and be lighter without losing any lethality or striking power. Consequently, the Committee did not include any special anti-aircraft organization within the division. The standard corps of the future had three infantry divisions; a corps artillery brigade; an engineer regiment; an air service with twenty-six observation airplanes and four balloons; a medical regiment; and corps supply trains. Most importantly for the Coast Artillery Corps, the structure also included an anti-aircraft artillery regiment.¹⁴

The army organization consisted of three corps, an artillery headquarters, an engineer brigade, an air service with attack, pursuit, and observation groups, two cavalry

divisions, a medical organizations, and logistical support units. Again, the Coast Artillery received recognition as the army structure included an antiaircraft artillery brigade composed of three regiments. The Committee also created a new organization called the "General Headquarters Reserve" that held a collection of resources not immediately required within the new army organization. These included, among other things, additional artillery, engineer, and air assets. Most notably for the Coast Artillery, the Committee plan assigned an oversized antiaircraft artillery brigade with a headquarters and six regiments to the "General Headquarters Reserve." With these actions, the War Department signaled its understanding of some of the lessons of World War I and its emerging acceptance of antiaircraft artillery as an increasingly important element in modern warfare.¹⁵

Temporarily satisfied with the external recognition provided the antiaircraft artillery by the Special Committee, Coe moved to secure his bureaucratic flanks and reached a gentlemen's agreement with Major General William J. Snow, the new Chief of Artillery, regarding the missions, roles, and armaments of their respective branches. This agreement, which eventually became War Department General Order 36, Section 5, dictated that in addition to responsibility for fixed and mobile coastal defense, the Coast Artillery controlled the antiaircraft artillery. With authority in hand, Coe settled down to organize the antiaircraft artillery service internally within the Coast Artillery Corps.¹⁶

One of Coe's first actions was to request a redistribution of tactical antiaircraft weapons. As a hurried convention of war, the distribution of 3-inch antiaircraft artillery guns had mollified popular concern over the possibility of enemy air attack. Now that the war was over, the time had arrived to reposition the guns in a defense more attuned to

present realities. The wartime plan placed a majority of the 159 guns around major population, industrial, and port centers on the East Coast. Some concentrations also defended San Francisco, Puget Sound, Oahu, and Panama. Interspersed at places like New Bedford, Charleston, Savannah, Key West, Tampa, New Orleans, and the mouth of the Columbia River were smaller groupings or occasionally a single two-gun battery. In designing the new defense, Coe decentralized the responsibility for selecting unit positions to the nine corps and department commanders established under the National Defense Act. The new plan consolidated the commanders' recommendations and presented a more accurate picture of the defense needs. The new distribution placed more emphasis on larger port centers like Boston, New York, and San Francisco and trebled the defense of the Panama Canal from 12 to 36 guns.¹⁷ It is noteworthy that Coe decentralized the responsibility for selecting antiaircraft unit locations, in essence relinquishing a great deal of tactical control over antiaircraft artillery. This was in stark contrast to members of the Air Service who demanded that the unique characteristics of air power required centralized control of aircraft and airmen, ultimately in a separate service commanded by airmen. This philosophical difference over centralized or decentralized control continued throughout the Interwar period and caused great frustration early in World War II.

Education and Consensus Building Inside the Coast Artillery Corps

Occurring concurrently with this tactical readjustment was an internal effort by members of the Corps to improve the level of antiaircraft artillery knowledge within the branch. Largely as a result of prodding from Captain F. S. Clark, Editor of the *Journal of the United States Artillery* (later the *Coast Artillery Journal*), articles discussing the

performance of the Antiaircraft Service during the war began to appear. Soon others with theoretical suggestions for organization and employment surfaced in the *Journal*. Some of the authors, like Major Glenn P. Anderson, were the "old men" and "founding fathers" of the antiaircraft artillery. Others were more recent converts to the cause and reflected the growing realization among Coast Artillery officers that the antiaircraft artillery was a progressive, developing element of the branch with great potential for growth, opportunity, and promotion. Some, like Captain Thomas Phillips, recognized the potential of air power and the need for antiaircraft artillery, but also realized how difficult it might be to convince others in the Coast Artillery to adapt to the new reality. In his 1922 prize-winning article in the *Coast Artillery Journal's* Annual Essay Competition, Phillips emphasized the impact of the "airplane as a new offensive weapon" and argued that the Coast Artillery Corps must "guard against military conservatism and be prepared to defend ourselves against this new weapon...."¹⁸ He was right on both counts.

One of the most significant developments in this regard was the inclusion of a published course of instruction on antiaircraft artillery in "The Beaten Zone" section of the *Journal*. Heretofore, "The Beaten Zone" served as a forum for officers to present problems and solutions to the more technical aspects of surface-to-surface coast artillery such as fire control, observation, and target ranging. In a move initiated by Clark, the *Journal* interrupted its surface-to-surface instruction and began a course on antiaircraft artillery. This action received immediate support from Brigadier General Johnson Hagood, the commanding general of the Coast Artillery Training Center at Fort Monroe, Virginia. Hagood assigned Major O. L. Spiller, a veteran of the World War I Antiaircraft

Service and current antiaircraft artillery instructor at the Coast Artillery School, to prepare an extensive written version of his course.¹⁹

Clark, Hagood, and others realized the impact that air power and antiaircraft artillery might have had on the conduct of World War I. Moreover, they had the foresight to envision the great influence these forces might have in the next war. Contrary to the prevailing belief, they concluded, "anti-aircraft artillery will occupy a place in the future development of the Corps which will be far greater than most of our readers imagine." Clark hoped to familiarize these readers with the "fundamentals of a subject which is now an essential part of the professional equipment of every Coast Artillery officer." He also wanted to supply the Coast Defenses with a text for the equipment they now employed and focus attention on antiaircraft artillery "with a view to encouraging discussion and development."²⁰ In a letter to General Coe requesting material assistance for Spiller, Hagood was more direct. He believed that it was "exceedingly important" to educate those officers "who are nearly or altogether ignorant" of antiaircraft artillery techniques. To that end, he directed Spiller to modify his text and illustrate "every piece of equipment with sufficient clearness" so that any officer could follow along.²¹

Spiller's contributions to "The Beaten Zone" ran continuously from December 1920 to May 1921, covering every aspect of antiaircraft artillery from general information to specific instructions on fire control operations and crew drill. This series supplemented the instruction occurring at the Coast Artillery School and was, for officers in the field, the first doctrinal information available on antiaircraft artillery. As a result of

the foresight, perseverance, and hard work of Clark, Hagood, and Spiller, many Coast Artillery officers gained a working knowledge of this emerging new field.²²

The success of the antiaircraft instruction in "The Beaten Zone" convinced General Coe and others in the Office of the Chief of Coast Artillery in Washington, D.C. of the need for a comprehensive field manual on antiaircraft artillery. Unfortunately, it was difficult to publish a comprehensive manual when the field was in a state of constant development. As an interim solution, the Office of the Chief of Coast Artillery published a monthly bulletin on antiaircraft artillery beginning in late 1922. The "Anti-Aircraft Series" ran from November 1922 until June 1929, updating the Corps on all facets of antiaircraft artillery. Designed to "coordinate the development and progress" of the widely distributed antiaircraft units, the bulletin supplemented the *Journal* as a means to foster institutional knowledge and disseminate information.²³

Increased Organizational Focus

Along with the increased emphasis placed on antiaircraft artillery literature—in addition to "The Anti-Aircraft Series," virtually every edition of the *Coast Artillery Journal* had one or more articles discussing some aspect of antiaircraft artillery--the Coast Artillery Corps began to place more institutional and organizational attention on antiaircraft artillery as it sought to revitalize the entire Coast Artillery force.²⁴ Ever since the Army reorganization in 1901, the largest unit in the Coast Artillery Corps was the separate company. During World War I, the Army created several ad hoc provisional Coast Artillery regiments and battalions. When the war ended, the Corps disbanded many of these ad hoc units and in the process lost much of the identity and *esprit de corps* that had developed. According to Lieutenant H. C. Barnes, an assistant to the

Chief of Coast Artillery, conditions worsened to the point where morale was “almost wholly lacking in the Coast Artillery Corps.”²⁵ One reason was that most of the Coast Artillery units in the continental United States had been reduced to “caretaker status” with less than ten percent of the required number of soldiers assigned.²⁶ An editorial in the *Coast Artillery Journal* detailing “The Work that Lies Ahead” lamented that even the units defending the nation’s insular possessions in Hawaii, Panama, and the Philippines had barely enough men to “permit even fire command to function, much less tactical coast defense commands.”²⁷ Amid this gloom, the *Journal* saw a bright spot, “one responsibility and one opportunity which confronts the Corps as a whole.” The *Journal* argued that “wider development of Anti-aircraft Defense” offered a new avenue beyond the “traditional and routine obligations” of coast defense and urged “every CA [Coast Artillery] officer ... [to] become personally familiar with the technique of Anti-aircraft Defense.”²⁸ If Coe and the Corps’ leadership could not get men to fill their units, at least they could reorganize and provide the few men they had with regimental affiliations around which to build *esprit* and camaraderie. They could also create additional antiaircraft units for aspiring young “Archies” to join.

To recapture some of the morale associated with regimental and battalion history as well as “to avoid any necessity in the future for hasty organization of regiments,” the Corps began to reorganize and streamline all of its various organizations.²⁹ In 1922, the Coast Artillery Corps maintained 289 separate harbor defense companies, four active motorized or railway regiments, one antiaircraft regiment in the Hawaiian Department, and three antiaircraft battalions.³⁰ By late 1924, the Coast Artillery Corps had reorganized all of the 289 separate companies into a more manageable structure

consisting of eighteen harbor defense regiments, two active railway artillery regiments, three active heavy tractor artillery regiments, and six active antiaircraft regiments. Three of the antiaircraft regiments were located in the United States and three protected each of America's insular possessions.³¹ Given that none of the active Coast Artillery regiments, antiaircraft or otherwise, were fully manned, this reorganization provided the Corps with an expandable structure in the event of war. Externally, the War Department supported and authorized the reorganization. Internally, the large increase in antiaircraft regiments signaled a major institutional and organizational step forward for the antiaircraft artillery establishment within the Coast Artillery Corps.

One place where the institutional progress of the antiaircraft artillery became very apparent was at Fort Monroe, Virginia. Fort Monroe was home to the Third Coast Artillery District, the Harbor Defenses of the Chesapeake Bay, the Coast Artillery School, the Coast Artillery Board, and the *Coast Artillery Journal* as well as a harbor defense and an antiaircraft artillery regiment. It was the hub of the Coast Artillery Corps and the intellectual center of all major coast artillery activity.³² It was at Fort Monroe that the early efforts of Clark, Hagood, Spiller and others began to create an emerging constituency in support of antiaircraft artillery. In addition to educating coast artillerymen and others through numerous *Journal* articles as well as increased instruction at the Coast Artillery School, the antiaircraft community took a major institutional step toward equality with the seacoast artillery when Coast Artillery Corps demonstrations around the country began to include antiaircraft units. One such demonstration occurred in May 1924 during the centennial celebration of the opening of the Artillery School at Fort Monroe. Attended by General Pershing, soon to be retiring as

the Army Chief of Staff, and E. Lee Trinkle, the governor of Virginia, the celebration began with a review of troops and a tour of the post. That afternoon, the Coast Artillery School conducted a mock battle in honor of the distinguished guests. The battle began with an attack by a series of towed wooden targets representing an enemy fleet of battleships, destroyers, and mine sweepers. Against this threat the Coast Artillery brought out its big guns, including 12-inch disappearing Parrott guns, 12-inch railway mortars, 12-inch mortars, 6-inch barbette guns, and a battery of 155-mm artillery. The enemy minesweeper survived only to be blown to pieces by submarine mines. Then came the air attack on Fort Monroe. Two planes out of Langley Field towed target sleeves, which the gunners from the 61st Antiaircraft Artillery Regiment quickly fired upon with their 3-inch guns. As the planes passed, the machine gunners from the 61st Regiment delivered the *coup de grace* as they opened fire on a group of free balloons simulating a low altitude air attack. The inclusion of the antiaircraft artillery in a demonstration before the Army Chief of Staff that in years previous had been focused on harbor defense represented another stop on the road toward the integration and acceptance of the antiaircraft artillery as part of the Coast Artillery and the mainstream Army.³³

For those who believed that antiaircraft artillery was still a “sideshow” that operated “outside the big tent of Coast Artillery activity and responsibility,” combined demonstrations such as the one at Fort Monroe did much to dispel that belief. In several respects, even by 1923-1924, many in the Coast Artillery viewed the two elements of the Corps as interdependent and equally essential to the continued viability of the branch. Phillips, in his prize-winning essay, highlighted the need to develop effective air defenses

comprised of sufficient airplanes and antiaircraft artillery weapons to enable harbor defense guns to operate without fear of destruction by enemy naval aviation.³⁴ In a May 1923 *Journal* editorial entitled “A.A. in the Big Tent,” Clark chastised members of the Corps for belittling the “status of Antiaircraft Defense,” arguing that it was “primarily an important and integral element of the *main job* of the Coast Artillery—namely, Coast Defense.”³⁵ Although he endorsed the antiaircraft artillery, Clark’s comment connotes both an equality and interdependence between the harbor defense community and the antiaircraft artillery, while simultaneously asserting the primacy of coast defense. Despite the recommendations of the Special Committee and the subsequent inclusion of antiaircraft brigades and regiments in the organizational structure of the field army and corps, Clark’s editorial made no mention of the Coast Artillery providing antiaircraft units to these organizations. No doubt this focus on coast defense occurred for several reasons, chief among them that, due to severe personnel shortages, the divisional and corps Army existed largely on paper alone. This situation left the Coast Artillery with the challenge of getting two disparate acts—harbor defense and antiaircraft artillery—to work together under the big tent in a one-ring coastal defense circus that was still searching for a loyal and supportive audience.

Tactical Organization

As outlined in the "Anti-Aircraft Series," the 61st Coast Artillery Regiment (Antiaircraft Artillery) and the other antiaircraft regiments now had a fixed structure that mirrored the composite structure of the World War I Antiaircraft Service. In addition to a regimental headquarters and a service battery, each 1,514-

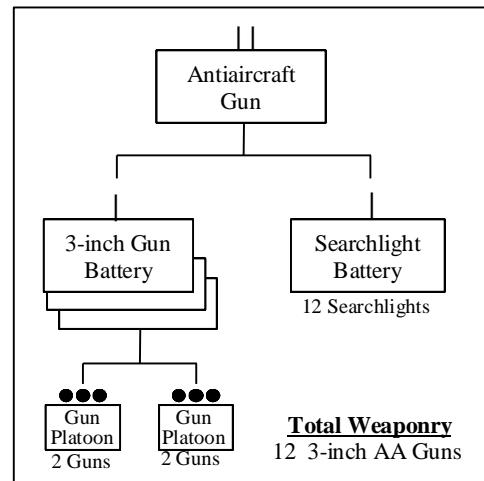


Figure 6.3 – AA Gun Battalion

man regiment consisted of one antiaircraft artillery gun battalion and one antiaircraft machine gun battalion, each with approximately 650 men.³⁶ The antiaircraft artillery gun (3-inch) battalion differed slightly from the World War I design, which maintained four gun batteries each with three guns. Instead, it combined three batteries of four guns each with a searchlight battery of twelve lights. In terms of firepower, this three-battery battalion was similar to the four-battery, three-gun battalion designed by Major Hugh Drum in 1917. Both units had 12 guns; the only difference between the two was the distribution of guns within each battalion.³⁷

This shift from three to four guns per battery (and thus from four batteries to three per battalion) resulted in part from the

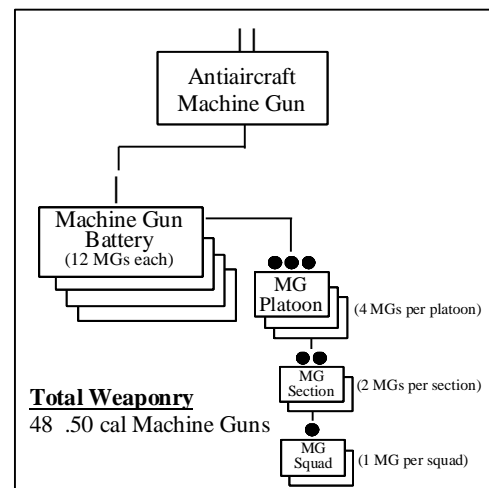


Figure 6.4 – Machine Gun Battalion

increased emphasis on motorization that followed World War I. Coast Artillery planners understood the need to keep their units mobile. The units had to stay abreast of the mobile forces they were defending. The difficulty of defending the lengthy United States coastline required that the batteries possess the ability to move rapidly between different positions. Given these constraints, Coast Artillery planners reasoned that to maintain the same rate of fire and accuracy as that achieved by the three-gun fixed batteries, the mobile batteries needed a fourth gun. Planners further subdivided each four-gun battery into two platoons, each with two guns. In this manner, the span of control remained at two guns per officer.³⁸

The antiaircraft artillery machine gun battalion retained its earlier World War I organization. Planners felt this structure had performed sufficiently well in combat to preclude the need for any changes. The battalion consisted of four batteries, each with three platoons. Within each of the three platoons were two sections of two squads each. Each squad possessed one .50 caliber machine gun, for a total of 12 machine guns per battery and 48 per battalion.³⁹

This regimental organization remained the backbone of the antiaircraft artillery structure. At the corps and army levels, planners adhered to the earlier recommendations of the Special Committee, assigning one regiment to each corps and one brigade (3 regiments) to each army. For the "General Headquarters Reserve," planners based their structure on six armies. In assigning six brigade headquarters, 18 antiaircraft regiments, and 12 searchlight batteries to the "G.H.Q. Reserve," planners intended to create an antiaircraft command similar in authority and control to the Antiaircraft Service of World War I.⁴⁰

Doctrine and Force Structure Debates

With its institutional *raison d'être* and organizational structure established, the antiaircraft artillery community had achieved a significant degree of internal acceptance within the Coast Artillery Corps. The next step was to meld this structure into the broader milieu of Army tactical doctrine. In 1923, it received some assistance in doing so from the War Department. In its *Field Service Regulations, 1923*, the Army recognized the antiaircraft artillery as a vital, although secondary, part of its antiaircraft defenses. In attacking enemy airplanes, the Army viewed pursuit aviation as the "most vital element of the Air Service" and charged it with gaining air supremacy. The antiaircraft artillery supported the Air Service by driving hostile aircraft to higher altitudes where they were more vulnerable to pursuit aviation and by illuminating zones at night within which the night pursuit planes could attack hostile aircraft. On the ground, the Army believed that combat units should use their organic small arms and machine guns to provide their own "immediate protection against low-flying hostile aircraft." The mission of the antiaircraft artillery was to "reinforce the antiaircraft measures" of these units and operate "against hostile aircraft flying beyond the range" of the small arms of the maneuver forces.⁴¹

Despite the increased attention paid to antiaircraft artillery in *Field Service Regulations, 1923*, General Coe recognized that these regulations pertained largely to the conduct of war by mobile field forces. He feared that since postwar political conditions made it unlikely that the United States would participate in any overseas conflict in the near future, any attention paid solely to mobile expeditionary forces would stymie the growth of the antiaircraft artillery.⁴² Furthermore, he believed that any attack on the

United States would begin with an aerial bombardment of key cities, ports, and industrial centers and not local field forces. Sparsely defended by area antiaircraft artillery units, these important assets were extremely vulnerable to air attack. Unhappy with the Army's focus, Coe petitioned the War Department in November 1924 to redirect its attention from field forces to home defense.⁴³

Stirred by Coe's petition and influenced by the ongoing clamor over the impact of air power, the War Department launched a project to reconsider the "whole subject of anti-aircraft defense" including the preparation of plans for frontier defense, protection of the overseas possessions, special contingencies, and "the tactical organization and employment of ... antiaircraft defense in the field forces."⁴⁴ As part of its inquiry, the War Department solicited opinions from all of the Chiefs of Arms as well as the Corps Area Commanders established under the National Defense Act. The divergent responsibilities of these individuals guaranteed a quick division of interest. The Chiefs of Arms became instantly concerned with the question of antiaircraft defense of the division, while the Corps Area commanders focused on the static defense of their areas. Thus, instead of shifting the War Department's focus from field forces to home defense, Coe succeeded in creating controversy in both areas.

Paramount in the minds of the Corps Area commanders was the antiaircraft defense of key industrial assets within their respective areas. Delighted with the prospect of designing their own defenses and having them approved, funded, and built by the War Department, each of the commanders responded enthusiastically to the request for information. Unfortunately, each responded with too much zeal and not enough fiscal responsibility built into their estimates. For example, the commander of the First Corps

Area (New England) requested 300 3-inch guns or the equivalent of 75 four-gun batteries for the defense of his area. At a cost of \$109,742 per battery, the defense of the First Corps Area promised to cost close to \$8.3 million just for the equipment. After accounting for all of the necessary associated equipment such as machine gun battalions and ammunition to accompany the gun units, the total cost for the 374 gun batteries requested by all of the Corps Area commanders exceeded \$60 million.⁴⁵

Also responding to the War Department's inquiry was Major General Mason Patrick, Chief of the Air Service, whose highly partisan report only exacerbated the concern over the cost of antiaircraft defense in the Corps areas. In his report, Patrick argued that although each service complemented the work of the other, pursuit aircraft represented the appropriate response to an enemy air threat. Patrick believed that a few guns were necessary around vital installations to quell popular concern, but that legitimate air defense was the work of the Air Service. In support of his argument, he estimated that to defend Washington, D.C. from an air attack with antiaircraft artillery units would require 12 batteries and associated equipment. He calculated the cost of this defense at \$6.4 million, an average cost per battery approximately five times greater than the Corps Area commanders' earlier estimate. In the same report, however, he claimed that it was "impossible to give any definite or even approximate figure" for the cost of "aerial anti-aircraft defense." This position rested on the belief that the mobility of aviation enabled it to perform a variety of missions (coast defense, support of ground forces, and independent offensive missions over land or water), making it difficult to estimate the cost for antiaircraft defense alone.⁴⁶

Despite the seeming contradictions in his argument, Patrick had good reason to press his point. The ideology of air power was receiving strong external support from some notable members of Congress as well as from influential newspapers, but not as much support inside the War Department or the rank and file Army. Thus, while Congressman Fiorello LaGuardia might levy charges of “standpatism” at the Army and the Coast Artillery Corps for not yielding to the logic of air power, and the *Washington Post* could run editorials claiming that “airships are virtually immune to attack from the ground,” the War Department could cite equally compelling information to the contrary.⁴⁷ In fact, a series of internal War Department actions and reports indicated that the Air Service was losing ground to the anti-aircraft artillery.

In 1923, Patrick received War Department approval to develop barrage balloons as an inexpensive means to protect critical sites. Coe immediately protested, claiming that the use of barrage balloons was a “legitimate function of the Coast Artillery Corps.” In a recommendation reminiscent of the aborted World War I arrangement for balloons, Coe suggested that the Air Service develop the balloons, but that the Coast Artillery Corps operate them. This time, however, both Patrick and the War Department agreed, and the seeds of further disharmony between the two organizations most responsible for defense against air attack were sown.⁴⁸

In 1924, the McNair Board, named after its president Colonel Lesley J. McNair, investigated the effectiveness of bombers against anti-aircraft guns and concluded that “anti-aircraft artillery ... is a thoroughly effective means of defense against the bomber....”⁴⁹ Patrick tried to counter these conclusions by complaining that the McNair Board conducted the tests under ideal and artificial conditions, including forcing the

bombers to tow targets at a predetermined speed and altitude. Ironically, these were the same complaints leveled against the Air Service after its successful sinking of the German battleship *Ostfriesland* in bombing tests conducted in the Chesapeake Bay in 1921. Equally damaging to Patrick's efforts were two separate Ordnance Department reports, which concluded that continued development of antiaircraft artillery fire would make combat between planes and guns a more even proposition than the Air Service was willing to admit.⁵⁰

Alarmed by the increasingly acrimonious tenor of the debate, General Coe stepped in, appealed for a rational discussion of the issues--not the "excesses of zealots"--and attempted to limit any damage caused within the War Department by the exaggerated cost estimates.⁵¹ In a secret letter to the Adjutant General, Coe argued the need for an antiaircraft artillery defense, but reasoned that a more realistic cost estimate was possible. Working on the assumption that the Corps Area Commanders inflated their totals, he reduced their count by an average of thirty-three percent. Understanding that the new figure of 249 mobile batteries still represented an enormous amount, he further divided the batteries into fixed and mobile categories. While only a small difference in firepower and accuracy existed between the four-gun mobile battery and the three-gun fixed battery, the almost \$50,000 savings per unit added up rapidly. Coe estimated that the commanders only needed a total of 135 mobile batteries, leaving 114 fixed units for permanent emplacement around vital assets. With the addition of the machine gun battalions, regimental headquarters, and ammunition required for this force, the cost for the antiaircraft artillery defense of the continental United States totaled \$39,794,217. Considering the cost of all associated equipment necessary to outfit the original 374

batteries, Coe's quick mathematics promised to save the War Department over \$20 million.⁵²

Impressed by Coe's reasoning, but still awed by the price tag (equal to 11% of all Army expenditures in 1925), the War Department decided to extend development over a five-year period. In the ensuing years, parsimonious behavior toward defense spending continued to limit the government's commitment to the project. Frugality reached the point that Coe's successor, Major General Andrew Hero, reduced his request to a modest six regiments costing only \$3.1 million. With the onset of the Depression, the War Department postponed the project indefinitely.⁵³

Divisional Antiaircraft Protection

The other central issue to emerge from the War Department's inquiry concerned the need for additional antiaircraft protection for the Army division. One of the enduring lessons the Infantry community drew from World War I was its vulnerability to strafing and bombing attacks by airplanes. Mindful of the increased potential for air attack in the next war, the War Department realized the necessity of improving the division's antiaircraft capability. According to *Field Service Regulations, 1923*, the current solution to this problem varied with the tactical situation. If on the march, the infantry was to "protect itself against aerial attack...."⁵⁴ When the troops stopped to bivouac, antiaircraft artillery units provided incidental protection based on their proximity to the infantry units. In other words, if infantry units camped in areas adjacent to where antiaircraft artillery units were already providing protection, then the Army considered the infantrymen well defended.⁵⁵

Only in the case of a defensive battle along a stabilized front did the Army plan to position antiaircraft artillery units near the troops. Army doctrine called for a "checkerboard formation" with "two continuous zones of antiaircraft fire" to provide a "belt" defense against incoming aircraft. This formation did not protect any specific "point" asset like an infantry unit. Instead, it defended everything within the vicinity of its position. Despite the "area" protection afforded by Army doctrine, the lack of "dedicated" antiaircraft artillery protection for the ground troops concerned infantry commanders. Commanders understood that the limited amount of antiaircraft artillery available to the Corps commander (one battalion of antiaircraft guns and one battalion of machine guns) dictated the use of these assets to defend higher priority targets, many of which existed in the corps rear area and not near the troops. The obvious solution to this problem amounted to nothing more difficult than adding organic antiaircraft artillery units to the division structure. The cure, however, ran into opposition on numerous fronts because it threatened to increase the size of the division and reduce its overall mobility on the battlefield.⁵⁶

As a result, the debate among the Chiefs of Arms centered on how to limit the size of the new Army division while still improving its defense against air attack. The argument quickly boiled down to two positions--add an antiaircraft machine gun battalion to the division or give the respective units their own antiaircraft machine guns and let them defend themselves. General Coe, in his response to the War Department inquiry, advocated the addition of "one highly mobile battalion of sixteen .50 caliber machine guns organized into two batteries of two platoons each" to the organic structure of the division. He reasoned that although the "present division [was] bulky," the increased

probability of air attack in the next war necessitated the addition of an organic antiaircraft unit and outweighed the disadvantages that might result from the division's increased size.⁵⁷

The Infantry branch disagreed with this recommendation, preferring instead to defend itself and requested the Army add a machine gun company to each infantry battalion. Much like the Air Service's position on airplanes and air defense, the Infantry recognized that in era of fiscal austerity multi-purpose weapons offered both flexibility and economy. Accordingly, the Infantry argued that the machine gun was a multi-purpose weapon, good for use against both tanks and airplanes. The Chief of Infantry maintained that the addition of a machine gun company per battalion permitted the smaller infantry units to defend themselves against both "tanks and airplanes regardless of location within the Army area..." In a letter to the Adjutant General, he described the duplication of effort and confusion that would occur if two different branches attempted to provide antiaircraft protection "within the Infantry combat area." Highlighting the ability of the Infantry to defend itself if given the means to do so, the letter also included a lengthy section on current antiaircraft experiments and training conducted by the Infantry branch.⁵⁸

With the battle lines now drawn, the equivocal comments of the other Chiefs of Arms did nothing to help resolve the dilemma facing the War Department. The Chief of Engineers supported both sides in the argument. The Chief of Field Artillery quietly lobbied for the transfer of antiaircraft artillery to Field Artillery and recommended that, as "a child of the World War," antiaircraft defense be the focus of "profound and continuous study."⁵⁹ The Chief of Cavalry had an idea analogous to that posed by the

Infantry. The Cavalry wanted an Air Service observation squadron, similar to that used by the infantry divisions, to spot incoming aircraft and alert the pursuit squadron to intercept them. The Cavalry also requested an armored car troop for each brigade equipped with multi-purpose machine guns and 37-mm guns. Like the Infantry, the Cavalry was willing to accept the responsibility for its own defense as long as its organizational structure grew accordingly. Finally, clouding the issue even further, the commandant of the Command and General Staff School at Fort Leavenworth recommended that the Army create a heavy machine gun battalion in each infantry and cavalry division, but give overall responsibility for the development of antiaircraft artillery to the Air Service.⁶⁰

In attempting to resolve the debate, the War Plans Division studied all of the proposals and concluded that future wars would require divisional units to possess their own organic means of antiaircraft defense. Furthermore, the study recommended that the War Department postpone a decision on the exact form of that defense until further progress occurred in the development of antiaircraft artillery weapons. The Assistant Chief of Staff, Brigadier General Hugh A. Drum, concurred with the recommendations of the War Plans Division, but added that developments in machine gun carriages might make the same weapon "suitable for both ground and aerial fire, thereby avoiding new units in a Division."⁶¹ Implied in his response was the unmistakable desire to maintain the division at its current size and provide the infantry with its own means of defense.

In the meantime, General Coe became irritated over the War Department's delay in reaching a decision. Demonstrating a total lack of appreciation for the highly charged political atmosphere surrounding the War Department during the Billy Mitchell court-

martial in the fall of 1925, Coe pressed for resolution of the issue with all the finesse of a 16-inch shell. Claiming to need a decision to complete the drafting of training regulations, Coe used this opportunity to query the War Department and renew his recommendation for a separate antiaircraft artillery machine gun battalion. On 9 November 1925, after reviewing the study by the War Plans Division, the Adjutant General responded tersely that although "a means of protection for units of the Division ... will be included in the Division.... the method by which anti-aircraft protection will be furnished ... [required] further study." He ended by stating that the Coast Artillery School should understand this position and write its manuals accordingly.⁶²

Unable to let the issue lie dormant, Coe repeated his request for resolution in early January 1926. This time the Adjutant General was more explicit in his response. He reiterated his earlier position that the study of antiaircraft defense had not progressed far enough to make a final decision, but added that the War Department now believed that no increase in the size of the division was possible without affecting its mobility. To drive the point home, the Adjutant General expressed his desire to give the "various elements of a division ... an opportunity to develop their own anti-aircraft defense...."⁶³ He added that the efforts of the Infantry to develop its own antiaircraft capability appeared promising and, if successful, should enable the infantry to "deliver fire against both ground troops and low-flying attack aviation" without altering the fundamental structure of the division. Finally, he directed that Coast Artillery training regulations conform to the present Army doctrine that required the divisional combat units to provide their own antiaircraft defense.⁶⁴

In retrospect, Coe pushed too hard and too fast against a War Department reluctant to tinker with the shape of its infantry divisions and politically unwilling to make further changes in its method for defending against air attack. As a result, he lost the case for the creation of a divisional antiaircraft artillery battalion. The Coast Artillery Corps conformed to the Adjutant General's guidance and published its training regulations and field manuals without reference to a divisional battalion. Despite changes in Army and antiaircraft artillery organization, doctrine, and equipment over the next two decades, the Army continued to resist the addition of organic antiaircraft artillery battalions to maneuver divisions until after World War II.⁶⁵

Antiaircraft Weapon “Systems” Development

Inextricably linked to the Coast Artillery's institutional legitimacy was its development of effective antiaircraft artillery weapons capability. From its earliest beginnings, the antiaircraft element suffered from a lack of equipment and limited funds with which to pursue improvements. Despite these handicaps, the Coast Artillery Corps continued to develop its antiaircraft artillery weapons, but full-scale procurement fell victim to isolationist tendencies, intellectual malaise concerning defense matters, and the Great Depression.

The United States emerged from World War I with 159 3-inch antiaircraft artillery guns positioned in various harbors and cities around the country. By 1920, this arsenal grew to include 117 3-inch trailer-mounted and 51 75-mm truck-mounted guns that came out of production after the war was over. To many casual observers, especially those in Congress, this small collection of guns seemed more than adequate to protect America's coast lines and insular possessions from a distant, unarticulated, and unproven

air threat. In the regimental mess, antiaircraft "Archies," full of *esprit* and espousing romantic attachment to their guns, echoed this sentiment, proclaiming, "We aim high" and singing:

Aloft we send our good shells screaming
To search the heavens, broad and blue,
Our Antiaircraft guns start speaking
With sleepless eye and aim so true.⁶⁶

In the opinion of General Coe and the Coast Artillery leadership, however, the stock on hand was already obsolete.⁶⁷

In particular, Coe considered the 75-mm gun "useless" in defending against aircraft. Although truck-mounted, the 75-mm gun was unstable during firing, difficult to emplace, and unable to travel rough roads. Those problems aside, it had significant limitations and was not a very effective gun.⁶⁸ The 3-inch M1917 (fixed mount) and M1918 (trailer mounted) model guns were not much better. In particular, the M1918 gun was very unsteady to fire and dangerous to operate.⁶⁹

Part of the problem Coe faced in increasing the size and capability of his arsenal evolved from the fact that effective antiaircraft artillery fire depended on the creation of a "system" composed of different weapons and sub-systems, not on the development of one good gun. In addition to 3-inch antiaircraft artillery guns, the "system" included .50 caliber machine guns, 60-inch Cadillac searchlights, sound locators, acoustic amplifiers, and various fire control directors and computers. Each of these items worked together within the "system" to enable the antiaircraft crewman to engage an airplane with accuracy. As a result of its recent emergence as a method of warfare, antiaircraft artillery expansion suffered from the immaturity and non-linear nature of the overall "system" as well as from the lack of development of each weapon and sub-system.

Confronted with a parsimonious Congress, Coe had trouble explaining the need for funds to develop the multi-faceted "system." To a great extent, Congress became confused over the need for the various projects and failed to appropriate adequate funds for further development. The lack of a credible enemy compounded this confusion and added to Coe's difficulty in obtaining money. Frustrated by this situation, Coe issued a memorandum to members of the Corps explaining the serious deficiencies that existed in antiaircraft equipment. More importantly, the memo highlighted the need for "every officer conversing with members of Congress ... to present a clear picture of the shortages and how it is proposed to remedy [them]."⁷⁰

Concurrent with the memorandum, the Coast Artillery Board and the Ordnance Department approved the design for a new 3-inch gun (M1923E), which Coe desperately wanted to test. The new gun retained all of the superior qualities of the earlier models, but also included an automatic breechblock to increase the rate of fire. Upon firing, the block opened and ejected the empty casing. After reloading, it closed automatically, greatly reducing the dead time between shots. Concerned that too much information on the new gun, current models, and other experiments might confuse Congress, Coe emphasized that every officer should know that the standard antiaircraft gun was the new 3-inch gun. Furthermore, he stated that it was the duty of each officer to clear up any confusion that might exist in the minds of Congressional committee members. Coe achieved limited success in this endeavor. The M1923E (Experimental) gun emerged from the testing process in 1925 as the M1925, better known as the M3 3-inch mobile gun or the M4 3-inch fixed gun. The first gun reached the field in 1928 and the model remained the standard until early in World War II.⁷¹

In light of the dearth of appropriations for antiaircraft development, General Coe's concern over Congressional confusion seems fitting. Since the end of the war, Congress had appropriated a meager amount of money for the development of antiaircraft artillery while providing the Air Service with millions for aircraft research work. From 1919 to 1924, Congress gave the Coast Artillery \$42,250 for antiaircraft development, while the Air Service received \$3 million just for 1924. Even the Ordnance Department, whose budget for antiaircraft development far outstripped that of the Coast Artillery, paled by comparison to the Air Service. From 1921 to 1924, the Coast Artillery and the Ordnance Department received a total of \$1,952,881. During the same period, Congress allocated \$15.8 million or over eight times as much for the development of airplanes.⁷²

By the end of the decade, the design of the antiaircraft "system" was almost complete, but the fiscal limits imposed by Congress and reinforced by the effects of the Depression constrained the actual procurement of antiaircraft artillery equipment. With respect to the "system" design, the Coast Artillery Corps adopted the new 3-inch gun, the .50 caliber machine gun, the MV1 distant-controlled searchlight, and the M1A1 Vickers antiaircraft gun fire control director as standard equipment. The only major piece of equipment still considered unsatisfactory was the sound locator, a set of four 14-foot horns that tracked aircraft by listening for their noise. The Army never totally perfected the sound locator and discontinued its use with the advent of radar in the early 1940's.⁷³

Development of barrage balloons, the one part of the "system" not under control of the Coast Artillery, proved slow and problematic. Many of the problems experienced in barrage balloon development were a byproduct of the bureaucratic bickering between the Air Service and the Coast Artillery Corps both in World War I and again in the early

1920's. In March 1923, Patrick, having accepted the task to develop, but not operate barrage balloons, directed the Air Service's Engineering Division at McCook Field in Dayton, Ohio to develop balloons suitable for antiaircraft defense. It was not until 1927, however, that the Air Corps (having changed its name from the Air Service by virtue of the Air Corps Act of 1926) delivered three balloons to Fort Monroe for testing. Once at Fort Monroe, the illogical division of labor between the Air Corps and the Coast Artillery Corps became obvious, as the Coast Artillery could not provide the required support facilities or the trained soldiers to conduct the test. Moving to nearby Langley Field where facilities were available, the test continued with soldiers from the 61st Coast Artillery (Antiaircraft) working under the supervision of Air Corps balloonists. The first balloon broke loose and drifted out to sea. After a lengthy period of modification, the second balloon was destroyed during testing. After further changes, the third balloon flew well, but required changes to the winch. It flew successfully during tests in 1929-1930, but by this time was too old for service. The story of barrage balloons in the 1920s was one where the Air Service had no organizational motivation to pursue the development of balloons. For most of the next decade, the Air Service lacked not only the motivation, but also the money to invest in balloons.⁷⁴

Designing a complete antiaircraft artillery "system" constituted a great theoretical and technical achievement for the Ordnance Department and the Coast Artillery. Procurement of the weapons and instruments to bring the "system" to life, however, was another matter altogether. Even prior to the Great Depression, fiscal conditions had deteriorated to the point where the Coast Artillery could claim six active antiaircraft regiments—a great step forward--but all were at reduced strength. In a confidential

report sent to the Adjutant General in March 1929, the Chief of the Coast Artillery, Major General Andrew Hero, complained about the small amount of modern antiaircraft equipment on hand in the continental United States. According to General Hero, there were only twenty-eight distant-controlled searchlights, eighty .50 caliber machine guns, and one 4-gun battery of modern 3-inch antiaircraft guns with Vickers fire control equipment defending the United States from air attack. With the October stock market crash, Hero's concerns fell on deaf ears. Economic hardship combined with earlier isolationist and antiwar sentiment to remove all hope of modernizing the nation's antiaircraft artillery force.⁷⁵

Internal Equality, External Recognition, and a Foundation for Growth

For the Coast Artillery Corps, the decade of the 1920's represented a period of immense progress in the development of antiaircraft artillery. Within the Corps, several complementary activities combined to propel the antiaircraft artillery establishment to a position of equality with, if not primacy over, its seacoast artillery counterpart. First, widely disseminated doctrinal literature and popular journal articles informed coast artillerymen and others of the emergence of a new aspect of warfare. Second, continued education at the Coast Artillery School not only legitimized antiaircraft artillery as a valid part of the Corps, it further reinforced the impact of the popular and doctrinal literature. Third, the creation of new antiaircraft regiments extended that legitimacy to the field by establishing organizations that rivaled the existing seacoast regiments and added leadership positions and avenues for promotion for the growing number of antiaircraft artillerymen. Finally, continued research and fielding of ever-advancing antiaircraft equipment limited the total money available to the Coast Artillery and Ordnance

Department to develop and procure materiel for both seacoast and antiaircraft artillery. While the amount spent was miniscule compared to that invested by the Air Service, it, nonetheless, displaced some seacoast artillery priorities and, most importantly, gave antiaircraft artillerymen improved materiel with which to train.

In 1929, the War Department recognized this fact and changed the mission of the Coast Artillery Corps to include serving as the nation's "first line of ground defense against enemy aircraft at sensitive points and vital areas." The War Department also required that, "in addition to [their] permanent assignments ... to fixed defenses, railway, or tractor artillery," the Coast Artillery Corps train all troops to "serve skillfully and effectively [on] antiaircraft armament ... [and] ... equipment..."⁷⁶ By mid-year, the intellectual and doctrinal evolution within the Coast Artillery Corps had progressed to the point that the Assistant Commandant of the Coast Artillery School was telling his various Department Directors that "[w]e must have another hour (day or week) out of your course for antiaircraft instruction." The *Coast Artillery Journal* reported, "Directors and instructors weep as their pet courses are slashed and belittled by ruthless antiaircraft-minded authorities."⁷⁷ By the end of the decade, the time spent between antiaircraft artillery and seacoast artillery instruction was equal. Concerned about the impact of these developments on his officers, Major General John W. Gulick, the new Chief of the Coast Artillery Corps, issued a statement denying the superiority of the antiaircraft artillery and telling seacoast artillery officers that their neither their careers nor their sub-discipline within the Corps were in jeopardy of becoming obsolete.⁷⁸

Within the Army, a comparison of the antiaircraft artillery establishment in 1930 with the remains of its wartime antecedent indicates great success in the creation of a

viable combat organization. Emerging from the ashes of World War I demobilization, the Coast Artillery secured bureaucratic ownership of the antiaircraft artillery, earned some measure of respect from the other branches as a necessary element of warfare, established a coherent warfighting doctrine, and designed a theoretically effective antiaircraft "system" for defending against air attacks. Although the Coast Artillery failed to translate this progress into the development of a sizable force structure, the Corps' lack of growth only reflected the larger environment in which it operated. Superimposed upon the evolution of antiaircraft artillery was a decade of declining defense spending that retarded most force development, with the possible exception of the Air Corps. General Coe's occasionally clumsy actions notwithstanding, the Coast Artillery Corps constructed a strong organizational and doctrinal foundation on which to build its antiaircraft artillery force as America and her Army recovered from the Great Depression.

CHAPTER 7

THE 1930s: FROM COMPETITION TO COOPERATION AND ACCEPTANCE

The increasing importance of antiaircraft artillery ... is due to the rapid development of aircraft in recent years and the possibilities for its ... future use as a weapon of warfare. Those who have the vision and the imagination, see in the huge commercial transport planes of today nothing more than bombardment aviation which can carry bombs as easily as they now carry passengers and merchandise.... Due to its great mobility it will be the first weapon with which our aggressive enemy will strike.... Our Air Corps and antiaircraft artillery will meet this menace, side by side, each in its own sphere of action. Antiaircraft guns, equipment, and trained personnel must be ready at all times for instant action.

*Major General Andrew Hero
Chief of Coast Artillery*

The 1920s began with the various elements of the military establishment maneuvering for bureaucratic position and scrambling after scarce resources. Conditioned to this behavior by a rapid post-war demobilization, an isolationist foreign policy, and the fiscal austerity imposed by the Harding Administration, each organization engaged in external and internal battles to secure its position within the military bureaucracy. The Army and Navy quarreled over the meaning of coast defense and its importance to each service. Meanwhile, the Air Service argued that it could protect America's coastline more efficiently than the Navy and more effectively than the Coast

Artillery and should be granted full autonomy in doing so. Simultaneously, within the Army, the Coast Artillery, the Field Artillery, and to a lesser degree the Infantry and Cavalry all claimed partial ownership of the antiaircraft mission.

By the end of the decade, equilibrium had been established among the competing organizations. The Army and Navy papered over the coast defense issue.¹ The Field Artillery and the Coast Artillery remained separate. The Coast Artillery gained proponentcy for the antiaircraft artillery establishment and in the process elevated AAA regiments to a level within the Corps that rivaled the older seacoast artillery. The Air Service, now the Air Corps in 1926, lost its battle for independence, but retained strong support within Congress and industry. Fiscal austerity, reinforced by the effects of the Great Depression, however, continued to hinder weapons development and kept most units at minimum manning. With the possible exception of the Air Corps, most of the Army's advances made during the 1920s were intellectual or institutional. The Army in 1930 had very little modern equipment to show for a decade of advocacy.

For most of the 1930s, the Army suffered the lingering effects of both a national economic depression and a continuing isolationist movement. Characterized as the "ten lean years" by a contemporary Army reformer, the decade witnessed a nation focused almost exclusively on establishing economic and institutional solvency and avoiding involvement in foreign conflicts.² This focus had a deleterious effect on the development of the military forces. Without the external support of the executive branch, which spent most of the decade trying to reduce rampant unemployment and restore public financial confidence, the military establishment lacked a strong patron to support and fund innovation. Support from Congress was also not forthcoming. In fact, through its

support for the 1928 Kellogg-Briand Pact outlawing war and subsequent passage of the Neutrality Acts in 1935, 1936, and 1937, Congress created a climate that undermined any movement toward preparedness, much less reform. Indeed, throughout much of the decade, the Army struggled simply to maintain the status quo. Without the organizational and fiscal slack to empower forward thinking and initiate revolutionary change, the Army focused inward, with most improvements occurring in an evolutionary manner at the margins of previously established organizational boundaries. The Cavalry did not exchange its horses for tanks nor did the Infantry embrace mechanization. The Coast Artillery elevated antiaircraft artillery, but did not forsake the seacoast artillery. With athletics, social events, and Civilian Conservation Corps duties filling the daily calendars at most Army posts, few organizations had the inclination or the resources to raise their heads out of their entrenched positions and undertake radical reform. In fitting with the times, preparation for combat was a remote consideration. Field exercises and annual service firings only occasionally interrupted an otherwise uneventful and pacific existence.

The Coast Artillery Corps existed within this unsupportive environment for most of the decade. Without external fiscal support for antiaircraft research and development or new equipment purchases, the Corps focused on expanding its tactical doctrine and worked with other branches to build consensus and gain acceptance within the War Department. Cooperation with the Air Corps replaced the aura of competition so prevalent in the 1920s. Restricted in its ability to create a credible force structure, the Corps built upon its earlier achievements and continued to develop its antiaircraft

doctrine and tactics. Only after Europe and Asia erupted into open warfare did America begin a frantic effort to improve its military situation.

Status of the Coast Artillery Corps

As the decade opened, General Douglas MacArthur, the new Army Chief of Staff, sat atop an Army that had deteriorated beyond any reasonable comparison to the doctrine it espoused. Although by 1931 the Army had reached a ten-year manpower peak, the 140,516-man force was only half of that authorized by Congress in the National Defense Act of 1920.³ To make matters worse, most of its equipment was obsolete material of World War I vintage.

Like the rest of the Army, the Coast Artillery Corps was short on resources. Using this austerity as justification, General Andrew Hero, Chief of the Coast Artillery Corps, dramatically reorganized the Corps, placing increased emphasis on the organization and training of antiaircraft artillery.⁴ In an address in the January 1930 edition of *The Coast Artillery Journal*, Hero confirmed what many suspected--that antiaircraft artillery was the Corps' "principal interest during the last ten years." He also reiterated the War Department's view that antiaircraft artillery was "the first line of ground defense against enemy aircraft..."⁵ Giving up all pretense of defending the nation against an attack from the sea, Hero announced the reorganization of the Corps, reduced seventy-five percent of the harbor defense sites to caretaker status, and transferred many of the men from these units to antiaircraft regiments. He moved two of the three stateside antiaircraft regiments and established a fourth regiment, the 69th Coast Artillery (Antiaircraft Artillery), at Aberdeen Proving Ground, Maryland. Finally, he directed that all seacoast artillery units devote half of their training time to antiaircraft equipment and

cut the amount of ammunition used in seacoast artillery practice by fifty percent. Hero concluded by stating that the importance of antiaircraft artillery was “due to the rapid development of aircraft in recent years and the possibilities for its further development and future use as a weapon of warfare.”⁶ He challenged the “entire [Corps] ... to put forth greater effort,” become proficient on antiaircraft equipment, and “be ready at all times for instant action.”⁷ With this statement, Hero ended conclusively any debate regarding the primacy of antiaircraft artillery and firmly established a new order within the Coast Artillery Corps.

Intellectual Change

At Fort Monroe, the center of all Coast Artillery and antiaircraft activity, the changes were swift and dramatic. The Coast Artillery School adjusted its instruction to reflect the new priority given to antiaircraft artillery. Not only was more time devoted to antiaircraft artillery tactics and technique, but more time was also spent on the study of air forces. To assist in this instruction, the School added an Air Corps officer to the faculty to teach the “tactical principles of our own Air Corps.”⁸ The Coast Artillery School reciprocated by teaching classes on antiaircraft artillery at the Air Corps Tactical School. In 1931, largely as the result of recommendations from the Coast Artillery Corps, the Air Corps stationed three planes and five officers at Fort Monroe to support antiaircraft artillery target practice.⁹

The change in priority affected almost all of the courses taught at the Coast Artillery School. In the Battery Officers Course, more time was spent on tactics and techniques with officers now “required to actually operate antiaircraft instruments, guns, and equipment.” Advanced Course students received hands on instruction on antiaircraft

equipment and more exposure to antiaircraft and aviation tactics. The Advanced Engineering Course changed its instruction to concentrate on antiaircraft position-finding equipment, data transmission systems, and other fire control equipment to build a “reservoir of officers ... highly qualified for engineering work in the development of antiaircraft equipment.”¹⁰

In the academic year that ran from September 1932 to June 1933, the amount of antiaircraft instruction far surpassed that given to seacoast artillery. In the Battery Officers Course, 304 hours were spent on antiaircraft artillery, aviation, field artillery, and combined arms instruction, while only 217 hours were devoted to seacoast artillery. In the Advanced Course, antiaircraft instruction led seacoast instruction 363 hours to 225 hours. When courses on infantry, cavalry, field artillery, and combined arms were added—courses largely unnecessary for harbor defense officers operating from concrete fortifications—the total jumped to 752 hours or almost three times the number of hours assigned to seacoast artillery. While instruction in the Advanced Engineering Course leveled off with antiaircraft artillery receiving slightly more hours, the real proof of priority came in the eight week Refresher Course given to senior field grade and general officers. In this course, the amount of antiaircraft artillery instruction nearly doubled that given to seacoast artillery even before adding an unspecified number of hours for combined arms tactics.¹¹

The shift in officer education reflected the War Department’s view about the growing importance of antiaircraft artillery. With its emphasis on combined arms training, the revised instructional program began to focus attention on more than just the antiaircraft protection of harbor defense units. For the Coast Artillery, this move was an

important step that signaled a desire to expand its jurisdiction beyond the niche market it maintained in coastal air defense. Finally, the emphasis on antiaircraft instruction was critical to building broad consensus and support for antiaircraft artillery across the entire Coast Artillery Corps, from the uninitiated junior officers to the highly influential senior officers. By enlightening senior leaders, the Corps attempted to bolster short-term support as it continued to fight for resources. In educating junior officers on antiaircraft artillery, the Coast Artillery made an investment in the future direction of the Corps.

Doctrinal Advances

The intellectual advance of antiaircraft artillery continued with the first full-fledged codification of its doctrinal principles. In June 1930, the Coast Artillery Corps published a two-volume field manual on branch doctrine. Volume one of this set covered harbor defense, railway and tractor-drawn units. Volume two dealt specifically with antiaircraft artillery, discussing all aspects of tactics, gunnery, and fire control. The new text greatly expanded and improved on the earlier, highly tentative *Training Regulation 435-30* published in 1926. Printed in mimeograph format, *Training Regulation 435-30* speculated on most issues, defined nothing, and reflected the uneasy existence of the antiaircraft artillery during the period. As a result of its simultaneous and in depth treatment of all Coast Artillery subjects in the 1930 manual, the Corps ended any remaining apprehension as to where the antiaircraft element stood within the branch. Coming on the heels of Hero's proclamation and reorganization of the Corps, the 455 pages of detailed, cloth bound text firmly established the antiaircraft artillery as an important, if not dominant, element within the Coast Artillery.¹²

The new manual reaffirmed many of the tentative principles first outlined in the "Antiaircraft Bulletins" and *Training Regulation 435-30*. It also made a few minor changes such as increasing the number of searchlights per battery from twelve to fifteen and incorporating the experimental 105-mm antiaircraft gun into units assigned to army and "G.H.Q. Reserve" brigades.¹³ The most significant change in doctrine concerned the allocation of antiaircraft artillery units to field forces. The new manual maintained the existing structure of one regiment per corps and three regiments per brigade, but emphasized that neither force was adequate to meet the entire projected defense needs. The new doctrine stated that "G.H.Q. Reserve" units reinforced the army antiaircraft brigade, which in turn supplemented the fires of the corps antiaircraft regiment. In light of General Coe's earlier failed attempt to create a divisional antiaircraft battalion, planners were careful to adhere to the Adjutant General's guidance on assigning antiaircraft units to the infantry and cavalry divisions. Going one step further, however, they stressed the division's inability to protect itself from air attack and advocated the attachment of corps antiaircraft assets to the division. The smallest unit recommended for attachment was a composite battalion consisting of one antiaircraft gun battery and two machine gun batteries.¹⁴

The difference between Coe's proposal and the new doctrine was both subtle and significant. Planners did not break with Army guidance, but merely altered it to suit their own needs. In military terminology, "assignment" meant establishing a permanent relationship between a smaller unit and a larger parent organization. Conversely, "attachment" denoted only a temporary assignment to the same parent organization. By suggesting the "attachment" of an antiaircraft unit to a division, planners achieved

General Coe's goal of providing additional protection without violating Army regulations. Furthermore, planners hoped that once this regimen became habitual, senior infantry and cavalry officers would appreciate the benefits of this relationship and petition the Army leadership to make it permanent.

A “Systems” Approach

In line with its “systems” approach to antiaircraft artillery--where effective defense against air attack rested not on one weapon, but on the development and orchestration of different, yet complementary “systems” and techniques--the Coast Artillery improved both its active and passive measures to protect against air attack. After adjusting its preferred doctrine to meet War Department mandates, the new antiaircraft manual prescribed active defense tactics that synchronized the capabilities of antiaircraft weapons with the new doctrine for support of ground forces at the tactical level. This adjustment reflected a growing concern over the vulnerability of infantry units to air attack. Tests conducted at Fort Benning, Georgia indicated that low altitude bombardment, not machine gun fire, presented the greatest danger to infantrymen on the march.¹⁵

In the new manual, the mission of the antiaircraft artillery remained "to provide [continuous] local defense for ground forces and establishments against enemy aviation."¹⁶ Within this larger mission, both the antiaircraft 3-inch gun and the antiaircraft machine gun battalions had specific, but complementary, functions. The antiaircraft 3-inch gun battalion conducted "area" defense missions, protecting key installations in the rear combat zone and field forces in the forward zone. Due to the extended range of the 3-inch guns, the antiaircraft gun units defended "areas" of friendly

terrain instead of specific "point" assets. In the rear area, the gun battalions defended against enemy high altitude bombers. In the forward area, they fired on bombers and observation aircraft used to adjust enemy artillery fire on the front lines. Normally, gun units did not engage pursuit or attack aviation because the high altitudes and fast speeds attained by these aircraft made it difficult for gunners to traverse quickly enough to stay ahead of the target. When the Army attacked, the gun units attached to divisions deployed to positions a few thousand yards behind them and followed the attack accordingly. In the defense, their limited mobility forced these units to stay farther back from the front to avoid being overrun.¹⁷

For the antiaircraft machine gun units, the shorter range of the .50 caliber machine gun required these units to deploy closer to the assets they defended. As a result, they provided a mobile "point" defense of vital assets in both the forward and rear combat zones. Due to its ability to maneuver rapidly and operate as an independent entity, the machine gun platoon served as the basic defensive unit. Commanders grouped platoons together according to the size of the "point" they protected. Some of the elements defended by machine gun units included troop concentrations, airfields, railheads, and command posts. A high volume and flexibility of fire enabled machine gun units to engage low altitude attack aviation and dive-bombers. As a function of their mobility, antiaircraft machine gun platoons protected march columns from positions in the front and rear of the column. In the attack, these units supported the main thrust of friendly forces. Similarly, when on the defensive, the mobility of machine gun units permitted them to remain close to the front and face the enemy's main air attack.¹⁸ Indicative of the concern over protecting infantrymen from air attack, Ordnance Department officers

discussed building a truck-mounted quad .50 cal antiaircraft machine gun complete with a hydraulic firing mechanism and onboard fire control devices.¹⁹ Due to lack of resources, this effort languished, only to reemerge during World War II.

In addition to active measures that involved actually firing on aircraft, the new manual discussed several passive measures designed to improve the effectiveness of antiaircraft units. Beyond simple camouflage and deception operations with dummy antiaircraft batteries, the manual advocated using barrage balloons to deter enemy pilots from attacking specific areas. Barrage balloon formations consisted of a series of captive (lighter-than-air) balloons deployed at 300 to 500 foot intervals floating at a height up to 20,000 feet. Used only at night, the barrage compelled fearful pilots to fly around the barrier. Aware of the moral effect it had on enemy aviators, commanders stationed gun batteries on the flanks of the barrage, forcing pilots to fly through a zone of shellfire to avoid the network of steel cables. By frequently shifting the location of the barrage, commanders maximized its moral effect and kept enemy pilots guessing its position.²⁰

Intelligence and early warning of air attack were also critical to establishing an effective defensive “system.” In early 1930, the War Department tasked the Coast Artillery and the Air Corps to test the “soundness of the organization and equipment for an Antiaircraft Brigade Intelligence Battery....” Accordingly, the Air Corps and antiaircraft artillery held joint exercises at Aberdeen Proving Grounds in May 1930. The exercises provided valuable insight into the antiaircraft and aviation defense of a fixed facility. The early warning network used during the test relied heavily on telephone and radio communications and as such proved useful to the Signal Corps in designing future systems. As a result of the test, the Coast Artillery Corps designed a provisional battery

capable of providing early warning of air attack out to 100 miles and agreed that the matter was of “sufficient importance to warrant the holding of future exercises...”²¹

Antiaircraft Artillery with the Mechanized Force

In addition to revising its own antiaircraft doctrine and working with the Air Corps, the Coast Artillery Corps expanded its area of concern and in late 1930 began providing antiaircraft protection for the new Mechanized Force. From November 1930 to November 1931, the War Department established the Mechanized Force at Camp Eustis, Virginia. The aim of the Mechanized Force reflected the ideas of British theorists Basil Liddell Hart and J. F. C. Fuller and foreshadowed German armored warfare. The Mechanized Force was a combined arms group designed to capitalize on its “armament, speed, marching radius, and mechanical reliability ... to maneuver beyond the immediate support of divisional infantry ...” and to accomplish “those tactical missions presenting an opportunity for a force capable of tactical and strategical [*sic*] mobility and quick, hard hitting striking power.” Its missions included seizing “key positions,” enveloping or turning the enemy, counterattacking, performing as a flank or rear guard, and conducting breakthroughs and exploitations.²²

From the outset, it was a combined arms outfit complete with a tank company, an armored car troop, an artillery battery, an engineer company, a chemical section, and an antiaircraft detachment from E Battery, 69th Coast Artillery Regiment. The unit trained and experimented through the winter and spring of 1930-1931 to “develop a combined tactical team and to determine appropriate organization and equipment.” The initial table of organization and equipment to emerge from these trials included “230 tanks, 50 self-propelled guns and mortars, 90 halftracks ... and antiaircraft vehicles on tank chassis.”

Major Robert W. Grow, the Operations Officer (S-3) of the Mechanized Force, recognized the importance of protecting the force from air attack. In his diary, he wrote: “The biggest antiaircraft job is to cover defiles. Each vehicle needs an antiaircraft weapon. The antiaircraft battery should be dispersed in the march column.”²³ While supporting the Army’s doctrinal position that units should employ their own weapons to defend themselves, Grow nonetheless endorsed the use of antiaircraft batteries with maneuver units—a vision that was partly at odds with current Army thinking, but that would ultimately proved correct.²⁴ Second Lieutenant Frank Ostenberg, the antiaircraft detachment commander, was more succinct. Arguing that maneuvers with the Mechanized Force proved the need for a specialized unit dedicated to “*maintaining continuous protection ... from low flying air attacks,*” Ostenberg concluded, “the troops best qualified to carry out this mission ... [belong to] ... the antiaircraft artillery....”²⁵

Although the Mechanized Force took great theoretical and practical strides toward establishing a mechanized combined arms unit, the effort stalled when the Chief of Cavalry gained control over the Mechanized Force. On 1 November 1931, the Army dissolved the Force, sending the tanks and armored cars to Fort Knox and the antiaircraft equipment back to Aberdeen Proving Grounds.²⁶ The limited success of the Mechanized Force notwithstanding, the provision of antiaircraft protection to maneuver units had made a significant impression on the men of the Mechanized Force. Ten years later, the battle over how best to protect divisional units from air attack would resume; then the stakes would be much higher.

The Impact of the Great Depression

As the impact of the Great Depression grew more intense, the majority of training stopped. In the meantime, the antiaircraft artillery establishment continued to develop its technique, alternating garrison duties with athletics and an occasional target practice. A shortage of ammunition along with the new requirement to train seacoast artillerymen in antiaircraft gunnery limited the number of antiaircraft weapons a unit could fire during target practice and forced machine gun batteries to conduct preliminary firings with shorter range .30 caliber weapons instead of more modern .50 caliber machine guns.²⁷

In late 1931, the War Department issued a new directive designed to maximize the value of what little training did occur. According to the directive, units were to gear “all garrison and armory training ... toward preparing units for field service,” focusing on “the command and tactical training of battalions and higher units....” The Army emphasized junior officer initiative with “opportunity being offered to exercise command in the next higher grade.” Mobile units were to hold annual field exercises lasting at least a week and drive not less than 100 miles. Harbor defense units would man installations continuously for at least a week annually, preferably during target practice or a joint exercise with the Navy. Finally, units were to stress offensive measures and train all troops to combat aircraft.²⁸ The directive demonstrated that the Army recognized its resource limitations and tried to make the best of the situation. The War Department accepted the obvious decline in military readiness that came with such limited training, but attempted to mitigate the effects by preparing its small professional cadre of leaders for greater responsibility in the future. Two areas, however, where the directive indicated

the Army would not compromise were in its desire to maintain an offensively-minded operational mind-set and in its concern for defense against air attack.

The directive also reflected the War Department's continuing Interwar policy that stressed the maintenance of manpower at the expense of modernization. This focus on manpower severely limited most of the Army's modernization and equipment programs. Between 1925 and 1940, Army appropriations totaled \$6,169,300,000. Of that amount, the Army spent only \$854,556,000 on modern equipment, most of it (\$509,900,000) on aviation. That left \$344,656,000, or 5.6 percent, for the "modernization and replacement of arms and equipment for the ground elements...."²⁹

As Chief of Staff, General Douglas MacArthur's belief in the primacy of man over machine reinforced the "manpower first" policy. In World War I, MacArthur led patrols across "no man's land" to capture prisoners and gather intelligence. Self-reliance, initiative, and personal leadership characterized his romantic, Victorian vision of the ideal soldier. According to MacArthur, "weapons are nothing but tools.... Effective results can be obtained only when an army is skillfully organized and trained...."³⁰ His feelings on the primacy of man notwithstanding, MacArthur "employed" the tools of war effectively during the Bonus March in July 1932 when he used tanks, horse cavalry, tear gas, and infantrymen to drive a hapless "army" of World War I veterans out of Washington, DC and across the Anacostia Bridge under the glow of "artificial moonlight" provided by Coast Artillery searchlights.³¹

MacArthur's Modernization Program

Regardless of policy or personal feelings, neither the War Department nor MacArthur could ignore the need to modernize the Army. Attempting to redress some of

the crippling equipment shortages, MacArthur instituted a program to modernize the force. Appalled by the state of equipment within the Army, he revamped war plans and directed funds toward an “Immediate Readiness Force” of 400,000 soldiers to respond in a crisis. MacArthur recommended an immediate procurement program that spent \$62 million on motorization and mechanization, \$39 million on aircraft, \$35 million on field artillery, and \$33 million on antiaircraft artillery. As he wrote in his 1933 report,

... these figures ... represent the extent to which the Army is deficient in modern weapons and equipment. This deficit has not occurred suddenly but rather is the cumulative result of years of failure to provide adequately for procurement and replacement.³²

As the Great Depression continued, however, maintaining a trained and equipped Army became increasingly more difficult. Two of President Franklin Roosevelt’s relief measures--the Economy Act and the Civilian Conservation Corps (CCC) Reforestation Relief Act--had a particularly pernicious effect on the morale and readiness of the Army. In addition to the cut in the federal salaries imposed under the Economy Act, reduced budgets and the immediate requirements of the Civilian Conservation Corps forced the cancellation of several military exercises. In May 1933, the War Department closed all service schools except the Army War College, the Industrial College, and the Air Corps Tactical School to release the students and sixty percent of the faculty for CCC work. With the loss of students and faculty, the Coast Artillery School stopped operating.³³ Additionally, the Fort Monroe garrison lost more than 200 officers and enlisted men. With fewer instructors, the Coast Artillery School cut its student quota for 1934 by fifty percent.³⁴

While the Civilian Conservation Corps supported Roosevelt’s efforts to ease unemployment, which peaked at over 12 million in 1933, it did nothing for the morale of

the individual soldier. The Economy Act cut federal salaries by fifteen percent, reducing the pay of an Army private to \$17.85 a month at the same time that CCC enrollees received \$30.00.³⁵ Moreover, the end to reenlistment bonuses and a growing distaste for CCC duty dramatically reduced recruiting and retention. For those soldiers who did remain in the Army, garrison life was not taxing. Most performed military duties in the morning and spent their afternoons involved in athletics or recreational activities. But while enlisted men at least had a job and received steady, if reduced pay, life was not always rosy. Many military families barely scratched out a living. As one Coast Artillery officer³⁶ commented, the

*Fifteen percent cut was bad enough
But the pay-freeze made it three times as tough;
...
There is no clause in an iron-clad lease
That takes account of your pay decrease,
So when you hint at reducing the rent
The landlord says "Not a God-damned cent."*

While this officer captured in print the dilemma facing many military families, others were dealing with the problems firsthand. In 1933, Colonel George C. Marshall not only commanded the Eight Infantry Regiment near Charleston, South Carolina, he also supervised the CCC camps in South Carolina. So that his soldiers could afford to feed their families, Marshall "personally supervised the building of chicken yards, vegetable gardens, and hog pens... [and] started a lunch pail system whereby the men could get a good hot dinner, cooked at the mess, to take home to their families at a very small cost."³⁷

Although the government restored full pay in 1935 and the size of the force grew to 167,816 by 1936, the Army still felt the effects of the Depression, particularly when it came to training and equipping the force.³⁸ Major LeRoy Lutes, a Coast Artilleryman

responsible for training new soldiers, captured the essence of the training problem when he asked plaintively of the recruits, “Are we going to train them into alert, active young soldiers or are we going to make them into hedge clippers, lawn trimmers, garbage haulers, etc. with soldiering as a sideline?”³⁹

As the man responsible for defending the nation from air attack, the Chief of Coast Artillery, Major General John W. Gulick, welcomed any effort to modernize the Corps’ antiaircraft artillery equipment. He had campaigned vigorously to convince the press and members of Congress of the need to increase spending on antiaircraft artillery, but attained only minor success. In his view, the nation’s stock of antiaircraft equipment was dangerously low and needed more development. As of May 1933, the Corps could muster only 122 3-inch guns, 32 fire control mechanisms, 98 .50 caliber machine guns, and 46 searchlights for the defense of the United States.⁴⁰

To maintain the eight active antiaircraft regiments in the Army, Gulick filled each to only a fraction of its authorized strength. This stopgap measure enabled the regiments to function at a basic level, keeping the doors open and the lights on. Without a full complement of personnel or equipment, however, the regiments were unable to conduct realistic, meaningful training. Concerned about the defense of the nation’s overseas territories, he gave priority to the four regiments defending the insular possessions, but could only supply them with half of the required number of guns, machine guns, and searchlights.⁴¹ In an address that September to the Army War College, Gulick argued that both low and high altitude antiaircraft weapons were insufficient to meet the challenges posed by faster aircraft. Reluctantly, Gulick admitted to the audience that “the shortage in guns ... directors, and searchlights remains so great, there is no necessity for

... a change....” While he desperately wanted more equipment, he did not believe that “in view of the materiel situation ... it [was] practicable to urge at the present time an increase in the antiaircraft artillery now assigned....”⁴²

From Competition to Cooperation

While money and equipment were in short supply, ideas on how to improve antiaircraft weapons and tactics were not. Throughout the decade, Coast Artillerymen continued to grapple with the problem of how to protect assets on the ground from air attack. Many recognized that the pendulum of progress, the action-reaction cycle, swung back and forth between the abilities of aircraft and antiaircraft artillery. In World War I, while both were in their infancy, most Coast Artillerymen acknowledged that airplanes probably had the upper hand. As a result of improvements in weapons and tactics in the early to mid-1920s, a growing number of Coast Artillerymen believed that antiaircraft artillery had caught up, if not surpassed, the airplane in the continuing duel for control of the skies. As one observer put it, the effect of antiaircraft artillery has been to “awaken aviation to its various deficiencies ... completely revolutionize bombing tactics ... accelerate the development of bombing aviation ... [and] counter the threat of bombardment aviation to such an extent that any attack on antiaircraft artillery [will be] ... almost prohibitive.”⁴³ By the early 1930s, however, aviators had awakened and, as even General Gulick acknowledged, were flying faster, higher, and more quietly making them harder to hear, track, and hit.⁴⁴ Indeed, in true Hegelian fashion, the pendulum had reversed course and now swung in favor of the airmen.

Gone from this debate, however, were the diatribes of the 1920s epitomized by Billy Mitchell’s dogmatic position on the primacy of air power. Characterized by at least

the appearance of cooperation, intellectual debate and “friendly rivalry” replaced political grandstanding. Throughout the 1930s, the Air Corps and Coast Artillery held several joint exercises to refine tactics, evaluate techniques, and discover deficiencies.⁴⁵ Early on, the two organizations even wrote a manual on combined training for coast defense.⁴⁶ The Coast Artillery School and the Air Corps Tactical School continued to exchange instructors and educate their students about their respective capabilities. Officers from both the Coast Artillery and the Air Corps called for the “closest cooperation” between the two groups. All sought to hold more joint exercises to refine techniques and develop “effective teamwork.”⁴⁷ Commenting on the need for close cooperation between the Coast Artillery and Air Corps, Major Claire Chennault remarked, “effectiveness in war depends on peacetime training; and it is especially necessary that our aerial defense be effective....”⁴⁸

Three Barriers to More Effective Antiaircraft Artillery

Many antiaircraft officers realized that changes in aircraft technology had made the airplane more difficult to engage. Engines had become quieter, making the sound locators even less effective, while increases in aircraft altitude and speed threatened to reduce the effectiveness of even daylight gunfire. Throughout the 1930s, antiaircraft officers at the Coast Artillery School, the Command and General Staff School, and the Army War College continued to grapple with these problems.⁴⁹ Three issues were particularly acute.

First, to engage aircraft, antiaircraft artillery units had to find them. The sound locators, which directed both antiaircraft searchlights and guns, were becoming increasingly useless. To rectify this problem, the Coast Artillery conducted several joint

exercises to test an antiaircraft intelligence network designed identify the number, location, and heading of attacking aircraft. The network, which in wartime might require over one thousand people to operate, placed spotters in three bands extending out to fifty, seventy, and one hundred miles. In tests at Fort Knox in May 1933, the network alerted pursuit aviation and antiaircraft artillery units and was largely successful in stopping daylight attacks on the Army post. Night bombing attacks, particularly by aircraft gliding in silently from 18,000 feet, proved more effective. Both spotters and sound locators failed to pick up a number of these dive-bombing aircraft.⁵⁰

Like the results of the 1930 Aberdeen tests, it was easy to agree on the need for an early warning system. Writing it into doctrine and providing manpower to operate the network, however, was much harder. War Department observers found the network useful, but ultimately balked at the high number of soldiers needed. They also disagreed as to the viability of using civilians, including Boy Scouts, to augment the network during any attack on the United States. In the end, they determined that the issue required further study. Only the invention and fielding of radar, which replaced the need for thousands of individual spotters, would make the early warning network effective.

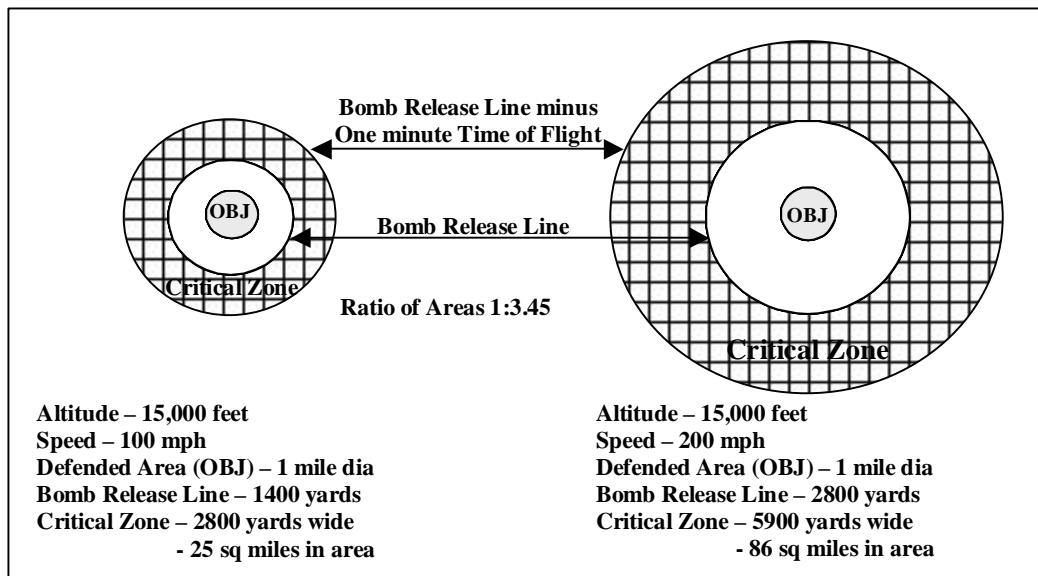
The second concern antiaircraft artillerymen had involved the defense of forces in the forward area, particularly within the division zone, against low flying or “hedge-hopping” aircraft. Although the fire control director for the 3-inch antiaircraft gun had been improved and simplified to the extent possible, low flying aircraft simply moved too fast for the director and the soldiers operating it to keep up. Conversely, the .50 caliber machine gun was a powerful weapon, but it fired a non-explosive bullet and relied on the gunner’s skill to hit the target. It would take several non-explosive rounds “hose-piped”

on to an airplane to bring it down. What the Coast Artillery needed, according to General Gulick, was an “automatic or semi-automatic weapon firing a high explosive projectile capable of inflicting vital damage on a plane with a small number of hits.”⁵¹ As early as 1932, Coast Artillery officers had identified the 37-mm gun as a likely candidate for the job.⁵² Unfortunately, in a depressed economy and without an immediate threat, this project sat in the Ordnance Department until 1937 when the War Department began to consider a dual-purpose antiaircraft-antitank intermediate caliber cannon.⁵³

The third issue facing antiaircraft artillerymen was whether a single regiment of antiaircraft artillery with its battalion of twelve 3-inch guns provided enough firepower to defend a corps area against air attack. In 1933, General Gulick expressed concern, doubting “very much the sufficiency of a single regiment in the corps ...” and arguing instead for a “brigade of two regiments...”⁵⁴ He expressed “hope that when our antiaircraft materiel and equipment situation improved, the antiaircraft component of the corps [would] be increased....”⁵⁵

Indeed, for most of the decade, antiaircraft planners had expressed growing concern that improvements in aircraft technology and bomber speed would reduce the volume of fire antiaircraft gunners could bring to bear on enemy airplanes and make them harder to hit.⁵⁶ Not only would bombers speed through the “critical zone” faster, but their increased speed also expanded the area that doctrine required the antiaircraft regiment to cover with fire. Without augmentation, antiaircraft gun batteries risked being spread too thin and unable to engage incoming bombers with enough shots to have any effect.

Antiaircraft doctrine required gunners to fire on attacking bombers for one minute prior to the aircraft reaching its bomb release line (see figure 6.1). The area between the bomb release line and the distance the aircraft could fly in one minute was known as the “critical zone.” Antiaircraft doctrine required that at least one gun battery, preferably two, cover the “critical zone.” The problem was that while this doctrine was sound for bombers flying at 100 miles per hour, by the mid-1930s they were flying in excess of 200 miles per hour. At this speed it took a minimum of six batteries or two antiaircraft gun battalions to defend a single asset.⁵⁷ The solution was to increase the number of 3-inch gun battalions in the regiment. This increase often took the form of a composite regiment with the configuration most often recommended being two gun battalions (4-6 batteries), a machine gun battalion, and a searchlight battalion.⁵⁸ While planners would quibble about the specific structure of the composite battalion for the rest of the decade, any real solution would have to wait until the brink of war before there would be sufficient antiaircraft equipment to turn any doctrinal solution into a battlefield reality.



Source: B. L. Milburn, "Defense Against Aviation and Mechanized Units," United States Army War College, 1936-1937, Course: G-3, Report of Committee No. 6, No. 3-1937-6, 23 October 1936, 78.

Figure 7.1 - Comparison of Critical Zones

Turning Inward for Solutions

Without advances in technology or increases in equipment, the Coast Artillery Corps shifted its focus and looked inward. Absent the fiscal resources to underwrite reform, the Corps invested its intellectual capital and continued to refine its doctrine. The Corps published updated editions of the *Coast Artillery Field Manual* in 1933, 1938, and 1940. Beginning with the 1933 edition, two changes in format occurred in the publication of the manual. First, it entered the Army's field manual system and became *FM 4-105*. Second, the Coast Artillery divided the antiaircraft volume into two separate pamphlets. In the 1933 edition, Part One contained information on antiaircraft artillery employment and tactics, while Part Two covered the crew drills and equipment operating procedures collectively known as "technique." This method carried over into the 1938

and 1940 editions. In those editions, the Coast Artillery combined the "technique" portion of the manual with another section consisting of firing tables and antiaircraft reference data. As a result, by 1940 all antiaircraft artillerymen possessed a small, but complete, library of information specific to their specialty.⁵⁹

With a few notable exceptions, the tactical portion of the 1933 edition resembled the earlier manual.⁶⁰ The greatest difference came with the increased amount of attention paid to the tactical employment of antiaircraft weapons and organizations. The new edition contained a lengthy section explaining the different antiaircraft tactics needed for each anticipated combat situation. In the rear area, the manual emphasized methods for protecting troop concentrations and bivouacs. In the forward combat zone, it focused on the employment of antiaircraft weapons during advances, offensive and defensive operations, pursuits, withdrawals, and retirements. Planners even included a section on how to provide supplemental antiaircraft defense for a separate division. Besides the in-depth treatment given to each subject, writers reinforced their textual comments with situational drawings and figures. With their appearance in the 1933 edition, these examples clarified the earlier written guidance and eased understanding of the interrelated nature of the antiaircraft artillery system. Finally, the manual highlighted the need for clear and concise combat orders and provided a section with examples of order formats so that commanders could convey their desires in a standardized and comprehensible manner.⁶¹ While the earlier manual elevated the antiaircraft artillery to a level of doctrinal equality with its seacoast counterpart and enabled all Coast Artillerymen to read off the same page, the real value of the 1933 manual was its clarity and simplicity. For a small peacetime Army that planned to expand quickly in wartime,

simple, clear doctrine was important. For an antiaircraft artillery establishment that employed complicated equipment and relied on part-time National Guard units for the majority of its force structure, it was essential.

The Slow Climb Back

Although it would take until World War II for the nation to recover from the Depression, by 1935 America began to show slight signs of recovery. For the Army, however, the mid-1930s offered promise, but not much else. Despite a \$200 million budget increase between 1934 and 1936, the Army still lacked modern equipment.⁶² In the two categories of hardware that dominated military Interwar development—tanks and airplanes—the Army was short \$16 million worth of mechanized equipment and over 350 aircraft.⁶³ For the Coast Artillery, although the funding of the last few years had been sufficient to enable the Ordnance Department to carry out experimental work, there was not enough money available to procure the equipment after pilot models had been standardized for manufacture.⁶⁴ Of the four active Coast Artillery Corps regiments located in the United States, none were at full strength in either personnel or equipment. In fact, three of the four regiments possessed only one battery each of searchlights, guns, and machine guns. Across the entire antiaircraft establishment, the situation was so dismal that none of the active or National Guard regiments located in the United States had enough equipment to train in peacetime. On the whole, the Army needed an additional 400 3-inch guns and over 2000 .50 caliber machine guns (of all types).⁶⁵

Shadowed by growing fiscal economy, War Department procurement languished. With best selling books such as *Merchants of Death* warning readers about the dangers of the “military-industrial complex” and Senator Gerald Nye’s Munitions Investigation

Committee conducting public hearings from 1934 to 1936 to “prove” that the United States entered World War I to protect bankers and arms dealers, the American public was in no mood to support rearmament. Still smarting over the Army’s ousting of the “Bonus Marchers” in 1932, the American peace movement grew to twelve million strong in the 1930s.⁶⁶ Growing isolationism led to the passage of the several measures designed to prevent American involvement in war, including the Johnson Debt Default Act in 1934, prohibiting loans to any foreign government in default to the United States, and the Neutrality Acts in 1935, 1936, and 1937.

While a chorus of isolationist activity argued for America to avoid involvement in the growing international disorder, others sensed danger and, if for no other reason than homeland defense, urged increased funding for antiaircraft artillery equipment. Leading the charge was the new Chief of the Coast Artillery, Major General William F. Hase. Reflecting in mid-1934 on the growing unrest in Spain, the German and Japanese withdrawal from the League of Nations, and the Japanese domination into Manchuria, Hase commented that “the world is now in such a disturbed condition, and ... so fraught with danger ... that we should look well to our means of national defense.” Remarking on the shortage of materiel, he emphasized the need to have equipment that industry could produce “rapidly and economically.... Our expansion will be great [for] our store of materiel on hand, particularly antiaircraft guns and accessories, is small.”⁶⁷

Secretary of War George H. Dern also expressed concern. Arguing that America’s national military policy contemplated “no aggressive action,” Dern continued that it was a “pity that we should have become so oblivious to the bitter lessons of the World War as to allow our defense to dwindle until ... [we are] ... unprepared for

effective action.” He maintained, “if another war should be forced upon us ... we should find that our so-called ‘economies’ have ... been a hideously extravagant waste of money and lives.”⁶⁸

Even usually cautious business journals echoed these worries. Following Hitler’s announcement of German rearmament, *Fortune* revealed the pitiful state of the Army in its September issue. In addition to highlighting the Army’s personnel and equipment shortages, *Fortune* proclaimed “the most important defense for the US or any other nation is antiaircraft defense. This alone will limit the effectiveness of an airplane in any future war....”⁶⁹

In 1935, the Army took a positive step forward when MacArthur initiated a series of six-year programs under the Protective Mobilization Plan to modernize the regular Army and National Guard. With respect to antiaircraft artillery, MacArthur requested funds to outfit all of the active regiments in the regular Army and the National Guard, followed by a similar program to equip all the inactive units.⁷⁰ By the end of June 1936, the War Department had achieved modest progress in meeting MacArthur's goals. General Malin Craig, MacArthur's successor as Chief of Staff, reported that the Army had equipped one of the regular Army antiaircraft regiments and would complete a second within a year. In the same report, Craig pushed for over \$7 million to improve the defense of the Pacific coast, Hawaii, and the Panama Canal Zone.⁷¹ While conditions had improved, the amount of antiaircraft equipment available fell far short of requirements. As an Army War College report of late 1936 indicated, the active and inactive units of regular Army and the National Guard were still short 240 3-inch antiaircraft guns, 58 fire control directors, 326 sound locators, 338 searchlights, and 1880

.50 caliber machineguns. The cost of supplying these shortages was approximately \$23 million.⁷²

In late 1936, President Roosevelt weighed in, expressing at least a passing interest in anti-aircraft equipment. After viewing a display of anti-aircraft artillery equipment, including the 3-inch gun, Roosevelt remarked that the gun was “marvelously mobile.” He continued, telling Major General Archibald Sunderland, the Chief of Coast Artillery, that he “wish[ed] we had more of them.”⁷³ In early 1937, influential members of Congress followed Roosevelt’s lead. In a full-page article in the *Coast Artillery Journal*, Senator Morris Sheppard of Texas, the powerful Chairman of the Senate Military Affairs Committee, admonished the general public and members of Congress for demanding on “a large and efficient Air Corps” while neglecting anti-aircraft artillery. He emphasized the need for an anti-aircraft rearmament program and argued that Congress “seriously consider [making] sufficient funds ... available for its execution.”⁷⁴

In 1937, after receiving numerous reports on the conduct of the war in Spain and China, the War Department altered its rearmament priorities, placing anti-aircraft artillery equipment at the top of the list. A series of reports from American, French, and British officers confirmed the effectiveness of modern anti-aircraft artillery weapons against aircraft. After reading comments like “only the Germans brought modern anti-aircraft artillery: the effects of this artillery are sensational” and “the Chinese are apprehensive about sending their bombers against concentrated Japanese anti-aircraft artillery,” planners became concerned about the adequacy of American anti-aircraft artillery. Citing these reports as the reason for the change in priority, General Craig emphasized the need to equip the active Army regiments immediately. Expressing concern over the possibility of

an attack on the United States, Secretary of War Harry W. Woodring commented on the lack of "sufficient antiaircraft artillery to provide for the defense of vital areas" and asked for enough money to equip all of the regular and National Guard regiments as well as provide for a "sizable reserve for emergency use."⁷⁵

Adjusting Doctrine to the New Reality

By 1938, the world situation had changed dramatically, a fact that did not pass unnoticed by the authors of antiaircraft artillery doctrine. Reports regarding the impact of air power in Spain and China not only convinced government officials to procure more equipment, they also drove antiaircraft planners to revise the doctrine in *FM 4-105* to reflect the lessons drawn from the overseas conflicts. The most fundamental lesson to impact on antiaircraft artillery doctrine concerned the need to employ all of the available forces and leave nothing in reserve.

Appropriately, the 1938 edition of *FM 4-105* altered the allocation of antiaircraft artillery units and eliminated any reference to the number of antiaircraft brigades in the "G.H.Q. Reserve." Increasingly driven by the realization that only a finite number of antiaircraft units were available, planners wanted to ensure those units deployed as far forward as possible in the combat zone and were not viewed by rear area commanders as belonging to the "G.H.Q. Reserve." Instead of assigning the "G.H.Q. Reserve" a specific number of antiaircraft brigades as it had in the past, the new doctrine directed that all units not allocated to subordinate headquarters remain in the control of the "G.H.Q. Reserve." In other words, instead of controlling over 50% of the available antiaircraft force, the "G.H.Q. Reserve" now collected the remaining elements after the forward units received their initial allocations and necessary reinforcements.⁷⁶

This policy was contradictory in several ways. Limiting the number of antiaircraft units held in “reserve” did not necessarily mean that additional units would go forward in large numbers to protect front line soldiers. Army regulations still maintained that front line units provided for antiaircraft defense and the lack of antiaircraft organization in the division reinforced this belief. Additionally, reducing the number of antiaircraft units in the “G.H.Q. Reserve” ran counter to the War Department’s 1936 policy on streamlining units and was destined to run head long into Lieutenant General Lesley J. McNair’s World War II policy of “pooling” antiaircraft artillery, tank destroyers, and other forces.⁷⁷

Besides changes in the allocation of units to the “G.H.Q. Reserve,” the 1938 manual expanded its coverage of the classification, characteristics, and tactics of aerial targets. Incorporating new information from overseas reports, this section focused on the general characteristics of aircraft as well as employment techniques of specific types of military aviation. While part of the section covered the capabilities and tactics of observation and pursuit planes, the majority of the chapter dealt with the day and night operations of bombardment and attack aircraft, paying particular attention to the methods used against ground targets and antiaircraft artillery units.⁷⁸

Equipment Concerns

As the wars in Spain and China continued, concern grew in the War Department over the Army's level of readiness. General Craig complained in his 1938 report that "the regular Army rank[ed] 18th among the standing armies of the world." More importantly, he argued that the United States "failed to keep pace with the development in defensive [antiaircraft artillery and anti-tank] weapons that had occurred since the World War." As

a result, he left anti-aircraft weapons at the top of the War Department's priority list and urged the continued procurement of these weapons so that the Army "be equal to that which it may be called upon to face."⁷⁹

In the same report, Secretary Woodring emphasized the amount of material still required to outfit the new "Initial Protective Force" of 400,000 men as well as "augment our air forces and anti-aircraft installations in the Panama Canal Zone."⁸⁰ His comments were indicative of the trend that continued through the American entry into the war in December 1941. The two issues--equipment for the troops and improved defenses for the insular possessions--dominated the thinking of defense planners. In both areas, problems occurred that hampered the short-term attainment of either objective.

In terms of anti-aircraft equipment, Assistant Secretary of War Louis Johnson expressed the situation accurately when he reported in 1938 that the nation's program for procurement "falls far short of providing even the minimum amount [of anti-aircraft hardware] ... necessary."⁸¹ As the War Department's "business manager" responsible for synchronizing the manpower and material needs of the Army, Johnson was acutely aware of the difficulties involved in rearming the nation. Despite his best efforts, the equipment deficit continued. While the War Department might claim modest progress in arming one active anti-aircraft regiment each year with modern equipment, as of early 1938 the Army would have to confiscate all the anti-aircraft materiel in the ten National Guard anti-aircraft regiments just to outfit one regiment properly.⁸²

The situation had improved slightly by the time the General Craig testified before Congress on the War Department's budget for 1939. Craig told members of the House Appropriations Committee the Army now ranked "seventeenth in size in the world ..."

but emphasized that “its deficiencies ... are well known to foreign experts.”⁸³ When asked if there was any one item that stood out as being particularly deficient, Craig responded that antiaircraft artillery equipment was his primary concern, that it represented “by far the most serious cut in military preparedness....”⁸⁴ Taking credit for everything planned in the 1938 budget, Craig estimated the War Department still needed over \$52 million in antiaircraft equipment and ammunition to complete its program. Realizing that the amount was too large for the Government to consider seriously, Craig reported that the War Department had prioritized its antiaircraft needs and asked for \$13 million only to have the Bureau of the Budget reduce that amount to \$4 million.⁸⁵ Appealing to the Budget Director and to President Roosevelt, Craig succeeding in having the money returned to the Appropriations Bill and now asked Congress to provide it. When asked by Congressman Dockweiler of California, if “antiaircraft [was] really sufficiently effective to keep airplanes away,” Craig responded that it was and cited reports from China and Spain, specifically praising the effectiveness of German antiaircraft artillery.⁸⁶

By late 1938, events in Europe created a sense of urgency that mocked the tedious peacetime budget and procurement process. In November, shortly after the Munich Agreement, Roosevelt held a meeting of top advisors and complained because they lacked air power, Britain and France bowed to Hitler’s wishes. He emphasized that the Air Corps was the weakest of all American military forces, followed closely by Army antiaircraft units.⁸⁷ In light of the continued deficiency in antiaircraft equipment and the President’s expressed concern about it, antiaircraft equipment topped the War Department's priority list for a third straight year in 1939.⁸⁸ Global events and

presidential interest had propelled antiaircraft artillery out of the shadow of seacoast artillery and into the spotlight.

Updating Doctrine on the Eve of Conflict

The effects of aviation and antiaircraft artillery in the overseas conflicts also caught the eye of planners in the War Department. In 1939, when the Army published a tentative update of its *Field Service Regulations, 1923* it placed increased emphasis on the tactical employment of antiaircraft artillery. Although antiaircraft artillery still "reinforced" the antiaircraft fire of the maneuver units, the War Department expanded beyond its 1923 guidance and included antiaircraft artillery units in its discussion of offensive and defensive operations and special contingency missions like river crossings. In the defense of assets in the forward and rear combat zone, the new regulation, now parenthetically entitled *FM 100-5: Operations*, reiterated many of the same themes present in the antiaircraft artillery manuals. In the forward area, antiaircraft units covered assembly areas, advancing troop movements, and defensive battle positions where they paid particular attention to the protection of the artillery pieces. In the rear area, these units guarded supply lines, ammunition depots, railroads, and critical points along the lines of communication that supported the maneuver forces. If, after reviewing reports from the fighting overseas, War Department planners remained skeptical about some aspects of modern warfare, they no longer questioned the importance of antiaircraft weapons on the battlefield. A decade after the Coast Artillery Corps achieved a modicum of internal consensus regarding the value of antiaircraft artillery, the external community as represented by the War Department's official sanction came to the same conclusion. While it would take proven combat capability on the battlefields of World War II for the

antiaircraft establishment to earn full recognition, *FM 100-5: Operations* nonetheless represented a watershed in the acceptance of antiaircraft artillery into the family of arms.⁸⁹

In August 1940, as the Battle of Britain raged across the Atlantic, the Coast Artillery published the final peacetime revision of its antiaircraft artillery manual. Two major changes occurred in this edition that signaled the maturation of Interwar antiaircraft doctrine. First, the type and composition of antiaircraft units evolved from the basic mobile antiaircraft regiment into a series of mission-specific organizations with differing structures. Second, in addition to enlarging the sections on enemy air characteristics and tactical employment, the authors of the new manual greatly expanded the treatment given to the protection of rear and coastal areas.

The changes in antiaircraft organization evolved from two separate developments. First, planners altered existing force structures to accommodate the new 37-mm antiaircraft gun just beginning to reach the field in 1940. Second, the threat of war spurred the design of organizations capable of performing separate and distinct missions. The Army needed one type of antiaircraft unit suitable for the mobile defense of field forces in the theater of operations and another for the protection of the insular possessions and the coastal and rear areas in the zone of interior. The result was an immensely confusing collection of antiaircraft units with varying levels of firepower and mobility.

The 37-mm antiaircraft gun, under consideration by the Ordnance Department since 1932, had undergone extensive testing in the latter half of the decade and entered production in early 1940. Designed as an intermediate automatic weapon to supplement the fire of the .50 caliber machine gun, the 37-mm gun rode on a highly mobile trailer,

fired a high explosive, point-detonating shell, and could be operated quickly.⁹⁰ Coast Artillery planners used it to form the basis for several new antiaircraft organizations--an "automatic weapons" battalion;⁹¹ a "separate" battalion (designed to reinforce the antiaircraft fires of other units including infantry and cavalry divisions);⁹² and a number of mobile and semi-mobile battalions⁹³ and regiments.⁹⁴ In fairness to the Coast Artillery Corps planners who created these various organizations, they simply tried to match new means to established ends. The confusing menu of antiaircraft organizations represented an attempt to maximize the firepower available given the very real expectations of limited manpower and mobility resources. At best, it indicated a modicum of pre-war doctrinal adaptation in expectation of competition for scarce resources, namely soldiers and vehicles.

Having created several different organizations along mobile and semi-mobile lines, the Coast Artillery adjusted the tactical portions of its doctrinal manual accordingly. Until 1940, the amount of attention paid, in both the professional literature and in antiaircraft doctrine, to the tactical employment of mobile units in support of the field forces far outweighed that given to the use of antiaircraft artillery in the protection of fixed facilities. Although the 1940 edition expanded coverage in both areas, the greatest increase came in the section on defense of rear and coastal areas. Concerned about the possibility of an enemy bombardment of important facilities in the rear combat area, the insular possessions, and the mainland of the United States, the Coast Artillery enlarged its discussion of defensive tactics in these locations. The latest revision contained extensive calculations on the size of the defended territory, the numbers of gun and "automatic weapons" units needed to protect various areas, and the interrelationship

between the altitude and speed of the bomber and the position of the antiaircraft artillery units. Additionally, the manual stressed the need for effective coordination between antiaircraft artillery units and the pursuit elements of the Army Air Force operating in the area defense. With the organizational and tactical adjustments made in the 1940 edition, the Coast Artillery closed any remaining gaps in its antiaircraft artillery doctrine.⁹⁵

The increased emphasis placed on rear area defense in the 1940 manual reflected growing concern over the impact of bombing civilian targets as witnessed in Guernica, Spain in late 1937 and more recently during the Battle of Britain. On 3 August 1940 less than a week before the beginning of the Battle of Britain, Secretary of War Henry L. Stimson dispatched Major General Delos C. Emmons, Commander of the G.H.Q. Air Force, and Brigadier General George V. Strong, Army Assistant Chief of Staff, to England to observe operations and report out any recommendations for the United States Army. Emmons and Strong visited with Prime Minister Winston Churchill, the War Cabinet, the heads of the Army, the Royal Navy, and the Royal Air Force, their deputies, and several other officials including those at Fighter Command and Antiaircraft Command before returning on 20 September. They concluded that that Britain would be involved in an air war for some time and that “sooner or later the United States [would] be drawn into this war.” Emmons and Strong believed that the “Destroyers for Bases” agreement of 3 September “made a very definite change” in the nation’s defense requirements and urged an immediate study of how to “best build up our air striking force and our air defense force in the shortest practical time.” Among their many recommendations, Emmons and Strong advocated antiaircraft guns for all bases, airfields, vital installations, and mobile columns. They “were astounded at the very large number

of searchlights in operation” particularly around London, noted with favor the effect barrage balloons had on causing the Germans to bomb short of the target, and were impressed with the British radio direction finding or radar system.⁹⁶

Mirror Imaging

Unfortunately, after a decade of close cooperation with the Air Corps and countless studies concerning increases in bomber speed and the additional number of antiaircraft guns it took to protect a locale or unit adequately, the Coast Artillery may have been guilty of mirror-imaging. Its tactical doctrine focused on defending against the predominant view of American air power instead of concentrating on how to defeat expected enemy tactics. At the very least, the impact of the Battle of Britain cast a long shadow over antiaircraft doctrine that otherwise dulled earlier concerns regarding the protection of the maneuver forces. Specifically, the 1940 edition of the Coast Artillery manual stressed defense against strategic bombing and rather than protecting front line units against “hedge-hopping” aircraft. In part, this focus emerged from the Army’s doctrinal position maintained throughout the Interwar period that maneuver elements provided for their own defense. As Chief of the Army Ground Forces, McNair’s strong support for “pooling” of antiaircraft units in the belief that corps and army commanders could shuttle them forward as needed reinforced this idea and served as a disincentive for permanent forward area.

Throughout much of the Interwar period, the Army Air Corps pursued a schizophrenic policy that oscillated between favoring air support to ground forces and strategic bombing. In the end, the strategic bombing cabal won out and by the mid 1930s strongly endorsed the bombing of enemy industrial targets immediately upon the

outbreak of hostilities.⁹⁷ In a sense, forbidden by the War Department from operating as part of the maneuver division, limited by Interwar isolationism to arguing for money on the basis of homeland defense, and culturally accustomed to the doctrine of strategic bombing through exposure to Air Corps doctrine at the Coast Artillery School and during joint exercises, the Coast Artillery Corps fell easily into the role of focusing on antiaircraft defense of the rear area. Yet the emphasis placed on rear area protection was not complete or total. Joint exercises as well as overseas reports confirmed the need to defend front line units. To a great degree, the emergence of the 37-mm gun as an intermediate range weapon and the development of a variety of antiaircraft organizations were in response to an obvious requirement.

On balance, however, the shift toward the rear area was enough to exert an influence on decision-making, particularly during the early battles of World War II. In combat, commanders would decide issues of tactical organization and disposition based on what was most valuable to them, what was most vulnerable to enemy attack, and what they had learned before the battle. Although doctrine was only a guide, to an Army without the leavening experience of combat, it maintained a strong influence on action. Many senior officers argued for more defense of the forward area, including incorporating antiaircraft units in the division, but others—most importantly, Lesley McNair—resisted that emphasis. What was obvious to some would become painfully apparent to all at Kasserine Pass.

Institutional Acceptance

In 1941, the War Department incorporated much of the 1940 antiaircraft doctrine into its revised field regulations. Beyond reaffirming the uses of antiaircraft artillery

discussed in the 1939 edition, the new *FM 100-5: Operations* placed special emphasis on the employment of mobile antiaircraft units in combined arms operations. Published shortly before the German invasion of Russia, the new manual codified the recent lessons of war and increased the numbers and types of operations that included antiaircraft artillery. Beyond highlighting the utility of antiaircraft weapons against mechanized and armored forces, the War Department integrated antiaircraft artillery units into its discussions of rail and air movements, the defense of river lines and bridgeheads, and cold weather operations. Thus, as the United States Army teetered on the edge of active involvement in the war, its acceptance of the antiaircraft artillery as a necessary part of its combined arms operations signaled the end of a twenty-year evolution in doctrinal thinking.⁹⁸

Despite Interwar achievements in military thought, Army doctrine indicated only how the War Department might employ its forces; it did not guarantee that those forces would actually exist when required. While both *FM 100-5* and *FM 4-105* proved invaluable as intellectual tools for focusing professional thought on the conduct of war, the power to procure the men and material necessary for a credible force structure lay beyond the reach of the military for most of the Interwar period. Although the Army was researching new weapons, including the “triple threat” 90-mm antiaircraft gun to replace the existing 3-inch gun, it had a limited amount of equipment on hand. By May 1940, the Army possessed only 448 3-inch antiaircraft guns, 168 fire control directors, 194 sound locators, 15 37-mm guns, 1014 .50 caliber machine guns, and 285 searchlights. This array was a considerable improvement over a few years earlier, but not enough for the War Department’s planned force of than 88 mobile and semi-mobile regiments.⁹⁹ The

massive increases in organization and equipment that accompanied the growth of the Army following the passage of the Selective Service and Training Act in 1940 directly challenged the Ordnance Department's ability to produce the necessary armament in a timely fashion. In fairness to the members of this Department, General Marshall's overall goal of 88 antiaircraft regiments represented an immense undertaking. Not only was the Ordnance Department having to keep up with existing orders, it was working hard to get prototypes like the 90-mm and 37-mm guns into full-scale production. With production at a virtual standstill in June 1940, the Army sought a total of 500 3-inch guns, 317 90-mm guns, 273 directors, 801 sound locators, 1,423 37-mm guns, 1,682 .50 caliber machineguns and 1,028 searchlights. In light of these requirements, it is understandable that the supply fell short of demand.¹⁰⁰

As the decade ended, the antiaircraft artillery establishment had solidified its position as an essential element of the national defense. Institutional changes within the Coast Artillery Corps elevated the antiaircraft establishment's organizational standing, making it the first among equals within the Corps and creating an internal consensus concerning the importance of antiaircraft artillery. Through its four doctrinal revisions, the Coast Artillery codified its tactical and technical antiaircraft principles, melding them efficiently into the Army's larger combined arms conception of warfare. Reports from overseas concerning the effects of air power and antiaircraft defense solidified the emerging external consensus developing outside the Coast Artillery Corps and propelled the antiaircraft artillery to a new level of acceptance within the War Department. Despite these achievements, the Interwar stagnation of military procurement limited the amount of antiaircraft equipment available to support the growing force structure, reduced the

Army's overall readiness, and threatened the security of the nation. As America's army looked to the future, it focused on training the huge influx of new soldiers, procuring badly needed equipment, securing the homeland and the nation's outlying possessions, and developing a combined arms force for potential combat overseas.

CHAPTER 8

BUILDING AN ANTI-AIRCRAFT COMMAND, 1939-1941

Thinking small in terms of anti-aircraft defense for many years has resulted in almost no defense. It is not too late to think big and repair the delays of the past. Any further delay may be too late. Money and personnel will be supplied generously when true need is demonstrated. And it is up to the army to demonstrate that need to our people.

*Major Thomas R. Phillips
Coast Artillery Corps, 1940¹*

For much of the Interwar period, competition and cooperation characterized the actions of the American military establishment. By 1938, the nation and its armed forces faced the challenge of rearming rapidly to meet the requirements of a growing international crisis. How the Army and its anti-aircraft artillery community reacted to this challenge and ultimately fought in the first battles of World War II tested the validity of its Interwar modernization efforts. How it responded to early failures in battle measured its resilience as an institution.

Despite several well-conceived attempts by the military establishment during the 1930s to improve readiness, rearmament efforts failed to achieve much progress until President Franklin Roosevelt expressed the desire to rebuild the nation's armed forces. As often occurs with such support, it may lead to different results than those originally planned. Roosevelt's decision to begin rearmament did not come easily nor did it occur

simultaneously for the Army and Navy. For the Army, senior War Department leaders significantly altered the President's initial decision, steering him away from a focus on a single, war-winning technology—in this case, aircraft—and toward a more balanced and ultimately robust solution to America's defense needs.

Although the Navy received early support from the National Industries Recovery Act of 1933 and the Vinson-Trammell Act of 1934, the Fleet did not expand beyond the limits of the Five-Power Naval Treaty until Congress passed the Naval Act of 1938. What began as a modest \$9 million naval project in January 1938--Roosevelt called it the "beginning of a vast program of [naval] rearmament"—ultimately rose to a ten-year, \$1.1 billion program that reflected America's growing concern over the rise of Japanese naval power and the potential for a war in the Pacific.² Ground and air force rearmament started later and dates from President Roosevelt's November 14, 1938 meeting with his principal civilian and military advisors concerning the Munich crisis and the rise of German air power.³ During that meeting, Roosevelt remarked that the America's defenses were patently weak. Comparing the numbers of French and British aircraft to that of Germany and Italy, Roosevelt stated that the United states must be prepared to defend the Western hemisphere "from the North to the South Pole." To do so, he wanted the Army Air Corps equipped with 10,000 new planes and the number of antiaircraft artillery units increased and their overall readiness improved.⁴

As Mark Watson and others have noted, Roosevelt focused almost exclusively on aircraft and, to a much lesser extent, antiaircraft artillery. After a long period of Interwar inattention, Roosevelt's bold action confused many within the War Department. Moreover, many officers feared that his call for 10,000 airplanes--without any additional

trained pilots, airbases, and associated equipment--meant that the President intended to give those aircraft as well as a large portion of the future output of American production facilities to France and Britain. As the thinking went, these aircraft would enable France and Britain to increase the size of their air forces so as to overawe Hitler and prevent war or at the very least help them prevail in a war without resorting to American intervention.⁵ The War Department preferred a more balanced approach that provided aircraft, pilots, and associated equipment to the Air Corps as well as men and materiel for the Protective Mobilization Plan (PMP) force and a program of industrial preparedness for a larger future force.⁶

The War Department's desire to pursue balanced readiness across the force grew from a growing uneasiness concerning Axis plans for Latin America, as revealed at the Standing Liaison Committee meetings between Army, Navy and State Department representatives. In October 1938, Chief of Staff General Malin Craig outlined the Army's concerns. In a memo to Assistant Secretary of War Louis Johnson, Craig expressed fear that the Germans and Italians were extending influence into Central and South America. Craig felt that these actions now required that America defend not just the continental United States and outlying possessions, but also the rest of the Western Hemisphere. To this end, in addition to building a modern and balanced air force, Craig supported three other War Department objectives. First, he wanted to expand the regular Army within the United States and to create an expeditionary force capable of securing airbases throughout the Hemisphere. Second, given German and Japanese air and naval expansion, the War Department felt compelled to enhance the defenses in the Panama Canal Zone, Puerto Rico, Hawaii, and Alaska. Third, to meet a potential air threat he

wanted to raise 27,000 additional National Guardsmen and form them into nine antiaircraft regiments along with lesser units of the Air Corps and engineers.⁷

While there were similarities between the two positions, the gap between what the President and the War Department wanted could not have been wider. Sensing that the War Department was marching out of step, Roosevelt summoned his military advisors and reminded them of his initial request, complaining that he had asked for \$500 million worth of airplanes, and they were offering him everything else. After a lengthy discussion, Roosevelt agreed to the War Department's recommendations. In his January 12, 1939 message to Congress, Roosevelt recommended \$110 million worth of new equipment for the ground forces. Congress increased that amount slightly and approved it in May. The Air Corps received its intensified pilot-training program in April.⁸ Ground, air, and antiaircraft artillery forces all benefited from this balanced approach. The programs were small and would expand enormously in the years ahead, but they were a start. After years of paltry appropriations, rearmament began in earnest. What no one could predict, however, was whether rearmament would be enough to deter aggression and to keep America out of the coming war, or, if forced to fight, whether the Army would prevail in combat.

Organize, Train, and Equip

The War Department's desire to increase the size of the Army, improve its ability to defend America's outlying possessions, and develop an expeditionary force all placed unique requirements on the antiaircraft establishment. The Coast Artillery Corps had to organize, train, and equip a greatly expanded antiaircraft artillery force. It also had to provide a significant portion of the air defense in the Philippines, Hawaii, and Panama.

Finally, the Corps had to integrate antiaircraft units into the expeditionary force to protect it from air attack.

The Coast Artillery Corps had spent much of the Interwar period writing and revising its antiaircraft artillery doctrine, attempting to train its skeleton force, and struggling to develop a suite of weapons and equipment that enabled its units to find, track, and hit hostile aircraft. With the resources provided by the President and Congress and a mandate from the War Department, the Coast Artillery now found itself challenged to produce.

Organizing the Expanding Force

From 1939 to 31 December 1941, the Army expanded almost nine-fold from 189,839 to 1,657,157 soldiers. From 1941 to 1945, it exploded to 8,157,386 men.⁹ As the Army increased in size, so too did the number of antiaircraft forces. From a mere seven “skeletonized” regiments in 1939, the antiaircraft force grew to 24 active battalions in 1940.¹⁰ By June 1941, the force totaled 118 battalions.¹¹ While it never reached the 811 battalions recommended by the Army Ground Forces, the size of the antiaircraft establishment peaked at 431,000 soldiers and 557 battalions in December 1943, before shrinking to 246,000 men and 331 battalions in 1945.¹²

As the Army grew, the War Department realized the need to centralize war preparation and training. To provide a centralized structure for the expanding force, the War Department began activating several upper level tactical headquarters as outlined in the Protective Mobilization Plan. On 26 July 1940, the Army activated the General Headquarters (GHQ) with the mission to organize and train tactical units and ready them for overseas commitments. Once that task was complete, the GHQ would then

transitioned into an expeditionary headquarters commanded by the Army Chief of Staff or another general officer designated by the President.¹³

This arrangement seemed satisfactory as long as the Army planned to defend America and its possessions or field a single expeditionary force. When the Japanese attacked Pearl Harbor on 7 December 1941 and Hitler and Mussolini declared war on the United States on 11 December, however, the Army's command structure immediately became obsolete. Gone was the idea of an expeditionary campaign, replaced by the concept of a worldwide war. By necessity, General George C. Marshall would remain in Washington to guide the creation of a global force and provide advice on military policy and strategy to the Secretary of War and the President. While joint planners organized the globe into combat regions, the War Department reorganized its command structure by functions, abolishing the General Headquarters and establishing the Army Ground Forces and the Services of Supply (later the Army Service Forces).¹⁴

General Marshall, having replaced General Malin Craig as the Army Chief of Staff in September 1939, also served as the commanding general of the General Headquarters. From July 1940 to March 1942, Marshall delegated the responsibility for Army training to the GHQ Chief of Staff, Brigadier General Lesley J. McNair.¹⁵ On 9 March 1942, the War Department created the Army Ground Forces with McNair as commander. In this position, McNair was responsible for organizing and training the land Army for war. With his appointment, McNair inherited much of the responsibility and authority previously held by the chiefs of specific combat arms.

Training the Force

The great influx of new soldiers entering the Army presented the War Department with an enormous organization and training problem. In military organizations, training occurs at two distinct echelons--the individual soldier level, and the unit or collective level. Contrary to the emphasis on social, athletic, and Civilian Conservation Corps activities that dominated daily calendars during the 1930s, training thousands of individual soldiers and preparing units for combat now became a top priority. Prior to 1940, individual training occurred in the Army's General or Special Service Schools. For antiaircraft artillerymen, individual training took place at the Coast Artillery School at Fort Monroe, Virginia. At the collective level, the limited training that occurred during the Interwar period did so under the general control of the four army and nine corps area commanders with specific directions coming from the unit commanders. For antiaircraft units, the regimental commander served as the senior collective trainer. While the War Department issued training directives that provided the broad collective training goals for that year, unit commanders exercised decentralized authority to set and enforce training standards. Due to differences in the levels of personnel, equipment, and resources available, the quality of training and the level of combat readiness varied dramatically between units. The Regular Army active antiaircraft regiments defending Hawaii, the Philippines, and Panama were generally much better trained and more combat ready than either the active or National Guard units stationed in the United States.

Individual Training

When it came to training individual soldiers, the War Department learned from the failure of its World War I system. In that war, the need for trained replacements quickly overwhelmed the capacity and flexibility of the six stateside replacement depots, including the one Coast Artillery depot at Fort Monroe. Confusion reigned as emergency draftees had swamped the depots, disrupting training schedules and resulting in poorly trained troops. On average, most World War I recruits received less than a month's training. Problems were particularly acute in the infantry. As the American Expeditionary Forces began taking casualties, the War Department pulled men out of the depots early, further disrupting their preparation for combat. The situation deteriorated to the point that the A.E.F. stripped infantrymen from the ten divisions arriving in France and reassigned them to the front. Ultimately, the A.E.F. assumed the burden of procuring and training soldiers in France and set up numerous training centers. The "Archies" of the American antiaircraft establishment, for example, trained near Langres along with several other A.E.F. specialty units. All told, the strain on the training centers was so great that many infantry replacements received little or no meaningful training before being thrown into battle.¹⁶

After World War I, the Army designed its mobilization plans to avoid a repeat of that experience. The prewar plans in effect in 1940 called for each arm and service to establish replacement training centers. The Army viewed these establishments as training, not reception centers; they were to focus solely on training individual soldiers in their military occupational specialty. While the Army planned to synchronize the activation of these centers with its manpower mobilization schedule, delays in

construction slowed the opening of most centers until about six months after the establishment of Selective Service.¹⁷ By March 1941, the Army had organized twelve such centers, including three for Coast Artillery replacement training at Fort Eustis, Virginia; Camp Wallace, Texas; and Camp Callan, California.¹⁸ While these centers received input and advice from the Chief of Coast Artillery, they operated under the auspices of the corps area commanders until centralized under the Army Ground Forces in March 1942.

Until the Army activated these replacement training centers, however, it relied on the Service Schools to train an ever-increasing number of individual officer and enlisted personnel. Reflecting the Army's priority at the time, the focus at the Coast Artillery School in Fort Monroe, Virginia, was on antiaircraft artillery instruction. From July to September 1940, the Coast Artillery ran six four-week refresher courses teaching a total of 375 lieutenants the finer points of antiaircraft gunnery, machine gunnery, materiel, and actual firing of the guns.¹⁹ Beginning in September and extending through March 1941, the school expanded the course to ten weeks, focusing first on antiaircraft artillery and after February 1941, including courses on seacoast artillery.

The schedule called for six classes with eighty officers each. With additional facilities that number would double to 160 officers per class. The School also taught a series of basic and refresher courses, some up to twelve weeks in length, to Regular Army and National Guard non-commissioned officers. With the large increase in students, creating adequate housing and instructional facilities quickly became a major area of focus. Students slept in tents, while instruction rotated between existing facilities. While still on a peacetime schedule with classes operating from 8:00 a.m. to 4:00 p.m.,

the school required officers to attend study hall for six nights a week. Whether this directive was designed to improve their knowledge or merely keep them off the streets in nearby Newport News, no one knows.²⁰ In March 1941, instruction expanded to the three Coast Artillery replacement training centers, with many of the officers and men trained at Fort Monroe serving as part of the initial cadre. From then until America entered the war in December, the average course of instruction lasted twelve weeks, after which soldiers were sent to units activated at antiaircraft training centers.²¹ To meet the growing need for trained officers, the Coast Artillery School created an officer candidate school in July 1941. As the expected number of officer candidates grew in 1942, the Coast Artillery Corps decided in February to move the officer candidate school to Camp Davis, North Carolina.²²

The rapid expansion of the antiaircraft artillery establishment caused great confusion among the various regiments and training camps. Major General Joseph A. Green, Chief of the Coast Artillery after April 1940, issued a series of personal letters to camp commanders and published an article in the *Coast Artillery Journal* to inform the force about individual and unit training and organization. Green reiterated the Army standard--new units had thirteen weeks to become combat ready, according to the War Department approved Mobilization Training Program (MTP). Given the shortage of officers and non-commissioned officers, Green encouraged units to consolidate and centralize training. He authorized them to use the replacement training camp system and rotate gun crews, platoons, and batteries through stations with expert instructors.²³ As if to underscore the urgency with which units should train, Green reported the Army had abolished "the old distinction between peace and war strength." New unit tables of

organization “show only *one* strength ... they provide weapons crews at the full strength required to actually operate and maintain the weapon....”²⁴ Finally, he reminded officers that “training [was] a responsibility of command. Commanders of all echelons energize training by organizing and preparing it completely.”²⁵

Concerned with the adequacy of training, and anticipating the need to further centralize training authority outside the Office of the Chief of Coast Artillery, Green requested War Department permission to organize an “Antiaircraft Force” to “...train officers and enlisted men for duty with antiaircraft artillery and barrage balloon units, and to activate, organize, equip and efficiently train such units for combat service.”²⁶ On 9 March when it activated the Army Ground Forces, the War Department also activated the Antiaircraft Command, assigning it responsibility for the three Coast Artillery replacement training centers (redesignating them as antiaircraft artillery replacement training centers), seven antiaircraft artillery training centers, and the barrage balloon training center.²⁷

Major General Joseph Green was the obvious choice to become the first Commanding General of the Antiaircraft Command. A West Point graduate of the class of 1906, Green had joined the Artillery, but transferred to the Coast Artillery in 1916. He served overseas for fifteen months, commanding the 1st Battalion, 52nd Railway Artillery Regiment during World War I. After the war, Green attended the Command and General Staff School and the Army War College before serving with the 62nd Coast Artillery Regiment, an antiaircraft artillery unit, in 1926-1927. Following a four-year detail to the War Department General Staff, Green returned to the antiaircraft artillery where he commanded the 61st Coast Artillery Regiment (Antiaircraft). In 1937, he transferred to

Washington and became the Executive Officer to the Chief of Coast Artillery until taking that position in 1940.²⁸ An incisive, disciplined officer, Green's personal knowledge of antiaircraft equipment and techniques, as well as his seven years of experience in Washington in key positions within the Army bureaucracy, served both he and the Antiaircraft Command well.

As the Commander of the Antiaircraft Command, Green's impact on training was no longer limited to providing the Chief of Staff with recommendations, drafting appropriate directives for approval, or preparing training literature. Previously Green maintained publicly that his control of training was "indirect; but nevertheless very real."²⁹ With his assumption of command, Green's impact was direct and to the point. Training was indeed the commander's business and Green was now the commander.

Green quickly established sound training policies and applied them to the training mission. He specified that the purpose of all antiaircraft artillery training was to reach "a complete state of *readiness for combat* of both individuals and units."³⁰ To that end, all training must focus on the proper tactical employment of the unit and "the ability to deliver *immediate and effective fire* with all weapons."³¹ To enforce standards, Green created inspection teams to determine the quality of training, the status of equipment, and the efficiency of all units and replacement training centers. The inspectors were to take every opportunity to instruct and offer "on the spot corrections." Initially, some training centers responded to the inspections by making special preparations and focusing on "eyewash." To correct the situation, inspectors started unannounced inspections. When the Army Ground Forces ordered the inspection of every organization under its command, the Antiaircraft Command drafted inspectors from all of its units. The wide

geographic dispersion of units, training centers, and replacement training centers forced the Antiaircraft Command to draw inspectors from antiaircraft brigades, groups, and battalions across the command, creating a tradition that remains today.³²

Following the attack on Pearl Harbor, the need for replacements and individual fillers was so great that, in accordance with an Army Ground Forces directive, the Antiaircraft Replacement Training Centers (AARTC) compressed the standard twelve-week program into eight weeks. The AARTC followed the accelerated curriculum until December 1942 when the Antiaircraft Command established a thirteen-week program. The additional week (from twelve to thirteen) was spent teaching and practicing various antiaircraft gunnery techniques. In August 1943, the program expanded to seventeen weeks. These centers trained technical gunners and maintenance men as well as specialists in fire control, communications, and meteorology. The Antiaircraft Command established troop schools and preparatory schools for officer candidates. To organize and arrange such a wide array of training requirements, the Command created training or “school” battalions and batteries whose primary function was to produce soldiers with individual specialties, another innovation that continues today.³³ At their peak in 1943, the three Antiaircraft Replacement Training Centers maintained a training capacity of 31,290 soldiers.³⁴

When the War Department activated the Antiaircraft Command, it also directed Major General Green to separate the antiaircraft artillery functions from the other Coast Artillery activities and establish an Antiaircraft School at Camp Davis, North Carolina. Located in Hollyridge, thirty-one miles northeast of Wilmington and seven miles inland from the Atlantic Ocean, Camp Davis already served as one of the seven Antiaircraft

Artillery Training Centers. Activated in late March 1942 with Brigadier General Oliver M. Spiller as commandant, the Antiaircraft School quickly created officer and enlisted divisions and absorbed the existing Officer Candidate School. The 514th Coast Artillery Regiment (Antiaircraft Artillery), which was already at Camp Davis to serve as a demonstration unit for the officer candidates, assumed that duty for the entire school. In January 1943, it was redesignated the 108th Antiaircraft Artillery (AAA) Group, remaining at the school until it deployed in December.³⁵

The rapid increase in students combined with constant changes in equipment to keep the Antiaircraft School in a state of flux. The School could not produce enough trained officers and men to keep up with demand. Moreover, a report by a visiting delegation of British officers faulted the instruction for being too theoretical and noted that it did not meet the needs of students preparing for combat. General Green concurred with the British officers' report and ordered the Antiaircraft School to adjust its instruction.³⁶ Appropriately, the School eliminated as much theory as possible and replaced it with more practical aspects of antiaircraft technique. Unfortunately, General Spiller focused too much on administration and did not closely supervise the quality of instruction given to the officer, officer candidate, and enlisted divisions. As a result, each division taught slightly different doctrine and technique. The difference became apparent when Officer Candidate School graduates, who had been taught one technique, attended the officer's course only to learn another.

General Green was not given to administration and more than once expressed displeasure with commanders who spent their time on tasks other than training soldiers for combat. In a classified personal log, Green noted an occasion where after visiting a

training center he chastised the commander, complaining of poor gunner skills and admonishing him that “the situation would not improve materially until he divorced himself almost entirely from problems relating to administration, and devoted at least nine-tenths of his time to the direct supervision of the training....”³⁷ In early 1943, the School reorganized and brought all instruction under a single Academic Division. In February 1943, Colonel Edgar F. Underwood, the architect of the reorganization, replaced Spiller as Commandant.³⁸ At its peak in July 1943, the Antiaircraft School had 11,000 students enrolled.³⁹

Organizational Training

Before the creation of the Army Ground Forces and the centralization of all antiaircraft training under the Antiaircraft Command, the First, Second, Third, and Fourth Army commanders were responsible for organizational or unit training. To say that these commanders failed to create combat ready units misrepresents the nature of the problem they faced as the Army emerged from the Interwar period. Prior to 1939, collective training was largely non-existent. Within the Coast Artillery, only a minimal amount of collective training occurred, usually during an infrequent and limited joint exercise with the Air Corps. While students at Leavenworth and the Army War College studied collective training and combined arms warfare, they did little of it.

In May 1940, while the German *Wehrmacht* and *Luftwaffe* conquered France, the “Red” Army of Texas invaded the “Blue” territory of Louisiana during exercises with the Third Army. While the Louisiana Maneuvers of 1940 were, as General Marshall described, “the first genuine corps and army maneuvers in the history of the Nation,” their primary benefit was to highlight just how unprepared the Army was for combat.⁴⁰

Several antiaircraft artillery units participated in the exercise. Of note, while all units practiced defense against air attack, the 61st Coast Artillery (Antiaircraft) Regiment experimented with the use of antiaircraft artillery weapons in an anti-mechanized role. In early May, as German tanks were crossing the Meuse, the Red Army of Texas fought across the Sabine River to take Leesville, Louisiana. With no tanks or infantry to meet a mechanized cavalry brigade assault from the north, General Walter Krueger directed the 3-inch antiaircraft guns to defend Leesville from air attack and the automatic weapons to pull double duty along the northern roads and approaches to Leesville.⁴¹

While the feared enemy attack never materialized, the dual-use employment made its point. As Captain Burgo Gill noted, the new *Field Service Regulations, 1939* did not address this possibility. Arguing that in light of its high mobility and great firepower, the antiaircraft regiment was “eminently fitted for dual missions, or even triple missions,” Gill admonished readers not to “be blinded by doctrine.... [but] be mentally prepared for the unpredictable whims of war.”⁴² Indeed, Gill was right, at least partially. The Army and the antiaircraft community planned for dual missions, writing training directives to that effect and authorizing additional 37-mm and .50 caliber ammunition for anti-mechanized target practice.⁴³ Commanders eventually employed antiaircraft weapons in a dual role against aircraft and mechanized forces. They also used them as “triple threat” weapons, but not as Gill imagined in “passive missions” along the line of communications. Instead, commanders called on antiaircraft weapons of all types to provide anti-air, anti-tank, and artillery fire during World War II.

Captain Gill was in good intellectual company. Following their visit to England during the Battle of Britain, Major General Delos C. Emmons, Commander of the G.H.Q.

Air Force, and Brigadier General George V. Strong, Army Assistant Chief of Staff, reached much the same conclusion. Advocating that the United States build up its air striking force and air defense force quickly, Emmons and Strong recommended large increases in antiaircraft guns for the defense of all bases, airfields, vital installations, and mobile columns. Citing the British use of antiaircraft guns in the anti-tank mode, they also urged that American antiaircraft guns be capable of firing on ground targets.⁴⁴

By late 1940, General McNair and his deputy, Lieutenant Colonel Mark W. Clark, had settled on a plan to improve the Army's combat readiness. The plan envisioned incremental advances beginning with division level training and progressing through multi-army maneuvers by the end of the year. Thus, on 15 September, a little more than year after its first large-scale exercises, the Army returned to Louisiana for maneuvers that arrayed the Second Army against the Third Army for the first time. Two months later, on 16 November, the Army repeated the exercise in North Carolina with the First Army fighting a smaller, but more mobile IV Corps.⁴⁵

As part of the incremental training strategy, antiaircraft units worked through battery, battalion, and regimental training problems. In the Third Army, these training problems began with simple daytime road marches to practice command and control and antiaircraft protection of a march column. They increased in difficulty and complexity, included cross-country and nighttime movements, and culminated with battalion and regimental antiaircraft defenses of an independent corps conducting an attack.⁴⁶ In March 1941, General McNair issued a GHQ training directive entitled "Advanced Training, Coast Artillery Units," in which he gave general guidance for antiaircraft and harbor defense units. While broad in scope—in fact, McNair directed training on

everything from antiaircraft weapons maintenance and the conduct of small arms practice to the execution of command post exercises and searchlight drills—he also addressed specific concerns such as defense against mechanized forces (including the actual firing against ground targets), defense against chemical (gas) attacks, and proper camouflage techniques.⁴⁷

During this period, antiaircraft units faced several problems stemming from the rapid mobilization of the Army. First, facilities in the Coast Artillery Training Centers (later Antiaircraft Training Centers) overflowed with personnel assembled from the hurried expansion of the force. By June 1941, the Army planned to send 131 out of every 1,000 soldiers inducted to Coast Artillery and antiaircraft units. Only the Infantry (290 out of 1,000) and the Field Artillery (141) were to receive more troops.⁴⁸ Second, the need to provide fillers for overseas regiments pulled the most highly trained individuals out of units just at the time when new soldiers, some of whom had bypassed the replacement training centers, were arriving and needed both basic and advanced training. Third, continuous changes in equipment caused units to stop training, field new items, and restart training with new and different gear. Fourth, the flow of equipment overseas left some units with shortages that inhibited training and created unnecessary adjustments.⁴⁹

Aside from these issues, one of the greatest problems for antiaircraft automatic weapons units was hitting the target. From January to August 1941, the automatic weapons section at the Coast Artillery School fired over 500,000 rounds of ammunition while instructing student officers. Over 415,000 rounds were for the obsolete .30 caliber machine gun, an indicator of the state of ammunition readiness in 1941. About 80,000

rounds of .50 caliber ammunition and 3,500 rounds of new 37-mm ammunition were also fired. The percentage of target hits, however, was “pitifully small,” about 0.7% for .30 caliber, 0.6% for .50 caliber, and 0.2% for 37-mm.⁵⁰ Some of the better equipped and manned overseas units also appeared to have trouble hitting the target. In annual target practices in Hawaii and the Philippines, none of the automatic weapons batteries fired excellent.⁵¹ Part of the problem was that the automatic weapons had no on-board fire control, and gunners still used tracer control to “hose pipe” their rounds on target. To improve marksmanship, the Coast Artillery Corps published instructions for training spotters and adjusters to interpret what they saw in the sky. The Corps also added “coaches” to the firing crew and modified lead charts to make them more readily usable.⁵²

Considerable organizational energy was also spent on anti-mechanized defense. In addition to McNair’s guidance, several articles appeared in the *Coast Artillery Journal* on the use of antiaircraft weapons against tanks and mechanized vehicles. Much of this emphasis reflected a growing concern over the perceived strength of German armored and mechanized forces, which had sliced through France in 1940 and were capturing large swaths of land (and great numbers of prisoners) in Russia in the summer of 1941. Commanders at the Mojave Desert Antiaircraft Artillery Firing Range in California and at Fort Bliss, Texas built anti-mechanized / anti-tank ranges. At the Mojave Desert Range, in the shadow of Tiefert Mountain, antiaircraft gunners enjoyed 650,000 acres of space.⁵³ At Fort Bliss, workers laid over 4,000 yards of narrow gauge railroad track to accommodate two targets traveling at speeds up to twenty miles per hour.⁵⁴ Back at Fort

Monroe, in July, the Coast Artillery Board tested anti-mechanized sights for the 3-inch and new 90-mm antiaircraft gun.⁵⁵

None of these developments mattered very much, however, if soldiers did not fire their weapons, antiaircraft or otherwise, at the enemy airplanes, tanks, or troops. That indictment, above all else, was the overarching conclusion reached at the end of the G.H.Q. maneuvers in 1941. At a 3 December meeting, held just three days after the conclusion of the Carolina maneuvers, McNair reported favorably on the use of tank destroyers, one of his personal projects, remarking that 760 tanks had been stopped by an equal number of antitank guns. Regarding the close air support to ground forces, McNair stated that while air units “had added a great deal of impetus” to the maneuvers, more work needed to be done. General Henry H. Arnold, Chief of the Army Air Forces (AAF) agreed. Several War Department officials, however, expressed concern about the lack of “air awareness” observed during the maneuvers. Assistant Secretary of War John J. McCloy remarked on instances in which antiaircraft gunners failed to fire at aircraft and ground units did not conceal their vehicles from air observation.⁵⁶

Indeed, despite McNair’s carefully programmed plan to develop units by incrementally increasing the scope and complexity of training events, the inadequacy of small unit training was particularly appalling. As the historian of the maneuvers, Christopher Gabel, notes: “Units behaved as if they did not know how to protect themselves from enemy action or how to bring effective force to bear upon the enemy.”⁵⁷ Soldiers disregarded defensive tactics and did little to avoid hostile fire. Using blanks instead of real bullets, soldiers had no worries about being shot. Umpires could levy scores against units, but scores were of concern only to officers looking to make an

impression upon their superiors. The average enlisted man could have cared less. In fact, “careless” aptly describes the attitude of soldiers who “stood in the open to watch air attacks that would have killed them in a real war.”⁵⁸ Real war came on 7 December 1941, a week after the end of the Carolina maneuvers. As Japanese Zeros attacked Pearl Harbor, McNair’s incremental plans to ready the Army went out the window. The carefully choreographed peacetime rearmament effort transformed over night into a frenzy to find men and materiel.

With the United States at war, the Army accelerated collective training. Operating under the War Department’s “Coast Artillery Mobilization Training Program for Antiaircraft Artillery Regiments at Unit Training Centers,” the Antiaircraft Command cut collective training to twelve weeks--four weeks for individual training, if soldiers had not already graduated from an Antiaircraft Replacement Training Center, and eight weeks for unit collective training. If units received enlisted fillers that had graduated from an Antiaircraft Replacement Training Center, they were to omit the first four weeks. The ambitious schedule was fraught with problems. One problem was that all of the personnel required to man a unit did not arrive simultaneously. Instead, they reported in groups, often as individuals, and occasionally not at all. This staggered arrival complicated the creation of units being built from scratch. Commanders frequently had to delay training until enough officers and enlisted personnel were present to make training meaningful. Late arriving fillers slowed the progress of units. The Army further hindered the creation of combat ready units by pulling soldiers from training early to furnish replacements in units either already overseas or farther ahead in the deployment queue. Shortages of equipment and ammunition as well as adverse weather further

complicated training. Despite the urgent need for trained antiaircraft batteries, Training Center commanders could recommend additional training time if a unit did not meet training standards. Based on these recommendations, the Antiaircraft Command could grant “set-backs” for units as appropriate.⁵⁹

By September 1942, the overseas demand became so great that the Antiaircraft Command directed units to begin collective training when they received 50% of their required fillers. This policy soon proved as impractical in 1942 as it had in the 1930s, when most units tried unsuccessfully to conduct training at half strength. In December, the Antiaircraft Command altered the policy, directing training to start when a unit reached 80% of required personnel.⁶⁰

Inspections during this period indicated that unit training was inadequate and that Center commanders spent too much time on non-combat essential tasks. As a result, General Green issued orders for commanders to focus on gunnery and tactical training and to keep “subjects involving parade ground precision ... to a minimum.”⁶¹ Green also petitioned Army Ground Forces to increase the unit training from a total of twelve weeks to four months. He further requested that mobile antiaircraft units receive more combined arms training with other Army Ground Force units. On 8 December, the Army Ground Forces approved Green’s request and directed that the Antiaircraft Command include individual, physical proficiency, and battalion tests in the program. Each unit received eighteen weeks after activation and organization to complete the program—four weeks for individual training and fourteen weeks for collective training. Prior to the thirteenth week of collective training, the unit was to have fired all assigned weapons and participated in at least two field training exercises, the most advanced lasting three days.

During the course of the war, unit training eventually extended to twenty-two and later twenty-six weeks.⁶²

As the pace of training intensified and expanded to include numerous types of antiaircraft equipment, the need for greater specialization within antiaircraft units became apparent. There simply was not enough time for each soldier to learn the intricacies of every weapon. Appropriately, Green directed all Training Center commanders to select officers who were experts in 3-inch (later 90-mm) gunnery, automatic weapons, searchlights, radar, and identification of aircraft to serve as assistant operations officers at the Training Center responsible for supervising technical training. This procedure proved effective as these officers kept a constant check on the technical portions of training.⁶³

The expansion of the seven Antiaircraft Training Centers from the beginning to the war to the middle of 1943 offers an indication of the rapid pace with which the Antiaircraft Command grew during this period. From March 1942 until March 1943, the

Antiaircraft Training Center	Battalion Capacity		
	9 March 1942	9 March 1943	Peak Capacity Reached
Camp Davis, North Carolina	8	12	14 (Oct 43)
Fort Fisher, North Carolina	2	8	8
Camp Stewart, Georgia	16	43	43
Camp Edwards, Mass.	7	22	37 (Jun 43)
Camp Hulen, Texas	12	13	13
Fort Bliss, Texas	12	23	41 (Aug 43)
Fort Sheridan, Illinois	6	7	7
Camp Haan, California	11	32	32
Camp Irwin, California	2	10	10
Total	76	170	205

Source: Cibula, Alvin M. *The Antiaircraft Command and Center (Army Ground Forces Study no. 26)*. (Washington, DC: Army Ground Forces Historical Section, 1946), 98.

Table 8.1 – Antiaircraft Artillery Training Center Expansion (1942-1943)

total capacity at the seven camps more than doubled. Some centers such as Fort Bliss doubled, while others such as Camp Haan and Camp Stewart tripled. Tiny Fort Fisher, a subsidiary center to Camp Davis, quadrupled, while Camp Irwin in the Mojave Desert increased five-fold. Even these increases in training capacity, however, could not keep up with demand. The populations of Camp Edwards reached thirty-seven battalions in June 1943, and Fort Bliss peaked at forty-one battalions in August. Given the high number of units, the scheduling of firing ranges became a scientific process executed with clockwork precision. To accommodate the large number of units needing to fire on the ranges, the Antiaircraft Command developed procedures whereby one or more batteries practiced tracking aircraft-towed targets, while other batteries fired at them. In addition to firing on aircraft, all units engaged vehicles on anti-mechanized ranges. Airborne antiaircraft units practiced loading and lashing equipment in mock up cargo aircraft. At the larger Training Centers, units used mock up railroad cars to rehearse loading and unloading procedures.⁶⁴ From March 1943 until September 1945, the Antiaircraft Command trained and released 603 combat units, including 30 brigade headquarters, 104 antiaircraft gun battalions, 214 automatic weapons battalions, 59 airborne machine gun batteries, and 47 searchlight battalions. Four hundred and fifty-one of these batteries and battalions deployed overseas.⁶⁵

Equipping the Force

One of the major problems faced by antiaircraft units during collective training was the influx of new and different equipment. While new equipment improved a unit's chance of hitting an airplane, the time it took to master a new weapon system often delayed the completion of collective training. Given the poor state of antiaircraft

equipment at the end of the 1930s, however, the Coast Artillery Corps (later the Antiaircraft Command) had no alternative. It simply did not have enough modern equipment to outfit even the few existing antiaircraft battalions. Outfitting those units and the hundreds that followed meant relying on the Ordnance Department and American industry to provide new guns, automatic weapons, searchlights, and radar.

For all of the War Department's industrial mobilization planning that occurred during the 1930s, including the placing "educational orders" with industry beginning in 1939, the Army was woefully short of modern equipment in 1940-41.⁶⁶ While American industry eventually produced the "Arsenal of Democracy" promised by Roosevelt, it suffered initially through many of the same mistakes experienced during World War I. This time, however, the airplane was a much more formidable foe. Fortunately, the majority of antiaircraft units did not see immediate combat. Most had at least some time between Roosevelt's call to arms in November 1938 and the commitment of large combat units in North Africa in late 1942 to receive and train on new and improved antiaircraft equipment.

From late 1938 through the end of the war, the Coast Artillery Corps and the Antiaircraft Command developed and fielded an ever-improving suite of antiaircraft materiel. Luckily, when activated in March 1942, the Antiaircraft Command inherited all of the developmental work accomplished by the Coast Artillery Corps in the 1930s. To ensure nothing was lost during the transition, Major General Green ordered all of the pertinent files and most of the antiaircraft officers transferred to the Antiaircraft Command when he left the Office of the Chief of the Coast Artillery. In a continuing effort to improve existing equipment, the Antiaircraft Command closely studied all

recommendations received from overseas units, military observers, and interested individuals. “The Quarterly Report of Antiaircraft Operations” submitted by overseas theaters and defense commands was particularly useful in this regard. Of note, by late 1943, all major primary armaments—guns, automatic weapons, or searchlights—then issued to antiaircraft units either did not exist on 7 December 1941 or had been modified substantially after the attack.⁶⁷

While the Coast Artillery Corps and the Antiaircraft Command worked hard to develop improved antiaircraft weapons, the Ordnance Department faced a series of problems in providing units with antiaircraft equipment. The Department suffered from a long period of inactivity prior to rearming. In 1940, the Ordnance Department had four arsenals capable of producing the small number of artillery and antiaircraft pieces required for the peacetime Army. Despite the "educational orders" placed with industry to permit companies to create mothballed assembly lines ready for use at a moment's notice, the necessary infrastructure did not appear until later in the war. Only one company, the R. Hoe Company of New York, could produce parts in any quantity (in this case 125 recoil mechanisms) for the 3-inch gun by mid-1941. As a result, when Assistant Secretary of War Louis Johnson placed the huge production orders necessary to outfit the planned antiaircraft force--a 400% increase in sound locators, a 210% addition in 3-inch guns and carriages, a 140% increase in antiaircraft machine guns, and a 130% increase in directors for fire control--the sudden upswing in demand overwhelmed the Ordnance Department's ability to react.⁶⁸

Besides the rapid increase in demand forced upon the Ordnance Department's limited facilities, changes in the type of gun combined with technical and production

difficulties to exacerbate the slow pace of rearmament. From the time the Ordnance Department let the first "educational orders" in early 1939 until the attack on Pearl Harbor, the type of gun, mount, and carriage changed for both the high altitude guns (from 3-inch to 90-mm) and the new intermediate altitude guns (from 37-mm to 40-mm Bofors). In the high altitude category, the War Department decided to replace the 3-inch gun with the newer, more powerful 90-mm gun in February 1940. Research into the gun had begun in 1938 when the Coast Artillery Board requested the Ordnance Department develop a gun powerful enough to hit aircraft flying at 32,000 feet. By 1940, the War Department had standardized the design and the gun entered into production. Capable of pumping a 21-pound projectile up to an altitude of 33,000 feet, the 90-mm gun represented a significant improvement over the 3-inch gun. In fact, by the end of World War II the gun became a "triple threat" antiaircraft, anti-tank, and artillery weapon. Early on, however, problems beset the program. First, the demand increased from 114 in the spring of 1940 to over 1000 by the end of the year. Second, because the 90-mm was a new, difficult, and untried weapon, only one company responded to the Ordnance Department's initial invitation to submit bids. Finally, once additional contractors signed on, delays in the retooling process and slow assembly lines resulted in a low unit turnout. In December 1941, almost two years after the production cycle began, only 171 complete units existed and less than 65 of those had been assembled and test fired.⁶⁹

After consideration for most of the Interwar period as a supplement to the .50 caliber machine gun, the 37-mm gun emerged as the antiaircraft intermediate altitude weapon of choice. In discussing the gun with Senate Committee on Military Affairs in 1939, General Marshall told the senators that, "we consider [it] very fine, but at present

we have only one gun."⁷⁰ When the gun eventually entered production in 1940 at the Colt Fire Arms Company, progress was so far behind schedule that General Marshall felt compelled to tell the same committee that, "at the current rate of production, the Army would gain only enough for three additional regiments by the end of the year and four more by the end of 1941."⁷¹ As if to add insult to injury, just as Colt, the only manufacturer, hit its stride and began producing the gun at a rate of 40 per month, the War Department changed its priority. Convinced that the Air Corps possessed a more urgent need for 37-mm cannon for its P-39 aircraft, the Army ordered production diverted from antiaircraft guns in February 1941.⁷² Even when commanders were fortunate enough to obtain 37-mm guns before the War Department changed priorities, they often did not have enough ammunition to make servicing the gun worthwhile. In one case the shortage of 37-mm ammunition was so acute that Major General Frank Andrews, commander of the Panama Canal Department, complained to the War Department in November 1941 that his 37-mm gunners only had one minute's worth of ammunition to fire.⁷³

As the Army shifted priorities for the 37-mm gun, the 40-mm Bofors, built in Sweden, surfaced as a new and more powerful replacement. In February 1941, the Ordnance Department let contracts for two pilot guns. The complexity of the Swedish design, however, slowed the process considerably. Besides having to convert all the metric measurements to inches and make standard gear shapes and thread sizes to conform to American practice, the complex system required Firestone Tire and Rubber Company, the prime contractor, to spread its work among more than 350 subcontractors. Firestone finished the pilots in July and began tooling up for production, but by Pearl

Harbor no guns stood ready for delivery.⁷⁴ While the 40-mm gun gradually replaced the 37-mm gun, the 37-mm gun remained in use in the Southwest Pacific throughout the war.⁷⁵

Once production began in earnest, however, the Antiaircraft Command and the Ordnance Department worked together to create several variants of these weapons that provided soldiers with more firepower and mobility. Beginning with the .50 caliber machine gun, the Ordnance Department designed several different mounts, including a ring mount for trucks that enabled a soldier to stand in the cab and fire at aircraft, a dual mount with two .50 caliber machine guns, and a quad mount with four guns. From September to December 1942, the Antiaircraft Command and the Ordnance Department designed three self-propelled antiaircraft automatic weapons by placing various gun mounts on half-tracked personnel carriers. The M13 and M14 antiaircraft guns were both half-tracks carrying dual mounted .50 caliber machine guns. The M15 “combination gun” carried dual mounted machine guns and a 37-mm gun. The most powerful of the group, however, was the M16 “multiple gun,” a half-track sporting a quad mount with four .50 caliber machine guns. In June 1944, the Ordnance Department achieved the vision first espoused by Major Robert W. Grow of the Mechanized Force in 1930 when it mounted two 40-mm guns on a M24 light tank chassis.⁷⁶

Another issue still festering from an earlier Interwar decision concerned the use of barrage balloons for close-in, low altitude defense. Since 1923, the Air Corps had responsibility for experimentation, development, and procurement of barrage balloons. Yet the War Department designated the Coast Artillery Corps as the “using arm.” While early technical setbacks and the effects of the Great Depression slowed the Air Corps’

development of balloons, the Coast Artillery Corps maintained intellectual involvement, including recommendations for the tactical use of balloons in all of its Interwar field manuals. The value of balloons as passive air defense weapons received further support in late 1940 as reports from Generals Emmons and Strong as well as several others circulated regarding the effectiveness of balloons during the Battle of Britain. In early 1941, the Air Corps released \$6,500,000 for procurement of balloons, hydrogen cylinders, cable, winches and other equipment with the potential for up to \$37 million more becoming available by July.⁷⁷

Concurrent with the Air Corps' decision to start buying balloons and equipment, Major General Henry H. Arnold, Chief of the Air Corps, argued for complete control of the barrage balloon program—testing, development, procurement, and *operation*. Not only had the Air Corps invested part of its budget on balloons, but Arnold believed that the Air Corps' experience with balloons, along with the need to integrate their tactical employment with pursuit aircraft, meant that the Air Corps should operate the balloons. Additionally, a survey of military powers indicated that every major nation in the world, except the United States, placed responsibility for barrage balloons with its air arm. Major General Green, the Chief of the Coast Artillery Corps, disagreed, maintaining that antiaircraft artillery and balloons were complementary systems designed to operate near each other on the battlefield. Therefore, Green argued, the Coast Artillery should operate the balloons and could achieve "economy" by incorporating balloon units under existing antiaircraft headquarters. While both sides made compelling arguments, Green tipped the balance when he offered to provide manpower for future battalions by taking men from either the antiaircraft reserve or unused harbor defense units. Brigadier General Leonard

T. Gerow, Acting Assistant Chief of Staff, of the War Department's War Plans Division, studied the problem and recommended the Coast Artillery take full control of barrage balloons. In March 1941, the War Department issued a directive repeating the instructions given in 1923, designating the Coast Artillery as the "using arm" and leaving the Air Corps "for the time being" responsible for development and procurement.⁷⁸ The War Department also directed the Coast Artillery to establish a Barrage Balloon Training Center. After much discussion between Air Corps and Coast Artillery officers concerning the Center's ideal location, the group finally agreed to locate it temporarily at Camp Davis, North Carolina. In May, the Coast Artillery opened the Barrage Balloon Training Center.⁷⁹

At the outset, thanks largely to the professional example set by Generals Arnold and Green, Air Corps and Coast Artillery officers cooperated in the transition of responsibility. Relations broke down, however, as the Coast Artillery Corps began to assert itself and make decisions regarding balloon design that seemed to reverse years of work by Air Corps officers on the subject. In fairness to the Air Corps, Coast Artillery Corps officers had no practical experience with balloons and should have deferred to the resident Air Corps expertise. Disagreement existed until December when the attack on Pearl Harbor galvanized both sides to overcome their differences. Rancor was such that when General Green called a conference on 2 January 1942, he took the issue off the table by stating that while the current balloon equipment might not be ideal, some equipment was better than none.⁸⁰ The War Department finally settled the issue in March 1942, when along with reorganizing the Army, the War Department gave responsibility for balloon development and procurement to the Engineer branch.⁸¹

Despite the investment by the Air Corps in balloons and equipment, the Army owned only three balloon companies and a total of three balloons in June 1941.⁸² In late 1941, as men and material began to fill the Army organization, the situation improved slightly. By November, the force totaled five battalions (or 15 companies), including the troops assigned to the Barrage Balloon School, all in training at Camp Davis. Not surprisingly, the popular utility of balloon defense increased after Pearl Harbor. In fact, its popularity rose such that on 13 December 1941, General Green asked for and received \$100,000 from the Army Air Forces to develop barrage balloon boats to float in the approaches to the Panama Canal. Shortly thereafter, three of the five balloon battalions deployed to the West Coast; the other two, including the school battalion, moved to Panama.⁸³ With the deployment of all barrage balloon units from Camp Davis, the Training Center moved to its final location at Camp Tyson, Tennessee.⁸⁴

Besides the issues with antiaircraft guns and automatic weapons, the most significant shortages, and most important developments, occurred with fire control and radar. Fire control development continued throughout the Interwar period with the Coast Artillery Corps and Sperry Corporation designing mechanical and electric antiaircraft directors for the 3-inch and 90-mm guns as well as for the 37-mm and 40-mm automatic weapons. The Antiaircraft Command also developed a carriage-mounted course and speed sight for emergency use on both automatic weapons.⁸⁵

By late 1941, the most serious deficiency within the antiaircraft artillery was the unit's inability to find and track enemy aircraft, particularly at night or during periods of limited visibility. Sound locators, while continually enhanced, proved unreliable. Improvements to searchlights enabled crews to "spread" the light of an 800 million

candlepower beam, making it ideal for use against high-speed targets at close range, but without a device to assist in aiming the light in the right direction, the eight to ten mile range of the focused beam was useless.⁸⁶ Searchlights, however, only worked in good weather. During periods of fog or low clouds, searchlights became increasingly ineffective. What the anti-aircraft artillery needed was a device that would enable crews to fire on “unseen” aircraft.

Work on infrared, and later radio wave, detection of aircraft had been ongoing since the late 1920s. By the mid-1930s, infrared detection failed to produce satisfactory results and the attention of scientists in the Army and Navy as well as several private companies turned toward using radio waves to detect passing objects. “Radar” (radio detection and ranging) used a specially propagated radio wave directed into space and reflected off a passing object to measure the distance, elevation, and direction of the object over time. The Army and Navy would eventually use radar for anti-aircraft artillery direction, navy ship location, air-to-air interception, air-to-surface vessel detection, and the proximity fuse. In December 1935, though, an unexpected proposal to examine radio detection experiments at the Naval Research Laboratory led the Chief of the Army Signal Corps, Major General James B. Allison, to ask the War Department for \$40,000 to study and develop radio finding and ranging equipment. When the War Department refused, Allison illegally diverted \$75,000 from the fiscal year 1937 budget, giving it to his engineers and securing a promise to have something to show for it by June 1937.⁸⁷

By December 1936, the engineers had developed a rudimentary system. In May 1937, they astonished Chief of Staff General Malin Craig; Secretary of War Harry

Woodring; several senators and congressmen; Major General Archibald Sunderland, Chief of the Coast Artillery; Major General Oscar Westover, Chief of the Air Corps; and Brigadier General Arnold, then Assistant Chief of the Air Corps, by erecting a gangly set of wires on a wooden framework and detecting the arrival of an unlighted night-flying bomber in time for an antiaircraft searchlight to illuminate it. Craig wanted to place the device into immediate production, but the Signal Corps held back as the system was not ready yet. When the War Department finally offered \$50,000 for further development, Allison refused, demanding instead \$250,000, which required Congressional approval. He got both.⁸⁸

The next step was to develop a full prototype of the system that would eventually become the workhorse of the antiaircraft artillery--the SCR-268 (Signal Corps Radio-268). To ensure soldiers could operate the system, a detachment from the 62nd Coast Artillery (Antiaircraft) Regiment under the command of Lieutenant S. F. Cassevant tested the radar at Sandy Hook, New Jersey. (Cassevant became such an accomplished radar engineer that he later transferred to the Signal Corps.) After a few modifications to system, the Signal Corps shipped it to Fort Monroe for evaluation by the Coast Artillery Board. After being severely damaged in a hurricane and nearly capsized during a ferry trip over the Delaware River, the radar arrived at Fort Monroe.

The tests occurred in late November 1938 with the Air Corps's Brigadier General Arnold and several Coast Artillery officers attending, including Major General Sunderland. The radar detected aircraft with better accuracy at greater ranges than the Sandy Hook tests. If there were any doubters, the last phase of the test convinced everyone in attendance of the value of radar. A B-10 bomber flying at 6000 meters in

altitude at night was to approach Fort Monroe from the west where the SCR-268 would acquire it and direct antiaircraft searchlights toward it. When the Air Corps liaison officer announced the plane was overhead, however, the radar failed to make contact. After a third try, the operator began to search in other directions and found the plane well out over the Atlantic—a very strong west wind had fooled the navigator. Another hour passed as the plane battled the wind on its return flight. As it came within range, the searchlight traversed its flight path only to hit a cloud. When the plane passed from the cloud into clear sky, the searchlight plastered it with brilliant light. Arnold, Sunderland, and the rest were sold.⁸⁹ It took until midsummer 1940 to incorporate the three antennas on the prototype into a single unit for field use, but the War Department soon let a contract to Western Electric and deliveries began in February 1941. The SCR-268, designed primarily to aim searchlights, remained the only antiaircraft radar until early 1944 when the Army fielded the SCR-584, a more accurate radar suitable for gun-laying.⁹⁰

While accurate enough for barrage fire, the SCR-268 lacked the accuracy for precision gunnery. It had more power than it needed, but not quite enough to suit the Air Corps's early warning needs. To find intermediate range targets, the Signal Corps used the SCR-270 mobile radar and its stationary companion, the SCR-271. Following the May 1937 tests, the Air Corps expressed interest in longer range radar. In June 1939, an engineering prototype tracked a single aircraft consistently at 125 kilometers and a flight of bombers at 240 kilometers. A year later in June 1940, the Signal Corps placed an SCR-271 at Fort Sherman in Panama. Two were operational in Panama on 7 December 1941 with three more enroute by the end of the month. From August 1940 to December

1941, Westinghouse produced 112 sets, many of which the Army shipped to Hawaii in the latter half of the year. There were six SCR-270s in place around Oahu when the Japanese attacked.⁹¹

CHAPTER 9

FIRST BATTLES: FROM THE PANAMA CANAL TO KASSERINE PASS, 1941-1943

“One minute you’re at peace, and the next you’re being bombed. It’s a big transformation, from peace to war. And it’s quite harrowing.”

*Sergeant Nicholas Chintis¹
Battery G, 515th Coast Artillery Regiment*

While the Army Ground Forces and the Antiaircraft Command struggled to organize, train, and equip an expanding antiaircraft artillery force, the War Department faced other challenges. Having convinced President Roosevelt to support a balanced military force, the War Department now had to meet the President’s other goals of securing the Western Hemisphere, protecting America’s outlying possessions, and providing the nation with an expeditionary military capability. In the midst of creating the largest military establishment in twenty years, the War Department had to refine its plans, improve the readiness of its overseas garrisons, and prepare its forces for war.

Defending America and its Possessions

Besides expanding the Regular Army, the War Department undertook several actions to defend the United States and its outlying possessions. For most of the Interwar period, the military oriented its war planning toward individual nations as described in a series of war plans, each identified by a color. Known as the Color Plans, the United States was the Blue nation; some of the other more prominent countries were Germany

(Black), Japan (Orange), France (Gold), Great Britain (Red), and Russia (Pink). War with Japan (Orange) had been a particular fixture in Navy planning since shortly after the Russo-Japanese War (1904-1905) and Army and Navy planners revised it regularly between 1919 and 1940. In 1934, the Army War College introduced “Participation with Allies” into its war-planning course, the first indication that America might not fight the next war alone or against a single enemy. In 1938, as President Roosevelt and General Craig expressed concern about Axis penetration into South America, the War Department General Staff began studying the defense of Brazil and drafted a Purple plan.² In May 1939, as German, Italian, and Japanese aggression continued, the Joint Army-Navy Board decided to revamp the existing Color Plans and produce five basic war plans that were more in line with current international military and political realities. These plans contemplated the likelihood of war against multiple enemies in multiple theaters of war. The Board abandoned the individual Color Plans and gave the new plans the appropriate code name Rainbow. While there were five original plans, Rainbow 5, represented a combination of earlier Rainbow plans and is the most well know. It envisioned the protection of the United States and its possessions, the defense of the Hemisphere, and the deployment of a force to Europe to fight with Britain and France to defeat Germany or Italy (or both).³

The focus on hemispheric defense and protection of America’s outlying possessions created opportunities and challenges for both the Army and the antiaircraft artillery. In the midst of rearmament in February 1940, the Army created an experimental Air Defense Command in the northeastern United States with the First Army, commanded by Lieutenant General Hugh Drum. While opinions differed on

which organization should actually coordinate air defense actions—the Air Corps, through the GHQ Air Force, or the First Army commander—an attack on America shores seemed a distant possibility and the issue lay fallow until Germany defeated France and attacked Britain in the summer and fall of 1940.⁴

When the Army considered creating four regional air defense commands operating on the First Army model, the issue of command and control erupted again. The issue divided those concerned into two camps. General Henry H. Arnold, Major General James Chaney (an Air Corps officer commanding the existing Air Defense Command), Major General Lesley J. McNair (then Chief of Staff, GHQ), and others were in favor expanding the number of air defense commands and placing them all under the GHQ Air Force. General Chaney, having just returned from observing British actions during the Battle of Britain, argued strongly to General Marshall in favor of this proposal.⁵ General McNair supported this position, but objected to the term “defense,” preferring to use “theaters” instead. The War Plans Division, represented by Colonel Jonathan Anderson, argued for unity of command under the four army commanders. After careful consideration, General Marshall decided to put the air defense system under the direction of the GHQ Air Force unless war was declared—in which case the army commanders would direct the system. In March 1941, the War Department divided the continental United States into four strategic defense commands (Northeast, Central, Southern, and Western). The War Department placed responsibility for command and coordination of all defense planning with the four army commanders, but gave the GHQ Air Force responsibility for peacetime organization, training, and defense planning of all air defense forces. This bifurcated arrangement created a confusing situation that left decentralized

geographical worries with each of the four army commanders, but functional control of all air defense resources with a centralized air commander.⁶

With the Japanese attack on Pearl Harbor, continental defense transitioned from a bureaucratic planning event to a vital national concern. Having the four army commanders directing defense commands, but also charged with training and preparing forces for combat, led to concerns over the ability of the commanders to accomplish both missions simultaneously. With the War Department reorganization of March 1942, the Eastern and Western Defense Commands remained under the First and Fourth Armies, but training of large units (corps and divisions) shifted to the Second and Third Armies. Since the reorganization abolished the General Headquarters Air Force, responsibility for air defense (including use of antiaircraft artillery) devolved to the First and Fourth Air Forces assigned to the Eastern and Western Defense Commands. The Army Air Forces challenged this arrangement in June 1942, proposing that it be responsible for the all air forces and suggesting a vastly different geographic arrangement for active air defense measures. The Army Ground Forces disagreed, commenting only that “centralizing air defense would disrupt unity of command in the defense commands.” General Drum also disagreed, emphasizing that the existing continental defense organization was beginning to function smoothly and to change now would further confuse subordinate units. The War Department agreed in theory that centralized control of air defense assets made sense, but in disproving the Army Air Forces’ request maintained that “unity of command within the geographical subdivisions [was] of paramount importance.”⁷

From the perspective of an antiaircraft artilleryman, this structure was an argument for control of very few resources. In late summer 1941, the Army had thirty-

seven antiaircraft regiments and nine separate gun battalions serving in continental defense roles. Many of these units were short personnel, equipment, ammunition, and training. A September 1941 War Department estimate determined that only about eighteen regiments were actually available, but due to weapons and ammunition shortages that it did not anticipate any units being available for homeland defense until mid-1942. As the threat to American shores declined throughout 1942 and attention shifted to overseas combat, concern over continental defense and the command of air defense forces declined as well.⁸

While continental defense was a phenomenon of the run-up to war, concern for the protection of overseas garrisons in Panama, Hawaii, and the Philippines had long been on the minds of Army planners. In the immediate aftermath of World War I, the 1920 version of the Orange war plan called for an aggressive campaign against Japan. The Washington Naval Conference called by the Harding Administration in 1921, however, quickly obviated that plan. The Four-Power Treaty reaffirmed the signatories' colonial possessions in Asia and the Pacific Ocean. The Five-Power Treaty set naval tonnage among the great powers and through Article XIX maintained the status quo on fortifications in the Pacific and prohibited the United States from fortifying any naval base west of Oahu. While the Nine-Power Treaty confirmed the Open Door to China and recognized Chinese territorial integrity, the cumulative effect of the Conference for the United States was to establish a strong defensive perimeter from Alaska-Hawaii-Panama at the cost of conceding a weaker position in the Philippines.⁹

Although the defense of the Panama Canal and the security of the U.S. Fleet in Hawaii were understood, debate continued for much of the Interwar period as to the

viability of defending the Philippines. In the early 1920s, a small group of officers, notably Colonel Stanley Embick of the War Plans Division, argued that the Philippines were indefensible. Other War Plans officers, including future Chief of the Coast Artillery Lieutenant Colonel John W. Gulick, countered that holding the Philippines with an “ample American force [was] essential to ... our Asiatic policy.”¹⁰ Supporters of a strong Philippine defense received a boost in 1930 when General Douglas MacArthur, whose relationship with the Philippines stretched back to his service with his father there, became Army Chief of Staff. MacArthur’s influence waned temporarily during the tenure of his successor, General Malin Craig. Of particular note, Stanley Embick returned to the General Staff for his second tour, this time as a brigadier general and the new director of the War Plans Division. Craig, Embick, and Colonel Walter Krueger, who would later command troops in the retaking of the Philippines, believed that at the outbreak of war, the Army should protect the continental United States, Alaska, Hawaii, and Panama. Accordingly, in the 1940 version of the Orange war plan, the Army would reinforce Hawaii, but the defense of the Philippines would be left to the garrison and any local troops available. That decision changed again in July 1941 when Roosevelt recalled MacArthur to active duty as the commander of the newly formed U.S. Army Forces in the Far East. Having convinced the War Department of his ability to defend the Philippines, MacArthur began receiving men and materiel, including over 400 of the Army’s newest fighters and bombers and an additional coast artillery regiment.¹¹ The sum total of this two-decade debate on the Army’s role in the Pacific was to maintain relatively robust defenses in Panama and Hawaii and to reinforce the largely indefensible Philippines at the last minute.

Defending the Canal

While War Department officers debated the need to defend the Philippines, no one questioned the need to protect the Panama Canal. Officials understood that any interruption of the flow of traffic through the Canal posed serious economic and military problems for the United States and its allies. In 1939, more than ninety percent of all trans-Panamanian shipping originated in Allied ports.¹² Equally important, the entire U.S. Fleet could transit the Canal in thirty-six hours. Sailing around South America took three weeks.¹³ These strategic concerns left no doubt as to why the Army viewed its mission in the Canal as "secondary only to continental defense."¹⁴ An analysis of the Canal's defenses, however, reveals that while strong in theory, they suffered from the same real, practical shortages of men and materiel that hindered effectiveness across the Army. The fact that, by 1943 when the war shifted direction, the Canal had not been attacked, signaled more the growing level of Axis strategic impotence than the validity of United States air defense efforts in Panama.

Coast Artillerymen had long identified Panama as a key strategic concern to the United States. In 1929, Major General Andrew Hero highlighted his concerns over the Canal's security.¹⁵ A year later, his successor as the Chief of Coast Artillery, Major General Gulick, explained the issue with prescient clarity. In a secret 1930 letter to the Adjutant General, General Gulick wrote,

... the Panama Canal locks are the world's most important bombing objective due to the vital limitations which the destruction or even the interruption of the facilities of the Canal would impose on our fleet. The strategic importance of the Canal and the vital necessity for protection of the locks are probably greatest during the initial stages of an emergency.... Nothing offers an enemy of the United States as much return for a successful air attack at the outbreak of hostilities as the destruction of the Panama Canal. It is therefore considered imperative that the antiaircraft

defenses of the Panama Canal be maintained at all times in a condition approaching war effectiveness.¹⁶

In his *Annual Reports* for 1938 and 1939, Secretary of War Woodring agreed, arguing that the increased range and destructive potential of air forces had "so shortened the elements of distance and time that any hostile air base established anywhere within striking proximity of the Panama Canal would prove a vital threat to that waterway ... and to the very security of these United States."¹⁷

In May 1940, Congress authorized \$15 million in initial outlays for a "by-pass" project to build a third set of locks on the theory that it provided redundancy and made destruction of the Canal more difficult.¹⁸ In January 1941, the Army established the Caribbean Defense Command to organize the Canal's defenses and protect areas in the Caribbean and South America from Axis influence. The Caribbean Defense Command ran from Guatemala and British Honduras south to the Brazilian border and extended past the West Indies. In the Caribbean and, to the extent possible, in the Pacific, the Army and Navy established a series of bases at key intervals designed to prevent an enemy from establishing a position from which to conduct an air strike on the Canal. Visualized from the air, the pattern made by these defenses represented an organized assembly of mutually supporting air and naval bases not unlike Vauban's famous system of fortresses and redoubts.¹⁹

The War Department placed further emphasis on the Caribbean Defense Command and defense of the Panama Canal following President Roosevelt's 27 October 1941 Navy Day radio address in which he discussed the German submarine attack of 11 October on the *USS Kearny*. During that speech, Roosevelt disputed Hitler's claims that Germany's intentions did not extend across the Atlantic Ocean. Claiming that Hitler had designs on the Western Hemisphere, he

described a map in his possession that showed the fourteen nations of South America consolidated into what Roosevelt called five "vassal states," Neuspanien, Chile, Brasilien, Argentinien, and French Guyana. The territory of Neuspanien, Roosevelt noted, also included the current boundaries of "the Republic of Panama and our great life line--the Panama Canal." Roosevelt vowed that the plan would "never go into effect."²⁰

Despite the build up of forces, by 7 December 1941 the air forces in the Canal Zone totaled only 183 (or 46%) of the 396 planes authorized by the Tables of Organization and Equipment. Of the planes available, only 83 (or 21% of the authorized, 45% of the available) were the more modern P-40 and A-20 aircraft. The bulk of the



German Map, undated, President's Secretary's Files (PSF) Safe Files: Germany Index, Franklin D. Roosevelt Digital Archives.

Figure 9.1 – German Plans for South America

force consisted of outmoded P-26 and A-17 aircraft whose "value in protecting the canal was negligible."²¹ In addition to these limited resources, the Canal defenses also relied upon the meager assets of the entire Caribbean Defense Command's heavy bombardment force, consisting of the eight B-17's then concentrated in the Canal Zone. Of these eight, however, only one squadron (typically six aircraft) was capable of operating at high altitudes. Following repeated complaints from Major General Frank M. Andrews, Commander of the Caribbean Defense Command, the War Department shifted twenty-five P-40's from Puerto Rico and transferred eighty additional pursuit planes from the United States. Although the transfer of planes from Puerto Rico weakened the expanded strategic defense in the Caribbean, it strengthened the interior of the Canal defense against a possible Japanese threat from the west.²²

If the air forces in the Canal Zone suffered from a lack of men and equipment, their counterparts in the air defense of the area, the antiaircraft artillery forces, also experienced significant shortages. The lack of forces available in the Canal Zone in 1941 surprised no one in the upper levels of the Coast Artillery Corps. For years, leaders of the Corps had lobbied the War Department for an increased force only to come away empty-handed. In the interim, the Coast Artillery Corps took several measures to offset the shortages in personnel and equipment. One of the most extreme measures taken to improve antiaircraft readiness began in 1931 with the "dual training" of all coast artillerymen in antiaircraft armament. Beginning in 1938, the shortages became so acute that the Canal Department and the Coast Artillery Corps included infantrymen in the cross training program.²³

By January 1939, the Panama Canal Department reached a strength of 13,500 men. Included in this number were antiaircraft elements from the 1st and 4th Coast Artillery Regiments, totaling just 1,740 men. Following the German invasion of Poland in September, antiaircraft reinforcements flowed into Panama from units in the United States. To incorporate these units into the larger Canal Zone defense, the Canal Department formed the Panama Provisional Coast Artillery Brigade (Antiaircraft) under the command of Brigadier General Sanderford Jarman.²⁴ The brigade, organized on 1 November 1939, absorbed the two antiaircraft battalions already present in the Canal Zone, redesignating them the 72d and 73d Coast Artillery (Antiaircraft). Additionally, the brigade received units from the 61st, 62d, and 63d Coast Artillery (Antiaircraft) located in the United States. Combined, these units totaled close to 5,300 men of the nearly 19,500 men stationed in Panama by January 1940. Increases continued for all arms stationed in Panama so that by late 1941 the total strength reached 31,700. The number of antiaircraft artillerymen available, however, still proved inadequate for the task at hand. In reporting his brigade's personnel status, General Jarman complained that he needed another 3,000 men just to operate the antiaircraft equipment currently assigned to his unit and 4,300 more men once additional armament arrived. In November 1941, General Andrews confirmed this condition when he reported to the War Department that manpower shortages prevented the harbor defense units from fielding one complete detail and the antiaircraft units proved unable to man all of their equipment.²⁵

General Andrews' comment regarding the antiaircraft artillery units' inability to man the equipment leads one to believe that enough weaponry existed to defend the Canal adequately. On the contrary, the shortage of personnel only exacerbated the

shortage of armament that already existed. A 1937 study concluded that the antiaircraft defense, consisting of twenty-five (5 mobile and 20 fixed) 3-inch gun batteries and four recently established 105mm gun batteries, failed to provide adequate protection against the expected force of hostile bombers. Of the 75 3-inch guns employed in the defenses, 44 were obsolete 1917 models. Even worse, the 25 batteries possessed a total of only 11 fire control directors and six height finders. Finally, of the 107 searchlight units projected for the Canal defense, none had sound locators and just 37% possessed searchlights.²⁶

By late 1939, the War Department began shipping what men and materiel they could to Panama. The combination of actual increases and organizational expansion brought the nominal size of the Panama Separate Coast Artillery Brigade to 18 antiaircraft regiments, or the equivalent of six brigades, through November 1940. In one instance, the 72d Coast Artillery (Antiaircraft) Regiment expanded its lettering of units from "A" to "X" and expected further enlargement. Organizational expansion, however, did not solve the defense problem. The skeletal structure of the Panama Brigade still required materiel to make it an effective whole, a dilemma faced by antiaircraft artillerymen everywhere.²⁷

While equipment shortages existed throughout the Army and the expanding antiaircraft artillery force, two examples highlight the level of unpreparedness in Panama on the eve of war. First, although production of 3-inch guns lapsed in June 1940, the defenses of Panama required 204 of the Army's existing 807 guns, many of which needed replacement.²⁸ Second, and more importantly, the defenders in Panama experienced significant limitations in their ability to "see" approaching enemy aircraft.

To spot enemy planes at great distances the defense relied upon long range air patrols operating out to a range of 900 miles. Yet there were not enough planes or bases to carry out the search as planned. The planes available lacked the necessary airborne-surface vessel detection equipment (ASV) to find enemy carriers before they launched aircraft. This deficiency forced pilots to rely on visual spotting with its customary hit-or-miss potential. To find intermediate range targets out to 120 miles, the defenders positioned one SCR-271 radar at each end of the Canal, but the radar's inability to show elevation hindered ground-controlled interception.²⁹

For close-in aircraft, the Army counted on the short-range, height-finding SCR-268 radar to direct its searchlight and barrage fire. Although more of the SCR-268 radars existed in Panama than all other types combined, only 75% of the 3-inch batteries possessed operational radar. In other words, because the missing radars held a critical spot in the illumination-fire control loop, one quarter of the gun units stood "combat ineffective" and unable to perform their mission. After the start of the war, the Panama Defense Command converted a number of SCR-268 radars for use against low-flying airplanes. In February 1942, Mr. Watson-Watt of the British Air Commission and a radar pioneer, recommended to Secretary Stimson that the War Department purchase British Chain Home Low (CHL) radar for use in Panama. Stimson agreed and the Army ordered sets from Canada. By mid-summer 1942, the CHL radar arrived along with additional SCR-270 and SCR-271 radars and other antiaircraft equipment. With this new equipment and the influx of two infantry regiments, two balloon units, and 1,800 antiaircraft filler replacements, the Panama Canal was at last secure--long after the crisis

passed.³⁰ The only threat against the Canal came during an aborted Japanese plan to send submarine launched float monoplanes to bomb the locks in July-August 1945.³¹

Paradise Lost -- Hawaii

If the Army viewed protection of the Panama Canal as "secondary only to continental defense," the Navy saw Hawaii as one of the "essential bastions, which had to be maintained...."³² Although Army-Navy relations were not always cooperative, the Army agreed with this assessment. Any perceived reluctance on the Army's part to support Hawaiian defense came more from its current difficulties in raising and equipping a large force in the United States rather than from any inter-service strife. In February 1941, General Marshall wrote a lengthy letter to the Army's new commander of the Hawaiian Department, Lieutenant General Walter C. Short, outlining concerns and emphasizing that the Army's primary mission in Hawaii was to protect the Fleet. In making his point, Marshall wrote, "the fullest protection for the Fleet is *the* rather than *a* major consideration for us; there can be little question about that...."³³ Marshall also noted that the Army was spread fairly thin and could not "perform a miracle." He had just taken twenty 3-inch antiaircraft guns from regiments training in the United States to bolster the antiaircraft protection of the Navy base at Cavite in the Philippines, and General Andrews in Panama was also complaining of shortages. Marshall told Short that the Army intended to ship him additional .50 caliber machine guns, but "I have no hopes for the next few months." He warned Short that sabotage and a surprise raid by "air and submarine constituted the real perils...."³⁴

When Short arrived, he inherited a meager array of air defense armament. Of the 148 pursuit planes required by the Department's war plan, 36 were on hand, 31 more

were due to leave San Diego shortly, and another 50 were due in March. For antiaircraft equipment, Short had almost all of the 3-inch antiaircraft guns authorized (82 out of 98) and somewhat less than half of the .50 caliber machine guns required (120 out of 308), but none of the 120 37-mm automatic weapons he needed to defend the island. The Army planned to deliver all twelve radars by June and install them shortly thereafter. As for barrage balloons, he had three, with eighty-four additional balloons scheduled for delivery that summer.³⁵

In the months ahead, Short worked tirelessly to improve the defenses. On a few occasions, his efforts clashed with those of his subordinate commanders. In mid-year, Short expressed concern about the potential of sabotage and required that the air forces in Hawaii practice ground defense tactics should an attack render their airplanes inoperable. The air commander in Hawaii, Major General F. L. Martin, disagreed with this order and appealed to General Arnold who, in turn, took the issue to Marshall. In October, Marshall sided with the airmen, reminding Short that the condition of the air force in Hawaii dictated that it should focus on flying and maintaining aircraft. Reluctantly, Short withdrew his demand. Ever diligent, Short repeatedly peppered the War Department with requests for more antiaircraft personnel and equipment, and more engineers to build additional aircraft dispersal areas. He also asked Marshall for help with the Interior Department, whose National Park Service blocked the use of a park where Short wanted to install an aircraft warning service radar.³⁶

On 7 December 1941, the Hawaiian Department included two infantry divisions, a light tank company, four antiaircraft regiments, four harbor defense regiments (two of which were incomplete), several aircraft warning units, eight squadrons of bombers, and

nine squadrons of pursuit planes. Of the seventy-two heavy bombers available that day, only six B-17s were capable of attacking Japanese carriers. Only 80 of 149 fighters were operational, as were six of the thirteen reconnaissance aircraft. Regarding anti-aircraft equipment, Marshall was right when he said that he had “no hope” of providing additional equipment in the near future. The four regiments had eighty-six of the ninety-eight 3-inch guns, an increase of just four since February, but still a potent force. While the 3-inch guns were useful against high altitude bombers, what the Hawaiian Department really needed to defeat low-flying Japanese aircraft were the more agile automatic weapons. Since February, the anti-aircraft units in Hawaii had received twenty 37-mm automatic weapons and now sported one-sixth of their wartime requirement. In the interim, however, they had also lost the services of seven .50 caliber machine guns and could deploy only one hundred and thirteen. Most disconcerting was the status of Aircraft Warning Service radar. Six mobile SCR-270 radars were operational, but only three of the six fixed SCR-271 radars authorized had arrived and the Signal Corps had not installed them yet.³⁷

Despite shortages of equipment, the units under Short’s command trained hard on their warfighting skills, even holding joint exercises with the Navy. Major General Henry T. Burgin, commander of the Hawaiian Coast Artillery Command, noted that for six weeks to two months prior to the attack, the Coast Artillery Command conducted joint exercises every Sunday morning. According to Burgin, the anti-aircraft units deployed to the field, often positioning guns “along roadways, sometimes in position, and practiced simulated fire against this simulated attack made by the Navy” with its carrier-

based planes.³⁸ When the Navy did not go to sea during the first week in December, these exercises ended—just one week prior to the Japanese attack.

In addition to these joint exercises, the crews of the six mobile SCR-270 radars belonging to the Aircraft Warning Service operated Monday through Friday from 7:00 a.m. to 4:00 p.m. and for another half-day on Saturdays. On 27 November, upon receiving a war warning from General Marshall, Short ordered the Hawaiian Department to Alert Level No. 1, the lowest of the three alerts provided for the Department. Alert Level No. 1 required all units to take “defense against sabotage and uprisings.” Alert Level No. 2 directed security against “subsurface, surface, and aircraft” attacks.³⁹ While reacting to what he perceived to be the threat as identified in Marshall’s message, Short also took an additional half measure of protection. Aware that all of the Department’s analysis indicated the most realistic threat was through air attack, Short ordered the radars of the Aircraft Warning Service and the Information Center to be operational from 4:00 to 7:00 a.m. daily. When asked why he chose those times, Short responded, the radar “was put into alert during what I considered the most dangerous hours of the day for an air attack....”⁴⁰

From all indications, the antiaircraft troops and radar crews stationed on Oahu in December 1941 had achieved a very basic level of training. There is a difference, however, between being trained, even at a basic level, and being ready for combat. War rarely comes to those who are ready. Peacetime training seldom accords the military the opportunity to train in the same rigorous and unforgiving environment in which it will one day have to fight. Indeed, at 7:50 a.m. on Sunday, 7 December, when the Japanese attacked, three mobile SCR-270 radar sets were up and running. Radarmen and

Information Center operators had just completed training. At 7:02 a.m. one of the sets, manned by Army Signal Corps soldiers Joseph Lockard and George Elliott, captured a strong echo at the extreme end of the radar sweep approximately 136 miles out. Private Lockard, the more experienced of the two soldiers, double-checked his settings. As the signals crept in to 132 miles, Lockard called the Information Center by telephone to report the observation. There was no answer on the tactical line, so he tried again on the administrative line. The Center was deserted except for an enlisted telephone operator and First Lieutenant Kermit A. Tyler, an Air Forces officer with little radar experience who was there to observe operations as the first step in his becoming a fighter controller. He had no operational function and had no knowledge of what the formation was. Tyler, believing that Lockard's signal indicated the arrival of a flight of B-17 bombers expected that day on their way to the Philippines, told him not to worry about it. Lockard and Elliot tracked the planes until they lost contact with them twenty miles from Oahu. At 7:55 a.m., the Japanese struck Hickam Field and Ford Island.⁴¹

The radar crews were marginally trained and ready. The men manning the Information Center, however, were not trained. Nor were they ready and alert to the possibility of an air attack. It was Sunday and their shift was over. The day was done. Breakfast was waiting. Ironically, less than a month earlier, the Hawaiian Department demonstrated what a trained and ready force could accomplish. During a joint Army-Navy tactical exercise, carrier based planes eighty miles away took off at 4:30 in the morning. Radar picked them up as they headed toward Oahu. The Information Center notified the pursuit squadron within six minutes. The aircraft launched in plenty of time to intercept the "enemy" thirty miles out.⁴²

While the failure of early warning to work as planned was one of the most glaring errors noted in the eight post-Pearl Harbor investigations, there are other equally stinging examples of trained units not being ready for combat. Most notably, of the 219 available antiaircraft guns, only the twenty-six fixed 3-inch guns were in position and had their ammunition in boxes adjacent to the guns. The remaining sixty 3-inch guns and all of the .50 caliber machine guns and 37-mm automatic weapons were without ready ammunition. According to the Army's Pearl Harbor investigation, "the Ordnance Department objected to having ammunition out and convenient to the guns because it might get dirty"—a real, but correctable concern. As General Burgin testified, "it was almost a matter of impossibility to get your ammunition out because in the minds of everyone who has preservation of ammunition at heart it goes out, gets damaged, comes back in, and has to be renovated." Burgin stated that both he and General Max Murray, the artillery commander, pleaded with General Short to release ammunition, as it was "extremely difficult to get your ammunition out of the magazines." In the end, Burgin stated, "we were put off, the idea behind it being that we would get our ammunition in plenty of time, that we would have warning before any attack ever struck."⁴³

The Army's interwar poverty had finally demonstrated its effect on the psyche of those charged with maintaining some of the War Department's most scarce resources. The ordnance officers in Hawaii were so concerned about preserving the few silver bullets they possessed that they refused to release them to antiaircraft crews prior to the declaration of an emergency. When the Japanese attacked, antiaircraft crews had to drive two to three miles to the supply point at Aliamanu Crater to pick up ammunition before proceeding to position and employing their weapons. In contrast, the Navy, which was

manning just one quarter of its 780 onboard anti-aircraft weapons continuously, had all of its weapons firing within ten minutes. While the Navy fired mostly in revenge, at least they fired on the enemy. Very few Army anti-aircraft units reached their positions in time to engage Japanese aircraft. Of the thirty-one separate anti-aircraft batteries assigned to the Coast Artillery Command, only four reached their positions before the attack ended. One fixed 3-inch gun unit on Sands Island, however, proved they were both trained and ready as they broke into their crate of ammunition and opened fire, downing two Japanese aircraft.⁴⁴

The nearly 25,000 pages of official investigations document clearly the strategic and operational intelligence and early warning failures that enabled the Japanese success. Also well known are the series of small errors and bad command decisions made by inept leaders that led to “the greatest military and naval disaster in our Nation’s history.”⁴⁵ Less well known and certainly less acknowledged, however, is the effect that two decades of inattention to military preparedness had on the military’s ability to be ready mentally for its first battle of World War II. It is part of the historiography of that war to blame civilian leaders for not providing the resources to build a stronger military before the war started. That argument fails to recognize that at Pearl Harbor, defeat came not from a lack of men or materiel, but from a lack of leadership, awareness, and initiative. Conversely, others have argued recently, that bickering within the Army led to its inability to innovate during the Interwar period. Again, this argument misses the mark at Pearl Harbor, for innovation had nothing to do with the lack of readiness shown by Army units. Instead, the penury of the Interwar period led to the expectation of poverty. A creeping, niggardly frugality infected the corporate culture of the Army to the point

where having resources was more important than using them. The lack of attention (both monetary and intellectual) paid to the military over the years dulled its edge. While some institutions turned inward in search of solutions, some individuals turned out not to have the intellectual ability to transition from peace to war. In many cases, apathy and indifference set in where reality and urgency feared to tread. The situation was changing prior to Pearl Harbor, but not fast enough. Leavenworth and the Army War College churned out educated and enlightened mid-level and senior level officers. Roosevelt selected Marshall to serve as Army Chief of Staff ahead of scores of other more senior general officers. The GHQ Maneuvers of 1940-41 tested many senior leaders and found them unable to adapt to simulated combat. Marshall relieved several senior commanders and placed younger, more aggressive leaders in charge. Still the pernicious effects lingered. Two years of concerted effort was not enough time to reverse nearly two decades of bad policy. It is hard to change the effect that bad policy can have on strategy, operations, and tactics. At Pearl Harbor, strategic and operational failures enabled the Japanese to get close to Oahu, but tactical failures engendered by poor, tired leadership lost the day.

After two decades of development, the antiaircraft establishment failed in its first encounter with the enemy. While successful in its efforts to achieve internal consensus and alter the status quo within the Coast Artillery Corps, the antiaircraft artillery received strong, but belated external support from the War Department, Congress, and the President. Prior to 7 December 1941, combat readiness carried a vague, unspecified meaning. Only the few remaining World War I veterans still on active duty, most of whom now ran the Army, really understood what being ready for combat meant. During

the “lean years,” the Army had organized its weapons ranges to maximize the performance of the meager allotment of available ammunition instead of replicating expected combat conditions. America had not provided the Army with enough men or materiel during the interwar period for soldiers to train properly. Mid-grade officers and non-commissioned officers understood how to drill members of the Civilian Conservation Corps and could meander through the Louisiana and Carolina maneuvers, but had only a limited understanding of true combat readiness. Even belated War Department support during rearmament was not enough to transform a peacetime garrison Army into a finely tuned fighting force ready to defeat the enemy at a moment’s notice. At Pearl Harbor, the anti-aircraft force suffered the effects of this somnolence. Like Rip Van Winkle, the forces in Hawaii had overslept and awakened to a new reality when the Japanese delivered a stunning shock to the military’s corporate consciousness.

Corregidor -- The Rock Falls

After two decades of debate on the strategic value and defensive ability of the Philippines, the President and the War Department decided that a combination of deteriorating relations with Japan and the potential power of the new B-17 bomber made the islands a prize worth defending. With tensions increasing, the September 1940 signing of the Tripartite Act binding Germany, Italy, and Japan to each other’s defense, followed by Germany’s invasion of Russia in June 1941, solidified views in the War Department on the strategic importance of the Philippines.⁴⁶ Anticipating a probable Japanese move South, Marshall envisioned the Philippines as a “Naval and Air Base upon the immediate flank of the Japanese southern movement.”⁴⁷ The emergence of the B-17 long-range bomber gave Marshall, Arnold, and others reason to believe that the

Army could cut the Japanese sea lines of communication, significantly damage any Japanese invasion force before it landed in the Philippines, and possibly threaten Japanese garrisons and cities. Confidence was such that the War Department planned to have 165 heavy bombers (B-17s and B-24s) in the Philippines by March 1942. This number accounted for 74 percent of the 222 heavy bombers scheduled for production between December 1941 and March 1942—a significant indicator as to the level of importance attached to the establishing an air force in the Philippines.⁴⁸

With this change of opinion came a dramatic change in priority of resources for the Philippines. On 31 July 1941, in a meeting with several senior staff members, Marshall “stated it was the policy of the United States to defend the Philippines. This defense will not be permitted to jeopardize the success of the major efforts made in the theater of the Atlantic.”⁴⁹ In September 1941, Marshall wrote to MacArthur, that the United States Army forces in the Philippines would “be placed in highest priority for equipment including authorized defense reserves for fifty thousand men.”⁵⁰ Being near the head of the line, however, did not make the line move any faster. In seeking reinforcements, the Philippines suffered many of the same problems faced by other outposts. American industrial war production was just beginning, the demand for equipment throughout the Army was enormous, and Great Britain and Russia were in critical need of supplies. As with units in the Panama Canal and Hawaii, reinforcing the Philippines also required shipping space, which at the time was extremely limited.⁵¹ For these reasons, instead of a torrential flow of reinforcements, men and equipment trickled into the Philippines

In July 1941, when MacArthur took command of the U.S. Army Forces in the Far East, the Philippine Department forces consisted of 22,532 men, half of which were Philippine Scouts. The Philippine Division, commanded by Major General Jonathan Wainwright, totaled 10,473 men, almost 8,000 of whom were Philippine Scouts. The only completely American infantry unit within the Division was the understrength 31st Infantry Regiment, about 2,100 men. A division in name only, the Philippine Division never operated as a single entity. The majority of its forces were stationed at Fort McKinley, just south of the city. The 31st Infantry operated out of the Port of Manila, just south of the city, while other units were scattered from Clark Field fifty miles to the north all the way down to the southeast coast of the Bataan peninsula.⁵²

Next to the infantry, coast artillerymen made up the second largest group of soldiers in the Philippines. At about 5,000 soldiers, the majority were harbor defense troops of the 59th, 91st, and 92nd Coast Artillery Regiments. American officers led the 91st and 92nd Regiments, but the enlisted men were all Philippine Scouts. The largest completely American unit was the 60th Coast Artillery Regiment (Antiaircraft) on Corregidor equipped with a battalion of 3-inch guns, and a battalion of 37-mm and .50 caliber automatic weapons.⁵³ All of these soldiers belonged to the Philippine Coast Artillery Command led by Major General George Moore. Moore's plans for defense of the Philippines called for defense of the four fortified islands in Manila Bay (Corregidor, El Fraile, Caballo, and Carabao) and the southern tip of Bataan. He also placed one 3-inch antiaircraft gun battery and a platoon of searchlights at Fort Wint in Subic Bay.⁵⁴

Between 27 August and 5 September the first group of reinforcements left San Francisco bound for the Philippines. This shipment included the 194th Tank Battalion

with fifty-four tanks and the 200th Coast Artillery Regiment (Antiaircraft) with 76 officers, and 1,681 enlisted men. The “Old Two Hon’erd” was a National Guard regiment of cowboys, ranchers, high schoolers, miners, college kids, and professional men from New Mexico. Previously this collection of Mexicans, Anglos, and Indians had served as the 111th Cavalry Regiment. In late 1940, the 111th Cavalry joined over 100 other units in converting to antiaircraft artillery. Amazingly, on 17 August 1941, the Army declared the “200th ... the best anti-aircraft Regiment (regular or otherwise), now available ... for use in an area of critical military importance.”⁵⁵

In this case, being the “best” was really a misnomer and, as the history of the regiment indicates, an indictment of the condition of the Army as it struggled through rearmament. According to the Army’s official history, the 200th Coast Artillery (AA) arrived in the Philippines in late September bringing with it twelve 3-inch guns, twenty-four 37-mm automatic weapons, and a similar number of machine guns.⁵⁶ Rearmament was never that simple, and the official history fails to confront some serious readiness issues that typified the plight of the antiaircraft force as a whole. The regiment received a large portion of its equipment as it boarded the USS *President Pierce* and the USS *President Coolidge* in San Francisco. During training at Fort Bliss, the 37-mm batteries “simulated guns from boxes and broomsticks ... fired rocks for ammunition and shouted bang.” One battery had a 37-mm gun, but no ammunition. The first time any soldier fired a 37-mm gun was in combat, but only after one enterprising trooper fed .50-caliber ammunition into the 37-mm gun, before figuring out it didn’t work. At Fort Bliss, the regiment trained primarily with 3-inch guns and M1903 Springfield .30-06 bolt-action rifles. Few of the men knew how to operate the SCR-268 radars they received.⁵⁷

As the regiment sailed out past Honolulu, the convoy ran into a typhoon that lasted for thirty-six hours. One soldier noted the ninety-mile per hour winds blew the ship off course, while sixty-foot waves tore at the equipment on deck. Lieutenant Jack Bradley watched in horror as the waves smashed into the gear sending “jeeps, 3-inch guns, and other equipment ... overboard.”⁵⁸ The situation did not improve once the regiment got to the Philippines. As he was unloading the *Pierce*, Bradley noted “incredible SNAFUS in the 2-6-8 radar trucks. The connecting cables and the M-4 directors were missing. We never were able to use the radar in combat, and had to rely on the old none-too-reliable range-finders.”⁵⁹ Another soldier, in charge of searchlights, noticed that the old searchlights he had rejected and turned in for new ones at Fort Bliss had mysteriously arrived in the Philippines, no doubt a trick played on the “Old Two Hon’erd” by a regular Army unit back at Fort Bliss.⁶⁰

Once in the Philippines, the 200th Coast Artillery (AA) received orders to move to Fort Stotsenberg and protect the 35 B-17 bombers General Arnold had sent over to nearby Clark Field to bolster the Philippine defenses.⁶¹ The regiment had one battery of .50 caliber machine guns, twenty-two 37-mm guns (seven of which were defective and sent to Manila for repair), and twelve 3-inch guns (one of which was sent to Corregidor for repair). At Clark, the regiment had difficulty moving into its wartime positions. As Colonel Harry Peck, the regimental executive officer recalled, the wartime battery positions around Clark Field “were closed to us. They were on private land and only the military reservation was open to us.” Even after the war began an officer was sent “to Manila to request legal authority to emplace [the] guns on Philippine territory.”⁶² Ironically, while the Philippine Department received a higher priority for reinforcements

than Hawaii or the Panama Canal—indeed, Marshall redirected equipment from both locations to the Philippines--the same Ordnance rules apparently applied to all three locations. As one soldier noted, his platoon “was definitely told, ‘DO NOT BREAK THE SEAL on the ammunition box.’ So prior to the day of the war, we had never seen a live round.”⁶³

The arrival of the 200th Coast Artillery Regiment (AA) ended the flow of antiaircraft units to the Philippines. Other forces continued to arrive, however, as the War Department resolved earlier supply and shipping problems, turning the trickle of men and materiel into a steady stream of reinforcements. By the end of November, the Army strength had increased by 8,500 men, including two tank battalions. The ten-division Philippine Army, a poorly trained and equipped militia, was two-thirds mobilized. By 15 December, it numbered 100,000. The Far East Air Force more than doubled in size from 2,400 airmen to 5,600 by 30 November. Moreover, MacArthur’s air force now included two bomber groups with thirty-five B-17s and a pursuit group with 107 P-40s, a down payment on a much larger force.⁶⁴

Two antiaircraft regiments armed with antiquated 3-inch guns were not enough defend the expanding Far East Air Force. Demands for antiaircraft protection of civilian areas further stretched the meager force. As a result, the only areas defended against air attack were small sections of Manila, Clark Field, and Corregidor. In October, before he left Washington to take command of the Far East Air Force, Major General Lewis Brereton, expressed concern about the protection of heavy bombers being sent to the Philippines. As Chief of Coast Artillery, Major General Green recommended that MacArthur reassign elements of the harbor defenses to antiaircraft duty. Although the

Corps had been training harbor defense crews to fire anti-aircraft weapons since 1930, the War Department rejected his suggestion, only to later reverse its decision and on 29 November permit one battery from the 59th Coast Artillery and two batteries of the 91st Coast Artillery to convert.⁶⁵

Besides anti-aircraft artillery and pursuit aircraft, the air defense “system” required adequate aircraft warning. The anti-aircraft artillery regiments had SCR-268 radars, which either they were untrained to operate or did not work. In September, MacArthur requested additional radar equipment and planned to establish an air warning service. The War Department approved his plan and shipped six SCR-270 by October. By 7 December, there were seven radar sets in the Philippines, but only two radars were operational. Native coast watchers positioned at key points throughout the Islands reported by telephone or telegraph to Interceptor Command and Nielson Field, which in turn passed the information to Clark Field.⁶⁶

Contrary to what occurred ten hours earlier at Pearl Harbor, the Japanese did not catch the air warning system off guard in the Philippines. It functioned before the battle, sending fighters to investigate intruders before the war started. The SCR-270 radar positioned at Iba, a fighter base about 80 miles northwest of Clark Field, picked up inbound Japanese aircraft 108 miles out. The Far East Air Force scrambled a squadron of P-40s to intercept the bombers, but they could not find the Japanese, most likely due to inaccurate information on the altitude of the incoming aircraft. Between 11:30 and 11:45 a.m., the Iba station reported a large formation of bombers headed for Clark Field. A teletype received at Clark Field confirms this report.⁶⁷ Virtually every coast watcher along the northwest coast of Luzon also reported high-flying enemy bombers. Colonel

Harold H. George, an outstanding air officer and chief of staff of Interceptor Command, was in the plotting room as the reports came in and predicted “the objective of this formidable formation was Clark Field.”⁶⁸ Descriptions of the attack there differ among various recollections from MacArthur, Brereton, and Brigadier General Richard K. Sutherland, MacArthur’s chief of staff. What is known, however, is that at about 12:15 p.m. the Japanese flew over the unprotected field in a V-formation at about 22,000 to 25,000 feet, dropping bombs just as the air raid warning sounded.⁶⁹

With the high wail of the air raid siren, men spilled out of the mess hall and reacted as best they could. Leaving their pork chops and chocolate cake, the men of the “Old Two Hon’erd” ran to their positions, but had extreme difficulty firing their guns. As one soldier commented, “we had never fired our 37s until that day.... We were blowing holes through trucks and tents.” Another remarked, “when the barrel on the 37-mm got hot it caught in the recoil position and the collar wouldn’t let it go forward.... We had to pump water down through the barrel to cool it.”⁷⁰ The crews on the 3-inch guns fared no better. Most of the ammunition was manufactured in 1932. An abnormally high percentage of the rounds were duds and “most of the fuses were badly corroded.” One observer noted that about one in every six shells fired.⁷¹ According to First Lieutenant Russell Hutchinson, “the shell casings were green with corrosion. Every time we fired a shot, [the rounds] had to be cleaned to go into the breechblock, and we had to break the frozen fuzes with a wrench. We had World War I weapons, and our modified ammunition had too much muzzle pressure for the guns to withstand.”⁷² Several gun tubes exploded injuring a number of soldiers and killing one.⁷³ To make matters worse, most of the shells exploded 2,000 to 4,000 feet short of their targets.⁷⁴ The men of a .50

caliber machine gun battery found themselves equally confounded. Sergeant Earl Harris remembers being particularly disgusted. “Our machine-gun ammunition was made in 1918, reinspected in 1929, and issued to us in 1941. We had to polish the corrosion off with steel wool before we could get it into the belt. The guns were 1918. The mounts were jury-rigged during World War I, and they didn’t work.”⁷⁵

After more than an hour, the attack ended. By achieving complete tactical surprise, the Japanese had destroyed eighteen of the original thirty-five B-17s and fifty-three P-40s and damaged several other planes. They had also badly damaged Clark and Iba Fields, killed 80 personnel and wounded 150 others. The destruction of the Far East Air Force cost the Japanese a mere seven aircraft.⁷⁶ All was not lost, however, for now the war had begun. The period of anxious waiting was over. Despite obsolete weapons, bad ammunition, and limited training, the “Old Two Hon’erd” scored five confirmed kills during the attack. Unfortunately, they also shot down at least one P-40 during the confusion. Nonetheless, as General Wainwright would later affirm, the 200th Coast Artillery Regiment (Antiaircraft) had been the first unit in the Philippines to fire its weapons.⁷⁷ That evening, the 200th Coast Artillery Regiment (Antiaircraft) divided its forces and sent a third of the regiment to provide air protection for critical areas in Manila. Initially designated the Provisional 200th Coast Artillery (Antiaircraft), it was later redesignated as the 515th Coast Artillery Regiment (Antiaircraft).⁷⁸

On 10 December, the Japanese made initial landings on Luzon. On 22 December, the main invasion began. Within days, the Japanese landed at Limon Bay, threatening MacArthur’s South Luzon Force. At risk of being cut off, MacArthur finally decided to withdraw into the Bataan peninsula and moved his headquarters to Corregidor. Isolated

from air and sea reinforcements, the American and Philippine forces fought back against continued Japanese attacks only to withdraw further south, abandoning critical food and ammunition, and establish a defensive line across the narrow waist of the Bataan Peninsula in late January. American and Philippine soldiers repulsed a second attack in late January and early February, forcing the Japanese to stop and wait for reinforcements. Although often battlefield victors, many troops succumbed to malnutrition, war injuries, and tropical disease. In March, when Lieutenant General Jonathan Wainwright took command following MacArthur's departure, he estimated that only about 20% - 25% of the force was fit for combat.⁷⁹ While a few destroyers and submarines slipped through the Japanese blockade to bring supplies to the Philippines and evacuate the wounded, the flow was not enough to rebuild the fighting capacity of the force on Bataan. The Japanese, however, had received reinforcements and by early April were prepared to attack. On 3 April, under the cover of air and artillery fire, they assaulted the US positions across the peninsula, breaking through the defenses and driving the Filipino-American forces back some ten miles in two days.

As the Japanese poured south, Major General Edward King, commander of the Bataan defenses, attempted to stop the enemy on a line just north of Cabcaben on the southeastern end of the peninsula. At 7:30 p.m. on 8 April, with his last reserves already committed, King turned to the only remaining organized unit, the Provisional Coast Artillery Brigade (Antiaircraft), which had formed on 7 April from the remnants of the 200th and the 515th Coast Artillery Regiments (Antiaircraft), and ordered it to destroy all antiaircraft weapons other than those useful to the infantry. At the same time, King ordered the 1st Philippine Constabulary, a national police force then serving as a combat

unit, to link up with the brigade and take a position on its left. Later, the retreating 26th Cavalry (PS) was ordered to assume positions on the right of the brigade. When neither the Constabulary forces nor the remnants of the 26th Cavalry arrived to join the brigade, the antiaircraft artillerymen from the deserts of New Mexico and west Texas stood alone to face the brunt of the final Japanese attack.⁸⁰

At midnight on 8 April, with Japanese light artillery within range of 12,000 defenseless patients in the vicinity of Cabcaban and no “further means of organized resistance,” King decided to surrender to the Japanese and ordered all weapons and useful equipment destroyed. At 9:00 a.m. on 9 April, King went forward to meet the Japanese and surrender Bataan.⁸¹ The war that had begun unexpectedly on 8 December was now over for the antiaircraft artillerymen of Bataan. They fought valiantly against both Japanese aircraft and infantry. They played a key role in the fighting on Bataan, winning two Presidential Unit Citations in the course of the four-month battle. While their efforts as infantrymen are better known, the soldiers of the “Old Two Hon’erd” acquitted themselves quite well as antiaircraft artillerymen, scoring 86 confirmed kills on Japanese aircraft.⁸²

Meanwhile, on Corregidor, the 60th Coast Artillery Regiment (Antiaircraft) was equally busy. Beginning on 29 December, the Japanese bombed and shelled Corregidor from every direction. The regiment maintained six 3-inch gun batteries (24 guns) and four .50 caliber machinegun batteries (48 machine guns). Prior to Bataan’s fall, King managed to evacuate four additional 3-inch guns and five searchlights to Corregidor. At about 12:00 p.m. on 29 December, the Japanese attacked and over the next two hours sent eighty-one medium bombers and ten dive-bombers against the island, dropping more than

sixty tons of bombs. When the raid ended, Colonel Stephen Mellnik, a coast artilleryman and part of MacArthur's headquarters, reported there was a crater every twenty-five yards or so across the entire Rock. When the Japanese flew back, however, they did so with thirteen less bombers and four fewer dive-bombers due to the antiaircraft fire of the 60th Regiment.⁸³

For the next eight days, the Japanese continued intermittent bombing of Corregidor. As the battle for Bataan opened, air attacks tapered off and the Japanese made no determined attacks from early January until 23 March 1942. At one point that Spring, Captain William Massello led sixty volunteers in refurbishing a battery of M1890 12-inch mortars that had not been used in twenty years and attempted to turn the 670-pound anti-personnel rounds into antiaircraft rounds.⁸⁴ Colonel Paul Bunker, commander of the seaward defenses on Corregidor fancied that if they could ever get it to work, it would "jolt the Japs ... who know so well the limitations of our antiaircraft guns."⁸⁵ The limits of powder-train fuzing enabled most batteries to hit only aircraft flying below 24,000 feet. What they needed were mechanical fuzes, but there were only enough of them to outfit two batteries of 3-inch guns.

From 24 March to 6 April, the Japanese, now refitted with additional airplanes, resumed their attack. The bombers' first priority was to attack the forces still fighting on Bataan, but the Japanese continued to send aircraft to bomb Corregidor. On 24 March, fifty-four bombers attacked the island from 27,000 feet. When the Japanese tried to bomb at night, however, the searchlights startled them, causing most to drop their bombs in the water and fly away. On April Fool's Day, the Japanese launched their one-hundred-sixteenth bombing raid on Corregidor. The Regiment shot down two aircraft,

and the rest fled without completing their mission. While he marveled at the ability of the 60th Regiment to shoot with such antiquated equipment, General Wainwright also doubted he could hold Corregidor.⁸⁶

With the surrender of Bataan, the Japanese turned their full attention and fury upon Corregidor. Frustrated that General Wainwright would not surrender the Rock, the Japanese pummeled it with artillery and air bombardment. The bombardment destroyed several seacoast artillery batteries and 3-inch antiaircraft positions. The 60th Coast Artillery Regiment was quickly down to only fifteen of the original twenty-four 3-inch guns. On 1 May, the bombardment intensified. Enemy artillery harassed the antiaircraft crews during bombing raids. On 4 May, an estimated 16,000 shells hit Corregidor. At 9:00 p.m. on 5 May, a heavy artillery bombardment on the eastern tail of the island indicated the Japanese were preparing to assault the beaches there. When antiaircraft sound locators picked up the sound of barge motors leaving Bataan, the guns of Corregidor shelled the Cabcaben dock area. As the Japanese approached the tail of the island, searchlights illuminated them and 75-mm and 37-mm anti-tank guns, which had not been used yet, opened fire at 300 yards. Colonel Mellnik reported the slaughter of Japanese in their barges was “sickening” and daylight saw “hundreds of bodies [clad] in orange ... life jackets floated in the water, giving the sharks and barracudas a feast.” Of the 12,000 Japanese that attacked Corregidor in two waves that night, only 6,800 made it ashore.⁸⁷

By mid-morning on 6 May, the American defenders had the Japanese pinned down on the island. The men of Corregidor had committed the last of their reserves, however, and expected another attack that evening. Despite heavy losses, the Japanese

had landed three tanks the previous night and continued to shell the island. The situation was desperate. One soldier, Irving Strobinger, summed up the predicament: "General Wainwright is a right guy and we are willing to go on for him, but shells were dropping all night, faster than hell. Damage terrific. Too much for guys to take. Enemy heavy cross-shelling and bombing. They have got us all around and from [the] skies."⁸⁸ With casualties mounting, water down to three days supply, and enemy artillery pinning soldiers in their foxholes, General Wainwright decided to surrender. At 10:30 a.m. he broadcast a surrender message to the Japanese and directed Colonel Bunker to raise the surrender flag at noon. Precisely at noon, Bunker marched to the flagpole and lowered the American flag while the bugler played taps. Bunker saved a small piece of the colors, which he kept with him until he died in a POW camp in May 1943, and burned the rest. He then ran a white bed sheet up the flagpole signaling that the Rock had surrendered.⁸⁹

As a fortified installation Corregidor held out far longer than the Japanese expected. For that matter, the entire defense of the Philippines delayed and frustrated the Japanese strategic and operational timetable for five months. While linked together by the tremendous heroism exhibited by the men in both units, the 60th and the 200th Coast Artillery Regiments (Antiaircraft) represent different sides of the same courageous antiaircraft fraternity. Together, out of approximately 2,076 aircraft launched at Luzon and Corregidor, these two units shot down an estimated 173 Japanese aircraft with another twenty-one probably destroyed, and sixty-six more damaged.⁹⁰ The 60th Regiment, however, accounted for a larger portion of downed and damaged aircraft and did so using slightly less ammunition. On the one hand, this result may point to the difference in skill, training, and equipment between long standing Regular Army

antiaircraft regiments and new units such as the 200th Coast Artillery Regiment (Antiaircraft). On the other hand, it may also highlight the difference between the stability of static defense of Corregidor and the increased difficulty of engaging aircraft while simultaneously conducting maneuver operations such as the withdrawal into the Bataan Peninsula. In their first battle of the war, American antiaircraft forces performed admirably under extremely trying circumstances. With the United States now at war, American strategy and operations slowly transitioned from its initial focus on hemispheric defense and protection of outlying possessions to an offensive war of invasion and conquest. Static asset protection of locations such as the Panama Canal and Pearl Harbor became less of a priority. A war of offensive maneuver was afoot and operations in North Africa would determine if American antiaircraft forces were up to the challenge.

A War of Maneuver – Kasserine Pass

The best way to prepare antiaircraft artillery units for a war of maneuver was to assign them to divisions and have them train with the infantry, artillery, and armor units they might support in combat. Coast artillerymen had argued this position for years, and on the eve of America's entry into the war there was a significant move afoot to include an antiaircraft artillery battalion in the division structure. Impressed by the power of German tactical aviation, Alfred C. Wedemeyer, then a major in the War Plans Division of the General Staff and the author of the "Victory Plan" of 1941, pushed for the inclusion of .50-caliber machine guns and 37-mm antiaircraft guns in the division structure.⁹¹

Lieutenant General Lesley J. McNair, chief of the Army Ground Forces, however, vetoed the idea. Fixated by the need for the division to maintain tactical mobility and wedded to the twin concepts of streamlining and pooling of units, McNair hoped that by reducing the size of units and removing elements (personnel, weapons, or vehicles) not needed continuously, he could mobilize and ship more units to the front. To compensate for the lack of specialized units in the divisions, he created pools at the corps and army level in the belief that the mobility of these forces allowed them to concentrate rapidly where needed. This technique offered "economy, mobility, flexibility, and the capacity for massed employment." Unfortunately, it also forced maneuver commanders to depend on higher echelon commanders for support at times when such support might not be available. Additionally, units that were only temporarily associated with each other had difficulty in developing into smoothly functioning teams.⁹² As the Army prepared for Operation Torch in November 1942, General Green, now head of the Antiaircraft Command, recommended to McNair that the Army Ground Forces attach certain mobile antiaircraft automatic weapons battalions to divisions for training. Ironically, on 8 November, the same day that Allied forces landed in North Africa, McNair approved the recommendation and selected separate automatic weapons battalions began combined training at various locations in the United States, including the Desert Training Center in California and the Amphibious Training Center in Florida.⁹³

Although they planned for air attack, attaching platoons of automatic weapons to infantry battalions, American forces met little resistance when they landed in North Africa. As they moved inland, however, enemy air activity increased. American antiaircraft artillery units shot down a number of enemy aircraft. Unfortunately, in their

eagerness to engage the enemy, antiaircraft crews also shot at friendly planes. Training at home had been rushed and the organization in the theater did not fill the void. Opportunities for joint training with the Army Air Forces in the United States were minimal. Many soldiers had never seen an American aircraft, let alone mastered identifying German airplanes. Despite General Green's best efforts, the need to provide units for deployment overtook the Antiaircraft Command's ability to ensure they were trained properly.⁹⁴ In North Africa, as the area captured by Allied forces expanded, so did the need for more antiaircraft artillery. Attacks on air bases and convoys occurred more frequently, forcing the twin issues of command over antiaircraft units and their assignment to divisions to reemerge.

With Allied air bases continually at risk from attacks by the *Luftwaffe*, the commander of the Twelfth Air Force, Major General Jimmy Doolittle, argued for placing all air defense weapons, including antiaircraft artillery, under the command of the air defense wing for a particular area. Air attacks on the Twelfth Air Force's forward bases were so frequent that Colonel Hoyt Vandenberg, Doolittle's chief of staff, predicted that "enemy high altitude bombing, dive bombing, and ground strafing will ... render these essential airdromes unavailable."⁹⁵ Despite the protests, in January 1943 Allied Force Headquarters disapproved Doolittle's recommendation.⁹⁶ The issue, however, did not disappear for long.

In February, concerned with the training of antiaircraft units and the coordination of operations in theater, the G-3, War Department General Staff, supported by Lieutenant General Arnold, proposed the War Department transfer the Antiaircraft Command to the Army Air Forces. Their primary argument was that antiaircraft artillery and fighter

aircraft worked together in combat as a team and therefore should train together. McNair, drawing on lessons from the Battle of Britain, had long argued for fighter aircraft and antiaircraft artillery to be under the same command when working together in the same area. Nonetheless, McNair did not see how placing the Antiaircraft Command under the Army Air Forces would improve the training of antiaircraft units or the coordination of fighters and antiaircraft artillery.⁹⁷ When General Green suggested that the Army Air Forces designate certain airfields in the United States for combined antiaircraft and air force training, McNair saw a way out. He agreed to identify certain antiaircraft gun, automatic weapons, and searchlight units, along with higher headquarters personnel to train for one to two months on airfield protection.⁹⁸ When McNair recommended against the Army Air Forces proposal and the Operations Division of the War Department concurred, the War Department dropped the issue.⁹⁹

One reason ground officers could not agree to relinquish control of antiaircraft artillery units to air force commanders was their concern that air officers would assign too many antiaircraft assets to air base defense, leaving the maneuver forces without adequate protection. One solution to the problem was to assign antiaircraft forces to the division, thereby ensuring they remained under the control of ground officers. Concerned about the need to protect infantry and armored troops from air attack, several senior leaders including Under Secretary of War Robert Patterson; Lieutenant General Jacob L. Devers, chief of the Armored Force; and then Lieutenant General Dwight D. Eisenhower, commander of the Allied Expeditionary Force in North Africa petitioned McNair to make antiaircraft units organic to the division.¹⁰⁰ McNair countered that to defend everywhere was in essence to defend nowhere. He believed that the most dangerous enemy air

attacks would occur in massed formations and therefore required masses of antiaircraft artillery held in mobile pools to meet them. Additionally, burdening divisions with "defensive "anti" weapons (antiaircraft and tank destroyers) ran counter to McNair's desire to encourage aggressive tactics and psychology in the divisions and to avoid diversion of resources to the production of mere countermeasures."¹⁰¹

Devers highlighted the need for better combined training and teamwork by emphasizing the problems non-organic units had in working with divisional combat forces. He wrote to General Marshall complaining that "economy of force [was] not gained by having a lot of units in a reserve pool where they train individually, knowing little or nothing of the units they are going to fight with." Devers reasoned that if needed elsewhere, antiaircraft units could be withdrawn easily and transferred to where they were needed. He closed with the admonition that "team play comes only with practice."¹⁰² Practice, however, was not much in the offing prior to the execution of Operation Torch. Of the thirty-one antiaircraft regiments, battalion, or batteries deployed overseas before November 1942, only ten had any measure of combined training with infantry or armor units. The War Department sent three of those units to North Africa.¹⁰³ While Devers' efforts offered external support for the long held position within the antiaircraft community concerning the need for a dedicated unit to protect frontline forces from air attack, it was not enough to carry the day against officers, like McNair, who did not wish to alter the existing status quo.

In North Africa, Eisenhower was coming to the same conclusion. In one division area, 95% of all air attacks were against the divisional artillery. American howitzers outranged German artillery and had developed into effective tank killers. German Field

Marshal Erwin Rommel, commander of the *Army Group Africa*, understood this fact and issued standing orders to the *Luftwaffe* to attack any artillery pieces it found.¹⁰⁴ On 19 December 1942, Eisenhower wrote Marshall asking for more antiaircraft protection for his divisional units. McNair responded that each division did not need antiaircraft protection all the time, that the infantry could defend themselves, and that pooled antiaircraft units could be assigned missions in divisional areas, if necessary. Despite his reservations, Eisenhower deferred to McNair.¹⁰⁵

In February 1943, after returning from a trip to North Africa to examine problems in armored force units, Devers resumed his quest. This time, however, he advocated placing antiaircraft equipment not only in the division, but as far down as the battalion. This position echoed Eisenhower's long held belief that while German dive bombers created limited material damage to front line forces, the psychological effects were devastating, especially when followed by an enemy infantry or tank attack against raw troops.¹⁰⁶

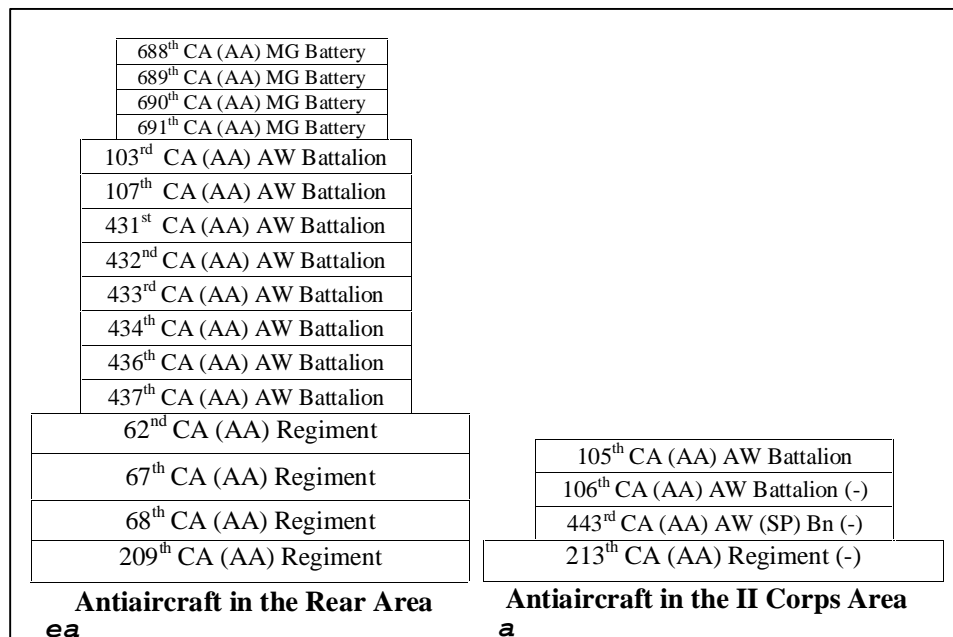
When Secretary of War Henry L. Stimson inquired about Devers' concerns, McNair replied that the question was really "whether these [limited] resources [were] to be dispersed in dribblets [or] organized in mobile masses which can be concentrated at the decisive point...." Indirectly commenting on Devers' lack of combat experience, McNair called Devers a "dispersionist" and held that the "artful concentration of forces at the vital point is the first essential of tactics...." Oddly, even McNair's own G-3, Brigadier General John M. Lentz, believed that antiaircraft weapons belonged in the division. Despite the many coherent arguments in favor of assigning antiaircraft units to divisions, McNair

resisted, repeating his belief in pooling and citing problems in fielding enough anti-aircraft equipment to meet current needs.¹⁰⁷

While McNair responded to the Secretary of War, the few anti-aircraft artillery units assigned to the II (US) Corps during the Battle of Kasserine Pass had to live with the consequences of his pooling concept. The performance of anti-aircraft units during the battle (19-22 February 1943) vindicated McNair's position -- as well as the proposals of Devers and Eisenhower, who supported the addition of anti-aircraft battalions to maneuver divisions. McNair received vindication in that anti-aircraft battalions were sent into the Kasserine area from the pool of available units in North Africa. Those wanting to see anti-aircraft battalions organic to divisions could counter that after providing coverage to key assets in the rear area, there were only a few anti-aircraft units left to cover forward combat units.

Luftwaffe air attacks on rear area airfields, ports, and logistics facilities reinforced the tendency of some commanders to mirror-image and reflect American strategic bombing doctrine on the enemy. As one After Action Report noted, "in general, our tactical doctrine ... has been developed to meet the form of air attack used by our own Air Corps and not that of the *Luftwaffe*."¹⁰⁸ Despite efforts by General Green and others to the contrary, this tendency colored much of the training of anti-aircraft units early in the war. One of the most egregious examples occurred at Camp Young, California. Despite being collocated at Camp Young with General George S. Patton's 2d Armored Division, anti-aircraft units never participated in combined arms training prior to fighting at Kasserine Pass.¹⁰⁹ In North Africa, the attention given to protection of the rear area--an attention at times seconded by ground commanders like Eisenhower--resulted in a severe

shortage of antiaircraft artillery units in the forward area. During the battle in February 1943, there were a total of four antiaircraft regiments, eight automatic weapons battalions, and four separate machine gun batteries in the rear area, but only one antiaircraft regiment and the equivalent of a reinforced automatic weapons battalion supporting the II (US) Corps at Kasserine Pass.¹¹⁰ This allotment actually exceeded by a small margin the doctrinal assignment of one antiaircraft regiment (one AW battalion and one gun battalion) to each corps. As General Gulick and others had predicted ten years earlier, however, this force was insufficient to cover all of the critical assets in the II (US) Corps area. Moreover, the antiaircraft forces sent forward suffered from an appalling lack of combined arms training, just as Devers had predicted.¹¹¹



Source: E. Paul Semmens, *The Hammer of Hell*, (Fort Bliss, TX: USAADS, 1990), 22.

Figure 9.2 Antiaircraft in North Africa (February 1943)

Intellectually, McNair may have understood the need to add antiaircraft artillery units to the division structure, but could not find a way to do so given his focus on mobility and the limited resources he had to work with in designing the Army Ground Forces. In an address to the graduating class of the Antiaircraft Artillery Officer Candidate School in October 1942, McNair commented that "about every combat unit insists on its own private antiaircraft unit" and acknowledged that "possibly that state of affairs will come to pass." He could not, however, disabuse himself of concern over maintaining the aggressiveness of the force, for he counseled not to become a technician, but "remain first and last a fighting man...."¹¹²

The antiaircraft soldiers that fought at Kasserine Pass remained "fighting men" to the last. The small force of automatic weapons batteries available in the II Corps forward area defended the Pass and II Corps artillery units against repeated ground and air attacks. In one engagement, on 20 February, the *Luftwaffe* attacked elements of the 27th Field Artillery, whose accurate fire had stopped part of the German attack in its tracks. The M15 antiaircraft half-tracks of the 443rd Coast Artillery (Antiaircraft) Battalion, armed with two .50 caliber machine guns and a 37-mm cannon, threw up a barrage of fire, downing two Stuka dive bombers and driving the rest away.¹¹³ Colonel Henry Dexter, the Operations Officer (G-3) for the II Corps in North Africa, would later write that in a sixty-day period the mobile antiaircraft artillery of the 443rd Battalion was efficient and flexible enough to support armored units. While attached to the 1st Armored Division from 18 February to 18 April, the battalion shot down sixty-eight planes, losing just one gun to air action.¹¹⁴

North Africa and the battles that followed were part of a war of maneuver that demanded mobile and agile antiaircraft weapons. The towed 40-mm Bofors, endorsed in the 1930s, did not have the mobility to keep up with the artillery or armored units. Likewise, the early 90-mm antiaircraft gun was not agile enough to move quickly or fire in the anti-tank mode. To their credit, the Antiaircraft Command and the Ordnance Department quickly enacted modifications to correct both of these problems. The campaign in North Africa and the battle at Kasserine also convinced even the most reluctant maneuver commanders of the value of antiaircraft artillery, garnering a large measure of “external support” for the notions developed during the Interwar period. In one instance, during an American counterattack as forces reorganized and moved forward, twelve *Luftwaffe* fighters and nine bombers attacked a thinly protected Combat Command, significantly delaying the counterattack force. An hour later another air attack inflicted more damage. The lone antiaircraft platoon assigned to protect the column was unable to defend the entire force. After Kasserine, thoughtful maneuver commanders would not move without adequate antiaircraft protection.¹¹⁵ By mid-1943, General George Patton was so sensitive to the threat of air attack that he recommended that each division have its own antiaircraft group and each corps a brigade of two groups.¹¹⁶ Others recommended up to sixty-four self-propelled antiaircraft automatic weapons protect each division.¹¹⁷

McNair was correct in believing that commanders should mass their antiaircraft units to meet the enemy. He was wrong in believing that they could move so quickly on the battlefield as to be everywhere all the time, and that commanders could shuttle units where necessary in time to protect friendly troops. The problem with “pooling” was that

the maneuverability and speed of aircraft was sufficient to overcome even the best intelligence and early warning. Hence, even with perfect knowledge of the enemy's intentions, the factors of time, distance, terrain, weather, the enemy's actions, and pure Clausewitzian "friction" would conspire to prevent the "pooling" of antiaircraft units from being an effective organizing principle around which to base the defense of key assets or soldiers in forward positions. Patton was convinced of the need for mobile antiaircraft artillery and by the time the Allies reached Sicily, American units, particularly field artillery battalions, would not move unless accompanied by mobile antiaircraft artillery weapons.¹¹⁸

For all of its success in defending against air attack, the antiaircraft force in North Africa experienced significant problems as well. Fratricide was particularly bad with soldiers occasionally so excited that they often fired on anything that flew. On one occasion, after driving the Stukas away from the 27th Field Artillery Battalion, the 443rd Coast Artillery Battalion engaged two flights of American aircraft, damaging seven of them, five of which were beyond repair. To prevent continued fratricide, Brigadier General Paul Robinett of the 1st Armored Division ordered the antiaircraft artillery units attached to his combat command to fire only after being fired upon—hardly a way to surprise the enemy, but a necessary action.¹¹⁹

Later in September, the issue of fratricide arose again after an antiaircraft unit shot down friendly aircraft over Sicily. This time the War Department appointed a board to investigate the incident and offer recommendations. The board submitted a number of findings, including that air commanders charged with defense of fixed facilities also command supporting antiaircraft units, something that McNair and others had urged since

1941. The board further recommended that air commanders control the allocation of antiaircraft artillery units, a finding that the Army Ground Forces could not agree with as it threatened to denude antiaircraft protection for ground units. Finally, the board found that combined training had been inadequate, a fact well known by that time and something that General Green and the Antiaircraft Command were already addressing. To correct these problems, the board recommended transferring the antiaircraft training to the Army Air Forces.¹²⁰

The War Department disregarded the board's recommendations, recognizing that the Army Ground Forces and the Antiaircraft Command were even then adjusting training regimens to correct the problems. As equipment and training time in the United States became more abundant, many of the problems created by the rush to train, equip, and deploy units corrected themselves. To ensure communication and coordination with theater commanders, Green recommended that the Antiaircraft Command send officers into combat theaters to supervise training and disseminate information. McNair vetoed this plan. To achieve his objective despite McNair's disapproval, Green arranged for an exchange of general officers between the Antiaircraft Command and the combat theaters. With this arrangement came the distribution of Antiaircraft Intelligence Circulars and Information Bulletins from the Antiaircraft Command to the theaters. In November 1943, the War Department approved Green's recommendation that each theater staff include an Antiaircraft Officer to function as a staff adviser.¹²¹

In the field, troops adopted several techniques to improve early warning and avoid fratricide. None of them were foolproof. SCR-268 radar proved very effective, but mostly in the rear areas. To avoid shooting friendly aircraft during raids on Allied air

bases, antiaircraft artillery commanders urged pilots to clear the perimeter area and allow antiaircraft units to fire. Often overzealous pilots would not comply and antiaircraft gunners frequently had to “withhold fire on [enemy] planes ... because of the presence of our own fighters.”¹²² In the forward areas where antiaircraft units were on the move, radar was seldom used or suffered degraded range due to the mountainous terrain. One battalion created its own Antiaircraft Artillery Information System using four vehicles with radios and positioning them with three-man crews 20-25 miles in front of the defended position along the most probable air avenues of approach. The system worked extremely well, reduced fratricide, and kept both the antiaircraft battalion and the unit it supported alert to enemy air attacks.¹²³

Many units invented localized solutions to guard against fratricide, including having friendly aircraft rock their wings upon returning to Allied lines, painting aircraft noses different colors, and dropping smoke. Some commands adopted aircraft flashcards. While these measures reduced, but did not eliminate fratricide, they remained local and were never standardized across the antiaircraft force.¹²⁴ The only anti-fratricide standard institutionalized by the Army was the one imposed by General Paul Robinette. In its October 1943 *Lessons from the Tunisian Campaign*, the War Department maintained that “positive identification of aircraft is essential before fire is opened. The best identification under such circumstances is attack by the aircraft.”¹²⁵

Platoon leaders and battery commanders did not always employ antiaircraft weapons properly. Doctrine recommended that leaders position self-propelled antiaircraft automatic weapons throughout convoys to protect against air attack. Indeed, Antiaircraft Command Intelligence Circulars indicated that German pilots would avoid

strafing columns that were “resolutely defended by the fire of .50-caliber machine guns.”¹²⁶ As a regimental combat team from the 1st Armored Division approached Maknassy in southern Tunisia toward the end of March, its antiaircraft battery took up positions at the rear of the column. Several JU-87 Stuka dive-bombers attacked the head of the column, stopping the advance, and causing over 400 casualties.¹²⁷

The most glaring deficiency demonstrated by all units in North Africa, including antiaircraft units, involved discipline. Rommel’s battle-hardened divisions employed combined artillery, armor, and infantry fires with devastating effectiveness. Then, with German Me-109 fighters providing cover, Stukas frequently attacked unprotected and shaken American units, causing some to retreat and many others to break and run. The limited success of antiaircraft units at Kasserine Pass had more to do with inspired junior officer leadership than any amount of individual discipline or toughness on the part of the average soldier. Combat was a fearful experience. As Patton and others understood, soldiers needed discipline to counteract the fear that accompanies combat. Antiaircraft artillerymen were no different, no better or worse, than any other soldier in North Africa. Commanders were urged to keep soldiers busy, to ensure they dug in their weapons and individual positions immediately upon stopping, to post air guards, to camouflage their guns properly when time was available, and to maintain local security even if positioned far behind friendly lines.¹²⁸ General Green, upon receiving word that 40-mm and 90-mm crews were performing “far below the standard that is absolutely necessary if our gun crews ... are to function as efficient combat teams,” dressed down Antiaircraft Training Center commanders and challenged each officer to take personal responsibility for training new officers and non-commissioned officers.¹²⁹ He also instituted a battle-

conditioning program to expose antiaircraft crews, as much as possible, to the friction of combat before actually entering a combat environment. This program included more rigorous and extensive field training exercises, obstacle courses, forced marches of 25 miles or longer with full field equipment, and the use of live ammunition and explosives to acclimate soldiers to the sounds and sensations of battle.¹³⁰

Although bloodied in North Africa, the Army survived its first battle at Kasserine Pass and went on to make adjustments that allowed it to begin the encirclement of Axis forces in Europe and the Mediterranean. Despite initial difficulties, the antiaircraft artillery establishment contributed mightily to the Army's success. In their thirteen months in North Africa, antiaircraft artillerymen shot down 526 enemy aircraft and damaged countless more.¹³¹ Still, many difficulties lie ahead. Antiaircraft units had made the transition from defending well-prepared static assets to the more difficult task protecting the maneuver force, albeit imperfectly. They had suffered through what Brigadier General Jack Parham, a British First Army artillery officer, called the first phase of combat rich with the "worst difficulties on a purely army level—a shortage of troops and ammunition and hard defensive fighting...." The second phase, according to Parham, began "when the Air Forces have almost completely driven the enemy from the sky." Between the two phases, he maintained, "lies a dangerous and trying period when the Air Forces consider they have eliminated the enemy air and the troops in the forward areas deny this hotly!" The challenge to antiaircraft artillerymen was to use their weapons in the first and intermediate phases to knock down as many aircraft as possible, to protect Air Force airfields, and to employ their antiaircraft weapons in new and novel ways during the second phase when the enemy is "down and out." The most important

thing, Parham recommended, was to “get the antiaircraft into the forward area ... [and] treat it as *normal* artillery...” For “no weapon ... has such wide publicity value as has the antiaircraft shell. Its burst is seen by thousands, all of whom praise and criticize it with an interest as truly personal as the interest taken in the efforts of the Company Cook.”¹³²

As the American Army advanced north into Sicily and Italy, fought island-hopping campaigns in the Pacific, and prepared to cross the English Channel into Normandy, Axis pilots would continue to test the tactical skill, the technical ability, and ultimately the pure tenacity of the antiaircraft artillerymen. Throughout this period, as the Army fought in the mountains of Italy, the jungles of Asia, and the forests of Western Europe, the variety of challenges faced by the antiaircraft artillery were so great and the outcome of such importance that even mess sergeants stopped to watch.

CHAPTER 10

ADAPTING UNDER FIRE: ANTIAIRCRAFT ARTILLERY FIGHTS ITS WAY ON TO THE TEAM

One of the reasons that we got along so well with [our division] was that, early on, we shot down an airplane for them. He flew right across ... was hit, burst into flames.... Very spectacular. This is the only way that you acquire your credentials with the rest of the Army. Not by telling them how good you are; not by showing them your target practice or IG inspection reports. The way to do it is to shoot down airplanes for them. There is no other way.

*Brigadier General (Ret.) Jack Rogers¹
Recalling his battalion's first kill
11 July 1944, Normandy*

Adapting to changing circumstances has always been the most difficult part of military operations. Although many of its soldiers and equipment did not survive the first battles of World War II, the United States Army, as an institution, made the transition from peace to war and lived to fight another day. Together with the Navy, Marine Corps and Army Air Forces, the Army Ground Forces recovered from their opening round losses, studied the lessons of those early defeats, and adapted to the challenges posed by combined arms warfare on a global scale.

The Antiaircraft Command and the hundreds of antiaircraft battalions training in the United States or fighting overseas joined in the great transition from peace to war.

The early antiaircraft engagements of the war were difficult encounters. Frequently, untrained or ill-equipped units faced determined German and Japanese pilots who flew higher and faster than expected and were harder to shoot down. Antiaircraft batteries, battalions, and regiments initially fought static battles, firing from concrete fortifications, jungle foxholes, and desert revetments. As the antiaircraft force changed from peace to war, it also shifted from defending static assets to protecting mobile forces engaged in a war of maneuver. Occasionally during their opening battles, antiaircraft artillerymen enjoyed a victory over enemy bombers and fighters. Just as often, however, they also downed friendly airplanes.

Before the war was over, the antiaircraft artillery force would face several new challenges, many of them more daunting than those experienced during the opening days of the conflict. It left the “terra firma of the last war” with a vision of the future and maneuvered through the bureaucratic battlefields of the Interwar period to emerge in December 1941 as an accepted, albeit under appreciated, member of the combined arms team. After reviewing its performance during the opening engagements of a new war, the antiaircraft establishment had to adjust its training, equipment, and tactics to counter German and Japanese efforts to control the sky.

The challenge facing the antiaircraft artillery was not unlike that confronting one of its junior officers, Captain William Massello, commander of “Erie” Battery (Searchlight), 2nd Battalion, 60th Coast Artillery (Antiaircraft) Regiment, during the fall of the Philippines. One of the few 60th Coast Artillery units on Bataan, on the night of 8 April 1942, Massello and the men of “Erie” battery received orders to abandon their searchlights and return to Corregidor. After waiting all night in vain for Captain Jack

Gulick, son of the former Chief of the Coast Artillery, Massello boarded a barge just before dawn. As the barge moved out, Massello knew he was leaving Bataan, headed for Corregidor. The Rock, however, was not entirely visible in the early morning fog. The farther he sailed from Bataan, the more he questioned where he was going and what he would do once he reached Corregidor.

Massello left Bataan understanding the battle he had just fought, but was unsure of what the future held. As the tugboat pulling the barge edged across the water, it made several course adjustments before finally reaching Corregidor. Massello fully expected a Japanese pilot to attack their helpless vessel, but none appeared until after it had already docked and been unloaded. Once ashore, Massello and his men had to adapt to another new situation. Soldiers were already manning the available searchlights. With all the other available antiaircraft equipment also occupied, Massello scouted the island until he found some antiquated 12-inch mortars, unmanned and unused for over twenty years. Having some previous experience with mortars, Massello convinced his commander to let him take charge of them. Later, as the Japanese systematically attacked the island and destroyed the mortars, Massello fired the last shot despite being severely wounded. Following the surrender of Corregidor, Massello and his men adapted once more, this time to the rigors of three and a half years in a Japanese prison camp. Like the antiaircraft artillery establishment in World War II, Massello and his men proved agile and flexible enough to adjust to changing situations and defeat the numerous challenges that confronted them.²

The war of maneuver required antiaircraft forces to operate in new and different ways. Antiaircraft units improved coordination with the Allied air forces, enhancing

effectiveness and reducing fratricide. They learned how to transition from ship to shore in amphibious operations while providing antiaircraft protection. They became skilled at shooting at not only at aircraft, but also at tanks and infantry, and served as artillery. Antiaircraft forces also adapted in the face of unexpected threats from Japanese *kamikaze* aircraft and Hitler's vengeance weapons, the V-1 and V-2. To meet these challenges, the Antiaircraft Command and its organizations in the field would have to change institutionally, adapt strategically and operationally, and innovate tactically. Like Massello, the Antiaircraft Artillery would emerge from the war, battered and bruised, but with its structure complete and its reputation enhanced. Both would find a meaningful role in the post-World War II Army.

Institutional Change

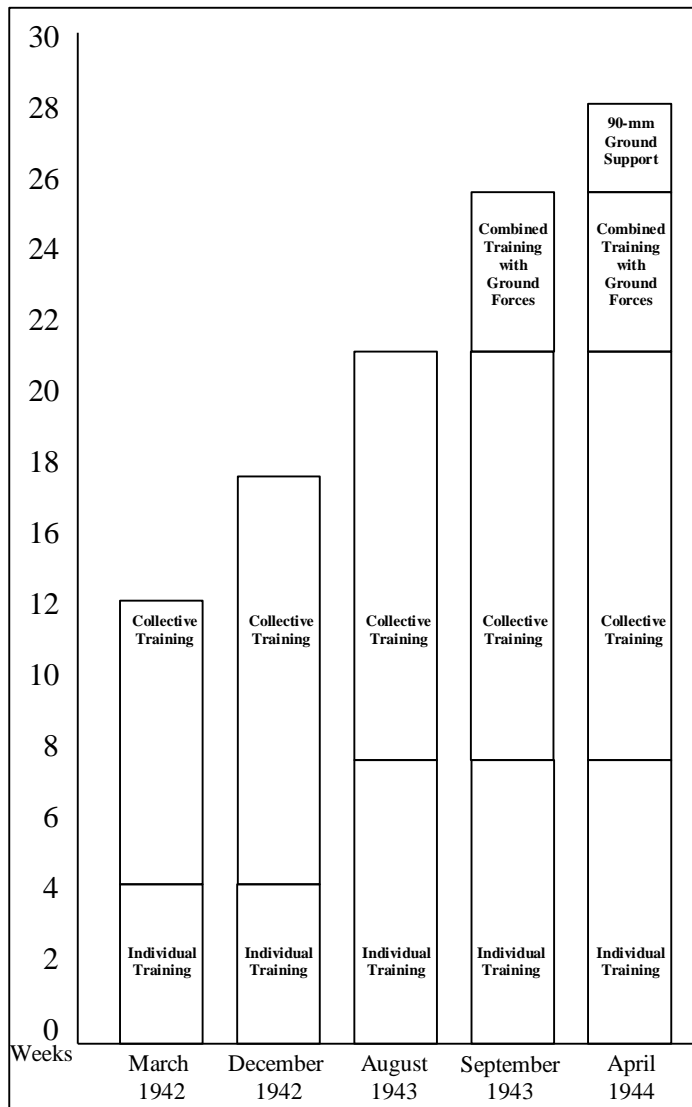
The lessons of Pearl Harbor, the Philippines, and Kasserine Pass all pointed to the damning conclusion that antiaircraft units were not trained, organized, or equipped adequately for overseas service. Moreover, there was an appalling lack of coordination between airmen and antiaircraft artillery operators. While several legitimate reasons existed to explain this condition, most notably that the rush to deploy antiaircraft forces overseas overwhelmed the Army's ability to train units and manufacture equipment, they did not make the problem any less vexing or correcting it any less important. Lieutenant General Lesley J. McNair, chief of the Army Ground Forces, noted in October 1943 that, "The Chief of Staff [General George Marshall] lacks confidence, to put it mildly, in the antiaircraft training that we are giving."³ In fact, the Army's Inspector General, whose office evaluated selected units prior to deployment, rejected nearly 25% of the antiaircraft

units scheduled for overseas assignment. While he believed that Marshall had the wrong impression of antiaircraft training, McNair also recognized the need for change.⁴

Since mid-1942, the Antiaircraft Command had used checklists to monitor the progress of individual and collective training. In response to criticism from the Army Ground Forces staff, the Antiaircraft Command revised the checklists, making them more detailed and exacting. In January 1944, the Army Ground Forces published the checklists giving them added institutional authority. In response to the faults noted by the Inspector General, the Antiaircraft Command also revised the readiness tests use by Antiaircraft Training Center commanders to evaluate their units.⁵

Checklists and deployment tests only evaluated a unit's readiness to deploy. What antiaircraft artillery units really needed was better training and longer training periods before deployment. Responding to criticism received from observers in North Africa, on 15 June 1943, Major General Joseph Green, commander of the Antiaircraft Command, requested an extension of the antiaircraft training period from eighteen to twenty-two weeks. McNair approved the request and directed training to begin after eighty percent of fillers had arrived. He also directed Green revise the training program along the lines use by the Field Artillery. Green aggressively implemented these directives and forwarded five completely revised master training programs back to the Army Ground Forces in less than thirty days. These programs divided the twenty-two week schedule into eight weeks for individual training and fourteen weeks for collective training. The programs further directed the number of weeks and hours for each subject and provided detailed unit training for the antiaircraft brigade and group headquarters and the gun, automatic weapons, searchlight, and balloon battalions. Renown for his curt

demeanor, McNair was effusive in his praise for the training programs. Writing to Green in July 1943, he complimented the Antiaircraft Command on “the excellency of this work and the expeditiousness with which it was accomplished” and expected that its “proper use will improve the quality and guarantee the uniformity of the training of antiaircraft artillery units.”⁶ With McNair’s complete approval, the Antiaircraft Command extended training to twenty-two weeks on 1 August 1943.⁷



Source: Alvin M. Cibula, *The Antiaircraft Command and Center*, (Army Ground Forces Study no. 26), (Washington, DC: Army Ground Forces Historical Section, 1946), 24.

Figure 10.1 - Antiaircraft Training Cycles

In late September and again in November, General Green changed the training regimen in response to reports from the combat theaters. He directed stricter attention to target practice technique and longer and tougher field training to better “accustom individuals and units to continuous living under field conditions.”⁸ Specifically, he called

for each unit to spend at least two continuous weeks in the field living with only the equipment authorized to the unit. In late summer 1943, as antiaircraft units became more plentiful, more time existed to allow them to train with other Army Ground Force units. In September, the War Department authorized a four-week period of combined training that took place at various sites around the country. This action dramatically reversed the earlier trend. Prior to September 1943, barely 20 percent (29 of 136) of the antiaircraft units (Brigades, Groups, Battalions, and separate Batteries) deploying overseas had participated in combined training. From September to April 1945, an overwhelming 70 percent (199 of 281) of the overseas bound antiaircraft force trained with infantry, armor, and artillery units. Certain periods saw nearly every deploying unit involved in combined training. From January through June 1944, 87 percent (70 of 80) of the antiaircraft units preparing to deploy worldwide participated in combined arms training. During that period, as the Army marshaled forces in England for Operation Overlord, 90 percent (55 of 61) of the antiaircraft units deploying to Europe spent at least one month training with other combat units before shipping out.⁹

The landings at Anzio in January 1944, and the five months of intense warfare on the beachhead that followed, saw the first major use of 90-mm antiaircraft guns in the ground support role. The performance of the 1st Battalion, 68th Coast Artillery (Antiaircraft) Regiment during that battle epitomized the value of antiaircraft weapons operating in support of ground forces. In his commendation of the unit, Lieutenant General Mark W. Clark, the Fifth Army commander, wrote that the battalion engaged 223 separate flights of enemy aircraft, destroying forty-six, and probably destroying another twenty-three. Equally important, he noted, the unit “fired thousands of rounds of

[90-mm] ammunition in terrestrial support of ground troops, on two occasions aiding materially in stopping German tanks, infantry, and air assaults.” On many occasions, the battalion was so involved in its ground support that it only interrupted terrestrial operations to fire on attacking aircraft. In two engagements, the battalion also captured 183 prisoners.¹⁰

Almost immediately upon receiving word of the 90-mm gun’s value in the ground operations, the Antiaircraft Command began testing the 90-mm gun and refining techniques for ground support. In April, the Army Ground Forces institutionalized the concept and directed the training of all antiaircraft units in the secondary role of ground support, including up to four weeks of training under the direction of corps and army commanders. To prepare 90-mm units adequately, General Green extended the training period another two weeks for a total of twenty-eight weeks.¹¹

Another change that influenced antiaircraft training involved the use of brigade and group headquarters to assist smaller units, usually battalions and batteries, during the training cycle. Not only did the lower echelon units benefit from operating under the supervision of higher level combat headquarters, but the brigade and group headquarters received much needed experience in the supervision of various types of antiaircraft units, many of whom might later fall under their tactical command. Antiaircraft Training Center commanders also gained from this relationship, as they no longer had to supervise the training of every battalion on their installations.¹²

Concerned with ensuring the Antiaircraft Command stayed abreast of the latest combat tactics and techniques, Green directed his staff in early 1942 to collect and analyze pertinent antiaircraft intelligence from units in the field. The Antiaircraft

Command published these reports in Antiaircraft Intelligence Circulars and furnished them to Antiaircraft Training Centers. The first circular, published in April 1942, consisted of two pages on the Japanese air attacks on Corregidor. The Command published twenty-eight circulars in all before issuing its last fifty-page circular in July 1944. After consultation with field commanders and the Army Ground Forces, the Command changed formats in August 1944 and published the Army Ground Forces Antiaircraft Information Bulletin containing combat lessons, notes on new equipment, training information, and visual aids every three to four weeks until the end of the war.¹³ While the changes in methods of collection and dissemination of information varied during the war, the efforts of the Antiaircraft Command and the Army Ground Forces to stay informed and assist commanders in the field added immeasurably to the flexibility and adaptability of the Army and the antiaircraft force.

One measure designed to increase tactical flexibility was the creation of antiaircraft artillery groups and brigades. The measure occurred as part of General McNair's drive for economy in organization and equipment. In mid-1942, the Army Ground Forces proposed eliminating all organic army and corps troops. Field armies and corps would retain only those elements necessary to exercise command—headquarters staffs and signal units. Interchangeable units—chiefly divisions and separate battalions—made up the rest of an army or corps based on the tactical situation. While the War Department objected to the overall plan, in December 1942 it did grant McNair authority to convert all nondivisional regiments of antiaircraft artillery, field artillery, mechanized cavalry, and combat engineers into separate battalions and to activate group headquarters to control these elements.¹⁴

The group differed from the regiment in that its component battalions were self-sufficient. The battalions conducted their own administration and obtained supplies directly from army depots. Moreover, they were not assigned to any specific group, but attached and detached as circumstances dictated. Normally, a group would control up to four separate battalions, although it might not contain any battalions or as many as six at any one time. Group headquarters were to avoid administration, supervise battalion training, and focus on the tactical control of battalions in combat.¹⁵

To control several groups, the Army Ground Forces activated brigades. Like the group, the new brigade organization consisted of a headquarters element controlling several subordinate groups as required. Although the Army designed these brigades to provide flexibility to any arm or service, they became common only in the antiaircraft artillery.¹⁶ The brigades, groups, and separate battalions underscored McNair's pooling philosophy. He had intended to provide commanders with a flexible architecture under which to attach and detach units as necessary to meet the needs of the tactical situation. Unfortunately, ideas that appeared to make sense in the boardroom did not always meet the needs of commanders on the battlefield. Such was the case with antiaircraft groups and brigades.

A post-war study of antiaircraft artillery organizations found that while the old regimental structure was not flexible enough to support the dynamic reorganization of antiaircraft defenses during combat operations, the "loose-knit group-battalion relation" was too fluid and did not afford group commanders the authority to command the separate battalions attached to their groups. "Although the battalion commander had complete command jurisdiction over his battalion, the authority of the group commander

over his attached battalions was not clearly defined.” As a result, “command, training, discipline, and morale suffered.”¹⁷ As Brigadier General Nathaniel A. Burnell, II, commander of the 52nd Antiaircraft Artillery Brigade, related the issue,

... the old regimental organization was quite advantageous to peace time training because it provided for continuity of command supervision. On the other hand, it was entirely too inflexible to meet the varying tactical situations of combat. The adoption of the new AAA group, divorced of administrative functions and with no permanent hold on any battalions, has swung the pendulum to the other extreme. Now there is complete flexibility, but no permanence.¹⁸

As a result of frequent changes in attachments, group commanders struggled with learning the capabilities and limitations of their new commanders and staffs. Group commanders rarely had enough time to “impress [their] leadership on a battalion” and battalion commanders never stayed under a group commander “long enough to find out the way he wanted things done.” Given this arrangement, battalion commanders frequently paid “little attention to the current group commander ... on the theory that next week there will be a new commander and a new way of doing things.”¹⁹

The War Department recognized this problem and published a circular in November 1944 which encouraged the continuity of command by retention of assignment of battalions to groups.” In practice, however, the desired continuity never occurred. The United States Forces in Europe never assigned battalions to groups and the misuse of “flexibility was universal in all armies and commands.” From 6 June 1944 until the end of the war in Europe on 8 May 1945, six antiaircraft groups had a total of 295 battalions attached to them for an average of twenty-one days each. The length of attachment varied from one day to several months with many battalions being attached and detached within a few weeks time.²⁰ In his post-war comments on the system, Colonel P. L.

Lewis, commander of the 31st Antiaircraft Brigade, invoked Napoleon's rationale for losing at Waterloo as the reason to reduce the reckless flexibility of the "group-battalion relation." Arguing that his 'men had not eaten soup long enough together,' Lewis maintained, "The basic fundamental of a military organization is that it is a homogenous entity. It takes time to build this. It means that the organization works together, trains together, plays together, and lives together." In his opinion, the many disadvantages in the exercise of command far outweighed "the slight tactical advantage of the loose group organization." A die-hard Bonapartist, Lewis closed by reminding everyone that "the moral is to the physical as two is to one."²¹

The Antiaircraft Section of the General Board concurred with Lewis, but believed the "regiment" as an entity held certain historical and moral value. In their report, the Antiaircraft Section combined the best of both structures, recommending that the new organization retain the flexibility of the World War II "groups," but call them "regiments." Moreover, the report recommended that the War Department assign battalions to these regiments and give the regimental commanders clearly defined command and administrative authority. Finally, to retain the desired degree of flexibility, the report suggested "battalions be able to operate independently for extended periods by drawing the necessary administrative and service personnel from the regiment."²² The wild swings of Burnell's pendulum had finally begun to settle down. It took a war for the Army to realize that General Jacob Devers was right--"team play comes only with practice."

One area where the Army quickly realized it needed more "teamwork" was in the integration of its antiaircraft and air forces. The confusion and fratricide experienced in

North Africa and Sicily was the product of poor coordination and untrained forces. The situation had to improve for both antiaircraft artillery and air forces to maximize their effectiveness. To a limited extent, efforts to improve coordination had been ongoing in the United States even as forces committed fratricide overseas. Following an earlier agreement with the Army Air Forces, the Antiaircraft Command, in August 1942, sent two searchlight battalions to Orlando to train with day-fighters in searchlight-pursuit plane operations at the Fighter Command School (in November 1942 it was renamed the Army Air Forces School of Applied Tactics). The Army Air Forces established the school to “train students of the AAF, Signal Corps, and the Coast Artillery Corps in the necessary teamwork required [for] the successful operation of air defense measures.”²³ The Antiaircraft Command and the Commandant of the Fighter Command School agreed to send key searchlight personnel to the three-week fighter-searchlight course and to send staff officers of newly activated antiaircraft units to a special one-week course on the organization of the air defense command, aircraft warning service, and fighter command. In September, the Antiaircraft Command transferred a composite antiaircraft battery consisting of one 90-mm gun, one automatic weapon, and one barrage balloon to the school for demonstration purposes. The next month it established an antiaircraft group to command the composite battery and the two searchlight battalions. In December, the school added antiaircraft staff officers to their instructor pool. With the June 1944 decision not to activate anymore searchlight battalions, the fighter-searchlight classes came to an end. The special staff officer course continued until March 1945.²⁴

The benefits of this training paid off in combat. In early 1943, an antiaircraft artillery officer with the United States Army Forces in the South Pacific Area

(USAFISPA) reported that fighter-searchlight operations were “working very effectively” and gave “all elements of the air defense system a crack at the target.” At Guadalcanal, searchlights from the Marine defense battalions and the 214th Coast Artillery Regiment combined with P-38’s of the XIII Fighter Command to attack Japanese aircraft at night. The P-38 aircraft orbited the airfield at an altitude well above the approaching enemy. Searchlights illuminated the “bogie” and antiaircraft gunners fired until it approached the edge of the defended area. As the guns ceased firing, the searchlights continued to carry the enemy plane as the P-38’s dove in for the kill. Despite occasionally firing too long, the P-38 pilots stated they had “no difficulty from antiaircraft fire.”²⁵ To ensure complete coordination between fighters and antiaircraft crews, the Fighter Control Room and the Antiaircraft Operations Room were in adjoining dugouts.²⁶

The Allies tested fighter-searchlight interception in North Africa, but due to limited shipping space the large number of searchlights necessary to make the tactic work were never available.²⁷ In April 1944, with the shipping situation improving, the most extensive fighter-searchlight belt installed in the Mediterranean area became operational at Foggia, Italy. The belt was 31 miles long, 28 miles wide, and covered thirteen airfields. It required 130 searchlights and 78 SCR-268 radars to direct the lights. While this belt worked well in mountainous terrain that otherwise limited radar, it required a vast amount of equipment. Moreover, the radar’s limited range (25 miles) and vulnerability to radar countermeasures such as “Window” made the effort too great for the payoff.²⁸ With improved night fighting aircraft and a decreased threat from the *Luftwaffe*, radar-equipped night fighters became the primary method for intercepting German night attacks.²⁹

Another effort to improve coordination between antiaircraft artillery and air forces began before the units left North Africa. In February 1943, during the battle of Kasserine Pass, Allied Force Headquarters reorganized the theater Antiaircraft and Coastal Defense Section (AA&CD) and expanded its responsibilities to encompass all antiaircraft defenses outside the battle area of the British and American armies. With this expansion of responsibilities, operational supervision of antiaircraft activities transferred from Colonel Aaron Bradshaw, an American antiaircraft officer, to British Major General R. B. Pargiter, also a ground officer, who in March became Eisenhower's chief adviser on Allied antiaircraft matters.³⁰

As the Allies occupied all of North Africa, Sicily, and southern Italy, the area under Pargiter's control continued to grow, forcing him to delegate the tactical supervision of units to ground officers and the control of antiaircraft fires to air officers. This arrangement, which paralleled that situation in the Defense Commands established in America in March 1941, permitted air officers to exercise operational control of antiaircraft fires (dictating when antiaircraft units could fire and what they could fire at), while leaving ground officers in command of antiaircraft units and responsible for their tactical proficiency. With both the ground and air chains of command partially responsible for the performance of antiaircraft units, a unified air defense command did not exist. Besides causing redundant staff work, this divided responsibility led to competition between air and ground commanders for the allotment of air defense weapons. Finally, this organizational structure violated both American and British doctrine, which placed responsibility for air defense in a theater with an air force officer.³¹

In November 1943, the Mediterranean Coastal Air Force proposed redesignating the AA&CD Section as the Mediterranean Antiaircraft Artillery Command and assigning it to the Coastal Air Force. In April 1944, Major General Ira Eaker, the theater air commander-in- chief, concurred and the changes took effect. Eaker was responsible for all Allied air defense matters and delegated the control and allocation of all antiaircraft resources, except those in the forward areas, to the Air Officer Commanding (AOC) the Mediterranean Allied Coastal Air Force (MACAF). The AA&CD Section became the Mediterranean Antiaircraft Advisory Committee charged with the responsibility to advise the Supreme Allied Commander (Eisenhower) and the Air Commander in Chief (Eaker) on antiaircraft policy and allocation of resources. General Pargiter retained responsibility for operational efficiency, supervision, and technical training. Allied Force Headquarters commanded and the AOC, MACAF controlled the allocation and operations of all American and British antiaircraft forces not operating with the armies or task forces. This new arrangement placed 58,000 antiaircraft personnel, or 59 percent of the total antiaircraft strength, under the control of MACAF. Eaker regarded this reorganization as far from ideal, but considered it a long step in the right direction.³²

The command structure notwithstanding, success in combat and a reduction in fratricide depended less on who was in command and more on better procedures for the uniform coordination of antiaircraft fires. In May 1943, Allied Force Headquarters attempted to address this problem by issuing instructions that listed four types of defended areas in which it restricted the operation of friendly aircraft so that antiaircraft artillery might fire freely. These instructions later became Air Defense Instruction 1, considered by many antiaircraft officers as the “bible” of antiaircraft fire control. One

antiaircraft officer, Lieutenant Colonel Lionel B. DeVille, a Cajun member of the West Point Class of 1939 and the executive officer of the 3rd Air Defense Wing in North Africa, called it the “finest [air defense] document ever written.”³³ Of the four areas, the best known and the most used was the Inner Artillery Zone (IAZ) over which friendly aircraft were prohibited. Antiaircraft crews were free to engage any aircraft in the zone not clearly identified as friendly.³⁴ Except when aircraft were flying through an Inner Artillery Zone, antiaircraft crews were to consider any aircraft as friendly unless it committed a hostile act. Other methods for determining friendly aircraft included visual recognition (which improved as antiaircraft artillerymen gained experience in the field), correlation with a friendly air route, display of proper recognition signals such as flying with its landing gear down, and broadcasting (squawking) the proper Identification Friend or Foe (IFF) signal. Conversely, soldiers could declare planes hostile if they attacked surface targets or friendly aircraft, dropped flares at night, dived on troops or ships, or flew directly toward ships at sea without first establishing their identity.³⁵

No set of rules, however, was foolproof and the *Luftwaffe* often endeavored to exploit Allied anti-fratricide measures to its own benefit. On several occasions, *Luftwaffe* pilots approached Allied airfields with their landing gear down, usually at dusk, with their landing lights blinking. This tactic, derisively labeled a “sucker play” by antiaircraft crews, sought to take advantage of the limited visibility and trick crews into ignoring the aircraft until it was too late. When lucky enough to achieve such surprise, German pilots fired cannon and machineguns at aircraft parked on the field or on the runway. They also dropped demolition, fragmentation, and incendiary bombs as well as booby traps in the form of cigarette cases and butterfly (antipersonnel) bombs. In one attack against the

airfield at Maison Blanche, Algiers, pilots dropped incendiary bombs, delayed action bombs, booby traps, and small metal pyramids about two inches on a side with very sharp points. Referred to as “crowsfeet,” these pyramids were designed to blow out aircraft and vehicle tires. German pilots also circled airfields pretending to dogfight with each other and then dove to attack friendly forces. When their timing was right, they often tried to attack friendly aircraft as they were landing at an airfield. This type of attack sought to take advantage of known restrictions in antiaircraft fire while friendly aircraft were in the air or in the process of landing. Reports indicate that the Germans even used captured Allied aircraft to attack friendly forces.³⁶

As Allied air forces in North Africa (and later throughout the Mediterranean Theater of Operations) gained air superiority, the *Luftwaffe* increasingly attacked at night. Reports from Naples in November 1943 showed repeated attacks at night by twenty to thirty JU-88s frequently dropping up to sixty red, green, and white flares in an apparent effort to designate primary and secondary targets.³⁷ Some of the night attacks were mere nuisance raids on suspected bivouac areas, troop concentrations, and headquarters locations. During these attacks, German pilots dropped flares, fragmentation bombs, and antipersonnel darts about the size of an ordinary lead pencil. The *Luftwaffe* also used flares during nighttime reconnaissance missions, with one plane dropping flares and another photographing the illuminated area. In the morning an observation plane would check on the presence or absence of targets in the area. If targets remained, attacks usually began about fifteen minutes later.³⁸ As the electronic battle became more sophisticated, the *Luftwaffe* also employed radar countermeasures, including “Window”

or chaff, with increasing effect against SCR-268 radars. In fact, by early 1944, the use of “Window” became grounds for declaring an aircraft as hostile.³⁹

As the North African and Mediterranean campaigns matured, air commanders increasingly apportioned fighter aircraft to offensive missions and the majority of air defense work shifted to the antiaircraft artillery. Despite a difficult beginning, both the Allied Force and antiaircraft artillerymen protecting it adapted quickly to a new, more fluid style of warfare and turned in some impressive results. From 17 February 1943 to 1 September 1944, American forces had gone from suffering a defeat at Kasserine Pass to capturing all of North Africa, Sicily, most of Italy south of the Arno River and destroying the *Nineteenth* German Army in Southern France. Meanwhile, Army Air Forces fighter pilots flew 103,719 sorties to protect Allied convoys totaling 12,801 ships. Of those ships, only twenty-two were sunk and sixteen damaged by surface or submarine attack, while just forty-six were sunk and fifty-two damaged by air attack. Fighter pilots also shot down 125 enemy aircraft and in the three-category system of accounting for enemy aircraft losses, probably destroyed another thirty-one and damaged 144. During the same eighteen-month period, American antiaircraft forces destroyed 1,127 enemy aircraft and probably destroyed another 253 more.⁴⁰

In England, many of the Allied commanders preparing for Operation OVERLORD, the cross-channel attack into Normandy, were veterans of the North African and Mediterranean campaigns. While historians have written a great deal about the competing strategic approaches that affected the war in Europe (for example, the “Transportation Plan” vs the “Oil Plan” and the “broad front” vs “single-thrust” debates), these commanders’ shared combat experiences made it almost natural that they adopt

many of the tactical procedures developed during the hard campaigns of the previous year. General Dwight D. Eisenhower, the Supreme Allied Commander of the invasion force, served previously as the commander of the Allied Force in North Africa and the Mediterranean. Lieutenant General Omar Bradley, selected to lead the American First Army, commanded the (US) II Corps in Sicily. Providing Bradley with tactical air support at the forward edge of the battle area was the IX Tactical Air Command (TAC) commanded by Major General Elwood (Pete) Quesada, who fought with him in North Africa. The battles of North Africa were fought by a “pick up team” unaccustomed to working together. The Army commanders preparing to lead a combined force into Europe were just the opposite. These battle-hardened commanders shared a common appreciation for combined arms warfare. As they trained in England, Eisenhower, Bradley, Quesada, and others worked hard to avoid the mistakes made in previous campaigns.⁴¹

The relationship between Bradley and Quesada, and the latter’s importance in working through air and ground coordination problems, were critical to the success of Bradley’s ground forces. In his biography, Bradley admits conducting virtually no air-ground training in England prior to invasion of France. In part, Bradley blames the commander of the Ninth Air Force, Lieutenant General Lewis Brereton, of Clark Field infamy, for the lack of training, claiming that some of “our uneasiness stemmed from the brush-off we experienced at the hands of Brereton himself, for in attempting to pin him down on air-ground training, I was told his air force was too heavily committed in the air battle for France.”⁴² Brereton did manage to establish the IX Air Defense Command in March 1944 with the mission to “protect Air, Ground, and Service installations [behind

the advancing armies] through the combined use of fighters, antiaircraft, and air warning weapons,” an important development given the expected advance of Bradley’s force.⁴³ In fairness to Brereton, Bradley acknowledges the Ninth Air Force’s efforts to stop the German V-1 pilotless aircraft attacks that were plaguing Britain at the time. A month before the invasion, the Ninth Air Force reported it was finally ready to train with Bradley’s First Army, but by then Bradley commented, it was too late, “we’ve completed our training. Troops are already moving into the sausages.”⁴⁴

The man responsible for correcting any training deficiencies and overcoming the disadvantages thereof was General Pete Quesada. A 40-year old airman who would not take no for an answer, Quesada “did more than anyone else to develop the air-ground support that was to speed us so successfully across France....” Bradley maintained that Quesada “succeeded brilliantly in a task where so many airmen before him had failed, partly because he was willing to dare anything once. Unlike most airmen who viewed ground support as a bothersome diversion ... Quesada approached it as a vast new frontier waiting to be explored.”⁴⁵ In other words, as an agent of change Quesada dared to challenge the existing orthodoxy and succeeded in bring about reform by combining bureaucratic power with tactical and operational innovation. He was the key agent of change in a time of dire need.⁴⁶

In September 1943, General George Marshall selected Lieutenant General Bradley, then in Sicily, to command the (US) First Army during the invasion of France. When Bradley returned to the United States in late September, Colonel Charles “Pat” Patterson, an antiaircraft artilleryman currently serving with the Eastern Defense Command, served as his escort officer. Bradley had been unhappy with the antiaircraft

officer assigned to his fledgling (US) First Army staff, then forming in America, and needed to find a suitable replacement for Colonel James E. Harriman, who had been with him in Tunisia, but had since been recalled to the United States and promoted to brigadier general. Bradley asked Lieutenant General Hugh Drum, commander of the First Army area and the Eastern Defense Command, to recommend someone to serve as his antiaircraft officer. Drum recommended Patterson, who was pleasantly surprised when Bradley offered him a job on his staff.⁴⁷

Patterson was a protégé of Major General Sanderford Jarman, having served with him during the Fort Bragg Joint Exercises in 1938; in Panama; at Camp Stewart, Georgia; and in the First Army's Antiaircraft Command (which was also the antiaircraft component of the Eastern Defense Command). A 1933 graduate of West Point, he finished 117 out of a class of 347, but was the first member of his class to reach colonel. Ambitious and "confident to the point of cockiness," Patterson was disliked by many, but respected by everyone that worked with him.⁴⁸

Another member of the Jarman's team in the Eastern Defense Command was Brigadier General Edward W. Timberlake. Standing six feet, four inches tall with a shock of white hair, "Big Ed" Timberlake hailed from Tennessee and was a member of the Great War class of 1917 at West Point. During the Interwar period, he served as the executive officer of the 61st Coast Artillery Regiment (Antiaircraft), and from 1942-1943 he commanded the 71st Coast Artillery Regiment (Antiaircraft) that defended Washington DC. Known as the "Rollin' Seventy-First," the Regiment was famous for its emphasis on mobility, something Timberlake nurtured by having units drive their vehicles to annual service firings instead of using equipment already located on the range. On occasion, he

also had them drive to Army maneuvers and to New York for air defense exercises. In mid-1943, Timberlake took command of the 49th Antiaircraft Brigade. In March 1944, after months of training at Blandford, England, the 49th Antiaircraft Brigade joined the First Army, and the two professionals joined forces. Patterson, the staff officer, brought an innovative approach to antiaircraft artillery. Timberlake, the commander, was the older, more mercurial warhorse who inspired men to sail the English Channel, invade France, and “write [their] history in the skies.”⁴⁹

Working for General Jarman in the Eastern Defense Command significantly influenced how both men viewed coordination with the Army Air Forces. Jarman believed in cooperating with the air component to protect key cities and installations such as New York, Washington, DC, and the Norfolk naval yards. He agreed with General McNair that Army Air Forces commanders should command the antiaircraft units in their areas. During joint exercises with the First Fighter Wing in New York, Jarman shared information with the Sector Operations Center, which reciprocated. Both the air force and the antiaircraft units were in constant communication with the Center, which displayed the movement of aircraft on an elevated board operated by Star and Garter chorus girls. The system was so effective that the Center established free fire zones for the antiaircraft artillery, similar to the restricted areas and Inner Artillery Zones used in North Africa, Sicily, and Italy. Lieutenant Colonel Patterson supervised the operations room for Jarman and recognized its tactical advantages.⁵⁰

After joining the (US) First Army staff, Patterson developed a warm relationship with General Quesada. Having operated in the Eastern Defense Command under a similar arrangement, Patterson agreed to accept the same degree of the operational

control that Quesada used in North Africa. Patterson stationed liaison officers from the First Army Antiaircraft Section in Quesada's operations room. These officers passed any changes in the IX Air Force hostile criteria to First Army antiaircraft units. In return, the antiaircraft officers shared the location of Inner Artillery Zones and other restricted areas with Quesada's airmen.⁵¹

When the campaign began on the Continent, antiaircraft operations rooms became the mechanism for passing general fire direction to local antiaircraft defense commanders. Rarely, however, did an operations room issue a direct order to fire on a particular aircraft and seldom did it furnish more than a general warning of enemy aircraft near a defended area. Battery commanders, in coordination with local antiaircraft defense commanders, selected targets and ordered the distribution and firing of weapons.⁵² Indeed, the battery commander was the focal point of all information. As one 90-mm battery commander recalled his operation, he ...

... listens to the intelligence radio, watches the early warning plots and directs his radar accordingly. He then follows the intelligence plots, and watches his own plots. He wears a headset on the Battery [communications] line to [the] director, height finder, and radar trackers, which enables him to get rapid results. By looking at the remote data indicator for the SCR-268 and by talking directly to the trackers he has full control of that unit. He also knows at a glance whether or not his elevation and altitude are reliable and acts accordingly. Again being satisfied his data is as good as possible, he orders his fire over the Fire Command telephone line. In order to be able to do the above, all operation within the Command Post must be handled by trained men supervised by either an NCO or another officer. Operation within the Command Post must be *quiet, rapid, and efficient*.⁵³

Given the orchestration of this complex movement, one wonders why more friendly aircraft were not shot down.

Besides the “positive” control maintained over antiaircraft fires by haggard battery commanders huddled inside blacked-out shelters working three communications networks simultaneously, air commanders imposed “procedural” controls that restricted flights over certain defended areas (Inner Artillery Zones, Gun Defended Areas, Beaches, and Airfields) and prescribed specific combat rules for each type of defended area. During the invasion, however, the rules became so confusing that they were impractical. Shortly after the invasion, the types of defended areas were reduced to two: unrestricted areas and Inner Artillery Zones. In unrestricted areas—areas where flying was not specifically prohibited—antiaircraft units could fire at all targets recognized as hostile or which committed a hostile act. Units could fire at “unseen” targets—targets visible only on radar—if they obtained consent from an air force area controller or in the absence of communications, when an attack was in progress and the local antiaircraft commander considered it necessary to protect the defended area.⁵⁴

Inner Artillery Zones (IAZ) were widely used within the European Theater of Operations. An IAZ consisted of an imaginary cylinder with a 12,000-yard radius extending 10,000 feet above sea level. The center of the IAZ corresponded to the middle of the defended area. It took ninety-six hours notice to establish an Inner Artillery Zone and they usually only operated at night when visual identification was difficult. According to a Supreme Headquarters, Allied Expeditionary Force (SHAEF) Operational Memorandum, friendly aircraft entering an IAZ “are likely to be engaged.” The memorandum also directed antiaircraft units to “fire on all ‘seen’ targets [in an IAZ] not identified or recognized as friendly ... unless ‘HOLD FIRE’ has been ordered.” Even then, antiaircraft crews could conduct “revenge fire” and engage an aircraft in an IAZ if it

committed a hostile act first. Finally, at night, 90-mm units could fire on any “unseen” aircraft in an IAZ not identified as friendly. Shorter-range antiaircraft weapons (40-mm, .50 caliber machine guns), however, could not fire on “unseen” aircraft unless they were participating in a “prearranged barrage firing directed by the AA Operations Room.”⁵⁵

By the end of September 1944, the system started to break down. Not only was it still confusing, but air force commanders complained that the large number of Inner Artillery Zones in place following the Allied breakout from the Normandy beachhead limited their freedom of maneuver and required them to fly long, circuitous routes to avoid friendly antiaircraft fire. While the Zones may have been the bane of airmen, antiaircraft commanders loved them and activated Inner Artillery Zones along the entire line of communications at “every river crossing or bottleneck.” According to antiaircraft notes from Bradley’s 12th Army Group, by “7 September 1944, an almost continuous chain of Inner Artillery Zones existed between Antwerp and Nancy,” creating a 200 mile long “no fly zone” southeast across the French frontier.⁵⁶ Pilots with the British Bomber Command found this situation particularly intolerable. The numerous Zones lengthened their flying routes and weather often prohibited them from flying above the top of the Zone. As an interim solution, antiaircraft commanders and airmen established air corridors. The use of corridors, however, only worked sporadically. It left noticeable gaps through which German night-fighters could pass and attack friendly targets. Information on the corridors was not always current and aircraft did not always return on schedule or fly in the proper corridors. Bomber Command further complicated the task of protecting friendly bombers when it refused to use IFF (Identification Friend or Foe) radar for fear that German night-fighters might “home” in on the signal.⁵⁷ Often when

pilots did use IFF, responses from the large numbers of bombers returning home from the Allies' massive air raids (particularly American raids) saturated friendly radars to the point of making them useless. Without a reliable identification system, neither the antiaircraft men nor the pilots were completely satisfied with the procedural controls established for their own protection.⁵⁸

As dissatisfaction grew along with the number of friendly aircraft shot down, SHAEF issued instructions in December 1944, significantly adjusting the rules for activating an Inner Artillery Zone. Communication between antiaircraft operations rooms and fighter control centers was now mandatory before a unit could consider an IAZ activated. Controllers were to rely on movement windows in planning when to close a Zone to allow safe passage of friendly bombers. Usually controllers closed the Zones restricting antiaircraft fire for thirty minutes prior to an outgoing flight of bombers crossing the Zone and for forty-five minutes prior to the return of friendly aircraft.⁵⁹ In a survey conducted after the war of forty-five antiaircraft gun battalions, commanders expressed dissatisfaction with this system. Units frequently did not receive any notification of movements of aircraft from England. On the occasions when they did receive notice, the information was given in such general geographic terms and broad time limits that units could not determine with accuracy when friendly aircraft might cross their Zone. "Hold Fire" periods, when all antiaircraft firing was to cease, were often unnecessarily long. Ultimately, commanders had so little confidence in the information they received that even when "Hold Fire" periods were not in effect, they harbored strong suspicions that the aircraft heard overhead were friendly.⁶⁰

With the application of these new rules, antiaircraft units lost the major advantages of the Inner Artillery Zone. In the absence of a working theater-wide system, armies and their tactical air commands began to improvise other methods for ensuring freedom of action for both antiaircraft crews and pilots without jeopardizing either group's safety or ability to complete their mission. Often, whenever the fighter controller was confident no friendly aircraft were in the sky, he would release antiaircraft units to fire on targets not identified as friendly. In General George Patton's Third Army, the 38th Antiaircraft Artillery Brigade and the XIX Tactical Air Command established a system whereby they agreed on Inner Artillery Zone areas ahead of time and without having to obtain clearance through higher headquarters. This arrangement made the system more responsive to commanders' needs. Entitled Operation BLANKCHECK, the system designated areas where antiaircraft units could fire on aircraft not identified as friendly until a predetermined time. Complete with code words such as "pincushion" and "raincheck" to stop engagements should a friendly aircraft suddenly appear, Operation BLANKCHECK depended on elaborate and robust communications between aircraft controllers and antiaircraft units and on controllers having confidence in the information they possessed. When controllers lost confidence in the fidelity of their information, they became reluctant to allow antiaircraft weapons to fire and the system broke down.⁶¹

Although coordination between antiaircraft units and airmen had improved immensely since North Africa, fratricide remained a problem in both directions. Despite the use of yellow smoke and panel markers to signal the presence of friendly forces, strafing and bombing of friendly troops by friendly aircraft continued. One of the most notorious air-to-ground fratricide incidents occurred during the breakout from Normandy

in July 1944. On two separate occasions, Allied bombers attacked from behind friendly troops instead of flying parallel along their front and bombed short of the planned target, causing over 900 American casualties and killing General McNair, who was observing operations in his foxhole. The 30th Infantry Division was particularly hard hit, so much so that it developed the reputation of being the most-bombed division in the American Army.⁶² Bradley was livid and Eisenhower promised to never again use heavy bombers in support of ground troops (although he would later find it necessary to do so during the German winter offensive).⁶³

Startled by the change of plans that brought the bombers in from such a dangerous direction, Quesada radioed Brereton, who replied that Bradley had been briefed on the plan. Bradley disputed Brereton's claim, arguing that he had heard nothing about the change of plans until eleven hours after the first short bombing fiasco.⁶⁴ While Bradley was discreet in his condemnation of the event in his 1951 history of the war, he was less so in his 1983 autobiography, flatly declaring that the "Air Force brass simply lied."⁶⁵ Brigadier General William K. Harrison, Jr., the assistant division commander, was so mad after the attack that he hollered into a radio for the Army to "send the Air Force home, we could win the war without their help..."⁶⁶ Afterward, soldiers in the unit derisively referred to the Eighth and Ninth Air Forces as the "Eighth and Ninth Luftwaffe."⁶⁷ In light of this sort of treatment, it is no wonder that Major General Leland K. Hobbs, the 30th Division commander ordered his attached antiaircraft unit to fire at all aircraft, including and especially friendlies!⁶⁸ Unfortunately, his troops and many other non-antiaircraft soldiers followed these orders too well and continued to engage friendly

aircraft. The dismal situation finally caused commanders to order friendly troops not to engage aircraft until nearby American antiaircraft units fired first.⁶⁹

Eisenhower offered a broader perspective on the event and displayed a better understanding of the role that risk taking plays in attempting innovation. In his dispatches as Supreme Commander, he wrote, “Unfortunately, perfection in the employment of comparatively new tactics, such as this close-support carpet bombing, is attainable only through the process of trial and error, and these regrettable losses were part of the inevitable price of experience.”⁷⁰ Eisenhower never lost sight of the main objective—to defeat Germany—and would suffer occasional setbacks, no matter how regrettable, if the outcome served to achieve the primary goal.

Technical Change

While antiaircraft artillerymen struggled to coordinate their efforts and avoid shooting friendly aircraft, they increasingly benefited from better weapons and equipment. As forces gathered in England, the trailer-mounted Quad-.50 machine gun began to arrive in large quantities to replace the single barreled .50 caliber machine guns in many antiaircraft units. While this quadrupling of firepower was significant, Colonel Patterson and his automatic weapons staff officer, Major Fred Jacks, did not believe the trailer-mounted version had the mobility necessary to keep up with the maneuver forces. Over the opposition of some senior officers outside of his chain of command, Patterson scrounged 700 excess half-tracks, had the quad-.50 caliber machine gun mounts removed from the trailers and bolted into the back of the vehicles. This contraption was similar to the half-tracked M16 quad-.50 machine gun being manufactured in America. Called the M16B, there were only enough of them to issue sixteen to each battalion (half the

authorized number), but Patterson believed that the increased mobility far offset the shortage of weapons. Through ingenuity and persistence, Patterson had created a more mobile and lethal antiaircraft force for Bradley's First Army.⁷¹

Meanwhile, in the United States, the Antiaircraft Command, together with the Ordnance Department, modified the 90-mm gun to reduce its emplacement time and to improve its mobility significantly. The new M-2 gun mount offered increased stability and enabled crews to fire from the wheels, if necessary, without lowering the four outriggers. A combination fuse-setter and rammer greatly enhanced the rate of fire, while an armored shield offered better protection for the gun crew. When combined with the new M-9 electronic director and better radar, the accuracy of the 90-mm gun improved immensely.⁷²

The SCR-268 radar was a vast improvement over the World War I sound locators that persisted throughout the Interwar period. The Signal Corps had designed it primarily to replace the sound locator and provide direction to the searchlights. Its accuracy was sufficient enough to direct the lights, but it was not a gun-laying radar suitable for fire control. The Coast Artillery had desired better fire control for over a decade and in 1941 work began on what was to become "the finest fire control radar set of World War II—the SCR-584."⁷³

The SCR-584 radar began as a companion project with airborne interception at the Radiation Laboratory at the Massachusetts Institute of Technology in 1941. The two men most responsible for designing the radar were Ivan Getting and Lee Davenport. Getting was a Slovak from New York City with a degree in nuclear physics from Harvard and the winner of a Rhodes Scholarship. He also had firsthand knowledge of antiaircraft

artillery techniques, thanks to a reserve commission in the Coast Artillery. Davenport grew up in Schenectady, New York with an interest in technology and science. Graduating from high school during the Great Depression, he took a job with the Federal Youth Administration, drawing illustrations for a revised edition of Kimball's *College Physics*. He worked his way through college at the University of Pittsburgh, almost earning a Ph.D. before moving to the MIT Radiation Laboratory.⁷⁴

In their early discussions, Getting and Davenport decided the radar should automatically track targets. While this requirement was unanticipated by senior officials, it proved not only simpler than expected to develop, but also fortuitous. The science behind automatic tracking was not foreign to developers at the Radiation Laboratory. MIT led the engineering world in the design of servomechanisms, small motors built to control the movements of larger machines, and had even followed students walking across campus using an automatic tracking device. By 31 May 1941, Getting and Davenport had a prototype system tracking objects with remarkable effectiveness. After some minor adjustments, the system was ready to show off.⁷⁵

The test of the prototype radar went so well that Brigadier General Roger Colton, director of the Army's Signal Corps Laboratories and one of the men initially behind the SCR-268, decided that the Army needed to have the new system immediately and placed primary and backup orders with MIT and Bell Laboratories to produce them. Turning the prototype into something that soldiers could use on the battlefield and not break in the process, however, did not happen overnight. To get the radar from the laboratory to the field meant taking the set and making it mobile. Getting and Davenport decided to put the system in a closed truck, designated XT-1 for experimental truck 1, with the radar

dish stowed inside, but placed on the roof of the truck during operation. The truck not only made the system mobile, but it also dramatically improved operating conditions for the soldiers.⁷⁶

With the shelter, troops no longer had to operate outside and endure the elements like they did with the SCR-268. Nor did have to keep their faces pressed against a light shield to see radar returns on the oscilloscopes during the day. During production, a trailer-mounted model replaced the truck version, while advances in power and sensitivity extended the range out to 54 miles, making it a viable search radar as well as a gun-laying system. On 6 February 1942, the Army tested the XT-1 at Fort Monroe with a new Bell Laboratory fire control director and a 90-mm gun firing at a towed sleeve. Ivan Getting recalled they “shot down targets with as few as eight rounds, all without human intervention or visual contact with the target.”⁷⁷ The Coast Artillery Board fully supported the results and recommended that each antiaircraft 90-mm gun battery have its own radar. In April 1942, the Signal Corps ordered 1256 units. The XT-1 became the SCR-584 and the new director became the M-9.⁷⁸

Delays prevented production from beginning for another year. It was not until 4 February 1944 that the first SCR-584 radar set made its operational debut with Battery A, 184th Antiaircraft Gun Battalion on Lippetts Hill, London.⁷⁹ A short while later another battery equipped with the radar shot down its first aircraft. After that, the SCR-584 radar went on to perform magnificently in all theaters. At Anzio, antiaircraft artillerymen received eight units in early March. The need was critical since the Germans were jamming all the longer wave SCR-268 radars with “Window.” The beachhead was so narrow that all the radars were within German 57-mm artillery range. To protect them,

soldiers dug the trailers in up to the roofline. After initial difficulties based on less than one hour's tracking experience, radar operators began to get the feel of the new radar. Within the anti-aircraft "system," the data they provided to the 90-mm gunners allowed them to fire with devastating effectiveness. In the first SCR-584 directed engagement, five of the twelve attacking aircraft were destroyed. Through the rest of March, the SCR-584 equipped batteries accounted for sixty-three kills.⁸⁰

The SCR-584, however, proved more than just an accurate gun-laying radar. Its superior tracking ability enabled soldiers to follow 90-mm rounds out to the target, leading to the discovery of errors in the gun's firing tables. Its tracking accuracy also allowed crews to follow and predict V-1 trajectories, improving the ability of anti-aircraft crews to shoot them down and enabling fire and rescue crews to receive advanced warning of likely impact areas. At the front, soldiers used the radar to track enemy artillery and mortar rounds and determine the location of enemy batteries. It also enabled the troops to detect the movement of enemy vehicles at night. On more than one occasion, commanders positioned the SCR-584 to spy on key road intersections and alert artillery units when vehicles approached. Once, after an SCR-584 radar crew spotted traffic leaving a German town, artillery fire interdicted the vehicles causing them to detour to another route. Again commanders fired artillery, resulting in a second detour. Later, interrogators learned from prisoners of war that SS troops conducted a house-to-house search looking for the person they believed targeted them and radioed the Americans. Another time, after radar crewman detected extensive vehicle activity on a nearby hill, friendly intelligence confirmed the chance of attack from that direction and

five artillery batteries opened up on the spot, causing the Germans to abandon the attack.⁸¹

When the German's began launching V-2 rockets, the Allies even devised a plan to counter them by using data from the SCR-584 to pinpoint launch sites. The plan, code-named "BIG BEN," was part of Operation CROSSBOW, the Allied effort against Hitler's Vengeance or V-weapons. During a test of the system from 26 February to 11 March 1945, SCR-584 radar detected 88 percent and tracked 81 percent of the 137 reported V-2 "incidents." From this data, Operational Research personnel could extrapolate backwards to find the launch point. While the Allies overran the launch sites before the plan could be fully tested, the SCR-584 proved that it could track the V-2 with good success.⁸²

Besides the SCR-584 radar, the other significant technical development that affected antiaircraft operations was the invention of the proximity fuse. At the time, standard fuses used either a powder-train timer, which allowed for up to fifteen seconds of flight, or a mechanical timer that ran for up to twenty-five seconds. As the antiaircraft crews on Corregidor found out, the powder-train fuse caused the antiaircraft round to explode before it reached the height of most of the Japanese bombers. Moreover, both types of fuses required crews to estimate the altitude at which they wanted the round to explode, regardless of whether the airplane was flying at that height or not. The proximity fuse worked on the principle that it sensed when the shell was near the target, triggering the device to explode and destroying the aircraft. Work on a proximity fuse began in Britain in 1937 and 1938 with experiments using acoustic and photoelectric mechanisms. Neither proved fruitful and in 1939, William A. S. Butement, the designer

of Britain's Chain Home radar stations, proposed two fuses based on radio frequencies. The first design called for the antiaircraft shell to carry a small radio and receive a signal from ground radar that told it when to explode. The second design was even more sophisticated. It called for the shell to carry a small radar device that emitted a signal, sensing when it was nearby a target and exploding. With radar still in its infancy, the exigencies of war now required that scientists miniaturize it and harden it so it could be shot out of a cannon, yet still work once airborne.⁸³

While work in Britain languished behind other higher priority radar efforts, scientists in the United States picked up on the project. Specifically, a scientist working for the newly formed National Defense Research Committee (NDRC) noticed in July 1940 that Western Electric and RCA were manufacturing 20,000 specialized electronic and photoelectric tubes for the British Army. This discovery led to speculation that the British were working on a proximity fuse. Vannevar Bush, president of Carnegie Institution and chairman of the NDRC, discussed the issue with physicist Merle Tuve, who ran Carnegie's Department of Terrestrial Magnetism. In mid-August Tuve and other scientists began testing vacuum tubes to see if they could withstand the rapid acceleration required of a proximity fuse. Tuve strapped tubes to bricks, suspended them from the ceiling, and then shot the bricks with a rifle. He tied tubes to lead spheres and dropped them from a three-story building. He even encased hundreds of tubes in wax and shot them out of a 1916 vintage 37-mm gun. The glass envelopes survived, but the electric circuitry collapsed. When the famous Tizard Mission arrived from Britain in September to broach all matter of scientific issues with the Americans, the British showed Tuve the

circuit designed by Butement. The combination of Butement's circuit and Tuve's hardened tubes pushed the project forward.⁸⁴

The next step was for Tuve to create a miniature battery to power the system and a delaying mechanism so the round would not explode in the breech of the weapon. Tuve, who had only months before led a handful of scientists, now directed hundreds in the project. A noted spendthrift, his guidelines were clear: "I don't want any damn fool in this laboratory to save money. I only want him to save time."⁸⁵ By February 1941, Tuve and crew were testing shells with 5-inch guns at the Naval Proving Ground in Dahlgren, Virginia. In January 1942, the success rate finally surpassed 50 percent and the proximity shell entered into production. In the previous year, the vacuum tube industry produced a total of 600,000 tubes. As the proximity fuse (along with other requirements) entered into production, that number rose dramatically to the point where by 1945, the industrial output reached 400,000 vacuum tubes per day. By November 1942, 5,000 proximity shells were enroute to the Pacific where Admiral Halsey divided them up among the ships most likely to see combat. On 5 January 1943, crewmen aboard the USS *Helena*, a cruiser on her way back from an attack on an airstrip on New Georgia, shot down a Japanese plane with a proximity fused shell, less than thirty months after the first discussions were held on creating such a device. By the end of the war, 112 companies produced over 22 million shells with proximity fusing at an average cost of \$18 per fuse.⁸⁶

Security surrounding the development of the proximity fuse (by mid-1943 called the "VT" for "variable time" or "velocity triggered") was stringent. After the first test firings aboard the USS *Cleveland* in August 1942 in the Chesapeake Bay, authorities

would not allow the ship to dock for fear that the crew had seen too much. Concern over duds falling into enemy hands drove the decision to send the rounds to the Pacific first for use by the Navy over water. When VT rounds were first used in Europe during the invasion of Sicily, the Navy again fired them over water. Secrecy hampered production as workers were never told what they were making or why, which led to issues of quality control that exacerbated existing worries over the dud rate. At times, parts were ordered under fictitious names to disguise their use. The plastic noses used in the fuses were called “rectal spreaders” and purchased through the Johns Hopkins Medical School.⁸⁷

In fact, the Navy was so enamored with the VT fuse that Admiral King at first refused to release any for use over land. When the antiaircraft fuses were at last released for use over land they arrived during the V-1 bombings of London. The combination of the SCR-584 radar, the 90-mm gun, and the VT-fused round had an immediate and a devastating effect on aircraft. Against the V-1, this combination succeeded in downing virtually all the pilotless aircraft that came within range. The Allies held the VT-fused artillery rounds in reserve for use only as the operational or tactical situation dictated. As fate would have it roughly six months later, they debuted during the Battle of the Bulge in December 1944. During the battle, the VT artillery round enabled artillerymen to fire airbursts over attacking German infantrymen without an observer in any type of weather, day or night. The use of the VT artillery round is credited with breaking up several attacks and causing General George Patton to remark: “The funny fuse won the Battle of the Bulge for us.”⁸⁸

During the early 1920s General Billy Mitchell and others had claimed that firing antiaircraft artillery at airplanes was a useless endeavor. By the mid-1930s, antiaircraft

techniques had improved to where the pendulum started to swing the other direction. By the end of the decade, however, advanced aircraft technology made airplanes even faster and harder to hit. By mid-1944, in the throws of war, the technological nexus of three interdependent antiaircraft “systems” that did not even exist five years earlier proved extremely lethal to any airplane that flew within range and pushed the pendulum back in favor of the antiaircraft artillerymen. The SCR-584 radar and the 90-mm antiaircraft gun were devastatingly effective in their own right, but it was the proximity fuse that provided the final technological edge and allowed the three “systems” dominate the skies above their positions. Thus, it is slightly ironic that the Navy proximity fuse tests in 1942 occurred less than one hundred miles from Mitchell’s 1921 sinking of the former German battleship *Ostfriesland* for the VT-fused shell along with naval radar and antiaircraft guns made the fleet relatively impervious to air attack. Over land, the Army’s integration of the three systems made it extremely perilous for German or Japanese aircraft to attack sites protected by American antiaircraft artillery. The SCR-584, the 90-mm antiaircraft gun, and the proximity fuse in the hands of well-trained antiaircraft artillerymen had turned Mitchell’s birds of prey into sitting ducks.

Operational and Tactical Adaptation

Technology may have afforded antiaircraft artillerymen the advantage in their ongoing battle with the airplane, but rarely does an enemy suffer disadvantage for any length of time without reacting. As the Allies grew stronger, Germany and Japan adapted, using terrain and technology in an asymmetric manner to offset American and British advantages. In Europe, terrain and technology forced antiaircraft artillerymen to transition from ship to shore at Normandy, defend the airspace against belated *Luftwaffe*

attacks, and battle pilotless aircraft and ballistic missiles aimed at London and Antwerp. In the Pacific, *kamikaze* pilots turned aircraft into cruise missiles, surprising antiaircraft men with their diehard tactics. As if those challenges were not enough, antiaircraft crews in both theaters found themselves adapting continuously and using their weapons in new and novel ways to support the ground forces in their fight against tanks and infantrymen. Improved technology provided antiaircraft crews with the means to defeat aircraft and other threats, but it was not technology or industrial might that won the war—although those factors certainly made victory possible. In the end, a competent military strategy and policy, sustained by vast quantities superior technology and enhanced by capable allies, enabled men—soldiers, sailors, airmen, and Marines--to win the war by adapting to the urgent demands of combat and fighting, often in innovative ways, to defeat two determined enemies.

While Eisenhower, Montgomery, Bradley, and other senior leaders organized Allied bombers and fighters, naval destroyers, landing ships, artillery, engineers, and infantry in preparation to seize the beach and establish a beachhead, Colonel “Pat” Patterson and General “Big Ed” Timberlake trained and organized American antiaircraft artillery units to defend the force from expected German air attacks. The antiaircraft organization in Bradley’s First Army consisted of Timberlake’s 49th Antiaircraft Brigade, comprised of several antiaircraft groups and battalions, and the antiaircraft groups assigned to the V Corps and VII Corps headquarters. Additionally, each division had one or more antiaircraft battalions attached—a standard practice across the army by 1944.

Timberlake and Patterson faced many problems in preparing their forces for combat in Europe. The most serious problem, however, was that very few units had

combat experience. While many of the infantrymen making the initial assault into France had seen combat in other theaters, only one of the thirty-one antiaircraft battalions involved in the Normandy invasion had previous combat experience.⁸⁹ When Timberlake arrived in England in late 1943, he immediately instituted an intensive training program to get these virgin forces ready. These units, stationed at nine camps around England, had the benefit of ample maneuver space and plenty of ammunition to fire. Timberlake and Patterson ensured that all units participated in amphibious training with the units they were to support on D-Day. This training established the habitual association necessary for a good working relationship and acquainted antiaircraft units with the unique procedures and idiosyncrasies of the units they supported. With each training exercise and joint maneuver, antiaircraft units gained increasing credibility, acceptance, and much needed external support from their combined arms brethren.⁹⁰

As an added benefit, the amphibious exercises, combined with the rigorous physical training Timberlake mandated, got the men in great shape and gave them a sense of the arduous task ahead. The centerpiece of Timberlake's training regimen was a month-long unit rotation through Camp Blandford, where his focus on mobility ensured units moved three to four times a day and were ready to keep pace with the infantry and armored units they would defend. Besides mobility exercises, antiaircraft units also held target practice, sometimes for up to sixteen hours a day. In one extreme example, the 397th Provisional Machine Gun Battalion, in preparation for its assault on Omaha Beach on D-Day, fired over 500,000 rounds of .50-caliber ammunition through its thirty-six machine guns.⁹¹

Besides assaulting the beach against a determined defense, Eisenhower and others worried about the vulnerability of forces while they sailed from England to France. Accordingly, naval anti-aircraft guns, fighter patrols, and every Army anti-aircraft automatic weapon and machine gun possible were trained skyward to fend off potential *Luftwaffe* attacks. Even the famous Mulberries, the man-made harbors necessary for quickly offloading supplies in France, bristled with anti-aircraft guns. As the great convoys moved toward Normandy, barrage balloons anchored to each ship floated above providing additional protection. One observer noted, that with the balloons all flying at the same altitude and bucking in the brisk wind, the entire convoy “appeared to be drunkenly listing to one side.”⁹²

When American forces landed on Omaha Beach at 6:30 a.m. on 6 June, they encountered stiff German resistance on the ground, but only minimal resistance in the air. The weather, notorious for forcing Eisenhower to delay the invasion until 6 June, caught the German forecasters and the entire German command structure by surprise.⁹³ What was left of the *Luftwaffe* fighter force after the devastating Allied raids in February and March had been pulled back into Germany to defend against American and British bombers. Only *Luftflotte 3*, the *Luftwaffe* unit responsible for the air defense of France, remained available to attack the Allied landing force. On 5 June, *Luftflotte 3* maintained 815 aircraft, of which 600 were operational. On D-Day, it launched less than 100 sorties. That evening bombers and anti-shiping squadrons launched 175 more.⁹⁴ The United States Army’s official history places this number at approximately 500 sorties, many of which occurred far inland, partially explaining the difference.⁹⁵ When it was over, the Germans claimed little victory and lost thirty-nine aircraft in combat with another twenty-

one damaged. By comparison, the Allied air forces flew 14,000 missions in support of the invasion, including 3000 sorties by Ninth Air Force fighters and bombers, losing only 127 aircraft. In part, due to the *Luftwaffe's* inability to react quickly, the Allies enjoyed total air superiority on D-Day.⁹⁶

Most of the German aircraft that did make it to the beach paid the price. In one of the few daytime attacks, German FW-190s and Me 109s attacked Omaha and Utah beaches around 10:30 a.m. Oberstleutnant Josef "Pips" Priller, flying a FW-190, looking out at the mass of men, ships, and materiel, remarked "What a show! There's everything out there. Believe me, this is an invasion!" before diving down to less than fifty feet and weaving through the barrage balloons. Amazingly, with every antiaircraft gun in the fleet and on the beach firing at him, Priller and his wingman managed to make their pass unscathed.⁹⁷ Many other aircraft, however, did not. In three attacks between 10:30 a.m. and 2:00 p.m., antiaircraft crews shot down nine of the thirteen fighters that strafed the beach.⁹⁸

Although there were relatively few aircraft to shoot, antiaircraft units still found plenty of targets to engage. On several occasions, antiaircraft automatic weapons fired into the bluffs above the beaches and provided covering fire as infantrymen moved forward. One crew, manning a M15 combination gun (two .50 caliber machine guns and a 37-mm cannon) named BLIP II, landed in the second wave at the Easy Red Sector of Omaha Beach and found a narrow draw leading away from the beach blocked by a German 88-mm antiaircraft gun. As German artillery and small arms fire swept the beach, the driver, Bill Hendrix, turned his half-track around and drove it into the surf so the gun was pointing in the right direction. Then the crew poured twenty-three rounds into the pillbox

containing the 88-mm. The surviving Germans surrendered.⁹⁹ Still other crews fought as infantry, firing rifles at pillboxes and searching for mines with bayonets.

Not every anti-aircraft unit was as fortunate as the crew of BLIP II. On D-Day, the 397th Provisional Machine Gun Battalion, which had fired so many practice rounds in England, wound up scattered all over Omaha Beach, with C Battery 800 yards to the west and A and B Batteries 2,500 yards to the east of their planned landing points on Dog Red and Easy Green beaches. In the process, the battalion, commanded by Captain Art Meyer, took 60 percent casualties in the first fifteen minutes. As fate would have it, however, other units, such as the self-propelled 197th Anti-aircraft Automatic Weapons Battalion, which landed on Easy Red beginning at 8:25 a.m., rode their half-tracks through D-Day, the Battle of the Bulge, and the defense of the Remagen Bridge without losing a single soldier.¹⁰⁰

Despite the dogged, determined actions of a few American soldiers on Omaha Beach, by mid-afternoon on D-Day the German defenders still had many units pinned down. At 3:00 p.m., General Timberlake landed in a LST he had commandeered, foregoing the doctrinally correct landing scheduled for D+8. Like Brigadier General Ted Roosevelt Jr. with the 4th Infantry Division on Utah Beach, Timberlake strode up and down Omaha Beach urging soldiers to move forward and “go get the bastards!” For his heroism under fire, he was nominated for the Distinguished Service Cross.¹⁰¹

In the end, largely due to the total air and naval superiority maintained by the Allies and the tremendous firepower applied by heroic soldiers, the invasion was a success. By the next morning, the Allies had landed more than 150,000 British and American soldiers.¹⁰² The Germans, having been caught unawares, reacted quickly to stop the build

up, sending ground and air forces into the fight. From 7 to 30 June, they launched more than 650 sorties at Allied forces in Normandy. Antiaircraft units shot down ninety-six of the sorties with several dozen more aircraft probably destroyed, while continuing to assault pillboxes and infantry positions, and securing the vital logistics necessary for the start of the campaign.¹⁰³ The din of battle was so severe that Major General Matthew Ridgway, commander of the 82nd Airborne Division, remarked shortly after the invasion that the “automatic weapons were going like the hammers of hell...”¹⁰⁴ Outmatched by the German Mark V (Panther) and Mark VI (Tiger) tanks, Bradley even started attaching 90-mm antiaircraft battalions to ground combat units, since the 90-mm was the only weapon “sure to penetrate” the front armor of the heavier German tanks.¹⁰⁵

During the several weeks of fighting among the hedgerows that followed, antiaircraft crews provided air protection and routinely assisted ground forces by spraying the *bocage* with automatic weapons fire ahead of assaulting infantry and armor units. Several units equipped with trailer-mounted 40-mm Bofors developed a method of firing the guns without lowering the outriggers, thereby allowing faster engagements and rapid displacement if necessary. In one attack, the *Luftwaffe* strafed an artillery battalion on the move. The soldiers of the trailer-mounted 40-mm unit attached to protect the artillery stopped, dismounted their truck, and, using this technique, destroyed three of the six attacking aircraft before they could make a second pass.¹⁰⁶ The 377th Antiaircraft Artillery Automatic Weapons Battalion attached to the 4th Infantry Division worked out a system to provide indirect fire support with .50-caliber machine guns in front of a double regimental attack down the N-171 Highway from Carentan to toward Périers. The

provisional battery conducting the mission fired 74,500 rounds over two days and enabled the attacking regiments to move forward against stiff German resistance.¹⁰⁷

In the subsequent breakout, these same units combined with their sister battalions, equipped with the 90-mm gun, to shoot down fifty-eight German aircraft. As the race across France began, the mobility and aggressiveness instilled by Timberlake paid off as antiaircraft battalions, along with elements of the Army Air Forces, kept the *Luftwaffe* at bay. Along the way, antiaircraft units continued to support ground forces with penetrating anti-tank, artillery, and automatic weapons fire.¹⁰⁸ In Brittany, the 54th Antiaircraft Brigade used 40-mm antiaircraft batteries to escort supply convoys past hostile pockets of resistance along the line of communications. In the pursuit of German forces eastward, ten miles east of Soissons, Sergeant Hollis Butler, a gun section commander with the 468th Antiaircraft Artillery Automatic Weapons Battalion, stopped his self-propelled M15 just long enough to disable a German locomotive and rake the train with machine gun fire. Then, adapting to the situation, Butler's men dismounted the gun, advanced on the train in squad formation with marching fire, and captured thirty-six cars and seventy prisoners. Searchlight units even put up "artificial moonlight," on a good night the equivalent of a three-quarter moon, turning night into day and illuminating operations for friendly forces.¹⁰⁹ All across France, antiaircraft battalions formed close relations with their divisions and served in several key roles other than antiaircraft defense. The successful support antiaircraft units gave to maneuver forces during the breakout and the race across France validated the efforts of the Interwar period and played a significant role in garnering the external support necessary for the antiaircraft artillery to solidify its position as a respected member of the family of combat arms.

On 12 June 1944, a less than week after the invasion of Normandy, Hitler launched the first of more than 16,500 of V-1 cruise missile attacks on London, Antwerp, and Liege in a nine-month campaign of strategic bombing using unmanned bombers. Then on 8 September, the Germans fired the first of roughly 3000 V-2 ballistic missiles, a few initially at Paris, then primarily at London, Antwerp, and Liege. With Hitler personally approving each mission, nearly all of V-1 and V-2 attacks were strategic in nature. When Field Marshal Gerd Von Rundstedt, Commander-in-Chief West, tried to gain approval to use missiles against the Allied troop concentrations near the ports of Southampton and Portsmouth, Hitler denied the request. Three such raids did occur without Hitler's approval with sixty to eighty V-1s being launched with some success. When Hitler found out, however, he ordered the officer responsible reprimanded. The Führer was adamant--the V-1s and V-2s were vengeance weapons for use against population centers and critical targets only. Only once did the Germans fire the V-2 at a tactical target. On 17 March 1945, they fired eleven missiles at the Ludendorff Bridge over the Rhine River at Remagen.¹¹⁰

Throughout 1943, all Hitler wanted in response to British Bomber Command's devastating attacks was to strike back in kind. He focused German aircraft production more toward bombers than fighters and fully supported the development of weapons of retaliation. His focus on retaliation instead of air superiority led to other serious errors. The German army was in the midst of producing its own vengeance weapon, the A-4 rocket (later called the V-2), while the *Luftwaffe* was developing the V-1. The V-2, while a triumph of science, was complex, expensive (approximately \$25,000), required the use of scarce raw materials, and overwhelmed the German electronic components industry. It

was, however, unstoppable and carried 1,620 pounds of high explosives. Conversely, the V-1 was simpler, cheaper (\$500), and placed less strain on German industrial production. It carried 1,660 pounds of explosives. With its more vulnerable launch and flight characteristics, the V-1 proved a much greater distraction. Its vulnerability demanded attention and kept a significant portion of the Allied air and antiaircraft forces occupied in 1944 and 1945 defending cities and chasing launch sites.¹¹¹

In addition to bombing suspected launch sites and production facilities, the British made plans to enhance their active defense plans. The British Antiaircraft Command, under General Sir Frederick Pile, was already established and had worked very well during the Battle of Britain. Pile briefed British Prime Minister Winston Churchill on the great accuracy achieved by the American antiaircraft community using the SCR-584 radar, the 90-mm gun, and the proximity fuse. Pile urged Churchill to seek American assistance in defending England. Churchill concurred. Upon receiving briefings on the attacks, General Marshall immediately sent 165 SCR-584 radars to England and General Eisenhower loaned twenty American 90-mm batteries to Pile. American antiaircraft forces were already training with the British in preparation for Operation OVERLORD. Now they were fighting side-by-side to protect London during the “Second Battle of Britain.”¹¹²

While they participated lightly in the defense of London, committing just five 90-mm gun batteries and downing two-hundred-eighty-one of the 1,651 V-1s killed by Allied antiaircraft fire, American antiaircraft crews learned a great deal from the experience.¹¹³ First and foremost, antiaircraft men learned that their 40-mm automatic weapons did not have the killing power necessary to bring the “Divers” down to earth.

Amazingly, while the round penetrated the skin of the airframe--sometimes even passing right through it--the simplicity of the vehicle left very few vulnerable points (fuel tanks, pilot, cabling) to hit and made it difficult to destroy. Conversely, the 90-mm proximity round aimed by the SCR-584 radar and the M9 director proved devastatingly effective, with gunners averaging 156 rounds fired for every V-1 destroyed.¹¹⁴ Defense in depth enabled more guns to engage the V-1s, while placing forces on the English coast enabled them to fire more freely. Finally, proper preparation and careful attention to gunnery drill paid off handsomely with an increased number of hits.¹¹⁵ American antiaircraft crews took these lessons with them as they left Britain for the Continent. It would not be long before they would have a chance to put them into action.

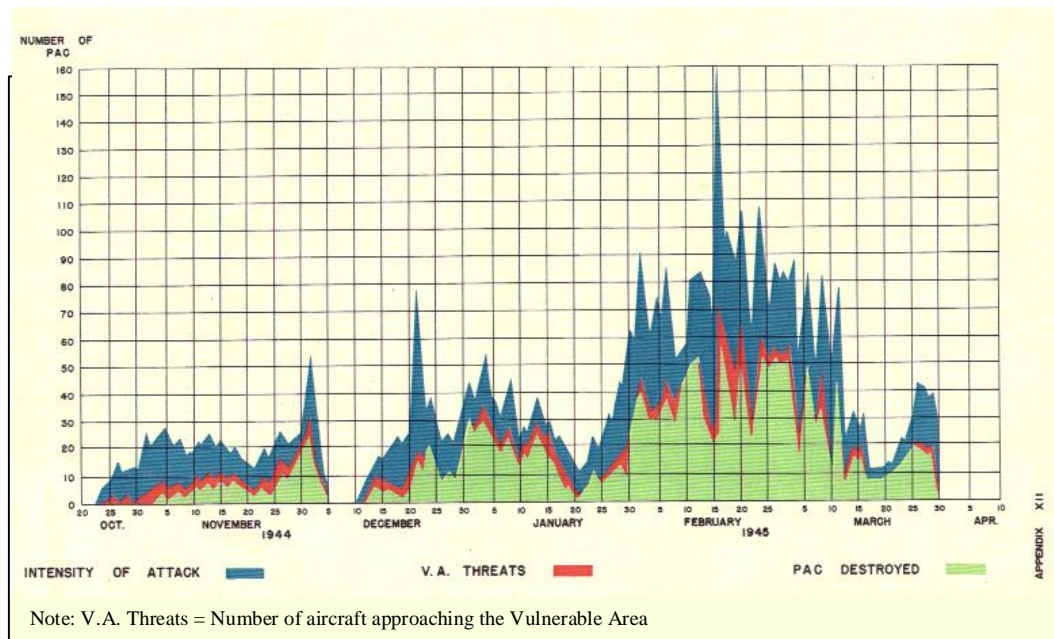
Following the breakout of Allied forces from Normandy and the eventual closure of the Falaise-Argentan Gap, the British Second Army advanced rapidly northward, capturing Brussels on 3 September and the key port city of Antwerp the next day with the docks virtually intact. Antwerp was critical to the next phase of the war in Europe. The supply line from Normandy was running dry and Antwerp was “the jugular vein through which supplies poured in vast quantities to the troops on the Continent.”¹¹⁶ Allied intelligence determined that the Germans would launch V-1 attacks at Antwerp in large numbers, beginning in latter part of October. In preparation for those attacks, antiaircraft planners began immediately to plan for the defense. On 15 October, the IX Air Defense Command received orders to deploy the American 30th Antiaircraft Group, which had participated in the V-1 defense of London, and three antiaircraft gun (90-mm) battalions to Antwerp. The British 80th Antiaircraft Brigade reinforced the defenses, followed soon thereafter by the American 56th Antiaircraft Brigade. The German’s struck on 24

October (within 24 hours of the time predicted by Allied intelligence) and began a five-month campaign against Antwerp that saw 4,883 V-1s launched at the city from multiple directions.¹¹⁷

By 10 November, when Brigadier Clare Armstrong's 50th Antiaircraft Brigade assumed command of all Allied antiaircraft units defending Antwerp, there were two antiaircraft brigades, four antiaircraft groups, seven gun battalions, two automatic weapons battalions, and a British searchlight regiment surrounding the city. Interestingly, given the problems in England with fighters entering the Inner Artillery Zone during the early V-1 raids, Armstrong deployed the searchlights in an irregular pattern to mark the edges of the IAZ for Allied aircraft. Despite this effort, 325 aircraft violated the zone from 26 November to 11 December. After several were shot down by friendly fire, the problem seemed to correct itself.¹¹⁸ As Armstrong continued to reinforce the defenses, adding five more gun battalions and an automatic weapons battalion by mid-December, the Germans continued to launch V-1s from different directions. The multiple attacks forced many antiaircraft units to redeploy continually testing the mobility skills they learned under Timberlake in England. The first phase of this attack peaked in early December with the Germans launching 54 V-1s at Antwerp on 2 December before going into a five-day halt.¹¹⁹ During this phase, the Allied units of the 50th Antiaircraft Brigade shot down 87% of the V-1s that would have otherwise landed in the eight-mile wide circle that marked the critical, yet highly "vulnerable area" of the docks. Of the hundreds launched at the docks, only 13 reached their target.¹²⁰

The respite was indeed the calm before the storm as the Germans marshaled their resources for a 16 December attack through the Ardennes Forest to split the Allied forces

and seize supplies at Antwerp. As American and British divisions battled the *Wehrmacht* in the Bulge, the *Luftwaffe* launched the fiercest V-1 attack yet on Antwerp. The attack, however, met with an equally stiff response. On 22 December, the Germans fired 78 V-1s at Antwerp. Sixty of these aircraft landed outside the “vulnerable area” Armstrong was charged to defend. Antiaircraft crews destroyed sixteen of the remaining eighteen “Divers.” Indeed, during the week of 24 December 1944 to 1 January 1945, antiaircraft units destroyed all of the approximately 115 V-1s that approached the “vulnerable” area.¹²¹



Source: Report of the General Board, United States Forces, European Theater. “Tactical Employment of Antiaircraft Artillery Units including Defense Against Pilotless Aircraft (V-1).” Antiaircraft Artillery Section. Study no. 38. File no. R 370/5, Appendix XII.

Figure 10.2 - V-1 Pilotless Aircraft (PAC) Attacks on Antwerp

The defense of Antwerp during the Battle of the Bulge was all the more impressive given that on 20 December Armstrong received orders to send eight battalions (five 90-mm gun battalions and three automatic weapons battalions) forward to reinforce

the field armies engaging the Germans. Equally impressive were the ground defenses organized by Armstrong to halt any penetration of Allied units by the Germans. Using a few selected 90-mm guns, 40-mm Bofors, and .50-caliber machine guns, the 50th Antiaircraft Brigade prepared to fight as infantry, erecting obstacles, registering antiaircraft weapons for indirect fire, and arming cooks, clerks, and mechanics with bazookas, Molotov cocktails, and small arms. The ground battle never occurred, and as the Allies pinched back the bulge, the V-1 attacks petered out toward the end of January.¹²²

The *Luftwaffe* did not rest for long. After a slow, but steady increase in launches in late January, the German's began their greatest assault V-1 of the war, launching over seventy "Divers" a day for most of February. Indeed, they twice fired over 100 V-1s during the week of 20 February after peaking on 16 February with a twenty-four hour total of 160 V-1s. During this blitz, the antiaircraft defenses of Antwerp reached their maximum efficiency. In one six-day period, antiaircraft crews destroyed eighty-seven out of ninety-six V-1s, or 96 percent of the "Divers" destined for the "vulnerable area." During the five-month campaign that ended on 30 March 1945, the Germans launched 4,883 V-1s at Antwerp. Only 211 of those aircraft exploded within the city, and of those 55 were not engaged by the guns due to firing restrictions. Twice during the last phase, when the attacks were particularly heavy, the defenders fired 15,000 rounds. Some 90-mm gun units replaced their firing tube four times, but somehow managed to keep firing.¹²³

The *Vergeltungswaffen* were not decisive factors in World War II. They did not deliver the crippling blow to the Allied war effort. As Allied actions in London and

Antwerp demonstrated, they did, however, compel the Allies to consume vast quantities of men and materiel in defense against the attacks. Moreover, the V-weapons that were not destroyed inflicted enormous casualties and suffering. Despite aggressive defenses, the V-1 attacks on England caused 23,500 casualties, while the V-2 attacks added another 8,466. In total, the V-weapons attacks on England killed or wounded 31,966 military and civilian personnel and destroyed approximately 23,000 homes. At Antwerp, similar attacks caused 10,145 casualties.¹²⁴ Still, for the Allies and certainly for the 22,000 American, British, and Polish antiaircraft crewmen that protected the city, the defense of Antwerp was one of the greatest achievements of the war. As British Major General W. R. Revell-Smith, commander of General Headquarters Antiaircraft Troops, remarked in a letter to General Armstrong, “It may not have been heralded or understood by the world at large in the same way as they would appreciate a victory by other arms ... but nevertheless this does not make it less important than any other form of major military success in its effect on the outcome of the war.”¹²⁵ As they had on the beaches and hedgerows of Normandy, antiaircraft artillerymen had written their “history in the skies” above Antwerp. As Major Jack Rogers would one day say, they were acquiring “their credentials” by shooting down airplanes, manned and unmanned. As their exploits during the Battle of the Bulge, at the Remagen Bridge, and in the Pacific would show, antiaircraft artillery units were valuable additions to the combined arms team that won World War II.

While General Armstrong’s 50th Antiaircraft Brigade was defending Antwerp from V-1 attacks, other antiaircraft units were fighting for their lives alongside American ground forces against determined German tanks, infantry, and aircraft in the Battle of the

Bulge. The majority of German forces that attacked through the fog-shrouded Ardennes Forest on 16 December were combat veterans, battle-hardened and freshly equipped for a last-ditch try to breakout and relieve the Allied pressure in the West. On the other side of the line stood elements of the VIII Corps, a subordinate unit to the (US) First Army and Bradley's 12th Army Group. Many of its units were new to Europe, like the 99th Infantry Division, which had arrived that fall, been in the line for five weeks, and had yet to mount an attack. The 99th Division, like many units new to Europe, had coughed up replacements shortly before shipping overseas only to have its squads and platoons filled with men transferred from among other sources, excess antiaircraft units. Other units were battle-weary divisions like the 28th Infantry Division, recovering from its participation in the Battle of the Hürtgen Forest where it lost five thousand men. The Ardennes was supposed to be light sector in the Allied line, a place where units went to accustom themselves to combat in Europe or to rest and recuperate, but certainly not to fight.¹²⁶

At 5:30 a.m. on 16 December, a series of flickering lights and quick flashes heralded the onset of the opening artillery German artillery barrage. The Battle of the Bulge had begun, and the Germans had achieved overwhelming tactical and strategic surprise over the bewildered American forces. The Germans quickly ruptured the thinly held American lines in several places, disrupting command and control, and cutting off and isolating several units. The initial stages of the battle quickly broke down into individual engagements. In the First Army Headquarters, the situation looked bleak. *Kampfgruppe Peiper*, a powerful force of 4,000 men and seventy-two tanks, named after the ruthless Joachim Peiper of the 1st SS Panzer Division, spearheaded the German

attack. Brigadier General “Big Ed” Timberlake almost met Peiper during the attack. Unknowingly, Timberlake had placed his 49th Antiaircraft Brigade Headquarters in the Hôtel du Moulin in Ligneuville, directly in front of Peiper’s advance. Around noon on 17 December, Timberlake learned of the breakthrough in the 99th Division’s sector through radio communications with a nearby 90-mm battery. He immediately ordered his staff to pack up and be ready to leave right after they ate lunch. Suddenly tank and machine gun fire erupted just north of the town. As elements of the 14th Tank Battalion drove north to investigate, Timberlake and his staff hurriedly left the Hôtel du Moulin. A short while later, Peiper entered the hotel and spent 30 minutes eating the food that “Big Ed” and his staff left behind.¹²⁷

Meanwhile, in the First Army Headquarters Colonel “Pat” Patterson, antiaircraft officer, recognized the urgency of the situation and ordered all available 90-mm units to the front to slow the German advance. One of those units, the 143rd Antiaircraft Gun Battalion, under the command of Major Myron Fleming, had just arrived from the United States a few days earlier. Patterson ordered it to the town of Stoumont where at around 7:00 a.m. on 19 December, soldiers from Battery C took on Peiper’s Panzers and won. Operating as infantry, two antiaircraft crewmen volunteered to go forward and “take care of a tank.” After creeping through the fog, they found not one, but four tanks, two Tigers and two Panthers. The soldiers fired their bazookas into the rear of the German tanks, setting both afire. A short while later, one of the remaining Tiger tanks moved into the sights of McGuire’s 90-mm gun. The first round damaged the front left sprocket; the second sheered off most of the barrel. Another 90-mm from the same battery took out a half-track and two Panthers before pressure from advancing infantrymen forced the

battery commander to destroy the gun.¹²⁸ A few days later, Battery B from the same battalion engaged a platoon of German tanks near Stavelot, killing all four.¹²⁹

Fighting in the frozen forests of the Ardennes challenged the ability of antiaircraft crews to maintain their equipment in fighting condition. Antifreeze was hard to come by except for division troops. Some antiaircraft crews scrounged wood alcohol from medics, while others drained their radiators nightly and substituted oil for water in their single machine guns. The weather played havoc with the already delicate weapons sights. The need to move quickly required crews to place wood underneath their wheels and half-tracks to keep them from freezing to the ground. The strain of heavy snow and the concentrated weight of the turret caused the rear axles on M16s half-tracks to snap frequently. The need for vehicle tires and tubes far exceeded supply. With replacement vehicles and parts taking three weeks to arrive in theater and priority given to frontline divisions, antiaircraft crews took superb care of their equipment. The alternative was to fight as infantry—which they frequently did anyway.¹³⁰

Besides their support for the ground forces, the antiaircraft crews continued to down German planes. On 1 January 1945, the *Luftwaffe* made its largest effort of the battle, launching over 800 planes in eight major raids against Allied positions across the front. In many places, the attack was intense. One automatic weapons battery shot down seven planes within minutes. Several units recorded fifteen kills. In what would later be called “The Antiaircraft Battle of 1 January 1945,” American antiaircraft units destroyed 320 planes and damaged another 102 to the point that they probably crashed on the way back to base. American fighter aircraft shot down another 160 for a total approximating 582 aircraft destroyed in one day.¹³¹ Unaware of the air offensive, German antiaircraft

units shot down another 90 to 100 of their own aircraft as they returned to base.¹³² Captured German pilots remarked that they had “never seen anything like it.... I’d rather jettison my plane than face ... American AA fire.”¹³³ First, by supporting the ground forces in their battle to stop advancing German divisions, and then, in the air during the greatest antiaircraft battle of the war, antiaircraft artillerymen were fighting their way on to the combined arms team.

Less than seven weeks after the Battle of the Bulge, antiaircraft crewmen made perhaps their most significant contribution toward directly shortening the war with the defense of the Ludendorf Railway Bridge across the Rhine at Remagen. On the morning of 7 March, the 9th Armored Division moved to seize crossing sites on the west side of the Rhine and establish contact with the Third Army to its south. As the Division moved toward Remagen, an artillery spotter plane looking for targets spied the bridge through the fog at 10:30 a.m. It was still standing; inexplicably, the Germans had failed to destroy it as they retreated across the Rhine. Apprised of the situation, Brigadier General William Hoge, commander of CCB, immediately ordered the nearest units to seize the bridge. As American forces approached the structure, retreating German engineers attempted to blow it up. They detonated explosives, but still the bridge stood. American engineers and armored infantrymen charged across the bridge and established a narrow bridgehead on the other side.¹³⁴

As American forces moved to exploit this unexpected opportunity, the 482nd Automatic Weapons (Self-Propelled) Battalion, commanded by Lieutenant Vincent Lupinacci, rushed to the bridge, arriving around 8:30 p.m. It would take until 3:00 a.m. the next morning before he could push vehicles across. Later that morning, the 413th

Antiaircraft (90-mm) Gun Battalion, which weeks earlier had destroyed six tanks and fought off several infantry attacks on Elsenborn Ridge during the Battle of the Bulge, arrived to reinforce the antiaircraft forces around Remagen. In an indication of how the perceived value of antiaircraft artillery had improved since the early days of rear area protection in North Africa, one of Lupinacci's half-track mounted Quad-.50 machine guns was the thirteenth vehicle across the bridge. By now, even infantrymen understood that capturing the bridge intact was a huge stroke of good fortune and that soon the Luftwaffe would strike.¹³⁵

It did not take long for the *Luftwaffe* to react. Later that morning, three Stukas and an Me-109 attacked the bridge in single file. In short order, "pieces of three Stukas and one Me-109 drifted to earth or crashed into the Rhine."¹³⁶ Again that afternoon, eight Stuka dive bombers attacked the bridge; none survived. Unable to attack the bridge from the air, the Germans shelled it with artillery. As American soldiers expanded the bridgehead and pushed the Germans back, the artillery attacks slackened, but not before Lupinacci's battalion lost ten half-tracks to enemy fire. As thousands of soldiers and vehicles poured into Remagen, the First Army continued to reinforce the antiaircraft units defending the bridge. The 16th Antiaircraft Artillery Group assumed responsibility for defending the bridge and coordinating the efforts of the antiaircraft units from III and V Corps. By 14 March, thirteen battalions had massed around the bridge. In what was probably the greatest concentration of antiaircraft weapons in the European Theater, the 16th Antiaircraft Group controlled a total of 64 90-mm guns, 128 trailer-mounted Quad-.50 caliber machine guns, 100 self-propelled Quad-.50s, 216 40-mm guns, 24 combined guns (37-mm and .50 caliber), and 140 .50 caliber machine guns and several barrage

balloons. The Group even used an SCR-584 radar to spy upstream and catch any saboteurs trying to swim or float to the bridge and disable it.¹³⁷

From 7 to 21 March, an estimated 442 German aircraft, including sixty-seven new Me-262 jet fighters, attacked the bridge and the surrounding defenses.¹³⁸ The jets were a new wrinkle. Capable of flying at up to 400 miles per hour, their speed forced automatic weapons crews to abandon aimed fire and resort to barrage firing in hopes of catching one in a wall of flak. Each time an aircraft passed near the bridge, antiaircraft crews threw up vast amounts of ordnance. One observer noted, “There was so much firing that the ground shuddered; it was awesome. The entire valley around Remagen became cloaked in smoke and dust before the Germans left—only three minutes after they appeared.”¹³⁹ Antiaircraft gunners destroyed 142 aircraft and severely damaged another fifty-nine more.¹⁴⁰ On 17 March, as a result of the earlier attempted demolition and the weight of advancing vehicles, but untouched by a single *Luftwaffe* bomb, the bridge collapsed. By that time, Lieutenant Colonel David Pergrin’s 291st Engineer Battalion had built a treadway bridge 200 yards downstream allowing thousands of soldiers to cross.¹⁴¹ That same day Hitler launched eleven V-2 ballistic missiles at Remagen to no avail.

The attack on the Remagen Bridge was the last great effort by the *Luftwaffe* and the bridge’s defense the last significant stand by American antiaircraft artillerymen in Europe. Together with their counterparts in England and along with the British and American air forces, American antiaircraft artillerymen demolished the *Luftwaffe*. In North Africa, the Mediterranean, Great Britain, and Western Europe, the complementary strengths of the Allied air forces and the antiaircraft artillery establishment proved too much for Germany to overcome. From D-Day until the end of the war in Europe on 8

May 1945, American antiaircraft artillerymen destroyed 3,165 enemy aircraft and over 2300 V-1 pilotless aircraft. They adjusted to the lessons of Kasserine Pass, made changes to their organizational structure, and with the aid of scientists, integrated new and better technologies into the force. Most of all, they learned how to operate with the other combat arms, if not as an equal, certainly as an accepted member of the family.

The Army also learned some valuable lessons as result of the campaign in Europe. As it applied to the antiaircraft structure, General McNair's concept of pooling was a failure. The flexibility needed to support the concept of pooling undermined the authority and responsibility of commanders, as witnessed in the flawed "battalion-group" arrangement. Moreover, it was simply impossible to implement either in the deserts of North Africa, the mountains of Italy, or the rolling terrain of Western Europe. Combat commanders quickly realized that they needed better teamwork and increased firepower. They could get neither quickly by drawing forces from a pool of centrally located units. Division commanders consistently employed a mix of infantry, armor, tank destroyers, engineers, *and antiaircraft units* to defeat the Germans. In June 1945, Eisenhower established a board of general officers to study the Army's performance and recommend changes to the structure of the force. One of the most far-reaching recommendations offered was the inclusion of an antiaircraft artillery battalion as part of the division. As a result of their performance in Europe, the antiaircraft artillery finally gained the credibility and respect of the rest of the Army. Most importantly, after more than twenty-five years of tireless effort, the antiaircraft artillery establishment had won a spot on the combined arms team.¹⁴²

Antiaircraft Artillery in the Pacific

Like their sister units in Europe, antiaircraft forces in the Pacific quickly learned the lessons of Pearl Harbor and Clark Field. Given the ability of aircraft to cross the vast distances of open ocean that characterize the Pacific, the protection of forward airfields became a primary importance. To defend the high number of airfields, antiaircraft units deployed to the Pacific in large numbers. Within a year following Pearl Harbor, 187 batteries and 27,000 antiaircraft artillerymen were sent to the area. They defended airfields, choke points, troop concentrations, and supply depots. As part of General Douglas MacArthur's island-hopping campaign, antiaircraft units conducted countless amphibious operations and coordinated airspace requirements closely with the Navy and Army Air Forces.¹⁴³

Antiaircraft units, confident in their own abilities, quickly established a solid reputation and gained acceptance with the ground and air forces. After a short while, the ritual became routine. Antiaircraft automatic weapons landed with the initial assault, often requiring crews to manhandle their weapons through the surf. Next came the 40-mm Bofors units, followed by the 90-mm guns and their radars—all in place by nightfall. During amphibious operations, airspace control resided with the Navy until land-based aircraft were ready to take over. In practice, however, the situation resolved itself much quicker. Usually as soon as the antiaircraft operations room ashore became operational, control passed from the Navy to the Army. The joint forces refined this procedure over several landings. By 1944, fratricide was almost nonexistent.¹⁴⁴

Becoming fully operational by nightfall was a critical component of unit defense in the Pacific. Japanese soldiers sometimes conducted "banzai" charges into American

positions in such strength that antiaircraft automatic weapons units were the only ones who could shoot fast enough to defeat the attacks. Like their counterparts in Europe, antiaircraft units in the Pacific employed their automatic weapons and 90-mm guns in support of ground operations on numerous occasions. At Nassau Bay, the 209th Antiaircraft Battalion swept Roosevelt Ridge, enabling the 41st Infantry Division to move forward. During the second Philippine campaign, 90-mm guns fired both in the direct fire mode and as field artillery. Indeed, the 90-mm gun became the sniper weapon of choice throughout the theater. In the Philippines, after twenty-two days of combat, a 90-mm detachment had closed seventy-five caves, destroyed forty pillboxes, and knocked out thirty-two gun positions and machine gun nests. On Bougainville in March 1944, 90-mm guns “sniped” at individual Japanese fighting positions too remote for infantrymen to approach unharmed. Not to be outdone, at Cebu, a 40-mm Bofors unit chopped down trees, sprayed the jungle prior to infantry assaults, and destroyed seventy-one pillboxes, twenty-nine machine guns and three mortars. On Saipan, both the 90-mm and 40-mm guns provided direct fire into caves. The half-tracked 40-mm guns even served as armored observation points for field artillery observers.¹⁴⁵

At night and for specific operations, antiaircraft units support the ground forces. During the day, they guarded against air attacks. In defense of Morotai, antiaircraft crews shot down thirty-seven of 200 attacking aircraft. At Leyte, from October to December 1944, the 32nd Antiaircraft Artillery Brigade destroyed more than 251 Japanese aircraft.¹⁴⁶

At Okinawa, however, *kamikaze* pilots posed the greatest challenge to antiaircraft artillerymen. Like their Allied brethren defending England and Antwerp against the V-1

bomb, antiaircraft crews defending Okinawa battled aircraft that did not turn away in the face of stiff antiaircraft fire. Unlike the German V-1, however, the Japanese *kamikaze* pilot was a living, breathing, and reacting force.¹⁴⁷ Okinawa was the bloodiest campaign of the war in the Pacific. The campaign cost the United States over 49,000 casualties, including 12,250 killed or missing. The United States lost 763 aircraft and had 36 ships sunk and another 368 damaged. *Kamikaze* suicide pilots sunk 26 of those ships and damaged 164 more. Japanese casualties, however, were much higher. The Japanese suffered approximately 110,000 military casualties and another 100,000-plus civilians deaths during the campaign. They also lost 7,830 aircraft, 1,900 of them *kamikazes*.¹⁴⁸

Although the Navy bore the brunt of the suicide attacks, antiaircraft units ashore added their fire to the “flak umbrella” that covered the fleet and protected the vital airfields. On 6 April 1945, the Japanese initiated the first and largest of ten coordinated suicide attacks against the American forces in the vicinity of Okinawa. The main attack consisting of almost 700 Japanese aircraft, including 355 suicide sorties, commenced that afternoon. *Kamikaze* pilots destroyed several ships, while

Number	Date (1945)	Suicide Planes
1	6-7 April	355
2	12-13 April	185
3	15-16 April	165
4	27-28 April	115
5	3-4 May	125
6	10-11 May	150
7	24-25 May	165
8	27-28 May	110
9	3-7 June	50
10	21-22 June	45
Subtotal		1,465
Additional Sporadic Attacks		435
Total		1,900

Source: United States Strategic Bombing Survey (Pacific), Naval Analysis Division, *The Campaigns in the Pacific*, (Washington, DC: Government Printing Office, 1946), 328.

Table 10.1
***Kamikaze* (Suicide) Attacks on Okinawa**

the Japanese lost an estimated 335 aircraft in the attack. While naval aviators scored the majority of victories, Army antiaircraft units got into the fight, downing at least two *kamikaze* planes and several other aircraft.¹⁴⁹

These mass raids continued throughout the campaign. Another raid of 392 conventional and *kamikaze* aircraft occurred on the night of 12-13 April. A third raid of 498 aircraft (165 of which were flown by *kamikaze* pilots) took place on 15-16 April. At the end of April, the Japanese attacked again with over 115 suicide pilots. On 24-25 May, during the seventh of ten attacks, the Japanese made their last concerted effort. This time, besides the 165 *kamikazes* sent toward Okinawa in seven waves, the Japanese dispatched five bombers toward Yontan airfield carrying 120 members of the Japanese Special Attack Corps, elite suicide commandoes, to create as much damage as possible. Army and Marine automatic weapons crews destroyed four of the five bombers as they landed and damaged another. Several heavily armed, suicidal Japanese soldiers managed to escape the wreckage and destroy seven aircraft and damaging twenty-six others before they were killed. Although the Navy suffered most of the damage from air attack and downed most of the Japanese aircraft, antiaircraft artillerymen performed admirably, accounting for 127 planes destroyed, twenty more probably destroyed and at least fifty-six damaged throughout the campaign.¹⁵⁰

By the end of the war, antiaircraft artillerymen operating in the Pacific destroyed 882 Japanese airplanes.¹⁵¹ The numbers of aircraft destroyed or damaged by antiaircraft men in the Pacific were not as high as the figures presented by antiaircraft forces in Europe. Nonetheless, the antiaircraft units in the Southwest Pacific Areas played an important role in defending ground forces from air attack. Moreover, they shared the salt

and the sand with infantrymen, gaining credibility and external support during countless amphibious assaults and an untold number of battles to fend off “banzai” charges with the amazing killing power of their automatic weapons. Over mountains, through jungles, and across the sand and surf, antiaircraft artillerymen emerged from their Interwar cocoon to overcome the hard beginnings at Pearl Harbor and Clark Field and grow into a formidable force that through shared sacrifice and strong performance on the battlefield solidified their place as important members of the combined arms team.

CHAPTER 11

CONCLUSION: LEGITIMACY, LEGACY, and LESSONS on INNOVATION

Now there is no longer a Coast Artillery Corps or even an Antiaircraft branch of the Army.... The day when Coast Artillery and Antiaircraft Artillery tended to function as entities more or less independent of the field army is long past. In World War II ... Antiaircraft Artillery has taken its place as a full-fledged member of the Army combat team. The great firepower, the flexibility and the accuracy of antiaircraft ... guns have proved their great value against targets on the ground as well as in the air....

*Lieutenant General Lyman L. Lemnitzer
Deputy Chief of Staff, Plans and Research
Department of the Army
December 1954¹*

By any imaginable standard, World War II was a colossal undertaking—
incredible in the scope and magnitude of its requirements and unparalleled in its cost in
lives and treasure. Millions of soldiers, sailors, airmen, and Marines fought for control
over hundreds of millions of square miles of the Earth’ surface, sub-surface, and airspace.
An estimated fifty-five to sixty million civilian and military personnel died in a conflict
that cost trillions of dollars to fight and destroyed physical assets of even greater value.
The dramatic increases in the size of the American armed forces to fight the war and the
budget to support it are but two of the statistics that highlight the vast extent of the
endeavor. Compared to 1939, the last year of pre-war military effort, the United States

increased its military spending 8000 percent and the size of its armed forces 3500 percent. In 1939, America spent approximately \$1 billion on defense and had 339,000 men in uniform. By 1945, defense spending topped \$82 billion and just over 12 million men and women were serving in the military.² The United States Army grew from 189,839 soldiers in 1939 to nearly 8.2 million in 1945, 5.9 million in the ground forces and 2.3 million in the air forces.³ Within the Army, the antiaircraft establishment grew from fourteen “skeletonized” battalions in 1939 to a peak of 431,000 men and 557 battalions in 1943.⁴ Organizing, training, equipping, deploying, and leading this force in global combat was an extraordinary achievement.

Performance Under Fire Leads to Changes in the Status Quo

World War II was also a cataclysmic event that violently demolished the standing order among nations and overthrew the existing status quo within American military organizations. It changed the status quo in Europe and the Pacific, reducing Germany and Japan to occupied powers and elevating the United States and Russia to positions of leadership within a bipolar world. The war also changed the status quo within the United States Army, raising the stature of the Army Air Forces and ultimately resulting in its independence from the Army in 1947.

The war further ended forever the battle between the antiaircraft and seacoast artillery for bureaucratic and institutional primacy within the Coast Artillery Corps. As rearmament began in the late 1930s, the antiaircraft artillery had already begun to surpass the seacoast artillery in perceived importance within the War Department. Largely because of concerns about the potential impact of air power, spending on antiaircraft force structure and equipment skyrocketed, while investment in seacoast artillery

stagnated. Beginning in December 1941, battlefield realities rapidly accelerated the pre-war trajectories of both organizations. In the opening months of the war, the antiaircraft and seacoast artillery establishments fought together on Corregidor. Following the surrender of the Rock, however, the divergent paths of these two institutions resembled twin siblings separated shortly after birth. The antiaircraft artillery went on to earn respect and renown on battlefields across the world, while the seacoast artillery faded into obscurity. Acknowledging this dichotomy, Major General Joseph Green commented delicately that “with the exception of a few units, our Seacoast Artillerymen have not had the opportunities for action and glory that have been offered the AAA.”⁵ In reality, after Corregidor, very few, if any, seacoast artillery batteries fired a shot in anger.

Regarding the antiaircraft artillery, Green reflected that the “AAA [was] performing its normal missions with distinction” and providing the ground forces with anti-personnel, anti-tank, and artillery fire “in a manner that reflects glory on the Coast Artillery Corps.” In early December 1944, Green offered that as a result of its battlefield performance, “other combat arms have learned to appreciate the work of the AAA and been unsparing in their praise.”⁶ The contributions of antiaircraft units during the Battle of the Bulge, the defense of the Remagen Bridge, and across the Pacific only further solidified the reputation of the antiaircraft artillery.

Indeed, combat commanders in Italy, Europe, and the Pacific had nothing but praise for the performance of antiaircraft artillery units during the war. In commenting on the “outstanding antiaircraft defense” he received, General George Patton lauded the “superior training, skill, and coolness under heavy enemy bombardment and strafing,” “the enviable record,” and “the high degree of efficiency” achieved by his antiaircraft

units and credited them with contributing “immeasurably to the overall success of the Third Army.” In offering his “congratulations” to General Green for revamping the Antiaircraft Command’s training program, General Lesley McNair forwarded comments from a corps commander in the Pacific who was equally pleased with the antiaircraft support he received, characterizing it as “excellent” and considering himself “privileged” to watch antiaircraft crews operate.⁷

As the failures at Pearl Harbor, the Philippines, and Kasserine Pass demonstrated, the success of antiaircraft units in protecting ground forces from air attack was not immediate. Like the Army as a whole, the antiaircraft artillery got off to a rough start and was bloodied early in the war. Together with the rest of the Army, however, the antiaircraft artillery recovered from its early defeats, learned from its mistakes, and made critical technical and tactical adjustments to emerge victorious. The Army and its subordinate headquarters and arms were learning organizations and their ability to adapt and learn from the experience of their “first battles” moved them to the head of the class in the “schoolhouse of war.”⁸ Most of the other students in the class—the French, Japanese, Germans, and Russians—studied the problem and invoked change from above. While the Germans (in World War I and following their victory in Poland in 1939) and Russians (after recovering from their initial losses to Germany in 1941-1942) were particularly effective in changing their doctrine and altering the way in which their armies fought, top-down change often takes time. As the French found out in 1940, time is often a luxury that top-down militaries cannot afford. Moreover, when change is driven from above, it is either “very, very right” or “very, very wrong,” as the German

military discovered when it ceded strategic, operational, technical, and often tactical control to Hitler.⁹

Compared to the other major warring powers, the American Army was a pragmatic organization whose ethos encouraged decentralized and nondirective problem solving. Neither the Army nor the Antiaircraft Command changed its warfighting doctrine once the war began in earnest. Instead, staffs collected, analyzed, and circulated combat lessons to the field. Unlike other armies, the American Army viewed doctrine as a guide to action, not a *vade mecum* to follow blindly. One of the hallmarks of American operations was the speed with which units adapted to challenging circumstances. Commanders were expected to use their training and experience, apply judgment and creativity to issues, and solve problems *quickly*. Like Colonel “Pat” Patterson’s non-standard, extramural “requisition” of 700 half-tracks to make his automatic weapons crews more mobile, innovation from within the ranks was the encouraged and rewarded.¹⁰

Institutionally, the War Department, the Army Ground Forces, and the Antiaircraft Command collected information from field commanders, dissected problems, and initiated far-reaching adjustments to organization, unit training and equipment that led to more effective combat units. These organizations also disseminated the latest combat information quickly to commanders in the field. The War Department did so through its *Combat Lessons* publications, while the Army Ground Forces circulated information via bulletins through the Army military education system and out to units. The Antiaircraft Command initiated several intelligence and operations summaries before

collaborating with the Army Ground Forces on the “Antiaircraft Artillery Information Bulletins” in 1944.

Technically, the 90-mm gun and the suite of mounted and towed multi-barreled automatic weapons greatly enhanced antiaircraft killing power, while the advent of the SCR-268, and later the SCR-584 radars, vastly improved early warning and target tracking. In fact, the SCR-584 radar was the “answer to the antiaircraft artilleryman’s prayer” and the “best ground radar airplane killer of the war.”¹¹ Technologically, however, the antiaircraft “system,” consisting of the SCR-584 radar, the 90-mm gun, the M9 electrical director for fire control, and the proximity fuze, revolutionized the context in which units conducted high altitude antiaircraft gunnery. The antiaircraft “system” was definitely non-linear in its origin, development and arrival in the field. Various elements of the “system” emerged from different stimuli and arrived in the field at unprogrammed intervals. Some “sub-systems,” such as the 90-mm gun, were logical extensions of the 3-inch gun, while others, like radar and the proximity fuze, resulted from recent technical breakthroughs enhanced by early wartime collaboration with the British. While not completely “hands free,” the “system” was fast, smooth, and accurate—a deadly combination. The skillful use of this “system” during the defense of London and Antwerp against V-1 pilotless aircraft and during the *Luftwaffe*’s final New Year’s Day surge in the Battle of the Bulge enabled the Allies to recapture the operational initiative, sustain their drive into Germany, and tip the strategic balance in Europe.

Tactically, antiaircraft crewmen proved they were adept at combat adaptation. Proving that “team play comes with practice,” antiaircraft, air, and ground forces learned

to work together to improve air-ground integration and to reduce fratricide incidents significantly. Similarly, the habitual association hoped for by antiaircraft doctrinal authorities in the 1930s came to fruition on the battlefield. In general, the concept of pooling as envisioned by General McNair did not work either in the Pacific or in Europe. In the Pacific, the tyranny of distance combined with the unique expertise required to support amphibious operations to limit the ability and desire of commanders to shift antiaircraft (or other) units around the theater quickly. In Europe, commanders abandoned the concept in favor of the semipermanent attachment of units necessary to accomplish the mission. “By late 1944, division commanders consistently had a mix of infantry, tank, tank destroyers, antiaircraft, an engineer units to influence the battle.”¹²

Concerned about air attack, division commanders tended to find an antiaircraft outfit they had confidence in and then to hold on to it. At Omaha Beach, for example, the 463rd Antiaircraft Battalion landed on 28 June without specific orders attaching it to a division so Lieutenant Colonel Robin McCormick, the commander, picked the 79th Infantry Division from a list of units already ashore. McCormick and Major Jack Rogers, the operations officer, went to see the division commander, Major General Ira T. Wyche, and found that the division did not yet have an attached antiaircraft automatic weapons battalion. They offered the battalion’s services to Wyche, who accepted. The next day, Wyche chased away another battalion whose commander insisted it was supposed to support the 79th Division, stating flatly, “Look, we know the 463rd, they’re here, they’re dug in; so why don’t you take your battalion and go away?” Eleven days later, the 463rd shot down their first aircraft while protecting the 79th Division and remained with it for the rest of the war.¹³

Beyond their demonstrated ability to protect units and assets from air attack at places like Omaha Beach and the Remagen Bridge, antiaircraft artillerymen captured the affection and respect of maneuver commanders with their flexible support for ground operations. Whether it was employing Quad .50 machine guns or 40-mm Bofors to suppress German positions in the hedgerows of Normandy or to stop Japanese “banzai” charges in their tracks, sealing caves with 90-mm “sniper” cannons, dropping silent and deadly 90-mm artillery fire on unsuspecting German units, or destroying Panther and Tiger tanks in the Ardennes forest, antiaircraft crews found innovative ways to kill the enemy—much to the delight of infantry, armor, and artillery commanders.

At the end of the war, many of those same commanders transformed their appreciation for the ability of antiaircraft units to support their divisions into action and provided essential external support for changing the status quo during the General Board review of lessons learned during the war in Europe. As part of the review that began in the summer of 1945, General Eisenhower directed a committee of general officers and experienced infantry commanders to examine the “organization, equipment, and tactical employment” of the division and recommend changes. One of the committee’s major recommendations was to add an antiaircraft artillery battalion to the division structure.¹⁴ In November 1946, the War Department changed the infantry and armored divisions accordingly and added a self-propelled antiaircraft automatic weapons battalion to the division organization.¹⁵

Occurring concurrently with the General Board in 1945, General George Marshall appointed a War Department board under the leadership of Lieutenant General Alexander M. Patch to investigate the roles and missions of the various branches and to make

recommendations for post-war reorganization of the Army. The results of this board recognized the obsolescence of the seacoast artillery and set the final nail in the coffin of the Coast Artillery Corps. Impressed by the performance of antiaircraft units during the war, the Patch board recommended dissolving of the Coast Artillery Corps and combining the antiaircraft artillery and remnants of the seacoast artillery with the Field Artillery.¹⁶

Bureaucracies, however, have a way of hanging on. As is often the case, in the aftermath of victory, change was slow in coming. In 1946, the Army began studying the issues of reintegration of the two artilleries, but it was not until the Army Reorganization Act of 1950 that Congress eliminated the Coast Artillery Corps after 43 years as a separate arm of the United States Army. The seacoast artillery disappeared and the antiaircraft artillery merged with the Field Artillery to form a single branch. As much to segregate and identify units as to signal a prescient understanding of the future, field artillery and antiaircraft units retained the “FA” and “AAA” suffixes to indicate their primary function.¹⁷ Eighteen years later, the Army acknowledged the ever-increasing importance of “AAA” for strategic and operational air defense and again split the artilleries, making air defense artillery a separate and distinct branch in 1968.

Adjustment in Combat is Only One Part of the Process of Change

Combat adaptation, the process of adjustment between the “first” and “last battles,” is simple to explain in theory, yet difficult to implement on the battlefield. Assuming a military force survives its “first battle,” it should examine its performance and adjust its doctrine, organization, training, tactics, and equipment to ensure success in the next engagement. The most effective forms of adaptation develop rapidly and, once

the decision to change is made, are ruthlessly executed and enforced. For those who are resistant to discard the comfortable routines and adopt new methods, the very tangible difference between victory and defeat serves as powerful incentive to change.

While understanding how and why an organization adapts in combat and emerges victorious is important, it is only one part of the process of change in military organizations. For a variety of reasons, the more difficult part of the process to conceptualize and affect occurs during the Interwar period, often long before the first cannon ever sounds. As discussed in theory and highlighted by example through the history of American antiaircraft development, strategists, analysts, and ultimately decision-makers must carefully review their most recent conflicts, extrapolate trends for the future, decide what adjustments to organization, doctrine, training, or equipment are necessary to ensure victory in the next war, and make the appropriate changes.

In World War I, commanders and national military leaders quickly recognized the increasing impact of dirigibles and later airplanes on combat operations. To counter this effect, all military organizations adapted their existing organizations and weaponry to fire upon the enemy's balloons and airplanes. Although America entered the conflict after the other warring nations, the "Archies" in the A.E.F caught on quickly, implemented a hybrid approach that borrowed more from the French than the British, and ultimately out-shot both their allies and enemies. After the war, a few visionaries within the Coast Artillery Corps recognized the effect the airplane had on the battlefield and foresaw a time when technology allowed the airplane to have a much greater impact on warfare. This combination of junior and senior officers--represented initially by the efforts of Captain Frank Clark, Major Oliver Spiller, and Brigadier General Johnson Hagood--

envisioned the future and realized their organization needed to change to be a meaningful part of it. Lest one ascribe too much prescience to this coterie of prognosticators, they received valuable intellectual assistance from General Billy Mitchell and the avatars of air power whose bombastic claims and spectacular demonstrations made the airplane hard to ignore.

To counter this expected development, Clark, Hagood, and others argued for increased institutional investment in the antiaircraft artillery element within the Coast Artillery Corps. In the post-World War I era of a “return to normalcy,” however, the timing was not right. When General Frank W. Coe, Chief of the Coast Artillery, tried to enlist external support for antiaircraft artillery development, the War Department offered only tepid doctrinal and institutional assistance. When he continued to push the issue and tried to have the Army include an antiaircraft battalion as part of the infantry division structure, the War Department responded by threatening to limit the Coast Artillery’s jurisdiction in antiaircraft artillery development.

Coe was unable to achieve the external consensus necessary to support increased antiaircraft development, but others achieved positive results by approaching the problem differently. Clark, Spiller, and Hagood initiated a program of doctrinal education designed to broaden the level of knowledge about antiaircraft artillery throughout the Corps, reduce anxiety among seacoast artillery officers about bureaucratic and professional competition, and foster internal consensus within the Coast Artillery in support of antiaircraft development. In this endeavor, they helped achieve an “intellectual revolution” among the leadership of the Coast Artillery and a “revolution on paper” among the rank and file. By 1930, the internal consensus was complete. Senior

Coast Artillery leaders mandated educational parity within the Coast Artillery School at Fort Monroe, the intellectual and institutional center of the Coast Artillery Corps, and junior officers wrote articles on a wide variety of antiaircraft topics and published them in the *Coast Artillery Journal* and other influential military periodicals. Although the Great Depression limited the amount of tangible financial support the Army could offer, a significant external consensus occurred as well by 1930. The War Department began to recognize the importance of antiaircraft artillery and further supported a shift in thinking within the Corps when it ordered all Coast Artillerymen trained in antiaircraft techniques. Indeed, the shifts of the 1930s prepared Coast Artillery for the rapid changes that took place from 1941-1945.

The Great Depression placed the Army on a subsistence diet that forced cooperation among the service arms instead of the competition that had previously existed. With respect to the battle for control of the sky, air and antiaircraft forces began to collaborate more frequently, conducting more joint experiments to examine and perfect current techniques. With the War Department somewhat willing, but now unable to offer financial support, the Coast Artillery continued its internal focus, revising its doctrine and organization several times throughout the decade. When the nation began to emerge from the Depression in mid-decade, the potential for global conflict seemed evermore likely. Soon evidence from wars in Spain and China confirmed the devastating potential of air power and motivated the War Department, starting in 1937, and President Roosevelt, as of November 1938, to support vast financial investment in antiaircraft artillery and aircraft.

By the end of the decade, the revamped antiaircraft artillery doctrine and organization received considerable external support throughout the Army. The War Department had revised its warfighting doctrine, increasing the role of antiaircraft artillery, and was slowly building a modern military force centered on hemispheric defense and protection of America's outlying possessions. When the Japanese attacked in December 1941, the military could see clearly the danger that lay ahead. Fortunately, the failures of Army and the antiaircraft artillery in their "first battles" at Pearl Harbor and in the Philippines were remote and limited enough that both organizations could regroup and reorganize before fighting again. At Kasserine, the Army and its antiaircraft artillerymen suffered a tactical defeat enroute to an operational and strategic victory. In the process, they learned valuable lessons that both organizations put to good use during combat in Europe and the Pacific.

Several official military histories of the Interwar and World War II periods argue that fiscal austerity imposed by a parsimonious Congress in the 1920s, and reinforced by the Great Depression in the 1930s, starved the Army of the resources it needed to develop a more capable force, and that lives were lost in combat for this failure to invest in defense. Recent scholarship by David Johnson in *Fast Tanks and Heavy Bombers* counters that internal barriers to change- and single-issue constituencies within a service- were the predominant reasons for the Army's manifest unpreparedness during the early stages of World War II. As this analysis has shown, with respect to the development of U.S. Army antiaircraft artillery the truth lies somewhere between these competing points of view. Certainly doctrinal and institutional development would have advanced further

had the seacoast and antiaircraft artillery establishments not fought over bureaucratic prerogatives.

Yet, by 1930, evidence indicates that near parity existed between the two entities and that most of the bureaucratic battles were over. The severe poverty that accompanied the Great Depression, however, drove units into caretaker status and retarded greater intellectual and technical development than otherwise might have been possible had more resources been available. Units that served with the Civilian Conservation Corps could not train or perfect their gunnery skills with the paltry amount of ammunition available. Antiaircraft units at half-strength or less, and with little or no money to support training, did not travel to training areas to develop the combined arms techniques necessary to integrate seamlessly with infantry divisions. The inability to invest in promising technologies caused the development of automatic weapons and radar to suffer. “Team play” came only “with practice,” and in the constrained fiscal environment of the 1930s, the Army found it too expensive to explore promising technologies.

Legitimacy, Legacy, and the Long View of Change

The antiaircraft artillery establishment gained final legitimacy in the eyes of the War Department and its combat commanders by earning respect where it counted most—on the battlefield. Yet the antiaircraft establishment’s historical legacy rests as much on the relentless pursuit of a *concept* for air defense as it does on combat achievements. It is a legacy illustrative of the change that likely occurs during the interwar period between each of America’s wars. Historically, during times of peace, the military establishment has not received the external support from outside the services necessary to maintain warfighting readiness, much less boldly innovate. The American public and its elected

representatives have typically focused away from military pursuits in the immediate aftermath of conflicts. The Interwar period following World War I provides one example of that trend. The periods immediately following World War II, Korea, Vietnam, and the 1991 Persian Gulf War offer other examples of reduced external support for the military. During these spans, the American military as a whole and the Army in particular have had difficulty comprehending the lessons of past wars, visualizing emerging changes in the conduct of warfare, initiating reforms to exploit these changes, and better preparing for the next war.

In this constrained environment, the Army has paid only scant attention to air defense until the eve of the next conflict. Yet, the evolution of the antiaircraft artillery and its successor institution, the air defense artillery, has continued. Much like their Interwar predecessors in the Coast Artillery Corps, the air defenders of the post-World War II era—like most military professionals—have focused their internal intellectual and organizational energies toward understanding the changes in warfare even if they did not have the fiscal wherewithal to develop and test new “systems.” These professionals have thought long and hard about the future of warfare, broke down internal barriers to change, and developed the requisite consensus and organizational flexibility necessary to adjust quickly when the next cannon called them to war.

In the final analysis, changes in warfare spur changes in military institutions. The conduct of warfare changed dramatically during World War I. Pre-war concepts of rapid warfare and the *offensive a'outrance* succumbed to the mud-laden stalemate on the Western Front. Out of the conflict, however, emerged new tools of war and new methods for applying the tools that had previously existed. From 1918 to 1945, the rapid changes

experienced in World War I first gave way to slow evolutionary development against a backdrop of massive global economic and social change. Toward the end of the Interwar period, however, American military development accelerated, becoming almost revolutionary. From 1938 to 1942, the march to war triggered a series of non-linear advances that punctuated the gradual evolution of the Interwar period and converged into a “system” of combined arms warfare. Mobile ground forces, advanced strategic and tactical air forces, and a global navy merged together as an awesome striking force, all of which was supported by a mature, if imperfect, doctrine of mobile warfare that exploited new technology and was sustained by the latent industrial might of the United States.

This transformation of the American military occurred after the armed forces spent years in the barren wilderness of defense reform, drawing only meager subsistence from a nation otherwise preoccupied. The development of antiaircraft artillery within this environment occurred as a result of timing, a continuity of effort, and protection for the agents of change. It succeeded against the purveyors of the status quo by establishing internal and external consensus in support of change, by taking an incremental approach that accepted limited success and did not sacrifice the overall development of antiaircraft artillery on the altar of sweeping reform, and by operating in a disparate, non-linear, almost unseen fashion that enabled separate and distinct elements of the antiaircraft “system” to mature, often in a chaotic and random manner. There was no grand plan behind this development, nor was there an unseen hand pulling strings or opening doors. To a great degree, the success of the process rested with the coterie of like-minded individuals such as Frank Clark, Johnson Hagood, and Andrew Hero, who operated with similar--but not exact—intent over a twenty-year period. Once established, that intent—

like a broad axis of advance on the battlefield--provided a future generation of leaders with a long term direction of travel, but left them free to maneuver around short term obstacles as they became visible.

In the end, the preparation for war, like the conduct of it, is an art, not a science. Exact formulas for success do not exist. Periodically, however, patterns, cycles, and general trends of development present themselves. When they do, the advocates of change would do well to step back, view the tableau of events unfolding before them, and understand the artistry in motion before trying to color the canvas with a particular hue.

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NOTES

CHAPTER 1 - INTRODUCTION

¹Jay P. Hopkins, "Final Report of the Chief of Antiaircraft Service," comp. Historical Division, *Department of the Army, United States Army in the World War, 1917-1919*, (Washington, D.C.: Government Printing Office, 1948), 15:207-220; Charles E. Kirkpatrick, *Archie in the A.E.F.: The Creation of the Antiaircraft Service of the United States Army, 1917-1918*, (Ft. Bliss, TX: U.S. Army Air Defense Artillery Museum, 1984), 85-86.

²Kirkpatrick, 122-123.

³Newton D. Baker, "Report of the Secretary of War, 1919," *War Department Annual Reports, 1919*, 3 vols. (Washington, D.C.: Government Printing Office, 1920), 1:68.

⁴George C. Marshall, "Biennial Report of the Chief of Staff of the United States Army to the Secretary of War, July 1, 1943-June 30, 1945," in *The War Reports of General of the Army George C. Marshall and Others*, with a Foreword by Walter Millis (New York: J.B. Lippincott Company, 1947), 299.

⁵Brian McAllister Linn, "Peacetime Transformation in the U.S. Army, 1865-1965," in *Transforming Defense*, ed. Conrad C. Crane (U.S. Army War College, Carlisle Barracks, PA: Strategic Studies Institute, 2001), 15.

⁶For this position within leading general military history volumes, see Allan R. Millett and Peter Maslowski, *For the Common Defense: A Military History Of the United States of America*, (New York: The Free Press, 1984), 363 ("With little popular appetite for 'foreign wars' and increased peacetime military spending, the United States, especially the staffs of the Army and Navy, attempted to design a postwar military policy that reconciled the nation's muted internationalism and its commitment to 'normalcy'.") Also Russell F. Weigley, "The Interwar Years," in *Against All Enemies: Interpretations of American Military History from Colonial Times to the Present*, ed. Kenneth J. Hagan and William R. Roberts (Westport, CT: Greenwood Press, 1986), 259 ("Parsimonious Congresses and chief executives in the 1920s and 1930s prevented the design of the National Defense Act from attaining fruition.") For this position in general military history underwritten by the U.S. Army, see Martin Blumenson, "Kasserine Pass, 30 January-22 February 1943," in *America's First Battles, 1776-1965*, ed. Charles E. Heller and William A. Stofft (Lawrence: University Press of Kansas, 1986), 226 ("Although many dedicated individual professional soldiers during the 1920s and 1930s

conscientiously studied to be ready for the next war, decline, neglect, and stagnation marked America's military forces.") For this position in official military history, see Mark S. Watson, *Chief of Staff: Prewar Plans and Preparations*, U.S. Army in World War II, The War Department. (Washington, DC: Government Printing Office, 1991), 15-56, and most specifically, page 15 ("The armed forces of the United States underwent an almost continuous weakening from 1918 onward for a decade and a half.... The abiding need for trained and equipped ground forces, recognized and continuously recalculated by the Army's General Staff, was generally ignored by the ultimate authority in government.") and page 23 for Watson's description of the famine and feast cycle of military expenditures and defense support.

⁷David E. Johnson, *Fast Tanks and Heavy Bombers: Innovation in the U.S. Army, 1917-1945*, (Ithaca, NY: Cornell University Press, 1998), 1-3.

⁸Ironically, Phillip Meilinger complains in *The Journal of Military History* that the tracing of the history of ideas (particularly the history of ideas on the theory and doctrine of air power) has proven to be a "fairly barren field." He then continues for the next 25 pages "to enumerate and assess those works on air power theory and doctrine." This author only wishes to have such a "barren field" to plow through in search of fruitful sources associated with the history of antiaircraft artillery. See Phillip S. Meilinger, "The Historiography of Airpower: Theory and Doctrine," *The Journal of Military History* 64 (April 2000): 467-502. See Robin Higham and Donald Mrozek, ed., *A Guide to Sources of United States Military History: Supplement IV*, (North Haven, CT: Archon Book, 1998) for 192 separate sources on the United States Air Force or air power including over 80 on various aspects of air power during World War II.

⁹Ian V. Hogg, *Anti-Aircraft: A History of Air Defence*, (London: MacDonald and Jane's, 1978); Kenneth P. Werrell, *Archie, Flak, AAA, and SAM: A Short Operational History of Ground-Based Air Defense*, (Maxwell Air Force Base, AL: Air University Press, 1988); and James D. Crabtree, *On Air Defense*, (Westport, CT: Praeger Publishers, 1994).

¹⁰For works focusing exclusively on German antiaircraft development, see Hans Werner Patzki, *Vom Train zum Roland: Eine Geschichte der Deutschen Flugabwehrtruppe*, (Berg am See, Germany: Vowinckel-Verlag, 1988); Horst-Adalbert Kock, *Flak: Die Geschichte der deutschen Flakartillerie, 1939-1945*, (Bad Nauheim: Verlag Hans-Henning Podzun, 1954); Edward B. Westermann, *Flak: German Anti-Aircraft Defenses, 1914-1945*, (Lawrence, KS: University of Kansas Press, 2001) and Westermann, "Fighting for the Heavens from the Ground: German Ground-based Air Defenses in the Great War, 1914-1918," *The Journal of Military History* 65 (July 2001): 641-669.

¹¹United States Army Air Defense School, *Air Defense: An Historical Summary*, 4 vols., (Fort Bliss, TX: U.S. Army Air Defense School, 1965).

¹²Merritt Roe Smith, "Technological Determinism in American Culture," in Merritt Roe Smith and Leo Marx, eds. *Does Technology Drive History? The Dilemma of Technological Determinism*, (Cambridge, MA: The Massachusetts Institute of Technology Press, 1994), 2. This excellent volume of essays highlights the different schools of thought regarding the concept of technological determinism. These range from "hard" determinism, where technology as an entity becomes an agent of change, to "soft" determinism, that views the influence of technology as occurring within a more complex social, economic, political, and cultural matrix. Smith and Marx conclude that the power of technology to effect change lies somewhere in between and "may be derived from certain specific socio-economic and cultural situations....Once it has been developed, its determinative efficacy may then become sufficient to direct the course of events. In that case, ... it now refers to the human tendency to create the kind of society that invests technologies with enough power to drive history." (page xiv.)

¹³Kenneth E. Hamburger, "Technology, Doctrine, and Politics of United States Coast Defenses, 1880-1945: A Case Study in U.S. Defense Planning," (Ph.D. diss., Duke University, 1986).

¹⁴Hamburger, 267.

¹⁵Victor Gondos, Jr. "Army Historiography in the Second World War," *Military Affairs* 7 (Spring 1943) 60-68; and John D. Millett, "Historical Section, Army Service Forces," *Military Affairs* 8 (Summer 1944): 126-129.

¹⁶Edward B. Westermann, *Flak: German Anti-Aircraft Defenses, 1914-1945*, 1-5.

¹⁷For American antiaircraft artillery statistics on effectiveness against enemy aircraft, see LTC Alvin M. Cibula, "The Antiaircraft Command and Center (Army Ground Forces Study no. 26)," (Washington, DC: Army Ground Forces Historical Section, 1946), 209-211. Hereafter referred to as AAC. The U.S. Air Force Historical Research Agency website places the World War II Air Force Aerial Victory Credit total at 15,811.

See http://www.maxwell.af.mil/au/afhra/wwwroot/aerial_victory_credits/avc_total.html. Also U.S. Army Air Forces Aid Society, *AAF: The Official Guide to the Army Air Forces*, (New York: Simon and Schuster, 1944), 292 indicates that from December 1941 through March 1, 1944 the total AAF accomplishments were 525,954 sorties flown, 285,350 tons of bombs dropped, 12,656 enemy planes lost in aerial combat, another 1873 enemy planes destroyed on the ground, and 4217 AAF aircraft lost in aerial combat. By simple subtraction the number of enemy aircraft destroyed in aerial combat between 1 March 1944 and the end of the war in the Pacific appears to be approximately 3,155 (15,811 – 12,656). By comparison, American antiaircraft units in Europe shot down about 3151 from D-Day until the end of the war in Europe, roughly a ratio of 1:1.

¹⁸Reporting of American antiaircraft artillery effectiveness divided enemy aircraft engagements into three categories: destroyed, probably destroyed, and damaged.

Destroyed: Plane destroyed in air or seen to fall to ground or into the sea.

Probably Destroyed: Plane damaged in air so severely that it is very unlikely that the plane could have reached its base.

Damaged: Plane damaged, but not so severely enough to prevent it from reaching its home base. The plane should be seen to trail smoke or pieces of the plane fall.

Reports were to be verified by independent observers. Like reports of air-to-air engagements by airmen and ground engagements by tankers and infantrymen, all battlefield reports are subject to some discrepancies. It is important to note that this listing of destroyed, probably destroyed, and damaged aircraft does not include additional aircraft that were engaged, but not counted due to incomplete information in battlefield records. One expects the numbers may be slightly higher in each category. See AAC, 209.

¹⁹Peter G. Cooksley, *Flying Bomb: The Story of Hitler's V-Weapons in World War II*, (New York: Charles Scribner's Sons, 1979), 174-175, 185.

²⁰Firing restrictions prevented 55 of the 211 V-1s that reached the target area from being engaged. A. R. Dallmeyer, Jr., "Antwerp X: The Secret Command which Saved the Allies' Number One Supply Port," *Coast Artillery Journal*, vol. LXXXVIII, no. 5 (September-October 1945): 6.

²¹AAC, 210. Also, see Werrell, *Archie, Flak, AAA, and SAM*, 19. Werrell states that no fighter aircraft were used to defend Antwerp.

²²For President Roosevelt's remarks on the need for 50,000 airplanes, see Franklin D. Roosevelt, "Fifty Thousand Airplanes," reprinted in Eugene M. Emme, *The Impact of Air Power: National Security and World Politics*, (Princeton, NJ: D. Van Nostrand Company, Inc., 1959), 69-72.

²³Mark S. Watson, *Chief of Staff: Prewar Plans and Preparations*, 127-166. Watson notes Arnold's recollection of the meeting on page 127 and quotes Senator Lodge on page 166. See Wesley F. Craven and James L. Cate ed., *The Army Air Forces in World War II, Vol. 6, Men and Planes*, (Chicago: University of Chicago Press, 1955), 13 for Arnold's statement regarding \$1.5 billion.

²⁴Peter R. Mansoor, *The GI Offensive in Europe: The Triumph of American Infantry Divisions, 1941-1945*, (Lawrence, KS: University of Kansas Press, 1999), 47.

²⁵Robert R. Palmer, Bell I Wiley, and William R. Keast, *The Procurement and Training of Ground Combat Troops*, U.S. Army in World War II, The Army Ground Forces, (Washington, DC: Government Printing Office, 1948), 120-123.

²⁶Kent Roberts Greenfield, Robert R. Palmer, and Bell I. Wiley, *The Organization of Ground Combat Troops*, United States Army in World War II, The Army Ground Forces, (Washington, DC: Government Printing Office, 1987), 203. Figures for

antiaircraft strength are taken from the table on page 161. These figures are given only to the nearest thousand.

²⁷The size of the antiaircraft establishment (246,000) represented 11.8 % of the combined antiaircraft and air force strength (246,000 + 1,831,091 = 2,077,091) in 1945.

²⁸For the number of enemy aircraft destroyed on the ground, see U.S. Army Air Forces, Office of Statistical Control, *Army Air Forces Statistical Digest, World War II*, (Washington, DC: Government Printing Office, December 1945), 262-268.

²⁹For information on numbers of aircraft destroyed in Europe by American antiaircraft gunners including those in the First and Third Army areas, see AAC, 209. Information concerning Normandy and the Breakout is paraphrased from Werrell, *Archie, Flak, AAA, and SAM*, 21-22.

³⁰AAC, 217.

³¹In addition to President Roosevelt's concern expressed in November 1938, see Watson, *Chief of Staff: Prewar Plans and Preparations*, 167 for Roosevelt's inquiry about the status of antiaircraft artillery in May 1940.

³²Greenfield, Palmer, and Wiley, *The Organization of Ground Combat Troops*, 419.

³³See Mansoor, *The GI Offensive in Europe*, 31-48 for a succinct discussion of problems with infantry division strength.

³⁴Eisenhower described this attack as causing the "greatest single loss from air action inflicted upon us during the entire period of Allied campaigning in the Mediterranean and in Europe." The attack struck a fuel ship. The escaping oil caused several other ships to catch fire. Additionally, one of the destroyed ships was loaded with mustard gas, which the Allies carried as a reprisal against the German use of chemical weapons. "Fortunately the wind was offshore and the escaping gas caused no casualties. Had the wind been in the opposite direction, however, great disaster could well have resulted." Moreover, the loss of life due to mustard gas would have been very difficult to explain and likely resulted in an Axis public relations coup. Dwight D. Eisenhower, *Crusade in Europe*, (Garden City, NY: Doubleday and Company, 1948), 204-206.

³⁵I.B. Holley contends that aluminum probably caused the most confusion and alarm of any material shortage. As he explains, this shortage was as much an issue about cooperative scheduling as it was a lack of raw materials. Irving Brinton Holley, Jr., *Buying Aircraft: Materiel Procurement for the Army Air Forces*, United States Army in World War II, Special Studies, (Washington, DC: Center of Military History, 1989), 250-252.

³⁶If not December 1941 as Craven and Cate indicate, the U.S. was certainly leading all nations in aircraft production by 1942. The combined production of the U.S. and Great Britain led the world in 1940.

Year	Japan	Germany	Great Britain	United States
1939	4,467	8,295	7,940	2,141
1940	4,768	10,826	15,049	6,086
1941	5,088	11,776	20,094	19,443
1942	8,861	15,556	23,672	47,836
1943	16,693	25,527	26,263	85,898
1944	28,180	39,807	26,461	96,318
1945	8,263		12,070	46,001

Source: Wesley F. Craven and James L. Cate ed., *The Army Air Forces in World War II*, Vol. 6, *Men and Planes*, (Chicago: University of Chicago Press, 1955), 350.

Table 1.3 – Aircraft Production by Year

³⁷R. Elberton Smith, *The Army and Economic Mobilization*, United States Army in World War II, The War Department, (Washington, DC: Center of Military History, 1985), 11 and 27. The ground forces, less the antiaircraft artillery, received the other 965,365 machine guns. Also, for comments on the machine gun program, see James A. Huston, *The Sinews of War: Army Logistics 1775-1953*, Army Historical Series, (Washington, DC: Center of Military History, 1988), 475. For a comparison of British, American, and German aircraft production, see Williamson Murray, *Luftwaffe*, (Baltimore: The Nautical and Aviation Publishing Company of America, 1985), 101-105, and Craven and Cate ed., *Men and Planes* 350.

³⁸Huston, *The Sinews of War*, 476-477.

³⁹Watson, Chief of Staff: Prewar Plans and Preparations, 314-316.

⁴⁰*Ibid.*, 150-151. Also see, Mark A. Stoler, *George C. Marshall: Soldier-Statesman of the American Century*, (Boston: Twayne Publishers, 1989), 65. Also, George C. Marshall interview, March 6, 1957, in *George C. Marshall Interviews and Reminiscences for Forrest C. Pogue*, ed. Larry I. Bland, (Lexington, VA: George C. Marshall Research Foundation, 1991), 108. Hereafter cited as Marshall Interview with date and appropriate page number.

⁴¹Carl von Clausewitz, *On War*, ed. and trans. Michael Howard and Peter Paret, (Princeton: Princeton University Press, 1976), 357.

⁴²See Walter Russell Mead, “The Jacksonian Tradition,” in *The National Interest*, 58 (Winter 1999):1-25 for more on the elements of the “Jacksonianism”.

⁴³Russell F. Weigley, *The American Way of War: A History of United States Military Strategy and Policy*, (Bloomington, IN: Indiana University Press, 1977), xix-xxii.

⁴⁴See Michael Sherry, *The Rise of American Air Power: The Creation of Armageddon*, (New Haven: Yale University Press, 1987) for more psychosocial analysis of America's understanding of the doctrine of air power, particularly strategic bombing, and its appreciation of the aircraft.

⁴⁵Greenfield, Palmer, and Wiley, *The Organization of Ground Combat Troops*, 295. Italics added.

⁴⁶This is Kenneth Werrell's phrase. Specifically, "Readers are more interested in aircraft than the weapons that bring them down." See Werrell, *Archie, Flak, AAA, and SAM*, xv.

⁴⁷Peter Paret, foreword to *To Change an Army: General Sir John Burnett-Stuart and British Armored Doctrine, 1927-1938*, by Harold R. Winton (Lawrence, KS: University Press of Kansas, 1988), vii.

⁴⁸See Clausewitz, *On War*, ed. and trans. Howard and Paret 1976 edition, 127-132.

⁴⁹For more on the need for militaries to learn, anticipate, and adapt to changes in warfare, see Eliot A. Cohen and John Gooch, *Military Misfortunes: The Anatomy of Failure in War*, (New York: The Free Press, 1990).

⁵⁰For an incisive explanation of five variations of military history, see Allan R. Millett, "The Study of Military History in the United States since World War II," in *Mededelingen van de Sectie Militaire Geschiedenis (Proceedings of the Army Historical Section)*, Centenary Issue, *Military History Around the World*, (The Hague: Army Historical Section of the Royal Netherlands Army, 1991): 109-129.

⁵¹Paret, foreword to *To Change an Army*, vii.

⁵²I am grateful to Dr. Christopher Gabel of the United States Army Command and General Staff College for his insightful comments on the "interwar" process.

⁵³Marvin Kreidberg and Merton Henry, *History of Military Mobilization in the United States Army, 1775-1945*, Department of the Army Pamphlet No. 20-212, (Washington, DC: Government Printing Office, 1953), 374-379; Russell F. Weigley, *History of the United States Army*, (New York: Macmillan Publishing Co., 1967), 258, 368-369; John C. Sparrow, *History of Personnel Demobilization in the United States Army*, (Department of the Army Pamphlet No. 20-210), (Washington, DC: Department of the Army, 1952), 21; and Association of the United States Army, "The U.S. Army

Between World War II and the Korean War," AUSA Background Brief, no. 40 (March 1992): 2.

⁵⁴Robert K. Griffith, Jr., *Men Wanted for the U.S. Army: America's Experience with an All-Volunteer Army Between the World Wars*, (Westport, CT: Greenwood Press, 1982), 85-173.

⁵⁵Michael Howard, "Military Science in an Age of Peace," *Journal of the Royal United Services Institute of Defense Studies (RUSI)*, 119 (Mar 1974): 5.

⁵⁶Weigley, *History of the United States Army*, 406-409; Christopher Gabel, "The Army and Mobilization Before Pearl Harbor," Unpublished manuscript in the author's possession; Also see Christopher Gabel, *The US Army GHQ Maneuvers of 1941*, US Army Center for Military History, (Washington, DC: Government Printing Office, 1991).

⁵⁷Heller and Stofft, eds. *America's First Battles, 1776-1965*, Introduction and page 1.

⁵⁸Martin Blumenson, "Kasserine Pass, 30 January-22 February 1943," in *America's First Battles, 1776-1965*, 264-265.

⁵⁹Williamson Murray, "The German Response to Victory in Poland: A Case Study in Professionalism," *Armed Forces and Society* 7 (Winter 1981): 286.

⁶⁰Allan R. Millett, "The United States Armed Forces in the Second World War," in *Military Effectiveness: Volume III, The Second World War*, ed. Allan R. Millett and Williamson Murray, (Boston: Allen & Unwin, 1988), 45-89. For a different view of American tactical ability, see Peter R. Mansoor, *The GI Offensive in Europe: The Triumph of American Infantry Divisions, 1941-1945*.

⁶¹Correlli Barnett, *The Swordbearers: Supreme Command in the First World War*, (Bloomington, IN: Indiana University Press, 1963), xvi.

⁶²For excellent discussions of American battlefield adaptation in Europe, see Michael Doubler, *Closing with the Enemy: How GIs Fought the War in Europe, 1944-1945*, (Lawrence, KS: University of Kansas Press, 1994). For an equally thorough discussion of American tactical prowess, superior artillery and air power, and ability to sustain its forces in battle, see Peter R. Mansoor, *The GI Offensive in Europe*.

⁶³Winston S. Churchill, *The Gathering Storm*, (Cambridge, MA: Houghton Mifflin Company, 1948), 449.

CHAPTER 2 – THE ANATOMY OF CHANGE

¹Stephen Peter Rosen, *Winning the Next War*, (Ithaca, NY: Cornell University Press, 1991), 7-8.

²Eliot A. Cohen and John Gooch, *Military Misfortunes: The Anatomy of Failure in War*, (New York: The Free Press, 1990), 1-28.

³Allan R. Millett, "Patterns of Military Innovation in the Interwar Period," in Williamson Murray and Allan R. Millett, eds. *Military Innovation in the Interwar Period*, (Cambridge, UK: Cambridge University Press, 1996), 332.

⁴Williamson Murray highlights this point and contends that of all the World War I armies, only the Germans were able to analyze, develop, and implement an effective method for dealing with the stalemate on the Western Front. See Williamson Murray, "Innovation Past and Future," in Williamson Murray and Allan R. Millett, eds. *Military Innovation in the Interwar Period*, 302. Learning and adaptation by Germany during World War I is best explained by Timothy Lupfer in Timothy Lupfer, *The Dynamics of Doctrine: The Changes in German Tactical Doctrine During the First World War*, Leavenworth Paper No. 4, (Fort Leavenworth, KS: Combat Studies Institute, U.S. Army Command and General Staff College, 1981).

⁵See John M. Gates, "Vietnam: The Debate Goes On," *Parameters*, Vol XIV, No. 1, (Spring 1984): 15-25. For a trenchant analysis of American policy toward Vietnam, see H.R. McMaster, *Dereliction of Duty: Lyndon Johnson, Robert McNamara, The Joint Chiefs of Staff, and the Lies that Led to Vietnam*, (New York: Harper Collins Publishers, 1997). For one analysis of strategy, see Harry G. Summers, Jr., *On Strategy: A Critical Analysis of the Vietnam War*, (New York: Dell Publishing, 1984). Also Andrew F. Krepinevich Jr., *The Army and Vietnam*, (Baltimore, MD: Johns Hopkins University Press, 1986). For a gripping tactical analysis of the Battle of the Ia Drang Valley, see Harold G. Moore and Joseph J. Galloway, *We Were Soldiers Once...And Young*, (New York: Random House, 1992).

⁶Carl von Clausewitz, *On War*, ed. and trans. by Michael Howard and Peter Paret, (Princeton, NJ: Princeton University Press, 1976), 102.

⁷*Ibid.*, 112.

⁸*Ibid.*, 77.

⁹Carl von Clausewitz, *On War*, ed. Anatol Rapoport, (London: Penguin Classics, 1968), Bk. II, Chpt 3, pp. 202-203; The Paret and Howard edition of *On War* says "In War, the will is directed at an animate object that *reacts*." (*Italics in original*), p. 149.

¹⁰For more on this phenomenon during the Cold War, see Lawrence Freedman, *The Evolution of Nuclear Strategy*, 2d ed. (New York: St. Martin's Press, 1989). For the effect of nuclear weapons and strategy on US Army doctrine, particularly in the 1950s and early 1960s, see A.J. Bacevich, *The Pentomic Era: The U.S. Army between Korea and Vietnam*, (Washington, DC: National Defense University Press, 1986).

¹¹For a slightly amended version of Roberts' lecture see, Michael Roberts, "The Military Revolution, 1560-1660," in *Essays in Swedish History*, (Minneapolis: University of Minnesota Press, 1967), 195-225; For Parker's initial response see, Geoffrey Parker, "The 'Military Revolution,' 1560-1660--a Myth?" *The Journal of Modern History*, vol. 48, (1976): 195-214.

¹²Geoffrey Parker, *The Military Revolution: Military Innovation and the Rise of the West, 1500-1800*, (Cambridge: Cambridge University Press, 1988); Jeremy Black, *A Military Revolution? Military Change and European Society, 1550-1800*, (Atlantic Highlands, NJ: Humanities Press, 1990); Andrew F. Krepinevich, "Cavalry to Computer: The Pattern of Military Revolutions," *The National Interest*, (Fall 1994): 30-42; and Clifford J. Rogers, ed. *The Military Revolution Debate, Readings on the Military Transformation of Early Modern Europe*, (Boulder, CO: Westview Press, 1995) and Clifford J. Rogers, "The Military Revolutions of the Hundred Years' War," *The Journal of Military History*, vol 57., no. 2., (April 1993): 241-278

¹³Crane Brinton, *The Anatomy of Revolution*, 3rd ed., rev. and exp. (New York: Vintage Books, 1965), 3.

¹⁴*Ibid.*

¹⁵*Ibid.*, 16-17.

¹⁶*Ibid.*

¹⁷Allan R. Millett, "Patterns of Military Innovation in the Interwar Period," in Williamson Murray and Allan R. Millett, eds. *Military Innovation in the Interwar Period*, 330.

¹⁸This epistemology of revolutions in military affairs draws heavily from Steven Metz and James Kievit, *Strategy and the Revolution in Military Affairs: From Theory to Policy*, (Carlisle Barracks, PA: Strategic Studies Institute U.S. Army War College, 1995), 2-3. Also see, MacGregor Knox and Williamson Murray, ed. *The Dynamics of Military Revolution, 1300-2050*, (Cambridge, UK: Cambridge University Press, 2001), 1-3. See Jeffrey R. Cooper, *Another View of the Revolution in Military Affairs*, (Carlisle Barracks, PA: Strategic Studies Institute U.S. Army War College, 1994) for more on Soviet influence and writing. For examples of early emphasis on technology in the "military technical revolution" see Michael J. Mazarr, Jeffery Shaffer, and Benjamin Ederington, *The Military Technical Revolution: A Structural Framework*, (Washington, DC: Center

for Strategic and International Studies, 1993); Dan Gouré, “Is There a Military-Technical Revolution in America’s Future,” *Washington Quarterly*, vol. 16, no. 4, (Autumn, 1993): 175-192; and John W. Bodnar, “The Military Technical Revolution: From Hardware to Information,” *Naval War College Review*, vol. 46, no. 3. (Summer 1993): 7-21.

¹⁹MacGregor Knox and Williamson Murray, ed. *The Dynamics of Military Revolution, 1300-2050*, 6-11.

²⁰*Ibid.*, 6-7.

²¹*Ibid.* Retired Admiral Art Cebrowski, currently leading the Defense Department’s Office of Transformation, characterizes these seismic changes as “vertical shocks” to the international system, which in turn generate first, second, third, and fourth order effects or perturbations throughout the system.

²²*Ibid.*, 6-11. Italics in original.

²³On one end, there is the definition of military revolution by Alvin and Heidi Toffler which purports in grand perspective that a “military revolution, in the fullest sense, occurs only when a new civilization arises to challenge the old, when an entire society transforms itself, forcing its armed services to change at every level simultaneously—from technology and culture to organization, strategy, tactics, training, doctrine, and logistics. When this happens, the relationship of the military to the economy and society is transformed and the military balance of power on earth is shattered.” Alvin and Heidi Toffler, *War and Anti-War: Survival at the Dawn of the 21st Century*, (Boston: Little, Brown, 1993), 32. At the other end, there is a somewhat shorter, but less complete definition of a military revolution as a “discontinuous increase in military capability and effectiveness” offered by Cooper, *Another View of the Revolution in Military Affairs*, 21.

²⁴Of all the official, unofficial, and academic attempts to understand the concept of revolution in military affairs and what it might mean for the American military establishment in the late 20th and early 21st centuries, no organization has dedicated more resources toward this effort than the Department of Defense, Office of Net Assessment led by Dr. Andrew W. Marshall.

²⁵Andrew F. Krepinevich, “Cavalry to Computer: The Pattern of Military Revolutions,” *The National Interest*, 30. (Fall 1994): 37

²⁶Quotation taken from Williamson Murray and MacGregor Knox, “Thinking about Revolutions in Warfare,” in MacGregor Knox and Williamson Murray eds. *The Dynamics of Military Revolution 1300-2050*, (Cambridge, UK: Cambridge University Press, 2001), 4-5, 13n. Dr. Andrew W. Marshall testified before the *Senate Armed Services Committee, Subcommittee on Acquisition and Technology* on 5 May 1995.

²⁷For another concise definition, see MacGregor Knox and Williamson Murray, ed. *The Dynamics of Military Revolution, 1300-2050*, 12 and 179-180.

²⁸Joseph S. Nye, Jr., *The Paradox of American Power: Why the World's Only Superpower Can't Go It Alone*, (New York: Oxford University Press, 2002), 77-10; Ellen L. Frost, "Globalization and National Security: A Strategic Agenda," in Richard L. Kugler and Ellen L. Frost, eds., *The Global Century: Globalization and National Security* Institute for National Strategic Studies, (Washington, DC: National Defense University, 2001), 35-74.

²⁹See Colin Gray, "The Changing Nature of Warfare?," *Naval War College Review*, Vol XLIX, no. 2, (Spring 1996): 7-22.

³⁰Clausewitz, *On War*, ed. and trans. by Michael Howard and Peter Paret, 88.

³¹Thomas S. Kuhn, *The Structure of Scientific Revolutions*, (Chicago: University of Chicago Press, 1970), 175.

³²James J. Schneider, *The Structure of Strategic Revolution: Total War and the Roots of the Soviet Warfare State*, (Novato, CA: Presidio Press, 1994), 163.

³³Derived from comments on the text by Allan R. Millett.

³⁴Paul Davies and John Gribbin, *The Myth Matter*, (New York: Simon and Schuster, 1992), 7 quoted in Schneider, *The Structure of Strategic Revolution*, 163.

³⁵Schneider, *The Structure of Strategic Revolution*, 163.

³⁶*Ibid.*, 209.

³⁷Robert A. Doughty, *The Seeds of Disaster: The Development of French Army Doctrine, 1919-1939*, (Hamden, CT: Archon Books, 1985), 7-8. See also Robert A. Doughty, *The Evolution of US Army Tactical Doctrine 1946-1976*, Leavenworth Paper No. 1., (Fort Leavenworth, KS: Combat Studies Institute, US Army Command and General Staff College, 1979), 1.

³⁸For Kuhn's view of the role of history and its importance to the process of scientific discovery see Kuhn, *The Structure of Scientific Revolutions*, 1-9.

³⁹For a discussion of the emergence of anomalies and how the scientific community responds to crisis see Kuhn, *The Structure of Scientific Revolutions*, 52-91.

⁴⁰Alan Beyerchen states that innovation is the "...spread of the new 'best practice.'" I believe that in the context of the Kuhn-Brinton model, Beyerchen is not entirely correct. As a subset of the "Symptomization-Crisis-Adaptation-Solution-

Instability” process, “Adaptation” involves solving for the anomalies, while “Solution” represents taking the “adaptation” beyond a one-time correction, accepting it as the “solution” to the problem, and introducing it to the force as such. At that point, the “solution” becomes “diffused” to those who need it. Given the tyranny of time and space in war, innovating or adapting to solve a problem and diffusing the “solution” to the rest of the force are two separate and distinct activities. Also Beyerchen contends, “...the introduction of new military doctrine is in general closely associated with the diffusion phase.” I believe the idea of diffusion must go beyond merely introducing new doctrine. In this context, diffusion can also represent the infusion of new equipment into the military or the reorganization of the force to better solve the military problem. This criticism should not detract from Beyerchen’s excellent conceptual work and insightful essay. See Alan Beyerchen, “From Radio to Radar: Interwar Military Adaptation to Technological Change in Germany, the United Kingdom, and the United States,” in Williamson Murray and Allan R. Millett, eds. *Military Innovation in the Interwar Period*, 267.

⁴¹I. Bernard Cohen, *Revolution in Science*, (Cambridge: Harvard University Press, 1985), 28. For an application of Cohen's model to the strategic revolution in the Soviet Union under Stalin, see Schneider, *The Structure of Strategic Revolution*, 274-276.

⁴²*Ibid*, 29; Schneider, *The Structure of Strategic Revolution*, 274.

⁴³Cohen, *Revolution in Science*, 29-30; Schneider, *The Structure of Strategic Revolution*, 275.

⁴⁴Carl von Clausewitz, "Note of 10 July 1827," in *On War*, ed. and trans. by Michael Howard and Peter Paret, 69. Interestingly, in *Revolutions in Science*, Cohen emphasizes that many important scientific thoughts never reach the larger community of scientists because their authors do not make an effort to present their theories in a public forum. Given his contention, one can only speculate on the progress of military thought had Clausewitz's widow, Marie von Clausewitz, not published her late husband's work in 1832.

⁴⁵Cohen, *Revolution in Science*, 31; Schneider, *The Structure of Strategic Revolution*, 275.

⁴⁶For more on Mahan and his influence see, Phillip A. Crowl, "Alfred Thayer Mahan: The Naval Historian," in Peter Paret ed. *Makers of Modern Strategy: From Machiavelli to the Nuclear Age*, (Princeton: Princeton University Press, 1986), 444-477. Also Margaret Tuttle Sprout, "Mahan: Evangelist of Sea Power," in Edward Earle Meade ed. *Makers of Modern Strategy: Military Thought from Machiavelli to Hitler*, (Princeton: Princeton University Press, 1948), 415-445.

⁴⁷There are many examples of this linkage between scientists and soldiers throughout history. For a specific example that of how scientists assisted sailors in

addressing the three dimensional problem of anti-submarine warfare, an undersea problem conceptually similar to that of anti-aircraft artillery, see Montgomery C. Meigs, *Slide Rules and Submarines*, (Washington, DC: National Defense University Press, 1990.).

⁴⁸Schneider, *The Structure of Strategic Revolution*, 273-274.

⁴⁹*Ibid.*, 274.

⁵⁰*Ibid.*

⁵¹For an excellent discussion of these three factors, see Antulio J. Echevarria II, "Tomorrow's Army: The Challenge of Nonlinear Change," *Parameters*, vol. XXVII, No. 3 (Autumn 1998), 85-98.

⁵²*Ibid.*, 89.

⁵³The dramatic increase in the number of automobiles in Europe and North America from 142,000 in 1908 to 1.5 million in 1913, is symptomatic of the rapid pace of change. In one documented case, Western armies made twice as many revisions to their doctrines in the last quarter of the Nineteenth Century as they had in the previous seventy-five years. See Echevarria, "Tomorrow's Army: The Challenge of Nonlinear Change," 89-90.

⁵⁴This example is taken from Echevarria, "Tomorrow's Army: The Challenge of Nonlinear Change," 90. For more on the non-linearity of innovation, see MacGregor Knox and Williamson Murray, eds. *The Dynamics of Military Revolution, 1300-2050*, 302-303.

⁵⁵Schneider, *The Structure of Strategic Revolution*, 275.

⁵⁶Kuhn, *The Structure of Scientific Revolutions*, 79.

⁵⁷Schneider, *The Structure of Strategic Revolution*, 275.

⁵⁸Michael Howard, "Military Science in an Age of Peace," 4.

⁵⁹*Ibid.*, 7.

⁶⁰For a lucid description of the theory of punctuated equilibrium, see Stephen Jay Gould, *Dinosaur in a Haystack: Reflections in Natural History*, (New York: Harmony Books, 1995), 123-132. Also, Clifford J. Rogers, "The Military Revolutions of the Hundred Years' War," *The Journal of Military History*, vol. 57., no. 2., (April 1993): 277; For more on the history of punctuated equilibrium evolution see Tim Beardsley,

"Punctuated Equilibrium: Darwin Survives as the Debate Evolves," in *Scientific American* vol. 262 (March 1990): 37-38.

⁶¹Ibid.

⁶²Andrew F. Krepinevich, "Cavalry to Computer: The Pattern of Military Revolutions," *The National Interest*, 30. (Fall 1994).

⁶³See Williamson Murray, "Innovation Past and Future," in Williamson Murray and Allan R. Millett, eds. *Military Innovation in the Interwar Period*, 302. Italics in original.

⁶⁴Ibid.

⁶⁵Ibid., 308. Italics in original.

⁶⁶Ibid.

⁶⁷Michael O'Hanlon, a military analyst from the Brookings Institute, coined the term "ambitious incrementalism" to describe what happens when the military innovates at a rate that balances the acknowledged need to change with the need to maintain a current warfighting capability. O'Hanlon is referred to, but not directly cited, in Ronald Brownstein, "Success in Afghanistan Clouds Military Transformation Plan," *The Los Angeles Times*, December 12, 2001, internet, <http://ebird.dtic.mil/Dec2001/e20011212success.htm>.

⁶⁸Williamson Murray, "Innovation Past and Future," in Williamson Murray and Allan R. Millett, eds. *Military Innovation in the Interwar Period*, 308-309.

⁶⁹The model and definitions that follow are taken from Alan Beyerchen, "From Radio To Radar," Williamson Murray and Allan R. Millett, eds. *Military Innovation in the Interwar Period*, 267-268.

⁷⁰Ibid., 268.

⁷¹For an excellent discussion of evolution of air power and its impact on every facet of World War I see Lee Kennett, *The First Air War, 1914-1918*, (New York: The Free Press, 1991).

⁷²Colonel Jay P. Hopkins, "Antiaircraft Artillery," Lecture delivered at the Army Center for Artillery Studies, Treves, Germany, 21 May 1919, TM, p. 4, Dec# 666/M, Box 139, Entry #9, Record Group 177 National Archives, Washington, DC; Colonel Jay P. Hopkins, "Final Report of the Chief of the Antiaircraft Service," 28 December 1918, Historical Division, Department of the Army, *United States Army in the World War, 1917-1919*, 17 vols. (Washington, DC: Government Printing Office, 1948), 15:217;

Charles E. Kirkpatrick, *Archie in the A.E.F.: The Creation of the Antiaircraft Service of the United States Army, 1917-1918*, (Fort Bliss, TX: U.S. Army Air Defense Artillery Museum, 1984), 57.

CHAPTER 3 – THE EXTERNAL AND INTERNAL DYNAMICS OF CHANGE

¹Perhaps a more familiar example of the difficulty inherent in the peacetime replication of wartime conditions lies in the difference between Billy Mitchell's sinking of the *Ostfriesland* and the destruction of the initial waves of American attacks on the Japanese fleet during the Battle of Midway in June 1942. All that Mitchell's bombing of a former German battleship off the Chesapeake Bay in 1921 proved was that an airplane could sink an unarmed, immobile ship on a clear day in calm water when the ship was incapable of fighting back. Conversely, at Midway, the Japanese Fleet equipped with air defense fighters and anti-aircraft weapons downed several waves of American fighters and unescorted torpedo-bombers while suffering no damage to their aircraft carriers. Ultimately, however, American dive-bombers caught the Japanese Fleet in the middle of rearming and refueling their aircraft and sunk three of their four carriers. American planes sunk the fourth carrier later the same day.

²Allan R. Millett, "Patterns of Military Innovation in the Interwar Period," in Williamson Murray and Allan R. Millett, eds. *Military Innovation in the Interwar Period*, 367. Millett calls this focus on doctrine the "habitual weakness of intellectuals." For an analysis of doctrine as a reflection of the degree to which the military accepts change, see William O. Odom, *After the Trenches: The Transformation of U.S. Army Doctrine, 1918-1939*, (College Station, TX: Texas A&M University Press, 1999).

³Williamson Murray and Mark Grimsley, "Introduction: On Strategy," in Williamson Murray, MacGregor Knox, and Alvin Bernstein ed., *The Making of Strategy: Rulers, States, and War*, (New York: Cambridge University Press, 1994), 1.

⁴*Ibid.*, 1-3.

⁵*Ibid.*, 7.

⁶Coe, in his 1920 "Report of the Chief of Coast Artillery Corps," warned that it would take \$20 million to provide Boston with the same level of anti-aircraft protection afforded Paris during World War I. Maj. Gen. Frank W. Coe, "Report of the Chief of Coast Artillery Corps," in *War Department Annual Report, 1920*, (Washington, DC: Government Printing Office, 1920), 308.

⁷Williamson Murray and Mark Grimsley, "Introduction: On Strategy," in Williamson Murray, MacGregor Knox, and Alvin Bernstein ed., *The Making of Strategy: Rulers, States, and War*, 7.

⁸Uri Bialer, *The Shadow of the Bomber: The Fear of Air Attack and British Politics*, (London: Royal Historical Society, 1980), 3-4.

⁹Ibid. For an interesting analysis of British air policy in the decade following World War I, see Neil Young, "British Home Air Defence Planning in the 1920s," *The Journal of Strategic Studies*, vol. 11, no. 4 (December 1988): 492-508. Young contends that Chief of the Air Staff, Sir Hugh Trenchard, used the threat of air attack from France as well as a desire to "substitute" air for land units in the policing of the Empire as a means to bolster defense spending on the RAF.

¹⁰In late 1941, American antiaircraft units were seriously short of close-in, height-finding SCR-268 radars and intermediate range SCR-270 and SCR-271 radars. Through the efforts of Secretary of War Henry L. Stimson and the active involvement of Mr. Watson-Watt of the British Air Commission, American antiaircraft units received numerous British and Canadian ground control intercept radars allowing them to rectify the situation by mid-1942. Stetson Conn, Rose C. Engleman, and Byron Fairchild, *The Western Hemisphere: Guarding the United States and its Outposts*, The United States Army in World War II, Office of the Chief of Military History, (Washington, DC: Government Printing Office, 1964), 425-429.

¹¹Williamson Murray and Mark Grimsley, "Introduction: On Strategy," 8.

¹²Ibid.

¹³Williamson Murray, "The Collapse of Empire: British Strategy, 1919-1945," in Williamson Murray, MacGregor Knox, and Alvin Bernstein ed., *The Making of Strategy: Rulers, States, and War*, 407.

¹⁴Quoted in Eliot A. Cohen, "The Strategy of Innocence? The United States, 1920-1945," in Williamson Murray, MacGregor Knox, and Alvin Bernstein ed., *The Making of Strategy: Rulers, States, and War*, 440.

¹⁵Williamson Murray and Mark Grimsley, "Introduction: On Strategy," 13. For more on "exceptionalism" and the impact of Andrew Jackson on American political and strategic opinion, see Walter Russell Mead, "The Jacksonian Tradition," in *The National Interest*, 58. (Winter 1999): 1-25.

¹⁶Howard, "Military Science in an Age of Peace," 4.

¹⁷Regarding American foreign policy (and by extension, defense policy) in the post-Cold War world, Rebecca K. C. Hersman makes the point in *Friends and Foes: How Congress and the President Really Make Foreign Policy*, (Washington, DC: Brookings Institution Press, 2000), 17 that "without the crisis atmosphere of the cold war, foreign policy often finds itself on the political back burner....In fact, most Americans continue to be profoundly disinterested in and ill-informed about international affairs." It

follows that in times of peace, if Americans are disinterested in international affairs, they will not care much for issues of military innovation and reform.

¹⁸Ibid.

¹⁹I. Bernard Cohen makes a similar point with respect to innovations and revolutions in science. While "revolutions in science are inevitable," Cohen contends that the pace or frequency of such revolutions varies with the degree of financial support given to the scientific community. A paucity of funds limits the possibilities for purchasing and constructing research instruments, conducting expeditions, recruiting and training the next generation of scientists, and relieving scientists of excessive administrative and teaching duties so they can "reflect" on their discipline. For more on this subject see, Cohen, *Revolution in Science*, 21.

²⁰Stephen Peter Rosen, *Winning the Next War* and "Understanding Military Innovation," *International Security*, vol 13, no. 1 (Summer 1988), 167; Michael Meese, "The Process of Organizational Change," in Richard Hooker ed. *Maneuver Warfare: An Anthology*, (Novato, CA: Presidio Press, 1993), 205.

²¹Omar N. Bradley quoted in Elias Huzar, *The Purse and the Sword: Control of the Army by Congress through Military Appropriations, 1933-1950*, (Ithaca, NY: Cornell University Press, 1950), 132-133.

²²Ibid.

²³I thank Professor Roger Spiller, the George C. Marshall Professor of Military History at the United States Army Command and General Staff College, for his comments on the sources of professional knowledge and growth.

²⁴This comment refers to conventional armed forces. In light of recent American concerns about terrorists using weapons of mass destruction, some may question whether possessing a superior weapon is indeed enough to increase a terrorist group's military effectiveness. There are flaws in that reasoning. First, while terrorists may be militant and act militarily, they are not professional military organizations—at least not as discussed within the scope of this paper. Second, as the attempted bombing of the World Trade Center in 1993 demonstrated, even terrorists must assimilate the effects of their innovative weaponry. In that event, the terrorists carried nerve gas in the van along with their explosives. When the van exploded, the heat from the blast incinerated the nerve gas preventing it from having any effect. Sadly, the terrorists adapted their tactics and employed a more asymmetric and idiosyncratic attack in September 2001.

²⁵Maurice Pearton, *Diplomacy, War, and Technology Since 1830*, (Lawrence, KS: University of Kansas Press, 1984), 27. Also see Michael Howard, *The Franco-Prussian War*, (London: Rupert Hart-Davis, Ltd, 1961). For an essay criticizing military historians for overselling technological determinism, see George Raudzens, "War-Winning

Weapons: The Measurement of Technological Determinism in Military History,” *The Journal of Military History*, vol. 54, (October 1990): 403-434.

²⁶Allan R. Millett, “Patterns of Military Innovation in the Interwar Period,” in Williamson Murray and Allan R. Millett, eds. *Military Innovation in the Interwar Period*, 335-336.

²⁷*Ibid.*, 342.

²⁸*Ibid.*, 348

²⁹*Ibid.*

³⁰*Ibid.* Italics in original.

³¹For a complete analysis of the Pentomic Division and an extremely cogent argument on the debilitating effect an unquestioning acceptance of technology can have on a military institution, see A.J. Bacevich, *The Pentomic Era: The U.S. Army between Korea and Vietnam*, (Washington, DC: National Defense University, 1986). Bacevich quotes General Decker on page 135.

³²Geoffery Till, “Adopting the Aircraft Carrier: The British, American, and Japanese Case Studies,” in Williamson Murray and Allan R. Millett eds., *Military Innovation in the Interwar Period*, 217-219.

³³*Ibid.* See also G. Till, *Airpower and the Royal Navy 1914-1945: A Historical Survey*, (London,: Jane’s Publishing Company, 1979), 149; S. W. Roskill, *The War at Sea, 1939-1945, Vol I, The Defensive*, (London: Her Majesty’s Stationary Office, 1954), 69; and J. Rohwer and G. Hummelchen, *Chronology of the War at Sea, 1939-1945: The Naval History of World War Two*, (Annapolis, MD: Naval Institute Press, 1992), 4.

³⁴Geoffrey Till, “Adopting the Aircraft Carrier: The British, American, and Japanese Case Studies,” 219.

³⁵*Ibid.*, 219

³⁶For an interesting discussion of “measures and countermeasures”, see Edward Luttwak, *Strategy: The Logic of War and Peace*, (Cambridge, MA: The Belknap Press, 1987), 27-31.

³⁷Michael Howard, "Military Science in an Age of Peace," 5

³⁸Andrew W. Marshall, Memorandum for Record, “Some Thoughts on Military Revolutions-Second Version,” 23 August 1993, 2. Author’s possession.

³⁹Ibid.

⁴⁰I wish to thank Harvey Rishikoff of the National War College, Washington DC for bringing this fact to my attention.

⁴¹Morris Janowitz, *Sociology and the Military Establishment*, (New York: Russell Sage Foundation, 1965), 102-103; Michael Howard, "Military Science in an Age of Peace," 5; Michael Meese, "The Process of Organizational Change," 202.

⁴²Alfred Thayer Mahan, *The Influence of Sea Power upon History, 1660-1805*, (Novato, CA: Presidio Press, 1987), 20. This work is a combination of Mahan's classic work, *The Influence of Sea Power upon History, 1660-1783*, abridged, and extracts from his *The Influence of Sea Power upon the French Revolution*. Parenthetical comment added.

⁴³Kurt Lang, "Military Organizations," in *Handbook of Organizations*, ed. James G. March (Chicago: Rand McNally & Co., 1965), 843; Stephen Peter Rosen, *Winning the Next War*, 19-20.

⁴⁴For a superb discussion of the development of French Army doctrine during the Interwar period, see Robert A. Doughty, *The Seeds of Disaster: The Development of French Army Doctrine, 1919-1939*. For similar discussion with respect to the development of Soviet doctrine, see James J. Schneider, *The Structure of Strategic Revolution: Total War and the Roots of the Soviet Warfare State*. Likewise, for a discussion of the development of doctrine in Britain, see Brian Bond, *British Military Policy between the Two World Wars*, (Oxford: University Press, 1980).

⁴⁵Matthew Cooper, *The German Army, 1933-1945: Its Political and Military Failure*, (Chelsea, England: Scarborough House, 1990), 149.

⁴⁶For a particularly interesting argument on behalf of the Army's position as well as a statement on the effectiveness of antiaircraft artillery, see testimony by Assistant Chief of Staff of the Army, Brigadier General Hugh A. Drum before the Select Committee of Inquiry into Operations of the United States Air Services, in Congress, House, Select Committee of Inquiry into Operations of the United States Air Services, *Inquiry into Operations of the United States Air Services*, 68th Cong., February 1925, 1791-1873. Drum's comment about stopping any bomber may be found on page 1868.

⁴⁷Ibid., 1909.

⁴⁸Congress, House, Committee on Military Affairs, *Department of Defense and Unification of the Air Service*, 69th Cong., 1st sess., 19 January to 9 March, 1926, 383-386.

⁴⁹Lang, "Military Organizations," in *Handbook of Organizations*, 857

⁵⁰Ibid..

⁵¹Michael Howard, *The Franco-Prussian War*, (London: Rupert Hart-Davis Ltd, 1961), 115-119; Also see Edward L. Katzenback Jr., "The Horse Cavalry in the Twentieth Century--a Study on Policy Response," in *Public Policy, a Yearbook of the Graduate School of Public Administration*, (Boston: Harvard University Press, 1958), 120-149.

⁵²Morris Janowitz, *Sociology and the Military Establishment*, 105.

⁵³Heinz Guderian, *Panzer Leader*, (New York: Ballantine, 1957), 383-384.

⁵⁴U.S. War Department, *Field Service Regulations, 1923*, (Washington, DC: Government Printing Office, 1924), 48, 73, and 111; Brig. Gen. Harry A. Smith, War Plans Division Staff Study, "Anti-aircraft Defense," October 1925, TM, Dec #666/AM-22, Box 139, Entry #9, RG 177, National Archives and Records Administration, Washington, DC (hereafter cited as NA); Letter, Col. John H. Hughes, Office of the Chief of Infantry, to the Adjutant General (hereafter AG), 19 March 1925, "Antiaircraft Defense," Dec #666/AM-34, Box 140, Entry #9, RG 177, NA.

⁵⁵For a concise history of the "Victory Plan" and Wedemeyer's role, see Charles E. Kirkpatrick, *An Unknown Future and a Doubtful Present: Writing the Victory Plan of 1941*, United States Army Center for Military History, (Washington, DC: Government Printing Office, 1990). For comments on the inclusion of antiaircraft artillery in the division as well as throughout the Army structure, see pages 88-114 passim.

⁵⁶Patterson and Devers are mentioned in Kent Roberts Greenfield, Robert R. Palmer, and Bell I. Wiley, *The Army Ground Forces: The Organization of Ground Combat Troops*, United States Army in World War II, United States Army Center for Military History, (Washington, DC: Government Printing Office, 1987), 295. Eisenhower is mentioned in E. Paul Semmens, *The Hammer of Hell*, 18. Eisenhower was promoted to General on 11 February 1943 and became Supreme Allied Commander Mediterranean on 16 February 1943. For Devers' comments, see Kent Roberts Greenfield, Robert R. Palmer, and Bell I. Wiley, *The Army Ground Forces: The Organization of Ground Combat Troops*, 296. For Eisenhower's comments on the effect of enemy air attack and the need for antiaircraft artillery protection, see Dwight D. Eisenhower, *The Papers of Dwight David Eisenhower, The War Years: II*, Alfred D. Chandler Jr. ed., (Baltimore: Johns Hopkins Press, 1970), entries 729, 770, and 841.

⁵⁷Kent Roberts Greenfield, Robert R. Palmer, and Bell I. Wiley, *The Army Ground Forces: The Organization of Ground Combat Troops*, 293.

⁵⁸Morris Janowitz, *Sociology and the Military Establishment*, 103; Lang, "Military Organizations," in *Handbook of Organizations*, 857.

⁵⁹For more information on the conflict between Major General Fred C. Ainsworth and Elihu Root and Major General Leonard Wood see Philip Semsch, "Elihu Root and the General Staff," *Military Affairs* 27 (Spring 1963), 16-27; Graham A. Cosmas, "Military Reform After the Spanish-American War: The Army Reorganization Fight of 1898-1899," *Military Affairs* 35 (February 1979), 12-18; Mabel E. Deutrich, *Struggle for Supremacy: The Career of General Fred C. Ainsworth*, (Washington, DC: Public Affairs Press, 1962); and Jack Lane, *Armed Progressive: General Leonard Wood*, (Novato, CA: Presidio Press, 1978).

⁶⁰Norman Dixon, *On the Psychology of Military Incompetence*, (New York: Basic Books, 1976), 115.

⁶¹A phrase communicated to this author in 1996 by a general officer--"I may be frequently wrong, but I am never in doubt"--is an excellent example of this phenomenon occurring even among the U.S. Army's rising stars.

⁶²Dixon, *On the Psychology of Military Incompetence*, 112.

⁶³*Journal of the United States Artillery* 14 (Fort Monroe, VA: Coast Artillery School Press, May 1919), 325-327.

⁶⁴Captain F.S. Clark, "Archie's Gunnery," *The Journal of the United States Artillery* 53 (December 1920): 639-640; Letter, Brig. Gen. Johnson Hagood, to the Chief of Coast Artillery, 29 March 1920, "Anti-aircraft Materiel," Dec #666/L, Box 145, Entry #9, RG 177, NA.

⁶⁵See "The Beaten Zone," in the *Journal of the United States Artillery*, vol. 53, no. 6. (December 1920) to vol. 54. no. 5 (May 1921) for specific articles on antiaircraft artillery. Also see War Department, Office of the Chief of Coast Artillery, Bulletin, "Anti-Aircraft Series," No. A.A. 1.001, 25 November 1922, TM, Dec #300.53, Box 3, Entry #9, RG 177, NA for copies of the "Anti-Aircraft Series" that ran through 1929.

⁶⁶Maj. Gen. Andrew Hero, Jr. "New Year Greetings from the Chief of Coast Artillery" *Coast Artillery Journal* vol. 72, no. 1. (January 1930): frontpiece; "The Coast Artillery School: Antiaircraft--'Cock o' the Walk,'" *Coast Artillery Journal* vol 72, no. 5. (May 1930): 435; and "Seacoast versus Antiaircraft," *Coast Artillery Journal*, vol 73, no. 3. (September 1930): 263. Major General Gulick replaced Major General Hero as Chief of the Coast Artillery Corps in 1930.

⁶⁷Barry Posen, *The Sources of Military Doctrine*, (Ithaca, NY: Cornell University Press, 1984), 224-226.

⁶⁸Stephen Peter Rosen, *Winning the Next War*, 10-13. For a more positive view of "mavericks" within the military, see General Donn A. Starry, "To Change an Army," *Military Review* 63 (March 1983), 22.

CHAPTER 4 – A THEORY TOWARD ATTAINING SUCCESSFUL CHANGE

¹ Morton Halperin, *Bureaucratic Politics and Foreign Policy*, (Washington, DC: The Brookings Institution, 1974) is an example of an excellent text on organizational theory and bureaucratic politics that was outside the scope of this analysis of military innovation. Halperin discusses with America's 1967 decision to deploy an anti-ballistic missile system. While rich in coverage of the bureaucratic politics involved at the top echelon of national security decisionmaking, his work is above the level of granularity desired for this study. Chester I. Barnard, *The Functions of the Executive*, (Cambridge, MA: Harvard University Press, 1938) was one of the most influential texts on executive management published during the Interwar period. Barnard provided a worthwhile counterforce to the scientific management theories espoused by Frederick Taylor (See Taylor, *The Principles of Scientific Management*, (New York: Norton, 1911.) Barnard proposed that organizations were cooperative systems and stressed social relations and communication within the organization. Focused on the internal structure and dynamics of business entities, Barnard's work provides worthwhile background for analysis of contemporary efforts at business innovation, but is not sufficiently relevant to military innovation to warrant inclusion in this study.

²Catherine Seckler-Hudson, *Organization and Management: Theory and Practice*, (Washington, DC: The American University Press, 1955) is based on the author's twenty-five years of experience teaching, researching, and writing as a faculty member at American University. Unfortunately, while the work is instructive, it is excessively long with over 200 pages of checklists and questions for managers to ask. Further, the author's twelve recommended principles of organization and management are largely utopian in prescription and reflect contemporary top-down business management practices geared toward improving the efficiency of mass production and ignore the pluralistic nature of the military community.

³Michael Howard, "Military Science in an Age of Peace," *RUSI, Journal of the Royal United Services Institute for Defense Studies* (March 1974): 3-9.

⁴Huba Wass de Czege, "Preparing for War: Defining the Problem," (Fort Leavenworth, KS: 1984) quoted in Harold R. Winton, *To Change an Army*, 6.

⁵Allan R. Millett, "Patterns of Military Innovation in the Interwar Period," in Williamson Murray and Allan R. Millett, eds. *Military Innovation in the Interwar Period*, 359.

⁶Williamson Murray, "Innovation: Past and Future," in Williamson Murray and Allan R. Millett, eds. *Military Innovation in the Interwar Period*, 310-325.

⁷General Donn A. Starry, "To Change an Army," *Military Review* 63 (March 1983): 20-27.

⁸George Hoffman and Donn Starry, "Introduction," in *Camp Colt to Desert Storm: The History of U.S. Armored Forces*, eds. George F. Hofmann and Donn A. Story, (Lexington, KY: University of Kentucky Press, 1999), xv.

⁹*Ibid.*

¹⁰Harold R. Winton, *To Change An Army: General Sir John Burnett-Stuart and British Armored Doctrine, 1927-1938*, (Lawrence, KS: University of Kansas Press, 1988), 239.

¹¹Harold R. Winton, "Introduction: On Military Change," in Harold R. Winton and David R. Mets, eds. *The Challenge of Change: Military Institutions and New Realities, 1918-1941*, (Lincoln, NE: University of Nebraska Press, 2000), xi-xv.

¹²I. B. Holley, *Ideas and Weapons*, (Camden, CT: Archon Books, 1971), 10.

¹³I. B. Holley, "The Doctrinal Process: Some Suggested Steps," *Military Review* 59 (April 1979): 2-13 quoted in Harold R. Winton, *To Change an Army*, 5.

¹⁴Dennis R. Showalter, "Military Innovation and the Whig Interpretation of History." In Harold R. Winton and David R. Mets, eds. *The Challenge of Change: Military Institutions and New Realities, 1918-1941*, 220-233.

¹⁵*Ibid.*, 232.

¹⁶Richard Swain, "Adapting to Change in Times of Peace," *Military Review* 74 (July 1994): 50-58.

¹⁷Timothy T. Lupfer, *The Dynamics of Doctrine: The Changes in German Tactical Doctrine During the First World War*, Leavenworth Paper No. 4, (Fort Leavenworth, KS: Combat Studies Institute, U.S. Army Command and General Staff College, 1981), viii.

¹⁸Barry Posen, *The Sources of Military Doctrine*, 47; Peter Paret, "Innovation and Reform in Warfare," in *The Harmon Memorial Lectures in Military History, Number 8*, (Colorado Springs, CO: United States Air Force Academy, 1986), 8.

¹⁹Hajo Holborn, "The Prusso-German School: Moltke and the Rise of the General Staff," in *Makers of Modern Strategy: From Machiavelli to the Nuclear Age*, ed. Peter Paret, (Princeton, NJ: Princeton University Press, 1986), 281-295.

²⁰Andrew F. Krepinevich Jr., *The Army and Vietnam*, (Baltimore, MD: Johns Hopkins University Press, 1986), 260.

²¹Mark Clodfelter, *The Limits of Air Power: The American Bombing of North Vietnam*, (New York: The Free Press, 1989).

²²David G. Chandler, *The Campaigns of Napoleon*, (New York: Macmillan Publishing Co., 1966), 332-378.

²³*Ibid.*, 9; Friedrich von Decken, *Betrachtungen über das Verhältniss des Kriegsstandes zu dem Zwecke der Staaten*, in Peter Paret, "Innovation and Reform in Warfare," 7.

²⁴Peter Paret, "Innovation and Reform in Warfare," 8.

²⁵Michael Meese, "The Process of Organizational Change," 203-204; Victor Thompson, *Bureaucracy and Innovation*, (University of Alabama Press, 1976) 42-46.

²⁶ For a complete history of the Marine Corps efforts to sustain its institutional existence see Allan R. Millett's *Semper Fidelis: The History of the United States Marine Corps*, rev. ed. (New York: The Free Press, 1991).

²⁷Gregg Martin and Jeffrey McCausland, "The Role of the Strategic Leader for the Future Army Profession," in Don Snider, Gayle Watkins, and Lloyd Matthews, eds. *The Future of the Army Profession*, (Boston: McGraw-Hill Publishing Company, 2002), 425-438. Martin and McCausland note that the American medical profession has pursued this course. For example, for years American doctors have prescribed medications to ease pain and kept practitioners of alternative medicine out of the mainstream medical profession. In the late Twentieth Century, the profession has begun to recognize not only the medical benefits of alternative medicine, but also the commercial benefits as more Americans are becoming educated on the subject. Similarly, the medical profession has begun to include midwifery into its profession in recognition of its growing popularity while simultaneously moving laboratory technicians, whose skill is rapidly becoming computerized, out of the professional medical jurisdiction. (See Martin and McCausland, page 431.) In the military, the U.S. Marine Corps has become particularly adept at moving competencies in and out of its jurisdiction as necessary. It adopted amphibious warfare in the Interwar period and jettisoned the responsibility for high altitude air defense leaving that task to the Army. The Marine Corps' recent creation of an "anti-terrorism" brigade fashioned largely by combining existing organization and functions is another example of roving jurisdictions.

²⁸Allan R. Millett, *In Many a Strife: General Gerald C. Thomas and the U.S. Marine Corps 1917-1956*, (Annapolis, MD: Naval Institute Press, 1993), xix.

²⁹General Donn Starry, "To Change an Army," 23.

³⁰Ibid.

³¹Ibid.

³²Friedrich von Decken, *Betrachtungen über das Verhältniss des Kriegsstandes zu dem Zwecke der Staaten*, in Peter Paret, "Innovation and Reform in Warfare," 6-7.

³³Michael Howard, "Military Science in an Age of Peace," 8.

CHAPTER 5 – WORLD WAR I AND THE BIRTH OF AMERICAN ANTIAIRCRAFT ARTILLERY

¹James D. Crabtree, *On Air Defense*, (Westport, CT: Praeger Publishers, 1994), 1-2.

²Ibid., 2; Letter, T.S.C. Lowe to Brig. Gen. F. J. Porter, September 16, 1861, U.S. War Department, *War of the Rebellion: A Compilation of the Official Records of the Union and Confederate Armies*, 128 vols. (Washington: Government Printing Office, 1880-1901), Series III, vol. 3, p. 262. Hereafter cited as *OR*.

³*OR*, Series I, vol. 5, p. 725 (Hooker); *OR*, Series I, vol. 5, p. 982 ("infernal balloon").

⁴*OR*, Series I, vol. 10, p. 770.

⁵Crabtree, 3.

⁶Ibid.

⁷*OR*, Series III, vol. 3, p. 275.

⁸General P.G.T. Beauregard recommends balloons to Brig. Gen. Gustavus Smith. *OR*, Series I, vol. 20, p. 508. General Robert E. Lee refers to sending signals via balloon. *OR*, Series I, vol. 14, p. 617.

⁹Joseph C. Breckinridge, "Report of the Inspector General of the Army," *War Department Annual Report, 1891*, vol. V. (Washington: Government Printing Office, 1892), 25. Students of military innovation understand that while change is continuous—often evolutionary, sometimes revolutionary—the human perception about change is timeless. In light of contemporary discussions regarding defense transformation, there is no doubt that similar statements reverberated throughout the corridors of the Pentagon during the decade following America's 1991 victory in the Persian Gulf War.

¹⁰For a thorough understanding of the Army in which Breckinridge served see, Edward M. Coffman, *The Old Army: A Portrait of the American Army in Peacetime, 1784-1898*, (Oxford: Oxford University Press, 1986). Coffman's characterization of the end of constabulary era is found on page 403.

¹¹Breckinridge, "Report of the Inspector General of the Army," *WDAR, 1891*, 26.

¹²*Ibid.*

¹³For a succinct view of the changes in American military policy and strategy during this period see, Allan R. Millett and Peter Maslowski, *For the Common Defense, A Military History of the United States of America*, (New York: The Free Press, 1984), 233-327; Russell F. Weigley, *The American Way of War: A History of United States Military Strategy and Policy*, (Bloomington: Indiana University Press, 1973), 167-191; and Walter Millis, *Arms and Men: A Study in American Military History*, (New York: G. P. Putnam's Sons, 1956), 131-209.

¹⁴Breckinridge entered military service in 1861. *Army Register, 1891*, (Washington: Adjutant General's Office, 1891), 10. For more on the professionalization of the Army and Navy, see Allan R. Millett, "Military Professionalism and Officership in America," Mershon Center Briefing Paper No. 2., (Columbus, OH: Mershon Center of The Ohio State University, 1977); and James L. Abrahamson, *America Arms for a New Century: The Making of a Great Military Power*, (New York: The Free Press, 1981).

¹⁵L. Van Loan Naisawald, *Grape and Canister: The Story of Field Artillery of the Army of the Potomac, 1861-1865*, (New York: Oxford University Press, 1960), 443.

¹⁶U.S. General Staff, Statistical Branch, Report D-2-153, cited in Harvey De Weerd, "Production Lag in the American Ordnance Program, 1917-1918" (Ph.D. diss., University of Michigan, 1936), 1, n 3.

¹⁷All characterizations about the effect of the airplane are taken from Michael Sherry, *The Rise of American Air Power*, (New Haven, CT: Yale University Press, 1987), 4-9. Sherry draws "mechanical messiah..." from Joseph Corn, *The Winged Gospel: America's Romance with Aviation, 1900-1950*, (New York, 1983), 39; "birds of hell" and "mercy" from Thomas C. Leonard, *Above the Battle: War-Making in America from Appomattox to Versailles*, (New York, 1978), 88; and "a furnace of crimson flames" from H.G. Wells, *The War in the Air*, first published in 1908, (New York, 1917), 211.

¹⁸Sherry, *The Rise of American Air Power*, 3.

¹⁹Millett and Maslowski, *For the Common Defense, A Military History of the United States of America*, 316.

²⁰Alfred Goldberg, ed., *History of the United States Air Force: 1907-1957*, (Princeton, NJ: D. Van Norstrand Company, Inc, 1957), 8.

²¹ Edgar S. Gorrell, *The Measure of America's World War Aeronautical Effort*, (Norwich, VT: Norwich University, 1940), 3.

²²Timothy K. Nenninger, "American Military Effectiveness in the First World War" in *Military Effectiveness: Volume I, The First World War*, ed. Allan R. Millett and Williamson Murray (Boston: Allen & Unwin Inc., 1988), 116-156; Allan R. Millett, "Cantigny, 28-31 May 1918," in *America's First Battles: 1776-1965*. ed. Charles E. Heller and William A. Stofft, (Lawrence, KS: University Press, 1986), 149-185. The reference to European armies lacking an offensive maneuver-oriented doctrine is based on their performance from the Battle of the Marne (5-10 September 1914) through Verdun (February - August 1916) and the Battle of the Somme (June - November 1916). For information on the development of German "elastic" defensive tactics after the Battle of the Somme and offensive maneuver tactics over the winter of 1917-18, see Timothy T. Lupfer, *The Dynamics of Doctrine: The Changes in German Tactical Doctrine During the First World War*, (Fort Leavenworth, KS: U.S. Army Command and General Staff School, 1981).

²³For a succinct discussion of the Plattsburg Movement and the National Defense Act of 1916, see Millett and Maslowski, *For The Common Defense*, 321-325. For complete treatment, see John P. Finnegan, *Against the Specter of a Dragon: The Campaign for American Military Preparedness, 1914-1917*, (Westport, CT: Greenwood Press, 1975).

²⁴Nenninger, "American Military Effectiveness in the First World War" 116-156; Allan R. Millett, "Cantigny, 28-31 May 1918," 149-185.

²⁵Memorandum, Colonel Thomas Dewitt Milling to Chief of the Air Service, American Expeditionary Forces, 9 January 1919, Series A, Volume 15, p. 1, in Edgar S. Gorrell, *History of the American Expeditionary Forces Air Service, 1917-1919*, (National Archives Microfilm Publication M990, rol 4), Records of the American Expeditionary Forces (World War I), 1917-1923, Records Group 120, National Archives, Washington, DC, also available at the U.S. Army Military History Institute, Carlisle Barracks, Pennsylvania.

²⁶Memorandum, Brigadier General Benjamin D. Foulois, to Chief of the Air Service, American Expeditionary Forces, 29 January 1919, Series A, Volume 1, p. 82, in Edgar S. Gorrell, *History of the American Expeditionary Forces Air Service, 1917-1919*.

²⁷Frank T. Hines and Franklin W. Ward, *The Service of the Coast Artillery*, (New York: Robert Drummond & Co., 1910), preface.

²⁸*Ibid.*

²⁹On the split between Field Artillery and Coast Artillery, see Boyd L. Dastrup, *King of Battle: A Branch History of the U.S. Army's Field Artillery*, (Fort Monroe, VA: US Army Training and Doctrine Command, 1992), 158; For highlights of the developmental history and benefits of the M1902 3-inch gun, see Dastrup, 145-147. I wish to thank Dr. Lawrence Kaplan, U.S. Army Center for Military History, for bring to my attention the Field Artillery's purchase of an Italian field piece with a split carriage in 1911.

³⁰The hearing is summarized in Charles E. Kirkpatrick, *Archie in the A.E.F.: The Creation of the Antiaircraft Service of the United States Army, 1917-1918*, (Ft. Bliss, TX: U.S. Army Air Defense Artillery Museum, 1984), 2.

³¹At this time in the Army's history, the Ordnance Department was the organization responsible for both determining the requirements for weapons and manufacturing them. This responsibility would change with the National Defense Act of 1920 that created several branches and gave the branch chiefs responsibility for determining their weapons requirements. The Ordnance Department, however, was still responsible for obtaining the weapon. Along with its announcement that the 3-inch gun was sufficient to engage balloons, the Ordnance Department ordered the carriages of field pieces modified to allow the gun to be elevated to higher angles. *Ibid.*, 4.

³²For airplane statistics, see the U.S. Air Force Museum, online at www.wpafb.af.mil/museum/history/preww1/pw23.htm. The following artillery was available to the U.S. Army in July 1915:

Type	With Units	In Reserve	Total Available for War Use	Additional Artillery under manufacture
2.95" Mountain Gun	56	24	80	0
3" Field Gun	412	120	532	80
3.8" Howitzer	0	28	28	32
3.8" Field Gun	0	8	8	0
4.7" Howitzer	16	40	56	42
4.7" Field Gun	16	22	38	22
6" Howitzer	2	24	26	24
Total	502	266	768	200

Source: Harvey De Weerd, "Production Lag in the American Ordnance Program, 1917-1918," (Ph.D. diss., University of Michigan, 1936), 40-42.

Table 5.1 -- U.S. Army Artillery Availability (10 July 1915)

³³De Weerd, 40.

³⁴Paul W. Child, ed., *Register of Graduates and Former Cadets, 1802-1990*, (West Point, NY: Association of Graduates, 1990), 304 (hereafter *AOG Register of Graduates*).

³⁵The Board recommended nearly quadrupling the number of 3-inch field guns to 492 batteries/1968 guns and increasing the number of 3.8-inch howitzers fifteen fold to 234 batteries/936 guns. The total cost of the program was approximately \$480 million over 8 years. The cost was so high that then Brigadier General William Crozier (USMA, 1876), Chief of the Ordnance Corps, eliminated the heavy reliance on howitzers and cut the amount of ammunition in half to bring the total in at \$280 million. DeWeerd, 40-42. By April 6, 1917, the Army had only 532 3-inch and 75-mm guns on hand with 870 more under manufacture. United States Army Ordnance Department, *Army Ordnance 1917-1919: Estimates and Requirements Division*, Pamphlet no. 85, (Washington: GPO, 1919), 36.

³⁶United States Army Ordnance Department, *Army Ordnance 1917-1919: Estimates and Requirements Division*, Pamphlet no. 85, (Washington: GPO, 1919), 38.

³⁷War Department, "Notes on Anti-aircraft Guns," (Washington, DC: GPO, 1917). Copy obtained from the Combat Arms Research Library (hereafter CARL) Archives, United States Army Command and General Staff College, Fort Leavenworth, Kansas. Class no. M9403-B15. Accession No. 42067.

³⁸*Ibid.*, 24.

³⁹*Ibid.*, 24-25.

⁴⁰John J. Pershing, *My Experiences in the World War*, 2 vols. (New York: Frederick A. Stokes, 1931), 1:16,

⁴¹U.S. War Department, *Field Service Pocket Book, 1917*, (Washington, DC: Government Printing Office, 1917), 82-85.

⁴²Based on personal correspondence between Bliss and Frederick Palmer. See Frederick Palmer, *Newton D. Baker: America at War*, (New York: Dodd, Mead & Company, 1931), 168.

⁴³*Ibid.*

⁴⁴Letter, Major R.C. Bolling to Chief Signal Officer of the Army, 15 August 1917, Series A, Volume 1, p. 46, in Edgar S. Gorrell, *History of the American Expeditionary Forces Air Service, 1917-1919*.

⁴⁵*Ibid.*, 52.

⁴⁶Baker maintained that the French and British missions were woefully unable to give him an accurate picture of the situation in Europe. He complained, among other things, that "They could not picture to us the association of aircraft, balloons, and

mobility aircraft with artillery uses.... They said to us: 'This is a moving picture.... It is not a static thing.'" Palmer, *Newton D. Baker*, 168.

⁴⁷In addition to Pershing and Baker, most of the officers in both groups were West Point graduates. Others on the Baker Board (with Class as appropriate) were Colonels William S. Graves ('89), Charles P. Summerall ('92), Dwight E. Aultman ('94), and Mark L. Hersey ('87); Lieutenant Colonels Hanson E. Ely ('91), Edward D. Anderson ('91), Kirby Walker ('92), and Sherwood A. Cheney ('97); Majors M. E. Locke, George S. Simonds ('99), F. A. Ellison; and Captain John G. Queckmeyer ('06). The officers in Pershing's Operations Section were Lieutenant Colonels John McAuley Palmer ('92) and Fox Conner ('98), and Majors Alvin B. Barber ('05) and Hugh Drum. No doubt this common background also facilitated work between the staffs.

⁴⁸Letter, Colonel Chauncey B. Baker, "Report of the Baker Board," 26 July 1917, Historical Division, Department of the Army, *United States Army in the World War, 1917-1919*, 17 vols. (Washington, DC: Government Printing Office, 1948) (hereafter USA/WW), 1:55-89; *AOG Register of Graduates*, 307; John J. Pershing, *My Experiences*, 1:100-101; Kirkpatrick, *Archie in the A.E.F.*, 7-8.

⁴⁹Major H.A. Drum, Headquarters A.E.F, Office of the Chief of Staff, Operations Section, "Report on Organization," 10 July 1917, USA/WW, 1:93-101; Colonel Jay P. Hopkins, "Final Report of the Chief of the Antiaircraft Service," 28 December 1918, USA/WW, 15:209; Kirkpatrick, 8-17.

⁵⁰Kirkpatrick, 10.

⁵¹Entry #3464: James Ancil Shipton, Class of 1892, *Register of Graduates*, 313; United States Adjutant General Office, *Army Register, 1921*, (Washington, DC: Government Printing Office, 1921), 1171; Kirkpatrick, 17.

⁵²Colonel Jay P. Hopkins, "Antiaircraft Artillery," Lecture delivered at the Army Center of Artillery Studies, Treves Germany, 21 May 1919, TM, p. 1, Dec#666/M, Box 139, Entry #9, Record Group 177, National Archives, Washington, DC; Hopkins, "Final Report of the Chief of the Antiaircraft Service," 209; Kirkpatrick, 19.

⁵³Hopkins, "Final Report of the Chief of the Antiaircraft Service," 209.

⁵⁴*Ibid.*, 209-220; Kirkpatrick, 21; Entry #3959: Jay Paul Hopkins, Class of 1900, *Register of Graduates*, 322; *Army Register, 1921*, 626; American Expeditionary Forces, General Orders No. 181, 16 October 1918, in *General Orders and Index to General Orders and Bulletins, A. E. F., 1918* (GHQ, A.E.F.: AG Printing Department, 1918).

⁵⁵The term "Archie" was actually a term of derision used by pilots to characterize the antiaircraft fire that tarnished their clear sky and otherwise disturbed their flight. In World War II, it would be called flak after the German word.... According to Charles

Kirkpatrick, in World War I, "'Archie' derived from a popular London music hall tune of 1915, in which a young lady sought to preserve her virtue. 'Archibald? Certainly Not!' became the memorable refrain which pilots carried back to the front" and applied to the challenge presented by antiaircraft fire. Kirkpatrick, xi.

⁵⁶Hopkins, "Final Report of the Chief of the Antiaircraft Service," 215.

⁵⁷*Ibid.*, 209-215.

⁵⁸*Ibid.*, 210.

⁵⁹*Ibid.*, 210; Kirkpatrick, 22; For a concurring British opinion see comments by the Commander of the London Air Defense Area, Major General Edward Bailey Ashmore, in Edward Bailey Ashmore, *Air Defense*, (London: Longmans, Green and Co., 1929), 97-99.

⁶⁰Hopkins, "Antiaircraft Artillery," Lecture at Treves, Germany, 2-3; Major Elmer J. Wallace, "Anti-aircraft Weapons," *Journal of the United States Artillery* 47 (May-June, 1917): 309.

⁶¹Hopkins, "Antiaircraft Artillery," Lecture at Treves, Germany, 2-9. See also William Barnett, "Development of Antiaircraft Artillery, World War I to 1951," Armed Forces Staff College Paper, 17 December 1951, Norfolk, Virginia, 3-4. Copy obtained from CARL, Fort Leavenworth, Kansas. Catalog no. CS-26.

⁶²Hopkins, "Final Report on the Chief of the Antiaircraft Service," 211.

⁶³*Ibid.*, 211.

⁶⁴*Ibid.*, 216.

⁶⁵*Ibid.*, 211

⁶⁶As of late 2002, the emerging American concept of "Effects-Based Operations" or EBO had several different, if still complementary, definitions. Briefly, Effects-Based Operations refers to the use of different methods and techniques in a synergistic and cumulative process to achieve direct, indirect, and cascading effects on an adversary. In the context of World War I antiaircraft artillery, to scare or blind an enemy pilot, forcing him off his attack profile so that his bombs landed harmlessly, was to achieve the same immediate effect as would have occurred had he been shot down. See United States Joint Forces Command, Joint Forces Command glossary, <http://www.jfcom.mil/about/glossary.htm#E> and Paul K. Davis, *Effects-Based Operations: A Grand Challenge for the Analytical Community*, (Santa Monica, CA: RAND, 2001).

⁶⁷Kirkpatrick, 73.

⁶⁸Shipton's emphasis on precise, "technical shooting" also reduced the overall consumption of ammunition, an item that, like the guns themselves, remained in short supply. Anderson's comments come from Glenn P. Anderson, "With the Anti-Aircraft in France," *Liaison: The Courier of the Big Gun Corps*, vol. 1, no. 23 (24 May 1919): 221-223. Cited in Kirkpatrick, 73.

⁶⁹*Ibid.*, 211-212; Register of Graduates, 328.

⁷⁰Hopkins, "Final Report of the Chief of the Antiaircraft Service," 211. Superelevation is the creation of additional elevation of the barrel of the weapon so as to offset the effects of gravity on the trajectory or flight of the round. The faster the muzzle velocity of the round, the flatter the trajectory. Weapons with faster muzzle velocities required less superelevation.

⁷¹*Ibid.*, 212; Kirkpatrick, 27.

⁷²Hopkins, "Final Report of the Chief of the Antiaircraft Service," 213-214; Kirkpatrick, 28-30.

⁷³Hopkins, "Final Report of the Chief of the Antiaircraft Service," 214; "Hopkins, "Antiaircraft Artillery," Lecture at Treves, Germany, 4-8.

⁷⁴Hopkins, "Final Report of the Chief of the Antiaircraft Service," 209-220; "Hopkins, "Antiaircraft Artillery," Lecture at Treves, Germany, 4; Kirkpatrick, 35-36.

⁷⁵Kirkpatrick, 74. American forces did use the French Caquot Balloon for observation. See United States Army Air Forces, *Barrage Balloon Development in the United States Army Air Corps, 1923-1942*, U.S. Army Air Forces Historical Study, No. 3. (Washington, DC: Assistant Chief of the Air Staff, Intelligence Section, Historical Division, 1943), 3.

⁷⁶Richard P. Weinert, Jr. and Robert Arthur, *Defender of the Chesapeake: The Story of Fort Monroe*, 3d ed., (Shippensburg, PA: White Mane Publishing Co, 1989), 232; Kirkpatrick, 34.

⁷⁷Kirkpatrick, 34-35.

⁷⁸*Ibid.*, 35.

⁷⁹Weinert and Arthur, *Defender of the Chesapeake*, 232 and 234. Additionally, the 4th Antiaircraft Battalion and the 13th, 14th, 15th, and 16th Antiaircraft Companies trained at Camp Eustis.

⁸⁰Hopkins, "Final Report of the Chief of the Antiaircraft Service," 214-220; Hopkins, "Antiaircraft Artillery," Lecture at Treves, Germany, 4-8; Kirkpatrick, 39.

⁸¹*Ibid.*

⁸²Congress, House, Committee on Military Affairs, *Hearings Before the House Committee on Military Affairs on House Resolution 12766*, 64th Cong., 1st sess., vol. I, 486-512. For an in-depth discussion of World War I production problems, see Harvey A. DeWeerd, "Production Lag in the American Ordnance Program, 1917-1918" (Ph.D. diss., University of Michigan, 1936).

⁸³*Hearings Before the House Committee on Military Affairs on House Resolution 12766*, 498.

⁸⁴*Ibid.*, 498.

⁸⁵Harvey A. DeWeerd, "Production Lag in the American Ordnance Program, 1917-1918," 69. Congress established the Council of National Defense on August 29, 1916 as part of the Army Appropriation Act. Congress charged the Council with the "coordination of industries and resources for the national security and welfare...." It consisted of the Secretaries of War, Navy, Interior, Agriculture, Commerce, and Labor. Congress also dictated that the Council appoint an Advisory Commission of seven persons with special knowledge of industry, public utility, and natural resources. Commission members were Bernard Baruch, Howard Coffin, Hollis Godfrey, Samuel Gompers, Franklin Martin, Julius Rosenwald, and Daniel Willard. It lacked any real authority to compel adherence to its rulings or generate cooperation. In March 1918, the War Industries Board replaced the Council. For a different view of its usefulness see Daniel Willard, "Advisory Commission, Council on National Defense During World War," Paper presented to The Army Industrial College, Course 1936-1937, May 14, 1937, 1-2. Available through the National Defense University Library Special Collections Digital Catalog.

⁸⁶Nenninger, "American Military Effectiveness in the First World War" in *Military Effectiveness: Volume I, The First World War*, 131.

⁸⁷Pershing, *My Experiences*, 1:106-107.

⁸⁸William Crozier, "Report of the Chief of Ordnance," *War Department Annual Report, 1917*, 3 vols. (Washington, D.C.: Government Printing Office, 1918) (hereafter *WDAR* followed by fiscal year), 1:813.

⁸⁹Erasmus Weaver, "Report of the Chief of the Coast Artillery," *WDAR, FY1916*, 1:1163-1174; Erasmus Weaver, "Report of the Chief of the Coast Artillery," *WDAR, FY1917*, 1:929; Memorandum, Major General Frank W. Coe, "Assignment of Anti-

aircraft Guns," 6 March 1920, Dec#666/J, Box 139, Entry #9, Record Group 177, National Archives, Washington, DC.

⁹⁰DeWeerd, "Production Lag in the American Ordnance Program, 1917-1918," 80-81

⁹¹Ibid.

⁹²In a May 26, 1917 letter from Ganne to Major General Crozier confirming their conference the previous day, Ganne offered that "beginning with August 1, 1917, the French Government can supply five 75mm field guns per day with an initial supply of 1,000,000 rounds of ammunition. From October 1, 1917, it can supply two 155mm howitzers daily with an initial supply of 100,000 rounds of ammunition and a daily supply of 6,000 rounds...." Cited in DeWeerd, "Production Lag in the American Ordnance Program, 1917-1918," 80.

⁹³Ibid., 87.

⁹⁴Erasmus Weaver, "Report of the Chief of the Coast Artillery," *WDAR, FY1917*, 1:929; William Crozier, "Report of the Chief of Ordnance," *WDAR, 1920*, vol. 1, part 4, pp. 3911-3914; Nenninger, 120-131; "Army Budget, FY1919," *WDAR, FY1918*, 1:96. The Air Service fared only marginally better. In June 1917, the Aircraft Production Board planned to provide 4,500 airplanes to the Army within a year. On July 24, 1917, Congress appropriated \$640 million to pay for the airplanes. The American aircraft industry, however, could not produce. "Only 696 American-built airplanes reached the front before the armistice." Jeffery S. Underwood, *The Wings of Democracy: The Influence of Air Power on the Roosevelt Administration, 1933-1941*, (College Station: Texas A&M University Press, 1991), 7.

⁹⁵Peyton C. March, "Report of the Chief of Staff," in *WDAR, FY1919*, 8.

⁹⁶Hopkins, "Final Report of the Chief of the Antiaircraft Service," 217; "Hopkins, "Antiaircraft Artillery," Lecture at Treves, Germany, 4; Kirkpatrick, 57.

⁹⁷Kirkpatrick, 122-123; *Journal of the United States Artillery 14* (Fort Monroe, VA: Coast Artillery School Press, May 1919), 325-327.

CHAPTER 6 – THE 1920s: A STRUGGLE FOR SURVIVAL AND A FOUNDATION FOR GROWTH

¹Weinert and Arthur, *Defender of the Chesapeake*, 235.

²Memorandum, Maj. Gen. Frank W. Coe, to the Chief of the War Plans Division, 11 December 1918, "Use of Antiaircraft Searchlights and Sound Position Finding

Apparatus," Dec #666, Box 139, Entry #9, Records Group 177, National Archives, Washington, DC (hereafter NA).

³Maj. Gen. Frank W. Coe, "Annual Report of the Chief of Coast Artillery Corps," in *War Department Annual Report, 1920*, (Washington, DC: Government Printing Office, 1920) (hereafter *WDAR* followed by fiscal year), 1:4047-4052; Paul W. Child, ed., *Register of Graduates and Former Cadets, 1802-1990*, (West Point, NY: Association of Graduates, 1990), 313.

⁴General Headquarters, The American Expeditionary Forces, *Report of the A.E.F. Superior Board on Organization and Tactics*, (Washington, DC), June 16, 1920, 44-45; and Larry H. Addington, "The U.S. Coast Artillery and the Problem of Artillery Organization, 1907-1954," *Military Affairs*, 40 (February 1976): 2. See also "Statement of Maj. Gen. Frank W. Coe, Chief of Coast Artillery" in Congress, House, Committee on Military Affairs, *Army Appropriation Bill, 1920*, 65th Cong., 3rd sess., 20 January 1919, 90.

⁵Addington, 2.

⁶Memorandum, Col. C. C. Hearn, to the Chief of the Coast Artillery Corps, 15 August 1919, "Transfer of Anti-Aircraft Defenses to the Proposed Department of Aeronautics," Dec #666/F, Box 139, Entry #9, RG 177, NA.

⁷*Ibid.*, 2.

⁸Peyton C. March, The Joint Board, "Defense of Naval Shore Stations against Aircraft Attack," Joint Board Serial #48, 12 February 1920, TM, p. 1, Dec #666/H-2 (Inc. 1), Box 139, Entry #9, RG 177, NA. The Joint Board was reorganized in 1919. In addition to the Army Chief of Staff and the Chief of Naval Operations, the Joint Board consisted of the Directors of the Operations and War Plans Divisions from the Army General Staff and the Assistant Chief of Naval Operations and Director of Naval Operations Plan. To study issues of joint action, the Secretaries of War and Navy also organized the Joint Army and Navy Planning Committee consisting of three or more members each from the War Plans Branch of the Army General Staff and the Plans Division of Naval Operations. See "Joint Army and Navy Action in Coast Defense," (Washington, DC: GPO, 1920), 15-16.

⁹Memorandum, Maj. Gen. F.W. Coe, to the Director of the War Plans Division, 16 January 1920, "Defense of Naval Shore Stations against Attacks of Aircraft," Dec #666/H-1, Box 139, Entry #9, RG 177, NA.

¹⁰"Joint Army and Navy Action in Coast Defense," 13-14.

¹¹*Ibid.*, 9

¹²See "Joint Army and Navy Action in Coast Defense" pages 10-11 for a list of the eight areas and pages 17-37 for the Navy's discussion of them. See pages 38-51 for the Army's discussion of "A Positive System of Coast Defense." The eight general forms of attack (with the number of pages devoted to their discussion by the Navy) were: 1) Aircraft attacks on seaports (5 pages); 2) Mine-laying attacks off the seacoast (4 pp); 3) Torpedo, bombing, and gunfire attacks on vessels off the seacoast (1 page); 4) Torpedo fire into seaports (1 page); 5) Blocking attacks on seaports (1 page); 6) Bombardment of seaports by naval vessels (1/2 page); 7) Penetration into a harbor or water area by naval vessels (2 pp); and 8) Landing attacks (2 pp). Of note, in listing assets supporting the Fleet in coast defense, the Navy lists Marine Corps advanced base forces and includes antiaircraft batteries among the Marine forces.

¹³Maj. Gen. Frank W. Coe, "Report of the Chief of the Coast Artillery Corps," in *WDAR, 1920*, 308.

¹⁴William O. Odom, *After the Trenches: The Transformation of U.S. Army Doctrine, 1918-1939*, (College Station, TX: 1999), 21.

¹⁵Letter, Lt. Col. John B. Murphy, to Maj. H.P. Worcester, 17 September 1920, "Antiaircraft Service and Organization," Dec #666/01, Box 139, Entry #9, RG 177, NA; For a more detailed treatment of the creation of Army organization and doctrine in the early 1920's see William O. Odom, *After the Trenches*; and Major A.W. Lane, "Tables of Organization," *Infantry Journal*, 18 (May 1921): 486-503.

¹⁶Addington, 3.

¹⁷Memorandum and Chart, Maj. Gen. Frank W. Coe, to Chief of Staff, 6 March 1920, "Assignment of Antiaircraft Guns," Dec #666/J and #666/J-1, Box 139, Entry #9, RG 177, NA; Additional chart dated 1 November 1921 shows completed gun assignments, Dec #666/J-6, Box 139, Entry #9, RG 177, NA; For Maj. Gen. Coe's position on decentralized defense planning, see Ltr, Lt. Col. Murphy, to Maj. Worcester, 17 September 1920, referenced in note 10.

¹⁸Thomas R. Phillips, "Some Phases of the Effect of Aircraft on the Future Mission, Organization, Equipment, and Tactics of the Coast Artillery Corps," *Coast Artillery Journal*, vol. 58. no. 3, (March 1923), 203-204.

¹⁹Captain F. S. Clark, "Archie's Gunnery," *The Journal of United States Artillery*, 53 (December 1920): 639-640; Letter, Brig. Gen. Johnson Hagood, to the Chief of the Coast Artillery, 29 March 1920, "Anti-aircraft Material," Dec#666/L, Box 145, Entry #9, RG 177, NA.

²⁰Clark, "Archie's Gunnery," 639-640.

²¹Ltr, Hagood, to the Chief of the Coast Artillery, 29 March 1920, "Anti-aircraft Material," Dec #666/L, Box 145, Entry #9, RG 177, NA.

²²See "The Beaten Zone" in *Journal of the United States Artillery* vol. 53, no. 6 (December 1920) to vol. 54, no. 5 (May 1921) for specific articles by Maj. Spiller on antiaircraft artillery.

²³War Department, Office of the Chief of Coast Artillery, Bulletin, "Anti-Aircraft Series," No. A.A. 1.001, 25 November 1922, TM, Dec #300.53, Box 3, Entry 9, RG 177, NA.

²⁴Articles on antiaircraft artillery also appeared in *The Field Artillery Journal*, *Journal of the Royal Artillery*, *Army Ordnance*, *Royal Engineer Journal*, *The Army and Navy Register*, *Army Quarterly*, *Revue D'Artillerie*, *Proceedings of the U.S. Naval Institute*, *American Machinist*, and *Revista Del Ejercito Y De La Marina*.

²⁵H.C. Barnes, "A Regimental Organization for the Coast Artillery Corps," *Coast Artillery Journal*, 60 (April 1924): 294.

²⁶War Department, "The Progress of the War Department in Compliance with The National Defense Act of 1920," (Washington, DC: GPO, 1922), 6 cited in "The Work that Lies Ahead", *Coast Artillery Journal*, vol 58., (January 1923), 63-70.

²⁷"The Work that Lies Ahead", *Coast Artillery Journal*, vol 58., (January 1923), 63.

²⁸*Ibid.*, 68.

²⁹H.C. Barnes, "A Regimental Organization for the Coast Artillery Corps," 295.

³⁰Four of the motorized and railway regiments were active and four were inactive. War Department, The Adjutant General's Office, *Army List and Directory*, Jan 1, 1922, (Washington, DC: Government Printing Office, 1922), 25-26. (Hereafter *Army List* followed by month and year).

³¹There were also three inactive railway artillery regiments and one inactive heavy tractor artillery regiment. *Army List*, January 1925, 19-20. By 1929, the only changes to the Coast Artillery Corps organization were the addition of one inactive harbor defense and four inactive antiaircraft regiments. *Army List*, January 1929, 24.

³²The 12th Coast Artillery Regiment (Harbor Defense) and the 61st Coast Artillery Regiment (Antiaircraft) were stationed at Fort Monroe. *Army List*, January 1925,

³³Weinert and Arthur, *Defender of the Chesapeake*, 243. One suspects that this was also Pershing's farewell celebration as he retired from the Army in September 1924.

Also see "The Coast Artillery School Centennial Exercises," *Coast Artillery Journal*, Vol 60., No. 6, (June 1924), 451. For a similar display with even more anti-aircraft involvement, see "Army 1st and 2nd Line in Joint Review: Regular and National Guard Artillery in Armory Exhibition (62d C.A and 245th C.A.)," *Army and Navy Journal*, May 3, 1924, 864.

³⁴Phillips, "Some Phases of the Effect of Aircraft on the Future Mission, Organization, Equipment, and Tactics of the Coast Artillery Corps," *Coast Artillery Journal*, 203-224.

³⁵F.S. Clark, "A.A. in the Big Tent," *Coast Artillery Journal*, vol. 58. (May 1923), 464-465. *Italics in original.*

³⁶War Department, Office of the Chief of Coast Artillery, Bulletin, "Anti-Aircraft Series: Organization," No. A.A. 5.001 - A.A. 5.005, 22 December 1922, TM, Dec #300.53, Box 3, Entry 9, RG 177, NA.

³⁷*Ibid.*

³⁸War Department, *Training Regulation 435-30: Coast Artillery Corps, Tactical Employment of the Antiaircraft Service*, (Washington, DC: Government Printing Office, 1926), Folder: General Manuals, Directives and Memoranda for the Training of Troops, Particularly Coast Artillery 1912-1941, Box 1, Official Papers 1906-1941, William C. Foote Papers, Military History Research Collection, U.S. Army Military History Institute, Carlisle Barracks, Pennsylvania, 6.

³⁹War Department, Office of the Chief of Coast Artillery, Bulletin, "Anti-Aircraft Series: Organization," No. A.A. 5.001 - A.A. 5.005, 22 December 1922, TM, Dec #300.53, Box 3, Entry 9, RG 177, NA.; War Department, *Training Regulation 435-30: Coast Artillery Corps, Tactical Employment of the Antiaircraft Service*, 11.

⁴⁰War Department, *Training Regulation 435-30: Coast Artillery Corps, Tactical Employment of the Antiaircraft Service*, 12.

⁴¹U.S. War Department, *Field Service Regulations, 1923*, (Washington, DC: Government Printing Office, 1924), 17-22.

⁴²Air power enthusiasts faced the same problem and were forced to market "strategic bombing" as "coastal defense."

⁴³Letter, Maj. Gen. Frank W. Coe, to the Adjutant General, 24 November 1924, "Anti-Aircraft Project for the United States," Dec #666/AM, Box 139, Entry #9, RG 177, NA.

⁴⁴Letter, Adjutant General, to the Chief of Coast Artillery, 7 January 1925, "Anti-Aircraft Defense," Dec #666/AM-3, Box 139, Entry #9, RG 177, NA.

⁴⁵Letter, Maj. Gen. Frank W. Coe, to the Adjutant General, 26 August 1925, Secret, "Anti-Aircraft Project for the United States," Dec #666/AM-18, Box 139, Entry #9, RG 177, NA.

⁴⁶Memorandum, Maj. Gen. Mason Patrick, to the Adjutant General, 27 March 1925, "Anti-Aircraft Defense," Dec #666/Am-34 (Inc.45), Box 140, Entry #9, RG 177, NA; Letter, Maj. Gen. Mason Patrick, to the Adjutant General, 8 August 1925, "Anti-Aircraft Defense," Dec #666/AM-34 (Inc.8), Box 140, Entry #9, RG 177, NA. The current term for "aerial anti-aircraft defense" is defensive counter-air. In other words, pursuit aircraft finding and attacking enemy aircraft before they can do damage to friendly assets.

⁴⁷Congress, House, Committee on Military Affairs, *Department of Defense and Unification of the Air Service*, 69th Cong., 1st sess., 19 January to 9 March, 1926, 383-386; and *Washington Post* editorial "New Coast Defense Plans Needed" cited J.A. Green, "Good Advice from General Coe," *Coast Artillery Journal* vol. 60, No. 3, (March 1924), 221-223. The *Post* editorial when on to claim the utter domination of air, land, and sea by the airplane and the "defenselessness of coastal fortifications against attacks from the air [and the] uselessness of coast artillery" unless "supported by the air force."

⁴⁸United States Army Air Forces, *Barrage Balloon Development in the United States Army Air Corps, 1923-1942*, U.S. Army Air Forces Historical Study, No. 3. (Washington, DC: Assistant Chief of the Air Staff, Intelligence Section, Historical Division, 1943), 4-5.

⁴⁹"Historical Study of Antiaircraft Defense," Army War College, AWC #216-319, 24 April 1925, TM, p. 193, Dec #666/AM-34 (Inc. 25), Box 140, Entry #9, RG 177, NA.

⁵⁰Maj. B. W. Simpson, "Statement Before the President's Special Committee on Investigation of Aviation," 14 October 1925, TM Dec #666/AM-34 (Inc. 28), Box 140, Entry #9, RG 177, NA; Memorandum, Brig. Gen. C. L'H. Ruggles, to Maj. G.V. Strong, 19 October 1925, TMs, "Copy of Brig. Gen. Ruggles Statement on Antiaircraft Defense to the President's Aircraft Investigation Board," Dec #666/AM-34 (Inc. 29), Box 140, Entry #9, RG 177, NA.

⁵¹Green, "Good Advice from General Coe," *Coast Artillery Journal*, (March 1924), 223.

⁵²The cost of 374 mobile batteries was \$41,043,588. A fixed battery cost \$60,839, a savings of \$48,903 over the cost of a mobile battery. Coe calculated \$14,815,170 for 135 mobile batteries; \$6,935,646 for 114 fixed batteries; \$4,601,636 for the 7055 machine guns required; \$2,635,245 for battalion and regimental overhead (10%

of the cost of equipment); and \$10,806,520 for 3-inch and .50 caliber ammunition. Using these figures adjusted for 374 mobile batteries, the aggregate cost exceeded \$60 million. For detailed calculations see Coe's letter to the Adjutant General referenced in note 44.

⁵³Memorandum, Col. W.S. Bowen, to the Chief of Coast Artillery, 23 December 1925, untitled, Dec #666/BK, Box 141, Entry #9, RG 177, NA; Letter, Maj. Gen. Andrew Hero Jr. to the Adjutant General, 22 March 1926, "Antiaircraft Defense," Dec #666/AM-30, Box 139, Entry #9, RG 177, NA; Russell F. Weigley, *History of the United States Army*, (New York: MacMillan Publishing Co., 1967), 561.

⁵⁴U.S. War Department, *Field Service Regulations, 1923*, 48.

⁵⁵*Ibid.*, 73.

⁵⁶*Ibid.*, 111; Brig. Gen. Harry A. Smith, War Plans Division Staff Study, "Anti-aircraft Defense," October 1925, TM, Dec #666/AM-22, Box 139, Entry #9, RG 177, NA; Letter, Col. John H. Hughes, Office of the Chief of Infantry, to the Adjutant General, 19 March 1925, "Antiaircraft Defense," Dec #666/AM-34, Box 140, Entry #9, RG 177, NA.

⁵⁷Letter, Maj. Gen. F.W. Coe, to the Adjutant General, 26 August 1925, "Anti-Aircraft Project for the United States," Dec #666/AM-18, Box 139, Entry #9, RG 177, NA; Brig. Gen. Harry A. Smith, War Plans Division Staff Study, "Anti-aircraft Defense," October 1925, TM, Dec #666/AM-22, Box 139, Entry #9, RG 177, NA;

⁵⁸Brig. Gen. Harry A. Smith, War Plans Division Staff Study, "Anti-aircraft Defense," October 1925, TM, Dec #666/AM-22, Box 139, Entry #9, RG 177, NA; Letter, Col. Willey Howell, to the Adjutant General, 5 August 1925, "Antiaircraft Defense," Dec #666/AM-34 (Inc. 12), Box 140, Entry #9, RG 177, NA.

⁵⁹Letter, Brig. Gen. Edgar Jadwin, to the Adjutant General, 5 August 1925, "Anti-Aircraft Defense," Dec #666/AM-34 (Inc. 11), Box 140, Entry #9, RG 177, NA; Letter, Maj. C.S. Blakely, to the Adjutant General, 26 March 1925, "Antiaircraft Defense," Dec #666/AM-34 (Inc. 12), Box 140, Entry #9, RG 177, NA; and "Clash on Anti-Aircraft," *Coast Artillery Journal*, Vol. 60, No. 6, (December 1924), 556.

⁶⁰Letter, Lt. Col. Daniel Van Voorhis, to the Adjutant General, 11 August 1925, "Antiaircraft Defense," Dec #666/AM-34 (Inc. 6), Box 140, Entry #9, RG 177, NA; Letter, Brig. Gen. Edw. L. King, to the Adjutant General, 8 July 1925, "Antiaircraft Defense," Dec #666/AM-34 (Inc. 39), Box 140, Entry #9, RG 177, NA.

⁶¹Brig. Gen. Harry A. Smith, War Plans Division Staff Study, "Anti-aircraft Defense," October 1925, TM, Dec #666/AM-22, Box 139, Entry #9, RG 177, NA; Memorandum, Brig. Gen. Hugh A. Drum, to the Assistant Chief of Staff, War Plans

Division, 31 October 1925, "Anti-aircraft Artillery," Dec #666/AM-22, Box 139, RG 177, NA.

⁶²Letter, Maj. Gen. F.W. Coe, to the Adjutant General, 6 October 1925, "Antiaircraft Artillery," Dec #666/AM-18F, Box 139, Entry #9, RG 177, NA; Letter (1st End.), Adjutant General, to the Chief of Coast Artillery, 9 November 1925, Dec #666/AM-18F, Box 139, Entry #9, RG 177, NA.

⁶³Letter (2nd End.), Maj. Clifford Jones, to the Adjutant General, 6 January 1926, Dec #666/AM-18F, Box 139, Entry #9, RG 177, NA; Letter (3rd End.), Adjutant General, to the Chief of the Coast Artillery, 5 February 1926, Dec #666/AM-18F, Box 139, Entry #9, RG 177, NA.

⁶⁴Letter (3rd End.), Jones, to the Adjutant General, 6 January 1926, Dec #666/AM-18F, Box 139, Entry #9, RG 177, NA.

⁶⁵All of the *Coast Artillery Field Manuals* on Antiaircraft Artillery (published in 1930, 1933, 1938, and 1940) and both of the *Army Field Service Regulations* (published in 1939/Tentative and 1941) list the Army Corps as the lowest level tactical organization with an organic antiaircraft artillery unit. Under the heading of "Antiaircraft Security" in both of the *Field Service Regulations*, soldiers are given instructions to follow in order to protect themselves from to hostile air attack. In priority of action, the steps are: "warning, concealment, dispersion, and fire" (*FSR, 1940*, 53). In all manuals, the mission of the antiaircraft artillery continued to be to reinforce the fires of the divisional units. For more on the controversy between advocates of a divisional antiaircraft battalion and Lt. Gen. Lesley McNair during World War II, see Kent Roberts Greenfield, Robert R. Palmer, and Bell I. Wiley, *The Army Ground Forces: The Organization of Ground Combat Troops in the United States Army in World War II*, (Washington, DC: Department of the Army Historical Division, 1947), 293-297.

⁶⁶This verse is part of the 64th Coast Artillery (Antiaircraft) Regimental Motto. See "R. E. Wyllie, "The 64th Coast Artillery (Antiaircraft)," *Coast Artillery Journal*, Vol. 61, No. 1, (July 1924), 19.

⁶⁷Memorandum, Maj. Gen. F.W. Coe, to the Chief of Staff, 6 March 1920, "Assignment of Anti-Aircraft Guns," Dec #666/J3, Box 139, Entry #9, RG 177, NA.

⁶⁸Letter, Lt. Col. John B. Murphy, to Maj. H.P. Worcester, 17 September 1920, Dec #666/01, Box 139, Entry #9, RG 177, NA; Memorandum, Maj. Gen. F.W. Coe, to the Assistant Chief of Staff, War Plans Division, 7 January 1925, "Information Concerning Antiaircraft Artillery," Dec #666/AM-1, Box 139, Entry #9, RG 177, NA; Maj. O.L. Spiller, "The Beaten Zone: Anti-Aircraft Artillery--Guns and Mounts," *Journal of the United States Artillery*, 53 (December 1920): 643-646. See also William Barnett, "Development of Antiaircraft Artillery, World War I to 1951," Armed Forces Staff College Paper, 17 December 1951, Norfolk, Virginia, 5.

⁶⁹Ibid.

⁷⁰Office Memorandum, Maj. Gen. F.W. Coe, 9 June 1923, Dec #666/AA, Box 139, Entry #9, RG 177, NA.

⁷¹Ibid.; Memorandum, Maj. Gen. F.W. Coe, to the Assistant Chief of Staff, War Plans Division, 7 January 1925, "Information Concerning Antiaircraft Artillery," Dec #666/AM-1, Box 139, Entry #9, RG 177, NA; U.S. War Department, *Coast Artillery Field Manual (Provisional): Antiaircraft Artillery*, vol. 2, (Fort Monroe, VA: The Coast Artillery, 1930) (hereafter *CAFM/AA* followed by the year of publication), 4; U.S. Army Air Defense School, *Air Defense: An Historical Summary*, vol. 1, (Fort Bliss, TX: U.S. Army Air Defense School, 1965) (hereafter *USAADS Air Defense*), 48-52.

⁷²For figures on the Coast Artillery and the Ordnance Department, see Memorandum (1st End), Lt. Col. H.C. Barnes, to Brig. Gen. Hugh A. Drum, 21 March 1925, "Antiaircraft Data," Dec #666/AW, Box 141, Entry #9, RG 177, NA; For figures on Air Service research and development funds, see John W. Weeks, "Report of the Secretary of War, 1924" in *WDAR, 1924*, 23.

⁷³Letter, Maj. Gen. Andrew Hero, Jr., to the Adjutant General, 18 March 1929, Confidential, "Antiaircraft Defense," Dec #666/AM-37, Box 139, Entry #9, RG 177, NA.

⁷⁴United States Army Air Forces, *Barrage Balloon Development in the United States Army Air Corps, 1923-1942*, 5-13.

⁷⁵Letter, Maj. Gen. Andrew Hero, Jr., to the Adjutant General, 18 March 1929, Confidential, "Antiaircraft Defense," Dec #666/AM-37, Box 139, Entry #9, RG 177, NA.

⁷⁶Maj. Gen. Andrew Hero, Jr. "New Year Greetings from the Chief of Coast Artillery" *Coast Artillery Journal* vol. 72, no. 1. (January 1930): frontpiece.

⁷⁷"The Coast Artillery School: Antiaircraft--'Cock o' the Walk,'" *Coast Artillery Journal* vol 72, no. 5. (May 1930): 435.

⁷⁸"Seacoast versus Antiaircraft," *Coast Artillery Journal*, vol 73, no. 3. (September 1930): 263. Weinert and Arthur, *Defender of the Chesapeake*, 247-248.

CHAPTER 7 - THE 1930s: FROM COMPETITION TO COOPERATION AND ACCEPTANCE

¹After arguing over areas of responsibility for coastal defense for most of the 1920s, Chief of Naval Operations Admiral William V. Pratt and Army Chief of Staff General Douglas MacArthur reached an informal understanding that gave the Navy

responsibility for air support to the fleet and left the Army with coastal defense. As Ronald Spector points out, the agreement was short-lived as renewed bickering continued only to be exacerbated in the mid-1930s when the Air Corps began planning to attack enemy ships in operations independent of either the Army or Navy. The 1935 version of the *Joint Action of the Army and Navy* papered over the issue, giving neither service exclusive jurisdiction and arguing instead that each service would have areas in which it would possess a “paramount interest.” From the outside, the *Joint Action* looked like a step forward, but in reality it was so muddled that it inhibited any real coordination. See Ronald Spector, “The Military Effectiveness of the US Armed Forces, 1919-1939,” in *Military Effectiveness Vol II: The Interwar Period*, eds. Allan R. Millett and Williamson Murray, (Boston: Allen & Unwin, 1988), 86-87. Also John F. Shiner, “The Air Corps, the Navy, and Coast Defense, 1919-1941,” *Military Affairs*, (October 1981), 113-119.

²Robert W. Grow, “Part I: The Ten Lean Years,” *Armor* vol. XCVI, (January-February 1987): 23. Major General Robert W. Grow began his career as a horse cavalryman and became one of the pioneers in the mechanization of the U.S. Army during the Interwar Period. He was the first S3 (Operations Officer) of the Mechanized Force under Colonels Adna Chaffee and Daniel Van Voorhis in the early 1930s. During World War II, he commanded the 6th Armored Division in the European Theater of Operations. He retired as a major general in 1953 after serving as military attaché in Moscow during the postwar years. He died in November 1985.

³Russell F. Weigley, *History of the United States Army*, (New York: Macmillan Publishing, 1974), 568.

⁴“The Reorganization and New Training Objective of the Coast Artillery Corps,” *Coast Artillery Journal*, vol. 72, no. 1 (January 1930), 1-11.

⁵*Ibid.*, 1.

⁶*Ibid.*, 10. After the reorganization, the only active harbor defense units were located at Long Island Sound, New York; Sandy Hook, New Jersey; Chesapeake Bay, Virginia; Pensacola, Florida; San Francisco, California; and Puget Sound, Washington. In all, Hero reduced 19 of 25 harbor defense units to caretaker status. The four antiaircraft regiments were located at Fort Totten, New York; Fort Oglethorpe, Georgia (69th CA to move eventually from Aberdeen); Fort Sheridan, Illinois (from Fort Monroe, Virginia); and Fort MacArthur in Los Angeles, California (from San Francisco). Hero maintained the harbor defense units and moved the antiaircraft regiments to their locations to establish harbor defense and antiaircraft training centers around major population centers. Still, the dramatic decrease in harbor defense installations and the increase in antiaircraft regiments is indicative of the relative standing each maintained within the defense establishment.

⁷*Ibid.*, 11.

⁸“The Coast Artillery School,” *Coast Artillery Journal*, vol. 72, no. 2, (February 1930): 157-158.

⁹Weinert and Arthur, *Defender of the Chesapeake*, 248. For more on the instructors and the program of instruction at the Air Corps Tactical School, see Robert T. Finney, *History of the Air Corps Tactical School, 1920-1940*, (Washington DC: Center for Air Force History, 1992), particularly 34-43.

¹⁰“The Coast Artillery School,” *Coast Artillery Journal*, 157-158.

¹¹This information was derived from a chart depicting the program of instruction for all officer courses taught at the Coast Artillery School in the academic year 1932-1933. See Coast Artillery Activities, “The Coast Artillery School,” *Coast Artillery Journal*, vol. 75, no. 4 (July-August 1932): 306.

¹²U.S. War Department, *Training Regulations 435-30, Coast Artillery Corps: Tactical Employment of the Antiaircraft Service*, (Fort Monroe, VA: Coast Artillery Corps, 1926); U.S. War Department, *Coast Artillery Field Manual*, vol. 2, *Antiaircraft Artillery Units*, (Fort Monroe, VA: Coast Artillery Corps, 1930) (hereafter *CAFM* followed by the year of publication).

¹³The increase in searchlights emerged primarily from a desire to employ the lights in two concentric rings around the defended asset instead of in the earlier box formation. Coast Artillery planners believed that this new formation enabled commanders to maximize the illumination range of their searchlights by extending their position further from the defended area. They reasoned that the earlier an antiaircraft unit detected an enemy plane, the longer the gunners had to fire on the aircraft before it flew close enough to drop its ordnance. For assets requiring the protection of an entire gun battalion, the commander positioned nine to eleven lights in an outer ring approximately 6000 yards from the gun locations. He placed the remaining lights closer to the asset to pick up the airplane if it passed through the outer bank without being destroyed. For a single battery defense, the manual assigned a platoon of five lights to perform a similar concentric illumination, but with a three to two light ratio. *CAFM, 1930*, 10, 23-27, 55-61. The history behind the addition of the experimental 105-mm gun is less straightforward. Until the late 1920s, antiaircraft units consisted only of 3-inch antiaircraft guns. In 1928, however, the Coast Artillery tested a 105-mm fixed antiaircraft gun at Aberdeen Proving Grounds and decided to produce four more guns for further testing and development. The 1930 manual incorporated the experimental weapon into the antiaircraft gun units assigned to army and "G.H.Q. Reserve" brigades. The 105-mm gun had a muzzle velocity of 2,800 feet per second and a vertical range of 36,900 feet. Except for its immense weight, the gun made an excellent addition to the family of antiaircraft armaments. Weighing 6,575 pounds, the 105-mm gun dwarfed the smaller 2,310-pound 3-inch gun and made the development of a functional mobile chassis impossible. Although it took until the mid-1930s, the Coast Artillery Corps eventually built fifteen of these guns before it stopped development and sent them to the

Panama Canal Zone. With the 1938 edition of the antiaircraft field manual, the Coast Artillery altered its policy and returned to its earlier reliance on 3-inch guns in all antiaircraft artillery gun units. *Ibid.*, 3, 10-11; U.S. War Department, *FM 4-105: Coast Artillery Field Manual*, vol. 2, *Antiaircraft Artillery: Part One--Tactics*, (Washington, DC: Government Printing Office, 1933) (hereafter *FM 4-105* followed by the year of publication), 133-134; U.S. Army Air Defense School, *Air Defense: An Historical Analysis*, vol. 1, (Fort Bliss, TX: U.S. Army Air Defense School, 1965) (hereafter *Air Defense*), 53.

¹⁴*CAFM, 1930*, 11. Also see Sanderford Jarman, "Future Coast Artillery," *Coast Artillery Journal*, vol 73, no. 5. (November 1930): 414-421. Jarman argued that antiaircraft artillery represented the future of the Coast Artillery and that seacoast artillerymen should not be afraid to learn antiaircraft techniques. He also pushed for a divisional antiaircraft battalion arguing that "attachment" would suffice, but was not optimal.

¹⁵"Is Attack Aviation Effective Against Infantry?" *Coast Artillery Journal*, vol. 72. no. 3 (March 1930): 242-244; James Wharton, "Protection of Infantry Against Air Attack," *Coast Artillery Journal*, vol 72. no. 6 (June 1930): 489-496. Wharton was an Infantry captain.

¹⁶*CAFM, 1930*, 2.

¹⁷*CAFM, 1930*, 14-15, 114-118.

¹⁸*CAFM, 1930*, 73-75, 114-118.

¹⁹"G. M. Barnes, "Mechanized Machine Guns," *Coast Artillery Journal*, vol. 72. no. 5. (May 30): 412-423. After describing this machine gun, Barnes also noted that it "should be able to deliver a great volume of accurate fire against the tank and outfight it...."

²⁰*CAFM, 1930*, 129-130. Groups of these balloons supported a horizontal cable from which 1000-foot vertical cables extended downward every 25 yards. Anchored at the bottom by 2-pound weights, these vertical cables formed a network or barrage.

²¹C. E. Atkinson, "Joint Antiaircraft Air Corps Exercises, Aberdeen Proving Ground, Maryland, (May 12-17, 1930)," *Coast Artillery Journal*, vol. 73. no. 4. (October 1930): 307-327. Quotations taken from page 307 and 326.

²²Grow, "Part I: The Ten Lean Years," 25, 28.

²³*Ibid.*, 28. Also Army Chief of Staff, General Charles P. Summerall, "New Developments in Warfare," *Coast Artillery Journal*, vol. 74, no. 2 (February, 1931): 99-101. Summerall argues for a Mechanized Force that is "self-contained" and has a

complement of other arms including antiaircraft artillery that are “all adapted to movement conforming to the tanks...” and appropriately equipped.

²⁴Perhaps unknowingly, Grow’s concern about antiaircraft protection of the Mechanized Force mirrored concerns expressed by the Secretary of War, Patrick Hurley. While the Mechanized Force was experimenting, Hurley directed the Chiefs of Infantry, Field Artillery, Engineers, Ordnance, and the Signal Corps as well as the Quartermaster General to provide “definite recommendations” as to what “reorganization and rearmament are necessary to insure the protection of all divisional units” from air attack. “Studies to be Made for Protection from Air Attacks,” *Coast Artillery Journal*, vol. 74. no. 1 (January 1931), 60.

²⁵Frank T. Ostenberg, “Antiaircraft Tactics for Moving Columns,” *Coast Artillery Journal*, vol. 74. no. 7 (November-December 1931): 494. *Italics in original.*

²⁶Grow, “Part I: The Ten Lean Years,” 29-30.

²⁷“Changes in Coast Artillery Target Practice Instruction Order,” *The Coast Artillery Journal*, vol. 74, no. 5. (July-August 1931), 378-379.

²⁸“War Department Training Directive, 1931-1932,” *Coast Artillery Journal*, vol 74. no. 6. (September-October, 1931): 458-459.

²⁹Figures taken from David E. Johnson, “From Frontier Constabulary to Modern Army,” in *The Challenge of Change: Military Institutions and New Realities, 1918-1941*, ed. Harold R. Winton and David R. Mets, (Lincoln, NE: University of Nebraska Press, 2000), 182; Excerpt from letter by Harry W. Woodring, Secretary of War, to House Military Appropriations Subcommittee, and to House and Senate Committees on Military Affairs, 28 May 1940, quoted in John W. Killigrew, *The Impact of the Great Depression on the Army*, (New York: Garland Publishing, 1979), app 2, and cited in Johnson, “From Frontier Constabulary to Modern Army,” 182.

³⁰General Douglas MacArthur, “Report of the Chief of Staff,” *War Department Annual Reports, 1934*, (Washington, DC: Government Printing Office, 1934), 11 quoted in Johnson, “From Frontier Constabulary to Modern Army,” 182

³¹See Roger Daniels, *The Bonus March: An Episode in the Great Depression*, (Westport, CT: Greenwood Publishing Corp., 1971), 157-181; Douglas MacArthur, “Report of the Chief of Staff to the Secretary of War on the Employment of Federal Troops in Civil Disturbance in the District of Columbia, July 29-30, 1932,” in Daniels, 291-307. Also Bryon Greenwald, “A Forgotten Stain: The U.S. Army, Domestic Support Operations, and the Bonus March,” *Military Review*, (March-April, 2000): 91-94.

³²General Douglas MacArthur, “Report of the Chief of Staff,” *War Department Annual Reports, 1933*, (Washington, DC: Government Printing Office, 1933), 19.

³³Editor's Note, *Coast Artillery Journal*, (July-August 1933), 253.

³⁴Weinert and Arthur, *Defender of the Chesapeake*, 250.

³⁵*The Army and Navy Journal*, April 1, 1933, 616.

³⁶Fred M. Green, "The Pen is Mightier than the Sword—Oh Yeah?" *The Coast Artillery Journal*, vol. 76, no. 2 (March-April 1933), 206.

³⁷Katherine Tupper Marshall, *Together: Annals of an Army Wife*, (New York: Tupper and Love, Inc., 1946), 5. For more on the impact of the Great Depression on the Army, see Robert K. Griffith, Jr., *Men Wanted for the U.S. Army: America's Experience with an All-Volunteer Army Between the World Wars*, (Westport, CT: Greenwood Press, 1982), 149-173; and John W. Killigrew, *The Impact of the Great Depression on the Army*, (New York: Garland Publishing, 1979).

³⁸Weigley, *History of the United States Army*, 568.

³⁹LeRoy Lutes, "The New Recruit Class," *The Infantry Journal*, vol. 42, no. 3 (May-June 1935), 264-265 cited in Griffith, *Men Wanted for the U.S. Army*, 167.

⁴⁰Lt. Col. J.H. Cunningham, "Antiaircraft Defense of the Continental United States under the Four Army Plan," 17 May 1933, TMs, Dec #666/CP-2, Box 139, Entry #9, RG 177, NA.

⁴¹*Ibid.*; Hans Christian Adamson, "Defense Against Air Attack Perils U.S. Safety, Warns Expert," *Washington Herald*, 10 June 1934, Dec #666/CW, Box 141, Entry #9, RG 177, NA; For examples of Gulick's campaign to raise support see letters to Congressmen Ross A. Collins (Dec #666/CE) and John J. McSwain (Dec #666/CR) and Maj. Gen. (Ret.) James E. Fechet, Director of the Aero Digest Bureau (Dec #666/CJ-1), Box 141, Entry #9, RG 177, NA.

⁴²John W. Gulick, "Extracts from the Address of Maj. Gen. John W. Gulick," *The Coast Artillery Journal*, vol. 76, no. 6 (November-December 1933): 406. For a complete speech with questions and answers, see John W. Gulick, "Antiaircraft Artillery Organization and Trend of Development," Lecture delivered at the Army War College, Washington, D.C. on 19 September 1933, G-3 Course, No. 14. 1933-1934.

⁴³Edward W. Timberlake, "The Effect of Antiaircraft Artillery on the Employment of Aviation," *Coast Artillery Journal*, vol. 75. no. 3 (May-June 1932): 180.

⁴⁴Gulick, "Extracts from the Address of Maj. Gen. John W. Gulick," *Coast Artillery Journal*, 405-407.

⁴⁵Exercises were held in Southern California in late 1932, at Carlsbad, California in March 1933, at Fort Knox, Kentucky in May 1933, and at Maxwell Field in 1934. Many of these exercises were reported in the *Coast Artillery Journal*. See “Defending Southern California from an Attack by Air,” *Coast Artillery Journal*, vol. 76, no. 1 (January-February 1933): 68-69; and A. J. French, “Ein Kriegspiel in Carlsbad,” *Coast Artillery Journal*, vol. 76, no. 3 (May-June 1933): 201-206; and “Summary of Reports on the Joint Antiaircraft-Air Corps Exercises Held at Fort Knox (May 15-27, 1933),” *Coast Artillery Journal*, vol. LXXVII, no. I (January-February, 1935): 47-49.

⁴⁶War Department. *Manual of Combined Training of the Coast Artillery and Air Corps in Coast Defense*. No Date. Referenced in R. T. Gibson, “A Study of the Best Method of Cooperation Between the Navy, the Air Corps, and Coast Artillery in Harbor Defense, Command and General Staff School Student Paper (hereafter referred to as CGSS Student Paper), IR-89-1930, Combined Arms Research Library, Fort Leavenworth, Kansas (hereafter referred to as CARL), 3.

⁴⁷Gulick, “Extracts from the Address of Maj. Gen. John W. Gulick,” *Coast Artillery Journal*, 407; and H. A. Dargue, “Bombardment Aviation and its Relation to Antiaircraft Defense,” *Coast Artillery Journal*, vol. LXXVII (September-October 1934): 333.

⁴⁸Claire L. Chennault, “Pursuit in Cooperation with Antiaircraft Artillery,” *Coast Artillery Journal*, (November-December 1935): 422. Also Claire L. Chennault, “The Role of Defensive Pursuit, (Part I, II, and III),”. This article ran in the *Coast Artillery Journal*, (November-December 1933), (January-February 1934), and (March-April 1934).

⁴⁹Antiaircraft artillery, like many other subjects, was studied and written about by students at the Coast Artillery School, the Command and General Staff School at Fort Leavenworth, and at the Army War College. Worthwhile Coast Artillery School studies often went directly to the Coast Artillery Board for evaluation or were published by the *Coast Artillery Journal*. A few of the studies on antiaircraft conducted at Leavenworth and the War College include: W. M. Cravens, “A Study of the Tactical Reorganization of Antiaircraft Artillery,” CGSS Student Paper, IR-108-1931, CARL; C. R. Finley, “To What Extent should Antiaircraft Artillery be relied upon for Defense against Aircraft?” CGSS Student Paper, IR-2-1931, CARL; Ward E. Duvall, “Antiaircraft Defense of Cities and Measures that should be taken in Time of Peace in Preparation Thereof,” CGSS Student Paper, IR-34-1932, CARL; John H. Hood, “The Protection of Ground Troops, Cities, and Fortifications by Antiaircraft Artillery,” CGSS Student Paper, IR-55-1932, CARL; Rolla Ladd, “Organization of Antiaircraft Artillery at all Echelons,” CGSS Student Paper, IR-58-1933, CARL; Elbert Ford, Jr., “The Employment of Antiaircraft Weapons against Ground Targets, with Particular Reference to the Defense against Mechanized Forces” CGSS Student Paper, IR-45-1934, CARL; Benjamin F. Harmon “A Comparison of Current American Doctrines as to Antiaircraft Defense with those of the British Army,” CGSS Student Paper, IR-54-1934, CARL; Christian G. Foltz, “The

Positions and Dispositions of Anti-Aircraft Artillery in Defense of Front-Line Troops in the Attack and Defense,” CGSS Student Paper, IR-35-1935, CARL; George M. Badger, “The Antiaircraft Artillery Doctrine of France,” CGSS Student Paper, IR-07-1936, CARL; Alexander H. Campbell, “The Coordination of Anti-Aircraft Defense in the Combat Zone,” CGSS Student Paper, IR-24-1936, CARL; R. V. Cramer, “Probable Methods of Defense to be Employed by Great Britain, France, Italy, Russia, and Japan Against Attack from the Air,” United States Army War College, 1935-1936, Course: Preparation for War, Part 1, G-2. G-2 Course No. 22-A, 21 December 1935; W. K. Dunn, “Antiaircraft Weapons,” United States Army War College, 1937-1938, 5 May 1938; and B. L. Milburn, “Defense Against Aviation and Mechanized Units,” United States Army War College, 1936-1937, Course: G-3. Report of Committee No. 6, No. 3-1937-6, 23 October 1936.

⁵⁰“Summary of Reports on the Joint Antiaircraft-Air Corps Exercises Held at Fort Knox (May 15-27, 1933),” *Coast Artillery Journal*, 47-49. Also Joseph A. Green, “The Fort Knox Distant Intelligence Net,” *Coast Artillery Journal*, vol 76. no. 4. (July-August 1933): 247-254.

⁵¹Gulick, “Extracts from the Address of Maj. Gen. John W. Gulick,” *Coast Artillery Journal*, 405-406.

⁵²Edward W. Timberlake, “The Effect of Antiaircraft Artillery on the Employment of Aviation,” *Coast Artillery Journal* vol. 75. no. 3 (May-June 1932): 180; and W. K. Richards, “An Estimate of the Antiaircraft Situation,” *Coast Artillery Journal*, vol. 75. no. 4 (July-August 1932): 256-259

⁵³Stanley R. Mickelsen, “Dual Purpose Antiaircraft-Antitank Intermediate Caliber Cannon,” Memorandum for the Assistant Commandant, No. 7-1938-60, United States Army War College, 1937-1938.

⁵⁴Gulick, “Extracts from the Address of Maj. Gen. John W. Gulick,” *Coast Artillery Journal*, 406.

⁵⁵*Ibid.*

⁵⁶See Command and General Staff School (CGSS) and Army War College studies referenced above by W. M. Cravens, “A Study of the Tactical Reorganization of Antiaircraft Artillery,” (CGSS); C. R. Finley, “To What Extent should Antiaircraft Artillery be relied upon for Defense against Aircraft?” (CGSS); John H. Hood, “The Protection of Ground Troops, Cities, and Fortifications by Antiaircraft Artillery,” (CGSS); Rolla Ladd, “Organization of Antiaircraft Artillery at all Echelons,” (CGSS); Christian G. Foltz, “The Positions and Dispositions of Anti-Aircraft Artillery in Defense of Front-Line Troops in the Attack and Defense,” (CGSS); and B. L. Milburn, “Defense Against Aviation and Mechanized Units,” United States Army War College, 1936-1937.

⁵⁷Milburn, 77-78.

⁵⁸Milburn recommends three different composite regiments. Also see Willard Irvine, "Organization of Guns in an Antiaircraft Regiment," *Coast Artillery Journal*, vol. LXXIX, no. 1 (January-February 1936): 10-12.

⁵⁹*FM 4-105*, 1933; U.S. War Department, *FM 4-105: Coast Artillery Field Manual*, vol. 2, *Antiaircraft Artillery: Part One--Tactics*, (Washington, DC: Government Printing Office, 1938) (hereafter *FM 4-105* followed by the year of publication); U.S. War Department, *FM 4-105: Coast Artillery Field Manual*, vol. 2, *Antiaircraft Artillery: Part One--Tactics*, (Washington, DC: Government Printing Office, 1940) (hereafter *FM 4-105* followed by the year of publication).

⁶⁰One notable organizational change occurred between 1930 and 1933 regarding the composition of the antiaircraft artillery gun battalion. Concerned over the vulnerability of the antiaircraft gun batteries to low-flying attack aviation, Coast Artillery planners assigned each battery a platoon of four .50 caliber machine guns for self-defense. These machine guns protected the 3-inch crewmen from strafing attacks by enemy aircraft seeking to open a path for incoming high altitude bombers. As an added advantage, the machine guns provided security for antiaircraft gun batteries during periods of road movement and emplacement. Combined with the 48 machine guns in the antiaircraft machine gun battalion, the additional weapons raised the regimental total to 60 machine guns. *FM 4-105*, 1933, 12-14, 24-30.

⁶¹*Ibid.*, 53-71, 123-132.

⁶²Army budgets during this period were 1934: \$408,587,000; 1935: 487,995,000; and 1936: 618,587,000. Russell F. Weigley, *History of the United States Army*, 561.

⁶³According to historian Ronald Spector, the Army needed 200 bombers and 179 pursuit planes just to reach air power recommendations made in the 1920s. Ronald Spector, "The Military Effectiveness of the U.S. Armed Forces, 1919-1939," in *Military Effectiveness: Volume II, The Interwar Period*, ed. Allan R. Millett and Williamson Murray (Boston: Allen & Unwin Inc., 1988), 80.

⁶⁴Henry T. Burgin, "Developments in Organization, Armaments, and Equipment in the Coast Artillery Corps," Lecture delivered at the Army War College, September 1934, Excerpts printed in *Coast Artillery Journal*, vol. LXXVIII, no. VI, (November-December 1935): 442.

⁶⁵Memorandum, Col. H.T. Burgin, to the Adjutant General, "Additional Antiaircraft Regiments Required for Continental U.S.," 8 November 1935, Secret, Dec #666/DF, Box 139, Entry #9, RG 177, NA; Ronald Spector, "The Military Effectiveness of the U.S. Armed Forces, 1919-1939," in *Military Effectiveness: Volume II, The Interwar Period*, 80.

⁶⁶Johnson, "From Frontier Constabulary to Modern Army," 178.

⁶⁷"General Hase Speaks," Notes of the Coast Artillery Association, *Coast Artillery Journal*, vol. LXVII, no. IV, (July-August 1934): 245.

⁶⁸Secretary of War George H. Dern, "Report of the Secretary of War," *War Department Annual Reports, 1935*, (Washington, DC: Government Printing Office, 1935), 1.

⁶⁹See "U.S. Army: Who's in the Army Now?; Why an Army?; and Strategic Map," *Fortune* vol XII, no. 3, (September 1935): 39-49 and 126-144. Quotation is on page 46.

⁷⁰Gen. Douglas MacArthur, "Report of the Chief of Staff," *War Department Annual Reports, 1935*, (Washington, DC: Government Printing Office, 1935), 68-69.

⁷¹Gen. Malin Craig, "Annual Report of the Chief of Staff for the Fiscal Year Ended 30 June 1936," *War Department Annual Reports, 1936*, (Washington, DC: Government Printing Office, 1936), 37.

⁷²Milburn, "Defense Against Aviation and Mechanized Units," United States Army War College, 1936-1937, Course: G-3. Report of Committee No. 6, No. 3-1937-6, 23 October 1936, 69.

Item	Regular Army (Active Units)			National Guard			Regular Army (Inactive Units)			Total Shortage
	Req	On Hand*	Short	Req	On Hand*	Short	Req	On Hand*	Short	
3"A.A. Gun	48	40	8	120	20	100	132	0	132	240
Director	12	9	3	30	8	22	33	0	33	58
Height Finder	12	10	2	30	0	30	33	0	33	65
Sound Locator	60	39	21	150	10	140	165	0	165	326
Searchlight	60	23	37	150	14	136	165	0	165	338
.50 cal MG	240	160	80	600	0	600	1200	0	1200	1880

*On Hand or Under Manufacture

Table 7.1 – Status of Peacetime Procurement of Antiaircraft Materiel for the Continental U.S. (1936)

⁷³A. H. Sunderland, "Forty Years with the Artillery: Major General A. H. Sunderland, Chief of Coast Artillery Inspects Past and Present, and Peers into Tomorrow," *Coast Artillery Journal*, vol. LXXIX, no. VI (November-December 1936): 416. The frontpiece to the November-December issue has a picture of Roosevelt in his car admiring the 3-inch antiaircraft gun. The caption reads "Marvelously mobile—I wish we had more of them." Sunderland describes the Presidential visit and Roosevelt's remarks in his article.

⁷⁴Morris Sheppard, "The Coast Artillery Corps," *Coast Artillery Journal*, vol. LXXX, no. I (January-February 1937): 3.

⁷⁵Gen. Malin Craig, "Annual Report of the Chief of Staff," *War Department Annual Reports, 1937*, (Washington, DC: Government Printing Office, 1937), 29-35; Harry W. Woodring, "Report of the Secretary of War, 1937," *War Department Annual Reports, 1937*, 5-6; Lt. Col. J.L. Homer, "Antiaircraft Artillery Operations in Spain," 15 May 1937, Restricted, TMs, p. 2, Dec #666/DR-4, Box 142, Entry #9, RG 177, NA; Office of the Chief of Coast Artillery, "China-Japanese Antiaircraft Summary," 5 October 1937, Dec #666/DR-5, Box 142, Entry #9, RG 177, NA.

⁷⁶*FM 4-105, 1938*, 16-25; For information on the development of antiaircraft artillery in foreign countries as well as its impact in the Italian conquest of Ethiopia, the Spanish Civil War, or the Japanese invasion of China see Decimal file #319.13, Boxes 4 - 9, and Decimal #666/DR, Box 142, Entry #9, RG 177, NA.

⁷⁷According to Army historian Robert Palmer, "a unit was streamlined when it had no elements (personnel, weapons, or vehicles) not needed continually, no elements not primarily useful against its normal objective, no elements so slow-moving as to impair its mobility, or so fast-moving as to be frequently usable elsewhere. Pooling existed to make these disparate elements available when and where they could most profitably be employed." General Pershing recommended "pooling" in 1920. In 1936, the War Department outlined the principle in a staff study on the modernization of the Army's organization. For more on McNair's "pooling" policy as it pertained to antiaircraft artillery, see Kent Roberts Greenfield, Robert R. Palmer, and Bell I. Wiley, *The Organization of Ground Combat Troops*, United States Army in World War II, The Army Ground Forces, (Washington, DC: Government Printing Office, 1987), 292-297.

⁷⁸*FM 4-105, 1938*, 27-37.

⁷⁹Gen. Malin Craig, "Annual Report of the Chief of Staff," *War Department Annual Reports, 1938*, (Washington, DC: Government Printing Office, 1938), 29-34.

⁸⁰Harry W. Woodring, "Report of the Secretary of War, 1938," *War Department Annual Reports, 1938*, (Washington, DC: Government Printing Office, 1938), 5-6.

⁸¹Louis Johnson, "Annual Report of the Assistant Secretary of War," *War Department Annual Reports, 1938*, (Washington, DC: Government Printing Office, 1938), 26-27.

⁸²"AA Equipment Deficiencies," *Coast Artillery Journal*, vol. LXXXI, no. I (January-February 1938): 62-63.

⁸³Congress, House, War Department Subcommittee of the Committee on Appropriations, *Military Establishment Appropriation Bill for 1939*, 75th Cong., 3rd sess., 31 January 1938, 31-32.

⁸⁴*Ibid.*, 35.

⁸⁵*Ibid.*, 35-36. Of the almost \$13 million Craig asked for, approximately \$1.5 million went to complete outfitting regular Army regiments, \$1.2 million to buy training equipment for National Guard antiaircraft regiments, \$3.8 million for antiaircraft equipment in harbor defenses along the Pacific coast, in Hawaii, and Panama, and \$6.5 million for war reserve equipment, much of which would go to the National Guard.

⁸⁶*Ibid.*, 37.

⁸⁷Franklin D. Roosevelt, "Fifty Thousand Airplanes," reprinted in Eugene M. Emme, *The Impact of Air Power: National Security and World Politics*, (Princeton, NJ: D. Van Nostrand Company, Inc., 1959), 62-79.

⁸⁸Gen. Malin Craig, "Annual Report of the Chief of Staff," *War Department Annual Reports, 1939*, (Washington, DC: Government Printing Office, 1939), 30

⁸⁹U.S. War Department, *FM 100-5, Field Service Regulations (Tentative): Operations*, (Washington, DC: Government Printing Office, 1939), passim.

⁹⁰The 37-mm gun had a muzzle velocity of 2,800 feet per second and an effective vertical (tracer) range of 10,500 feet. Mounted on a highly mobile trailer, crews could set it up within a minute and have the fire control system operational in less than five minutes. The gun fired a 1.25-pound high explosive, point-detonating shell at a sustained rate of over 60 rounds per minute. The actual maximum rate of fire was 120 rounds per minute, but at that speed the gun overheated after approximately 70 rounds. Each 37-mm gun battery consisted of eight guns divided into four platoons of two guns each. Despite its problem with overheating, planners viewed the gun as a complementary addition to the current arsenal. *Air Defense*, 56; *FM 4-105, 1940*, 11, 36-37.

⁹¹In the first new organization, "the automatic weapons" battalion, planners replaced three of the .50 caliber machine gun batteries in the machine gun battalion with 37-mm gun batteries. The "automatic weapons" battalion consisted of one .50 caliber machine gun battery with 12 machine guns and three 37-mm batteries. This "automatic weapons" battalion combined with the 3-inch gun battalion to form the standard mobile antiaircraft artillery regiment. *FM 4-105, 1940*, 3-11.

⁹²The second organization developed for the new gun was the "separate" 37-mm gun battalion. This "separate" battalion differed from the "automatic weapons" battalion in that it consisted of four 37-mm gun batteries. The Coast Artillery created these, and other "separate" battalions, as a method for reinforcing the existing fires of corps and

army antiaircraft artillery units. In the case of an infantry or cavalry division, which by regulation possessed no organic antiaircraft artillery, "separate" battalions reinforced the small arms fire of the ground troops. Ibid., 14-16.

⁹³Planners formed two different 37-mm gun "separate" battalions--the mobile and the semi-mobile "separate" battalion. In both cases the four battery composition remained the same. The only difference occurred in the units' ability to transport themselves from one place to another. Mobile units existed for use in fluid situations, like overseas combat, where planners anticipated frequent changes of position. These types of units, both "separate" and combined, possessed the necessary vehicles to tow or carry all of their organic equipment, including guns. On the other hand, planners designed semi-mobile units for use in more stabilized locations where frequent moves were unlikely. Some of these locations included metropolitan areas, key industrial and communications centers, airplane factories, and naval yards in the nation's zone of interior. As a result, semi-mobile units did not have the organic transportation necessary to move and needed outside assistance to do so. To change location, these units relied on vehicles from the battalion motor pool to shuttle men and material between positions. With an eye toward the possible manpower and equipment demands of an expanded army, planners designed the semi-mobile units to maximize firepower, but minimize the need for personnel and vehicles. The Coast Artillery also organized "separate" 3-inch gun battalions (semi-mobile) and machine gun battalions (mobile and semi-mobile). The composition of these units remained unchanged from their 1938 organization. Ibid., 1-2, 14-16.

⁹⁴The final organization created in the 1940 edition of *FM 4-105* was the semi-mobile antiaircraft artillery regiment. Besides its characteristic shortage of vehicles, the semi-mobile regiment differed from the mobile regiment in that it consisted of three battalions instead of two. The first two battalions in the regiment were semi-mobile 3-inch gun battalions, each with the same four-battery composition (three gun units and one searchlight unit) as the gun battalion in the mobile regiment. The third battalion in the semi-mobile regiment was a semi-mobile 37-mm gun battalion. This battalion possessed the same structure as the "separate" 37-mm battalion--four batteries of eight guns each. As with the other semi-mobile units, planners designed this organization to maximize firepower in locations where rapid mobility was not as great a concern. Ibid., 12-14.

⁹⁵Ibid., 60-93.

⁹⁶Memorandum, Major General Delos C. Emmons and Brigadier General George V. Strong, to the Chief of Staff, 25 September 1940, "Observations in England – Report of Generals Strong and Emmons," AG 380.3 (10-7-40) M-WPD-M, File 131-8, United States Army Military History Institute, Carlisle Barracks, Pennsylvania.

⁹⁷For more on the development of doctrine at the Air Corps Tactical School, see Finney, *History of the Air Corps Tactical School, 1920-1940*, 55-82.

⁹⁸U.S. War Department, *FM 100-5, Field Service Regulations: Operations*, (Washington, DC: Government Printing Office, 1941), passim.

⁹⁹"The Armament Program", *Coast Artillery Journal* 83 (July-August 1940): 370; Gen. George C. Marshall, "Biennial Report of the Chief of Staff, 1941," *War Department Annual Reports, 1941*, (Washington, DC: Government Printing Office, 1941), 69. Also for more on the Army's antiaircraft needs, see Gen. George Marshall's testimony before the Senate Appropriations Committee, Congress, Senate. Subcommittee of the Committee on Appropriations, *Military Establishment Appropriations Bill for 1941*, 76th Cong., 3rd sess., 30 April 1940, remarks throughout, but especially 67-68 and 421-422.

¹⁰⁰George C. Marshall, "Biennial Report of the Chief of Staff of the United States Army to the Secretary of War, July 1, 1939 to June 30, 1941," in *The War Reports of General of the Army George C. Marshall and Others*, with a Foreword by Walter Millis (New York: J. B. Lippincott Company, 1947), 46-47; Harry C. Thomson and Lida Mayo, *The United States Army in World War II. The Technical Services: The Ordnance Department: Procurement and Supply*, comp. Office of the Chief of Military History, U.S. Army, (Washington, D.C.: Government Printing Office, 1960), 69-79; and Congress, Senate. Subcommittee of the Committee on Appropriations, *Military Establishment Appropriations Bill for 1941*, 76th Cong., 3rd sess., 30 April 1940, 421-422.

CHAPTER 8 – BUILDING AN ANTI-AIRCRAFT COMMAND, 1939-1941

¹Thomas R. Phillips, "National Defense and Antiaircraft Defense," *Coast Artillery Journal*, vol. LXXXIII, no. I (January-February 1940): 2-13.

²Mark S. Watson, "First Vigorous Steps I Re-Arming," *Military Affairs*, Vol. 12, no. 2 (Summer 1948): 65n2. On December 12, 1937, Japanese planes bombed a U.S. river gunboat, the *Panay*. The boat sank with the loss of 2 killed and 30 wounded. On January 28, 1938, President Roosevelt asked for a large increase in naval construction as well as over \$17 million to correct a few of the many Army equipment deficiencies (\$8.8 million of that amount was for antiaircraft materiel). The Congress ultimately authorized a \$1.1 billion expansion of the Navy under the Naval Act of 1938. Although the Naval Act provided the Navy with a tremendous boost, it did not provide America with naval superiority over Japan, which had initiated its own naval expansion program.

³*Ibid.*, 65.

⁴*Ibid.*, 72.

⁵*Ibid.*, 69, 76. Also Edward R. Stettinius, *Lend-Lease: Weapon for Victory*, (New York: 1944), 13-19.

⁶*Ibid.*, 73-75.

⁷Ibid., 73. These concerns and others would eventually become part of the Rainbow series of plans. See Steven T. Ross, ed. *American War Plans, 1919-1941*, (New York: Garland Publishing, Inc., 1992), vols. 4 and 5.

⁸Ibid., 75-77.

⁹To maintain consistency with the figures presented in the Introduction, the Army strength is drawn from Greenfield, Palmer, and Wiley, *The Organization of Ground Combat Troops*, 203; 1938 figure came from Weigley, *History of the United States Army*, 569.

¹⁰Actually, 12 active regiments. LTC Alvin M. Cibula, *The Antiaircraft Command and Center (Army Ground Forces Study no. 26)*, (Washington, DC: Army Ground Forces Historical Section, 1946), 1. Hereafter referred to as AAC. Adjutant General, *Army Directory*, (Washington, DC: Government Printing Office, 1940), 16.

¹¹A comparison of the number of antiaircraft units with others within the Coast Artillery Corps gives an appreciation for the relative increase in importance that took place gradually over the Interwar period, but most dramatically in the late 1930s and early 1940s. On 30 June 1941, there were 43 mobile antiaircraft regiments, 6 semi-mobile regiments, 13 separate mobile battalions, and one barrage balloon battalion in the antiaircraft establishment. By contrast, there were only 34 harbor defense regiments, two railway artillery regiments, and seven 155-mm gun regiments in the rest of the Coast Artillery Corps. AAC, 2.

¹²Greenfield, Palmer, and Wiley, *The Organization of Ground Combat Troops*, 176 and 179. The "Victory Plan," drafted in 1941 by Major Alfred C. Wedemeyer, called for over 800 antiaircraft battalions. See Charles E. Kirkpatrick, *An Unknown Future and a Doubtful Present: Writing the Victory Plan of 1941*, U.S. Army Center of Military History, (Washington, DC: Government Printing Office, 1990), 93-100.

¹³Christopher R. Gabel, *The U.S. Army GHQ Maneuvers of 1941*, United States Army Center of Military History, (Washington, DC: Government Printing Office, 1991), 185-186.

¹⁴Ibid., 186.

¹⁵Ibid., 14.

¹⁶Robert R. Palmer, Bell I. Wiley, and William R. Keast, *The Procurement and Training of Ground Combat Troops*, United States Army in World War II, The Army Ground Forces, (Washington, DC: Department of the Army, 1948), 169-170.

¹⁷Ibid., 170-171.

¹⁸*Ibid.*, 369.

¹⁹These officers had already been received basic officers training.

²⁰Brigadier General F. H. Smith, "The Coast Artillery School in the Emergency," *Coast Artillery Journal*, vol. LXXXIII, no. 5 (September-October 1940): 402-409.

²¹*AAC*, 28.

²²*Ibid.*, 116.

²³Major General Joseph A. Green, "Training," *Coast Artillery Journal*, Vol. LXXXIII, no. 6 (November-December 1940): 498-499.

²⁴*Ibid.*, 500-501. Italics in original.

²⁵*Ibid.*, 499.

²⁶Memorandum, Major General J. A. Green, Subj: Activation of Antiaircraft Command, 9 March 1942, in *AAC*, 225.

²⁷The antiaircraft artillery training centers were located at Camp Davis, North Carolina; Camp Stewart, Georgia; Camp Edwards, Massachusetts; Camp Hulen, Texas; Fort Bliss, Texas; Fort Sheridan, Illinois; and Camp Haan, California, which included the Mohave Desert Antiaircraft Artillery Firing Range. The Barrage Balloon Training Center was located at Camp Tyson, Tennessee. The three Replacement Training Centers were located at Fort Eustis, Virginia; Camp Wallace, Texas; and Camp Callan, California. *AAC*, 221.

²⁸Green remained the Commanding General of the Antiaircraft Command until 27 October 1944. *AAC*, 6.

²⁹Green, "Training," *Coast Artillery Journal*, 500.

³⁰*AAC*, 18. Italics in original.

³¹*Ibid.* Italics in original.

³²*Ibid.*, 21-22. Since World War II, antiaircraft artillery (later air defense artillery) battalions, groups, and brigades have all had separate inspection teams that reported to the unit operations officer and commander. These teams became notorious during the Cold War for arriving in the dead of night only to awaken a unit by declaring "Blazing Skies," a peacetime version of the wartime alert phrase "Battle Stations." Upon declaration, the unit being inspected would have a specific amount of time to declare it

was ready for combat. If the unit did not reach battle stations in the allotted time, it failed the inspection and the battery commander risked relief.

³³Ibid., 105-107. As of 2003, the U.S. Army's Air Defense Artillery School maintains the 6th Air Defense Artillery Brigade whose primary function is to provide all air defense enlisted advanced individual training and non-commissioned officer education as well as all air defense officer basic and advanced training.

³⁴Ibid., 28-30, 105-106.

³⁵Ibid., 116 and 138.

³⁶Ibid., 20.

³⁷Ibid., 18. Green kept a personal logbook in which he made brief notations of important events, which might not otherwise appear in official files or correspondence. Log date for the quotation cited is 26 May 1942.

³⁸Ibid., 121. It is unknown if Green replaced Spiller for poor performance.

³⁹Ibid., 119.

⁴⁰Greenfield, Palmer, and Wiley, *The Organization of Ground Combat Troops*, 10. See also Fred L. Walker, "Second Army Maneuvers," *Coast Artillery Journal*, vol. LXXXIII, no. 6 (November-December, 1940): 512-516. The Second Army Maneuvers were anticlimactic for the 202d Coast Artillery (Antiaircraft) Regiment as low ceilings kept the GHQ Air Force from participating.

⁴¹Burgo D. Gill, "AA-Antimechanized Defense of Leesville," *Coast Artillery Journal*, vol. LXXXIII, no. 4 (July-August, 1940): 357-358.

⁴²Ibid.

⁴³"Dual Missions," *Coast Artillery Journal*, vol. LXXXIII, no. 5 (September-October, 1940): 466. Also see Francis G. Smith, *History of the Third Army, (Army Ground Forces Study no. 17)*, (Washington, DC: Army Ground Forces Historical Section, 1946), 11-19.

⁴⁴Memorandum, Major General Delos C. Emmons and Brigadier General George V. Strong, to the Chief of Staff, 25 September 1940, "Observations in England – Report of Generals Strong and Emmons," AG 380.3 (10-7-40) M-WPD-M, File 131-8, United States Army Military History Institute, Carlisle Barracks, Pennsylvania.

⁴⁵For insight into the planning and execution of these maneuvers, see Christopher Gabel, *The U.S. Army GHQ Maneuvers of 1941*.

⁴⁶Joseph A. Green, "Tactical Training of AAA in the Third Army," *Coast Artillery Journal*, vol. LXXXIV, no. 3 (May-June 1941): 248-250; Francis G. Smith, *History of the Third Army*, 11-19.

⁴⁷*Ibid.*, 250-251.

⁴⁸"Composition of the Army," *Coast Artillery Journal*, vol. LXXXIV, no. 2 (March-April 1941): 164. The Air Corps was to receive 128 new soldiers for every 1,000 inducted, Engineers 61, Cavalry and Signal Corps 29 each, and the Armored Corps was to get 22.

⁴⁹Greenfield, Palmer, and Wiley, *The Organization of Ground Combat Troops*, 418-419.

⁵⁰Wofford T. Caldwell, "You Can Get Hits," *Coast Artillery Journal*, vol. LXXXIV, no. 5 (September-October 1941): 442.

⁵¹Milan G. Weber, "Hawaiian Separate Coast Artillery Brigade," *Coast Artillery Journal*, vol. LXXXIV, no. 2 (March-April 1941): 176; S. McCullough, "Corregidor," *Coast Artillery Journal*, vol. LXXXIII, no. 4 (July-August 1940): 374.

⁵²Caldwell, "You Can Get Hits," 442-447.

⁵³Paul B. Nelson, "Camp Haan AA Firing Range," *Coast Artillery Journal*, vol. LXXXIV, no. 5 (September-October 1941): 448-453.

⁵⁴Frank C. McConnell, "Fort Bliss Anti-Mechanized Target Range," *Coast Artillery Journal*, vol. LXXXIV, no. 5 (September-October 1941): 454-456.

⁵⁵Coast Artillery Board Notes, "Antimechanized Sights," *Coast Artillery Journal*, vol. LXXXIV, no. 5 (September-October 1941): 485-486.

⁵⁶Gabel, *The U.S. Army GHQ Maneuvers of 1941*, 171.

⁵⁷*Ibid.*, 172.

⁵⁸*Ibid.*

⁵⁹AAC, 23, 98-99.

⁶⁰*Ibid.*, 23.

⁶¹*Ibid.*, 25.

⁶²Ibid.

⁶³Ibid., 99.

⁶⁴Ibid., 96-101. Fort Fisher served as a subsidiary part of Camp Davis until the latter closed in October 1944. Similarly, Camp Irwin served a subsidiary portion of Camp Haan. Units at Camp Haan, located near Riverside, California, had to travel 135 miles north to Camp Irwin to fire their weapons. The Antiaircraft Command stopped using Camp Haan in January 1945.

⁶⁵Ibid., 85.

⁶⁶Mark S. Watson, *Chief of Staff: Prewar Plans and Preparations*, United States Army in World War II, The War Department, (Washington, DC: Government Printing Office, 1991), 33-35.

⁶⁷AAC, 145.

⁶⁸Louis A. Johnson, "Report of the Assistant Secretary of War for the Fiscal Year Ended June 30, 1939," *WDAR, FY1939* (Washington, D.C.: Government Printing Office, 1939), 16; Harry C. Thomson and Lida Mayo, *The Ordnance Department: Procurement and Supply*, The United States Army in World War II. The Technical Services. (Washington, D.C.: Government Printing Office, 1960) 69-79.

⁶⁹Chart, Office of the Chief of Coast Artillery, "Status of Antiaircraft Artillery Equipment, Panama," 12 April 1938, Dec #470/CR-10, Box 104, Entry #9, RG 177, NA; Thomson and Mayo, *The Ordnance Department: Procurement and Supply*, 79; Constance McLaughlin Green, Harry C. Thomson, and Peter C. Roots, *The Ordnance Department: Planning Munitions for War*, The United States Army in World War II. The Technical Services. comp. Office the Chief of Military History, U.S. Army, (Washington, D.C.: Government Printing Office, 1955), 413-414.

⁷⁰Watson, *Chief of Staff: Prewar Plans and Preparations*, 151.

⁷¹Thomson and Mayo, *The Ordnance Department: Procurement and Supply*, 76.

⁷²Ibid. The 37-mm cannon was mounted in the nose of the P-39.

⁷³Stetson Conn, Rose C. Engleman, and Byron Fairchild, *Guarding the United States and its Outposts*, The United States Army in World War II. The Western Hemisphere, comp. Office the Chief of Military History, U.S. Army, (Washington, D.C.: Government Printing Office, 1964), 349.

⁷⁴Ibid., 77-78.

⁷⁵AAC, 147.

⁷⁶Ibid., 146-151. The M24 was the forerunner of the Korean and Vietnam War “Duster” antiaircraft gun, which had two 40-mm cannons mounted on an M48 tank chassis.

⁷⁷United States Army Air Forces, *Barrage Balloon Development in the United States Army Air Corps, 1923-1942*, U.S. Army Air Forces Historical Study, No. 3. (Washington, DC: Assistant Chief of the Air Staff, Intelligence Section, Historical Division, 1943), 31; Office of the Chief of the Coast Artillery, *Coast Artillery Field Manual: Volume II, Antiaircraft Artillery Units*, (Fort Monroe, VA: The Coast Artillery School, 1930), 129-130; War Department, *FM 4-105--Coast Artillery Field Manual: Volume II--Antiaircraft Artillery, Part One--Tactics*, (Washington, D.C.: Government Printing Office, 1933), 133; War Department, *FM 4-105--Coast Artillery Field Manual: Volume II--Antiaircraft Artillery, Part One--Tactics*, (Washington, D.C.: Government Printing Office, 1938), 138.

⁷⁸Ibid., 31-38.

⁷⁹Ibid., 37-38; AAC, 138.

⁸⁰United States Army Air Forces, *Barrage Balloon Development in the United States Army Air Corps, 1923-1942*, 47-53.

⁸¹Ibid., 56-57.

⁸²Conn, Engleman, and Fairchild, *Guarding the United States and its Outposts*, 62-63, 349, 413. Part of the delay in fielding equipment arose from the Air Corps having to provide balloons and support equipment to the Marine Corps. United States Army Air Forces, *Barrage Balloon Development in the United States Army Air Corps, 1923-1942*, 51-52.

⁸³Conn, Engleman, and Fairchild, *Guarding the United States and its Outposts*, 62-62, 349, 413; Letter, Maj. Gen. J. A. Green, to Chief of the Air Corps, "Procurement of Barrage Balloon Rafts," 13 December 1941, Dec #560/DE, Box 131, Entry #9, RG 177, NA.

⁸⁴AAC, 138.

⁸⁵Ibid., 163, 168.

⁸⁶Ibid., 151,163.

⁸⁷AAC, 163; Louis Brown, *A Radar History of World War II: Technical and Military Imperatives*, (Philadelphia: Institute of Physics Publishing, 1999), 70. Also see

Henry E. Guerlac, *Radar in World War II*, 2 vols. (American Institute of Physics: Tomash Publishers, 1987).

⁸⁸Brown, *A Radar History of World War II*, 71; Dulany Terrett, *The Signal Corps: The Emergency*, United States Army in World War II, The Technical Services, (Washington, D.C.: Government Printing Office, 1956), 47.

⁸⁹Brown, *A Radar History of World War II*, 71-72.

⁹⁰*Ibid.*, 72.

⁹¹Conn, Engleman, and Fairchild, *Guarding the United States and its Outposts*, 425-429; Brown, *A Radar History of World War II*, 72.

CHAPTER 9 – FIRST BATTLES: FROM THE PANAMA CANAL TO KASSERINE PASS, 1941-1943

¹Dorothy Cave, *Beyond Courage: One Regiment Against Japan, 1941-1945*, (Las Cruces, NM: Yucca Free Press, 1992), 64.

²The recent discovery of 25 footlockers of Army War College course material from the Interwar Period has changed the standard interpretation of American war planning, which held that the United States went directly from the Color Plans to the Rainbow series in 1939. Henry Gole, in *The Road to Rainbow: Army Planning for Global War, 1934-1940*, makes a persuasive case for the role of the Army War College and its graduates in the transition from single color to multicolor or Rainbow plans. Henry G. Gole, *The Road to Rainbow: Army Planning for Global War, 1934-1940*, (Annapolis: Naval Institute Press, 2003), 1-80.

³Watson, *Chief of Staff: Prewar Plans and Preparations*, 103-104.

⁴Conn, Engleman, and Fairchild, *Guarding the United States and its Outposts*, 1-21.

⁵Memorandum, War Department General Staff, G2 to Commandant Army War College, Subj: Final Report of Commanding General, Air Defense Command (Report of Observations on Trip to England), 12 February 1941, G2/183-316, File #39-60, United States Army Military History Institute, Carlisle, Pennsylvania.

⁶Conn, Engleman, and Fairchild, *Guarding the United States and its Outposts*, 22-32.

⁷*Ibid.*, 33-41. From this arrangement, one can see the conflict that still exists today between the United States Air Force's preference for centralized control of all

assets including U.S. Army air defense (antiaircraft) assets and the Army's desire to maintain command and positioning authority over its air defense units. The situation is such that ground commanders now choose the tactical location of air defense units, while the air commanders determine the specific rules by which those units can use their weapons.

⁸Ibid., 57-60.

⁹Brian McAllister Linn, *Guardians of Empire: The U.S. Army and the Pacific, 1902-1941*, (Chapel Hill: University of North Carolina Press, 1997), 170-171.

¹⁰Ibid., 172.

¹¹Ibid., 173-183; Gole, in *The Road to Rainbow: Army Planning for Global War, 1934-1940*, 81-112.

¹²Norman J. Padelford, *The Panama Canal in Peace and War*, (New York: The MacMillan Company, 1942), 265. Padelford reports Axis shipping through the Canal in fiscal year 1939 accounted for 7.8 percent of all shipping. Also Secretary of War Harry Woodring reported in his 1939 *Annual Report* that 76 percent of the vessels transiting the Canal in fiscal year 1939 were of American (35.6%), British (24.4%), Norwegian (12.2%), or Swedish (3.6) registry. Harry H. Woodring, "The Annual Report of the Secretary of War, 1939," *WDAR, 1939*, (Washington, DC: Government Printing Office, 1939), 11.

¹³"The Panama Canal: The Army Looks at its Wartime Defenses," *Life*, 6 November 1939, 77.

¹⁴Stetson Conn and Byron Fairchild, *The Framework of Hemisphere Defense, The United States Army in World War II. The Western Hemisphere*. comp. Office of the Chief of Military History, U.S. Army, (Washington, DC: Government Printing Office, 1960), 15.

¹⁵Fred Greene, "The Military View of American National Policy, 1904-1940," *American Historical Review* 66 (January 1961): 361.

¹⁶Letter (14th End.), Maj. Gen. John W. Gulick, to the Adjutant General, 6 December 1930, Secret, Dec #666/35-B-30, Box 158, Entry #9, RG 177, NA.

¹⁷Harry H. Woodring, "The Annual Report of the Secretary of War, 1938," *WDAR, 1938*, (Washington, DC: Government Printing Office, 1938), 5-6; Harry H. Woodring, "The Annual Report of the Secretary of War, 1939," *WDAR, 1939*, 2-3.

¹⁸Conn, Engleman, and Fairchild, *Guarding the United States and its Outposts*, 319-321; Padelford, *The Panama Canal in Peace and War*, 157-158; John Cooley, "The

United States and the Panama Canal, 1938-1947: Policy Formulation and Implementation from Munich through the Early Years of the Cold War" (Ph.D. diss., Ohio State University, 1972), 31-36.

¹⁹Conn and Fairchild *The Framework of Hemisphere Defense*, 15-16, 239-336; Conn, Engleman, and Fairchild, *Guarding the United States and its Outposts*, 323-326; Wesley Frank Craven and James Lea Cate, eds. *The Army Air Forces in World War II. Plans and Early Operations: January 1939 to August 1942*, comp. Office of the Air Force History, (Chicago: University of Chicago Press, 1948), 160-165.

²⁰Franklin D. Roosevelt, Navy Day Radio Address concerning the German attack on the USS Kearny, 27 October 1941, available online at <http://www.ibiblio.org/pha/> (Speeches of Franklin D. Roosevelt), 120. German Map, undated, President's Secretary's Files (PSF) Safe Files: Germany Index, Franklin D. Roosevelt Digital Archives. Available online at <http://www.fdrlibrary.marist.edu/fdrbx.html>. Translation of German writing that appears on the map appears to be as follows: On the right: "Fuel reserves for Trans-Atlantic traffic – (a) with what capacity, (b) Whom to interest for installation, (c) Estimate." On the left " (1) Is a fuel monopoly planned? (2) Can private capital participate in expansion? Under what conditions? (3) To what extent will Mexico F participate in installation and expansion F as furnisher of fuel? Lacks fuel reserves." William Stevenson, better known as the British agent Intrepid, provided the German Map. See William Stevenson, *A Man Called Intrepid*, (New York: Ballantine Books, 1976), 188.

²¹Craven and Cate, *The Army Air Forces in World War II. Plans and Early Operations: January 1939 to August 1942*, 163.

²²*Ibid.*, 163-165, 274; Conn, Engleman, and Fairchild, *Guarding the United States and its Outposts*, 349.

²³This cross training involved taking seacoast artillerymen and giving them both antiaircraft gun and .50 caliber machine gun instruction and target practice. Twenty-one various memoranda on Dual Training in the Panama Canal Department, dated 26 August 1931 to 23 November 1933, Dec #353/DM-1 to 353/DM-21, Box 29, Entry #9, RG 177, NA; Conn, Engleman, and Fairchild, *Guarding the United States and its Outposts*, 302-303.

²⁴Memorandum, Col. J.A. Green, to the Assistant Chief of Staff, G-3, "Augmentation of Coast Artillery Troops in the Canal Zone," 8 December 1938, Secret, Dec #320/35K-1, Box 17, Entry #9, RG 177, NA; Memorandum, Col. J.A. Green, to the Assistant Chief of Staff, War Plans Division, Untitled, 6 January 1939, Dec #320/35L-2, Box 17, Entry #9, RG 177, NA; Also see monthly strength returns for the Atlantic and Pacific Sectors, Panama Canal Department in Records Group 407, Records of the Office of the Adjutant General, 1917- National Archives, Washington, DC; Lieutenant C.G. Patterson, C.A.C., "Coast Artillery Activities: Panama Provisional Coast Artillery

Brigade (AA)," *Coast Artillery Journal* 82 (November-December 1939): 587-595; Conn, Engleman, and Fairchild, *Guarding the United States and its Outposts*, 314-315.

²⁵Lieutenant C.G. Patterson, C.A.C., "Coast Artillery Activities: Panama Provisional Coast Artillery Brigade (AA)," 587-589; Lieutenant Charles R. Finley, C.A.C., "The Coast Artillery in Panama," *Coast Artillery Journal* 83 (November-December 1940): 522-527; Memorandum, MG Sanderford Jarman, to Commanding General Panama Canal Department, "Coast Artillery Personnel," 7 May 1941, Secret, Dec #320/35-V (Inc. 2), Box 17, Entry #9, RG 177, NA; Memorandum, Lt. Gen. Van Voorhis, to the Adjutant General, "Increased Personnel for the Panama Coast Artillery Command," 15 May 1941, Secret, Dec #320/35-V, Box 17, Entry #9, RG 177, NA; Conn, Engleman, and Fairchild, *Guarding the United States and its Outposts*, 314-315, 348-349.

²⁶Office of the Chief of the Coast Artillery, "Recommendation for the Revision of the Antiaircraft Artillery Defense Project of the Panama Canal, 1937," 24 September 1937, Dec #666/35M, Box 148, Entry #9, RG 177, NA; For complete equipment status of the antiaircraft defense of the Panama Canal Zone, see the five photostats sent to the Office of the Chief of Coast Artillery from the Panama Canal Department enclosed in Letter, Col. Edward A. Stockton, Jr., to Col. J.A. Green, 23 August 1937, Dec #666/35-L, Box 148, Entry #9, RG 177, NA.

²⁷Lieutenant Charles R. Finley, C.A.C., "The Coast Artillery in Panama," 522; Conn, Engleman, and Fairchild, *Guarding the United States and its Outposts*, 313.

²⁸Thomson and Mayo, *The Ordnance Department: Procurement and Supply*, 69-79.

²⁹Conn, Engleman, and Fairchild, *Guarding the United States and its Outposts*, 425-429.

³⁰*Ibid.*, 412, 425-429.

³¹Kent Carter, Director of the National Archives, Southwest Region, Fort Worth, Texas provided the following information regarding a Japanese threat to the Panama Canal. Captain T. Ariizumi, the commander of Submarine Division One, developed a plan to bomb the Panama Canal in July 1945 using Japanese I boats. The Japanese I boats I-13, I-14, I-400, and I-401 were the largest submarines in the world. The Japanese had developed them as underwater aircraft carriers. Each carried a number of low-wing monoplanes equipped with floats. The original plan called for ten float planes, each carrying a 1,700-pound bomb or "long-lance" torpedo, to bomb the Panama Canal locks. Captain Ariizumi even went so far as to have a full-sized model of the Canal's locks built at the Maizuru Navy Yard and towed to Nanao Bay for training. Ultimately, the Japanese Imperial General Headquarters decided to attack the American naval base at Ulithi instead. For potential Japanese attacks on the Canal later in the war, see Edwin Hoyt,

Closing the Circle: War in the Pacific, 1945, (New York: Avon Publishers, 1984), 50-51; and Zenji Orita, *I Boat Captain*, (Canoga Park, CA: Major Books, 1976).

³²Fred Greene, "The Military View of American National Policy, 1904-1940," *American Historical Review* 66 (January 1961): 360-61.

³³Watson, *Chief of Staff: Prewar Plans and Preparations*, 471. Italics in original.

³⁴*Ibid.*, 471-472.

³⁵*Ibid.*, 470-471. Guerlac, *Radar in World War II*, 117.

³⁶*Ibid.*, 472-473.

³⁷*Ibid.*, 474.

³⁸Major General Henry Tacitus Burgin, Commanding General, Hawaiian Coast Artillery Command, testimony before the Army Pearl Harbor Board, in Report of the Army Pearl Harbor Board, 188. Available online at www.ibiblio.org/pha/pha/army/chap_6.html.

³⁹The following information is drawn from the Joint Committee of Congress, Report of the Investigation of the Pearl Harbor Attack.

Alert Level No. 1: Defense against sabotage and uprisings. No threat from without.

Alert Level No. 2: Security against attacks from hostile subsurface, surface, and aircraft, in addition to No. 1.

Alert Level No. 3: Requires occupation of all field positions by all units, prepared for maximum defense of Oahu and the Army installations on outlying islands.

See Congress. Joint Committee on the Investigation of the Pearl Harbor Attack, *Investigation of the Pearl Harbor Attack*, 79th Cong., 2nd sess., 20 July 1946, 120.

⁴⁰*Ibid.*, 127.

⁴¹Guerlac, *Radar in World War II*, 118-119; Louis Brown, *A Radar History of World War II: Technical and Military Imperatives*, (Philadelphia: Institute of Physics, 1999), 218.

⁴²Guerlac, *Radar in World War II*, 117-118.

⁴³Congress. Joint Committee on the Investigation of the Pearl Harbor Attack, *Investigation of the Pearl Harbor Attack*, 192-193.

⁴⁴*Ibid.*, 67-68.

⁴⁵Ibid., 65.

⁴⁶Watson, *Chief of Staff: Prewar Plans and Preparations*, 439.

⁴⁷Memorandum, General Marshall to General Arnold, 16 July 1941 cited in Linn *Guardians of Empire*, 244.

⁴⁸Ibid.; Louis Morton, *The Fall of the Philippines*, United States Army in World War II, *The War in the Pacific*, (Washington, DC: Government Printing Office, 1989), 38.

⁴⁹Comments drawn from the office diary of Brigadier General Leonard T. Gerow, Chief War Plans Division. See Watson, *Chief of Staff: Prewar Plans and Preparations*, 438-439.

⁵⁰Louis Morton, *The Fall of the Philippines*, 32-33.

⁵¹Ibid., 33.

⁵²Ibid., 21.

⁵³Ibid., 21-22, 44.

⁵⁴Ibid., 44-45.

⁵⁵Citation reprinted in Dorothy Cave, *Beyond Courage: One Regiment Against Japan, 1941-1945*, (Las Cruces, NM: Yucca Free Press, 1992), 7.

⁵⁶Morton, *The Fall of the Philippines*, 33.

⁵⁷Cave, *Beyond Courage*, 23.

⁵⁸Ibid., 38.

⁵⁹Ibid., 43.

⁶⁰Ibid.

⁶¹Morton, *The Fall of the Philippines*, 48.

⁶²Cave, *Beyond Courage*, 51.

⁶³Ibid. Capitalization in original. For examples of equipment diverted from Hawaii and the Panama Canal, see Morton, *The Fall of the Philippines*, 36.

⁶⁴Morton, *The Fall of the Philippines*, 42-50. Morton notes that “some writers place the [number of P-40s] at 90 and Walter Edmonds estimates that there were ‘only 54 first-line, combat-worthy fighter planes to throw against the Japanese on the morning of December 8,’” 42n.

⁶⁵*Ibid.*, 45.

⁶⁶*Ibid.*; Brown, *A Radar History of World War II*, 219.

⁶⁷Brown, *A Radar History of World War II*, 219.

⁶⁸Morton, *The Fall of the Philippines*, 84-85.

⁶⁹*Ibid.* For Morton’s view of the attack, see *The Fall of the Philippines*, 77-90. For the official Air Force account of the attack on Clark Field, see Wesley F. Craven and James L. Cate, eds. *The Army Air Forces in World War II, Vol. I, Plans and Operations January 1939 to August 1942*, (Chicago: University of Chicago Press, 1948), 201-214; Walter Edmonds was commissioned by the Air Force to write the account of air operations in the Philippines. He published his findings in Walter D. Edmonds, “What Happened at Clark Field,” *The Atlantic*, (July 1951): 20-33.

⁷⁰Cave, *Beyond Courage*, 68, 70.

⁷¹Morton, *The Fall of the Philippines*, 86.

⁷²Cave, *Beyond Courage*, 70.

⁷³*Ibid.*

⁷⁴Morton, *The Fall of the Philippines*, 86.

⁷⁵Cave, *Beyond Courage*, 70.

⁷⁶Morton, *The Fall of the Philippines*, 88.

⁷⁷Cave, *Beyond Courage*, 72. Wainwright made this remark during a speech in Deming, New Mexico, 11 December 1945.

⁷⁸*Ibid.*, 73.

⁷⁹Morton, *The Fall of the Philippines*, 384

⁸⁰*Ibid.* 451-454; Cave, *Beyond Courage*, 121-146.

⁸¹Morton, *The Fall of the Philippines*, 454-464.

⁸²Cave, *Beyond Courage*, 145.

⁸³Morton, *The Fall of the Philippines*, 474-480; Mellnik, "How the Japs took Corregidor," *Coast Artillery Journal*, vol. LXXXVIII, no. 2 (March-April 1945), 4; and Frank J. Caravella, *First to Fire*, (Fort Bliss, TX: Office of the Chief of Air Defense Artillery, 1995), 17-22.

⁸⁴William Massello Jr., Interview by Terrie Cornell, 4 May 1995, transcript, Oral History Collection, Fort Bliss Museum and Study Center, Fort Bliss (El Paso), TX, 25 (hereafter cited as Massello Oral History); Mellnik, "How the Japs took Corregidor," *Coast Artillery Journal*, 6.

⁸⁵Mellnik, "How the Japs took Corregidor," *Coast Artillery Journal*, 6; and Paul D. Bunker, *Bunker's War: The World War II Diary of Col. Paul D. Bunker*, Keith A. Barlow ed., (Novato, CA: Presidio Press, 1996), 105.

⁸⁶Mellnik, "How the Japs took Corregidor," 7; Caravella, *First to Fire*, 24-27; and Morton, *The Fall of the Philippines*, 496.

⁸⁷Later Mellnik reported that the Japanese had approximately 5,000 men killed and another 3,000 wounded in the 15-hour assault on Corregidor. American casualties were between 600-800 killed and another 1,000 wounded. Mellnik, "How the Japs took Corregidor," 10-11; and Bunker, *Bunker's War*, 148.

⁸⁸Irving Strobinger, "Last Message from Corregidor," in Stephen M. Mellnik, "How the Japs took Corregidor," 11.

⁸⁹Mellnik, "How the Japs took Corregidor," 10; and Bunker, *Bunker's War*, 150-151.

⁹⁰United States Army Air Defense School, *Air Defense: An Historical Summary*, 4 vols., (Fort Bliss, TX: U.S. Army Air Defense School, 1965), 1:252.

⁹¹The "Victory Plan" was the Army's general mobilization and operational concept plan for World War II. For a concise history of the "Victory Plan" and Wedemeyer's role, see Charles E. Kirkpatrick, *An Unknown Future and a Doubtful Present: Writing the Victory Plan of 1941*, United States Army Center for Military History, (Washington, DC: Government Printing Office, 1990). For comments on the inclusion of antiaircraft artillery in the division as well as throughout the Army structure, see pages 88-114 passim.

⁹²Kent Roberts Greenfield, Robert R. Palmer, and Bell I. Wiley, *The Organization of Ground Combat Troops*, The Army Ground Forces, United States Army in World War II, (Washington, DC: Government Printing Office, 1987), 293.

⁹³AAC, 205.

⁹⁴Greenfield, Palmer, and Wiley, *The Organization of Ground Combat Troops*, 419-420.

⁹⁵C. L. Grant, *AAF Air Defense Activities in the Mediterranean, 1942-1944*, United States Air Force Historical Study No. 66, USAF Historical Division, (Maxwell AFB, AL: Air University, 1954), 66.

⁹⁶Ibid.

⁹⁷Greenfield, Palmer, and Wiley, *The Organization of Ground Combat Troops*, 420.

⁹⁸AAC, 207-208.

⁹⁹Greenfield, Palmer, and Wiley, *The Organization of Ground Combat Troops*, 421.

¹⁰⁰Patterson and Devers are mentioned in Greenfield, Palmer, and Wiley, *The Organization of Ground Combat Troops*, 295. Eisenhower is mentioned in E. Paul Semmens, *The Hammer of Hell*, (Fort Bliss, TX: USAADS, 1990), 18. Eisenhower was promoted to General on 11 February 1943 and became Supreme Allied Commander Mediterranean on 16 February 1943.

¹⁰¹Greenfield, Palmer, and Wiley, *The Organization of Ground Combat Troops*, 295.

¹⁰²Ibid., 296.

¹⁰³According to Antiaircraft Command records, thirty-one regiments, battalions or separate batteries deployed overseas before November 1942. Of those units only ten possessed a minimum of one month's combined training with other arms. Of those ten, a comparison with units deployed to North Africa and present in February 1943 during the battle at Kasserine Pass indicates that of those ten units only two battalions and a separate airborne machinegun battery had participated in at least one month's combined training. The two battalions were the 105th Coast Artillery (Antiaircraft) (Automatic Weapons) Battalion and the 443rd Coast Artillery (Antiaircraft) (Automatic Weapons) (Self-Propelled) Battalion. The 692nd Coast Artillery (Antiaircraft) Separate Airborne Machine Gun Battery also received combined training before deploying to North Africa. For a complete list of deployed antiaircraft units, see AAC, 243-244. For a list of antiaircraft units in North Africa, see George F. Howe, *Northwest Africa: Seizing the Initiative in the West*, U.S. Army in World War II, United States Army Center for Military History, (Washington, DC: Government Printing Office, 1957) and Semmens, *The Hammer of Hell*, 22.

¹⁰⁴War Department, *Lessons from the Tunisian Campaign*, (Washington, DC: Government Printing Office, October 1943), 66.

¹⁰⁵Memo USW to Asst Secy Army, dtd 23 December 1942, no sub, 370/4, GNDCG, 321, CAC, NA, Box 337-55-118 cited in Semmens, *Hammer of Hell*, 3.

¹⁰⁶For Devers' comments, see Greenfield, Palmer, and Wiley, *The Organization of Ground Combat Troops*, 296. For Eisenhower's comments on the effect of enemy air attack and the need for antiaircraft artillery protection, see Dwight D. Eisenhower, *The Papers of Dwight David Eisenhower, The War Years: II*, Alfred D. Chandler Jr. ed., (Baltimore: Johns Hopkins Press, 1970), entries 729, 770, and 841.

¹⁰⁷Greenfield, Palmer, and Wiley, *The Organization of Ground Combat Troops*, 296-297.

¹⁰⁸Antiaircraft Command, *Intelligence Circular No. 5*, undated N-6174.8, United States Army Military History Institute, Carlisle Barracks, Pennsylvania (hereafter USAMHI), 3.

¹⁰⁹Semmens, *The Hammer of Hell*, 16.

¹¹⁰Semmens, *The Hammer of Hell*, 18, 22, and 27.

¹¹¹Semmens, *The Hammer of Hell*, 29-36; see also, Martin Blumenson, *Kasserine Pass*, (New York: Jove Books, 1983) and "Kasserine Pass, 30 January-22 February, 1943," in Charles E. Heller and William A. Stofft ed., *America's First Battles, 1776-1965*, (Lawrence, KS: University of Kansas Press, 1986), 226-265; and Howe, *Northwest Africa: Seizing the Initiative in the West*, 401-481.

¹¹²McNair's address reprinted in Lieutenant General Lesley J. McNair, "Our Expanding Antiaircraft," *Coast Artillery Journal*, vol. 85, (November-December 1942): 30-31.

¹¹³Semmens, *The Hammer of Hell*, 33; Howe, *Northwest Africa: Seizing the Initiative in the West*, 462.

¹¹⁴AAC, 212.

¹¹⁵Howe, *Northwest Africa: Seizing the Initiative in the West*, 419-420. Thomas Christianson, "Triple A," *ADA Magazine*, (May-June 1994): 16.

¹¹⁶Semmens, *The Hammer of Hell*, 35.

¹¹⁷Antiaircraft Command, *Intelligence Circular No. 5*, USAMHI, 3.

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- ¹¹⁸Semmens, *The Hammer of Hell*, 36.
- ¹¹⁹Howe, *Northwest Africa: Seizing the Initiative in the West*, 468.
- ¹²⁰Greenfield, Palmer, and Wiley, *The Organization of Ground Combat Troops*, 421-423.
- ¹²¹*Ibid.*
- ¹²²Antiaircraft Command, *Intelligence Circular No. 4*, 12 June 1943, N-6174.6, USAMHI 10.
- ¹²³*Ibid.*, 17
- ¹²⁴*Ibid.*
- ¹²⁵War Department, *Lessons from the Tunisian Campaign*, 66-67.
- ¹²⁶*Ibid.*, 70; Antiaircraft Command, *Intelligence Circular No. 4*, 6 and 9.
- ¹²⁷Antiaircraft Command, *Intelligence Circular No. 4*, 6 and 9.
- ¹²⁸*Ibid.*, 12-14.
- ¹²⁹AAC, 18-19.
- ¹³⁰*Ibid.*, 101-102.
- ¹³¹*Ibid.*, 211.
- ¹³²Antiaircraft Command, *Intelligence Circular No. 5*, USAMHI, 9-10. Italics in original.

CHAPTER 10 – ADAPTING UNDER FIRE: ANTIAIRCRAFT ARTILLERY FIGHTS ITS WAY ON TO THE TEAM

¹In 1944, Jack Rogers was a newly promoted major and the S-3 (Operations Officer) of the 463rd Antiaircraft Automatic Weapons Battalion. His battalion landed in France on D+21 (27 June 1944). Supporting the 79th Division, the 463rd AA Battalion scored its first kill against two FW-190s on 11 July 1944. After the war, Rogers went on to a distinguished career in the Army, retiring in 1972 as the Assistant Commandant of the U.S. Army Air Defense School. Patricia Rhodes, “Interview with Brigadier General (Retired) Jack Rogers,” *ADA Magazine*, (May-June 1994): 48.

²Massello Oral History, 25. While commanding the mortars during the last days of the Japanese assault on Corregidor, Massello was badly wounded and severely bleeding. Refusing to retire for medical assistance, he ordered his men to prop him up against the revetment so he could continue to direct fire. Although it cannot be confirmed absolutely, Massello is said to have fired the last shot before the surrender. Jack Gulick was captured and spent the rest of the war as a POW. Christianson, "Triple A," *ADA Magazine*, 42.

³Greenfield, Roberts, and Wiley, *The Organization of Ground Combat Troops*, 421.

⁴*Ibid.*, 422

⁵*Ibid.*

⁶AAC, 25-26.

⁷*Ibid.*

⁸*Ibid.*, 26.

⁹*Ibid.*, 243-253. These figures presume that all units deploying from Boston or New York sailed to Europe.

¹⁰Mark W. Clark, "Commendation, 68th AAA Gun Battalion," Headquarters Fifth Army, reprinted in *Coast Artillery Journal*, vol. LXXXVIII, no. 2 (March-April 1945), 62-63. Also see Martin Blumenson, *Salerno to Cassino*, United States Army in World War II, The Mediterranean Theater of Operations, (Washington, DC: Government Printing Office, 1969), 352-432; and Ernest Fisher, *Cassino to the Alps*, United States Army in World War II, The Mediterranean Theater of Operations, (Washington, DC: Government Printing Office, 1977), 103-159.

¹¹AAC, 27.

¹²*Ibid.*, 28.

¹³*Ibid.*, 20, 52-53.

¹⁴Greenfield, Roberts, and Wiley, *The Organization of Ground Combat Troops*, 356.

¹⁵*Ibid.*, 356-357.

¹⁶*Ibid.*, 358.

¹⁷Report of the General Board, United States Forces, European Theater, “The Effectiveness of Antiaircraft Artillery Groups as Compared with Antiaircraft Artillery Regiments,” Antiaircraft Artillery Section, Study Number 39. File No. R 320.2/53, 2. General Board reports are available in bound volumes at the Pentagon Library, Pentagon, Washington, DC. (Hereafter referred to as The General Board, “Effectiveness of AA Groups”).

¹⁸Brigadier General Burnell commanded the 52nd Antiaircraft Artillery Brigade from 1943 to 1945. See The General Board, “Effectiveness of AA Groups,” Appendix III.

¹⁹Ibid.

²⁰Ibid., 2-3.

²¹Ibid. Appendix VII.

²²Ibid., 8.

²³AAC, 202.

²⁴Ibid., 203. The last searchlight-fighter class graduated on 26 July 1944.

²⁵Antiaircraft Command, *Intelligence Circular No. 5*, USAMHI, 17. Also see John Miller, Jr. *Guadalcanal: The First Offensive*, United States Army in World War II, The War in the Pacific, (Washington, DC: Government Printing Office, 1989) and Charles D. Melson, *Condition Red: Marine Defense Battalions in World War II*, (Washington, DC: U.S. Marine Corps, 1996).

²⁶Antiaircraft Command, *Intelligence Circular No. 1*, 15 January 1944, USAMHI, 2.

²⁷A fighter-searchlight belt was in operation in the Telergma (Algiers) area from May-mid-July 1943 to cover several bomber bases, but no hostile planes came within range. Grant, *AAF Air Defense Activities in the Mediterranean, 1942-1944*, 56.

²⁸“Window” was the British code name for what Americans called “Chaff” or strips of aluminum foil cut to specific lengths and widths so as to reflect signals back at enemy radar sets to saturate radar returns and confuse enemy antiaircraft units and fighter-interceptors. The SCR-268 radar, with its relatively long wavelengths was susceptible to “Window.” The SCR-584 radar, which reached the field beginning in February 1944, used much shorter wavelengths and was less vulnerable to it. “Window” would affect the SCR-584’s ability to conduct long range searches for aircraft, but not its ability to track closer targets.

²⁹Grant, *AAF Air Defense Activities in the Mediterranean, 1942-1944*, 57.

³⁰*Ibid.*, 67-70.

³¹*Ibid.*

³²*Ibid.*, 70-72.

³³*Ibid.*, 73.

³⁴The other areas were Gun Defended Areas (GDA), Special Areas, and airfields. Gun Defended Areas were less important areas that relied primarily on anti-aircraft fire for protection. A Special Area was any area deemed so important that delaying anti-aircraft fire for recognition purposes was unsafe. The airfield depended on fighters and anti-aircraft guns for its defense. *Ibid.*, 72-74.

³⁵*Ibid.*, 73-75.

³⁶Anti-aircraft Command, *Intelligence Circular No. 6*, no date, File No. N-6174.10, USAMHI, 26-28; Anti-aircraft Command, *Intelligence Circular No. 1*, 15 January 1944, File No. N-6174.1, USAMHI, 34.

³⁷Anti-aircraft Command, *Intelligence Circular No. 1*, 4-7.

³⁸Anti-aircraft Command, *Intelligence Circular No. 6*, 29.

³⁹Anti-aircraft Command, *Intelligence Circular No. 1*, 4-7; Grant, *AAF Air Defense Activities in the Mediterranean, 1942-1944*, 75.

⁴⁰Grant, *AAF Air Defense Activities in the Mediterranean, 1942-1944*, 22. The numbers of enemy aircraft destroyed or probably destroyed by American anti-aircraft artillery units in North Africa, Sicily, and Italy differ slightly from that reported in the Introduction. The numbers differ by 8 aircraft destroyed and 4 aircraft probably destroyed. The aircraft shot down near Corsica and Sardinia account for these numbers. Apparently, in his analysis of air defense activities in the Mediterranean, Grant omitted these figures. Therefore, since Grant supplied the figures for other Army Air Force activities, it seemed best to use his figures for Army anti-aircraft forces as well.

⁴¹For OVERLORD, the organization at the higher echelons of command was just as complex as the ultimate Anglo-American strategy for defeating Germany. General Dwight D. Eisenhower was the Supreme Allied Commander. British Admiral Sir Bertram Ramsay commanded all naval forces, while British Air Marshal Sir Arthur Tedder, Eisenhower's deputy, coordinated the operations of both the strategic and tactical air arms. Lieutenant General Carl Spaatz, commanded the U.S. Strategic Air Forces

(USAAF), which consisted of the Eighth Air Force, commanded by Doolittle, and the Fifteenth Air Force, commanded by Major General Nate Twining. Air Chief Marshal Sir Arthur Harris commanded the British Bomber Command. Although the strategic air forces operated separately from Eisenhower's headquarters, he took personal control of the Eighth Air Force and Bomber Command from May to September 1944 to assure adequate air support for OVERLORD. Immediate command of the tactical air forces was even more diverse with the overall effort coordinated by the Allied Expeditionary Air Force (AEAF) commanded by Air Chief Marshal Sir Trafford Leigh-Mallory. Under the AEAFF and directly supporting ground operations on the Continent came the U.S. Ninth Air Force (commanded by Lieutenant General Lewis Brereton), the British 2nd Tactical Air Force, and the Air Defense command of Great Britain. General Sir Bernard Montgomery, commanding the 21 Army Group, was in charge of all Allied ground forces during assault. Under Montgomery were two armies. Lieutenant General Miles Dempsey commanded the British Second Army, while Lieutenant General Omar Bradley led the American First Army. Dwight D. Eisenhower, *Crusade in Europe*, (New York: Doubleday and Co., Inc, 1948), 220-223; Martin Blumenson, *Breakout and Pursuit*, United States Army in World War II, The European Theater of Operations, (Washington, DC: Government Printing Office, 1961), 8-9; and E. K. G. Sixsmith, *Eisenhower as Military Commander*, (New York: Da Capo Press, 1972), 127-131.

⁴²Omar N. Bradley, *A Soldier's Story*, "Great Commanders" edition, (New York: Henry Holt & Company, 1994), 202.

⁴³The IX Air Defense Command would eventually administer the air defense of Granville, Morlaix, Rouen, Paris, Le Havre, Liege, and Antwerp. "The IX Air Defense Command," *Coast Artillery Journal*, vol. LXXXVIII, no. 3 (May-June 1945): 79-80.

⁴⁴Bradley, *A Soldier's Story* "Sausages" was the term applied to the oval-shaped assembly areas in southern England where units gathered prior to embarking ships for the invasion of France.

⁴⁵*Ibid.*

⁴⁶See Thomas A. Hughes, *Overlord: General Pete Quesada and the Triumph of Tactical Air Power in World War II*, (New York: Free Press, 1995).

⁴⁷Semmens, *The Hammer of Hell*, 39.

⁴⁸*Ibid.*, 37.

⁴⁹*Ibid.*, 37-42.

⁵⁰According to E. Paul Semmens, who interviewed Charles Patterson in 1990, the most difficult experience Patterson had in running the operations room was convincing

the Start and Garter girls to wear slacks, instead of skirts, when working on the situation board. Ibid., 38-39.

⁵¹Ibid., 42-43.

⁵²The exception to this general information occurred in the so-called “Diver Belt” where V-1 pilotless aircraft attacked from relatively fixed directions and between specific altitudes. See Report of the General Board, United States Forces, European Theater, “Antiaircraft Artillery Techniques,” Antiaircraft Artillery Section, Study Number 40. File No. R 353/2, 7-8. (Hereafter referred to as The General Board, “Antiaircraft Artillery Techniques”).

⁵³Antiaircraft Command, *Intelligence Circular No. 7*, no date, File No. N-6174.11, USAMHI, 13. Italics added.

⁵⁴The General Board, “Antiaircraft Artillery Techniques,” 9.

⁵⁵Operations Memorandum No. 7, SHAEF, 9 March 1944, cited in Ibid.

⁵⁶12th Army Group AAA Notes cited in Ibid., 10.

⁵⁷Identification Friend or Foe (IFF) was developed almost simultaneously with the development of radar. The idea was to develop a way to determine if the blip on the radar scope was a friendly aircraft or ship. Visual identification was never certain nor was it possible at night, in bad weather or at great distances. The solution was for aircraft (and ships) to carry transponders which “answered” friendly radar beacons, or “interrogations,” with a coded signal that registered on Allied radar scopes. With this technique, pilots could alert radar crews and other properly equipped aircraft that they were friendly. Research began in 1938. Driven by the exigencies of war, radar technology advanced to the point where the initial Mark I and Mark II IFF systems were obsolete by the mid-1941 when the use of microwaves radar beams changed the scientific parameters for IFF. The standard World War II IFF system was the Mark III system. Throughout the war, IFF operations did not always work as planned. Large formations responding to IFF “interrogations” produces a mass of signals called “IFF clutter” that easily obscured the radar operators view of any enemy aircraft. Occassionally, pilots would turn their transponders off when crossing into enemy territory and forget to turn them back on when they returned leaving radar crewman guessing if the aircraft was friendly or hostile. Just as often, aircraft returned to base with transponders damaged by enemy fire. By and large, antiaircraft operators did not rely solely on IFF, but used it along with other measures (visual identification, and positive and procedural control) to determine the status of approaching aircraft. For more on the development of IFF, see Brown, *A Radar History of World War II*, 129-131; Guerlac, *Radar in World War II*, 367-374.

⁵⁸The General Board, “Antiaircraft Artillery Techniques,” 10. American pilots tended to fly raids in mass formations. The British preferred to fly in a massive stream—one behind the other—sometimes as much as seventy miles long.

⁵⁹*Ibid.*, 11.

⁶⁰Headquarters, European Theater of Operations, United States Army, Antiaircraft Artillery Questionnaire, 11 June 1945 cited in *Ibid.*, 11.

⁶¹Headquarters, 38th Antiaircraft Artillery Brigade, Operations Memorandum No. 3, undated, Subj: Operation “BLANKCHECK” cited in *Ibid.*, Appendix III.

⁶²Blumenson, *Breakout and Pursuit*, 228-238; Mansoor, *The GI Offensive in Europe*, 165.

⁶³Bradley, *A Soldier’s Story*, 279-282.

⁶⁴*Ibid.*

⁶⁵Omar N. Bradley and Clay Blair, *A General’s Life: An Autobiography*, (New York: Simon and Schuster, 1983), 279.

⁶⁶Mansoor, *The GI Offensive in Europe*, 165.

⁶⁷*Ibid.*

⁶⁸Semmens, *The Hammer of Hell*, 43.

⁶⁹War Department, *Combat Lessons, No. 1, The Rank and File in Combat: What They’re Doing, How They Do It*, available at the United States Army Military History Institute (USAMHI), Carlisle Barracks, Pennsylvania, 46.

⁷⁰Quoted in Richard P. Hallion, *Strike from the Sky: The History of Battlefield Air Attack, 1911-1945*, (Washington, DC: Smithsonian Institution Press, 1989), 211.

⁷¹Semmens, *The Hammer of Hell*, 40-41; Christianson, “Triple A,” *ADA Magazine*, 32.

⁷²AAC, 146, 163; Christianson, “Triple A,” *ADA Magazine*, 35.

⁷³Brown, *A Radar History of World War II*, 169.

⁷⁴*Ibid.*, 169-170.

⁷⁵*Ibid.*, 170.

⁷⁶Ibid., 171; Ivan A. Getting, *All in a Lifetime: Science in the Defense of Democracy*, (New York: Vantage Press, 1989), 120-121.

⁷⁷Ibid.

⁷⁸Brown, *A Radar History of World War II*, 171; Guerlac, *Radar in World War II*, 282-283.

⁷⁹Guerlac, *Radar in World War II*, 853.

⁸⁰Ibid.

⁸¹Ibid., 893.

⁸²Brown, *A Radar History of World War II*, 171; Guerlac, *Radar in World War II*, 895-896.

⁸³Some of the impetus behind proximity fusing came from the knowledge that the Germans were working on a similar project. This knowledge came, in part, from a document entitled the "Oslo Report," which was mailed to British scientists by a "German friend." The "friend" turned out to be Hans Mayer, a physicist working at the German firm of Siemens und Halske where the work was ongoing. A visit to the Siemens factory by an English engineer and friend of Mayer's in the summer of 1939 yielded additional clues of proximity fuse work. Mayer was later imprisoned by the Nazi regime for incautious talk. Brown, *A Radar History of World War II*, 104, and 174-176.

⁸⁴Ibid., 176-179.

⁸⁵Ibid., 179-180.

⁸⁶Ibid., 181.

⁸⁷Ibid., 181-185.

⁸⁸Ibid., 403.

⁸⁹E. Paul Semmens, "D-Day: June 6, 1944," *ADA Magazine*, (May-June 1994): 22-25.

⁹⁰Ibid., 25.

⁹¹Ibid.

⁹²Cornelius Ryan, *The Longest Day: 6 June 1944*, (New York: Touchstone, 1994), 38-39.

⁹³For example, Field Marshal Erwin Rommel, commander-in-chief of Army Group B, was in Germany celebrating his wife's birthday.

⁹⁴Williamson Murray, *Luftwaffe*, (Baltimore, MD: Nautical & Aviation Publishing Company of America, 1985), 265.

⁹⁵Gordon Harrison, *Cross-Channel Attack*, United States Army in World War II, The European Theater of Operations, (Washington, DC: Government Printing Office, 1989), 335.

⁹⁶Harrison, 335; Murray, *Luftwaffe*, 265.

⁹⁷Ryan, *The Longest Day*, 247-248. Priller would end the war with 1307 flying missions and 101 victories, all on the Western Front.

⁹⁸Semmens, "D-Day: June 6, 1944," 29.

⁹⁹Ernie Pyle, "Dispatch," reprinted in *ADA Magazine*, (May-June 1994): 18.

¹⁰⁰Semmens, "D-Day: June 6, 1944," 27.

¹⁰¹*Ibid.* Although nominated for the Distinguished Service Cross, Timberlake received the Silver Star for his heroism on D-Day.

¹⁰²By the next morning, 72,215 British and Canadian troops and 57,500 American soldiers crossed the beaches at Normandy. Another 23,000 airborne troops, including a combined anti-tank/antiaircraft airborne battalion, parachuted behind the beaches.

¹⁰³Christianson, "Triple A," 34.

¹⁰⁴Semmens, *The Hammer of Hell*, 1.

¹⁰⁵Blumenson, *Breakout and Pursuit*, 45.

¹⁰⁶William Kintner, "AW in Europe," *Coast Artillery Journal*, vol. LXXXVII, no. 3 (May-June 1945): 18.

¹⁰⁷Edwin Philbrick, "AA Weapons Support the Infantry," *Coast Artillery Journal*, vol. LXXXVII, no. 3 (May-June 1945): 22-24; Blumenson, *Breakout and Pursuit*, 128-130.

¹⁰⁸See Charles B. Miller, “An AA Battalion with an Infantry Division,” *Coast Artillery Journal*, vol. LXXXVII, no. 3 (May-June 1945): 8-10.

¹⁰⁹Christianson, “Triple A,” 34; Blumenson, *Breakout and Pursuit*, 354 and 674; G-2 Section, AA Command, “Artificial Moonlight,” *Coast Artillery Journal*, vol. LXXXVII, no. 3 (May-June 1945): 16-17. For examples of antiaircraft artillery supporting ground troops in Southern France, see Antiaircraft Command, “AAA in Ground Roles,” *Coast Artillery Journal*, vol. LXXXVII, no. 1 (January-February 1945): 2-8; and John C. Henagan, “AW Ground Targets in France,” *Coast Artillery Journal*, vol. LXXXVII, no. 3 (May-June 1945): 2-7.

¹¹⁰The V-1 and the V-2 were Hitleresque weapons. Called *Vergeltungswaffen* (“vengeance weapons”), they struck not so much at an opponent physically (although they did cause significant damage when they struck), but at the enemy’s psyche by infusing the populace with fear of the unknown and the unstoppable. In short, they were terror weapons. In November 1943, when he thought the weapons were ready Hitler told an audience in Munich, “Our hour of revenge is nigh! ... Even if for the present we cannot reach America, thank God that at least one country is close enough to tackle.” The V-weapons were also *Wunderwaffen* (“wonder weapons”) in that they provided Hitler and his high command with a fanciful way to connect the ends of German strategy—the defeat of Britain and America—with their ever declining military means to achieve it. See Murray, *Luftwaffe*, 237. For dates and statistics, see Frederick Pile, *Ack-Ack: Britain’s Defence Against Air Attack during the Second World War*, (London: George G. Harrap & Co., 1949), 311-390; Report of the General Board, United States Forces, European Theater, “Tactical Employment of Antiaircraft Artillery Units including Defense Against Pilotless Aircraft (V-1).” Antiaircraft Artillery Section. Study no. 38. File no. R 370/5, 41. (Hereafter referred to as The General Board, “V-1 Defense”); and Report of the General Board, United States Forces, European Theater, “V-2 Rocket Attacks and Defense.” Antiaircraft Artillery Section. Study no. 42. File no. R 471.6/1, 11. (Hereafter referred to as The General Board, “V-2 Attacks”).

¹¹¹Murray, *Luftwaffe*, 181; David Johnson, *V-1 V-2: Hitler’s Vengeance on London*, (Chelsea, MI: Scarborough House Publishers, 1981), 23-26.

¹¹²Pile, *Ack-Ack*: 339; The General Board, “V-1 Defense,” 41.

¹¹³Pile, *Ack-Ack*: 326; The General Board, “V-1 Defense,” Appendix XII.

¹¹⁴Christianson, “Triple A,” 35; The General Board, “V-1 Defense,” 42.

¹¹⁵The General Board, “V-1 Defense,” 42.

¹¹⁶A. R. Dallmeyer, Jr., “Antwerp X: The Secret Command which Saved the Allies’ Number One Supply Port,” *Coast Artillery Journal*, vol. LXXXVIII, no. 5 (September-October 1945): 3. Also see George Badger, “Some Sidelights on Antwerp

X,” *Coast Artillery Journal*, vol. LXXXVIII, no. 5 (September-October 1945): 11-13; and E. S. Watkins, “The Secret Phase of the Flying Bomb,” *Coast Artillery Journal*, vol. LXXXVIII, no. 5 (September-October 1945): 43-46.

¹¹⁷Dallmeyer, Jr., “Antwerp X,” 3-4; The General Board, “V-1 Defense,” 43.

¹¹⁸Christianson, “Triple A,” 36.

¹¹⁹The General Board, “V-1 Defense,” 43.

¹²⁰Christianson, “Triple A,” 36.

¹²¹In the figure 9.2, “V-1 Pilotless Aircraft (PAC) Attacks on Antwerp,” the “intensity of attack” (in blue) indicates the number of V-1s fired on that day. The “V.A. (Vulnerable Area) Threats” (in red) shows the number of V-1s possessing a trajectory that would have brought them to within eight miles of the Antwerp dock area. The “PAC destroyed” (in green) highlights the number of V-1 pilotless aircraft destroyed by antiaircraft fire on a specific day. See The General Board, “V-1 Defense,” Appendix XII.

¹²²*Ibid.*, 43; William Edgar, “Ground Defense Plan: Antwerp X,” *Coast Artillery Journal*, vol. LXXXVIII, no. 5 (September-October 1945): 8-10.

¹²³The General Board, “V-1 Defense,” 44-45, and Appendix XII; Dallmeyer, Jr., “Antwerp X,” 6.

¹²⁴Cooksley, *Flying Bomb: The Story of Hitler’s V-Weapons in World War II*, 174-175, 185.

¹²⁵Dallmeyer, Jr., “Antwerp X,” 7.

¹²⁶Charles B. MacDonald, *A Time for Trumpets: The Untold Story of the Battle of the Bulge*, (New York: William Morrow & Company, 1985), 83-84.

¹²⁷*Ibid.*, 227-229.

¹²⁸*Ibid.*, 438-441.

¹²⁹Stanley Roicki, “Antitank Mission,” *Coast Artillery Journal*, vol. LXXXVIII, no. 4 (July-August 1945): 31; “Battery B’s Revenge,” *Coast Artillery Journal*, vol. LXXXVIII, no. 4 (July-August 1945): 32-34.

¹³⁰William Kintner, “AW in Europe,” *Coast Artillery Journal*, vol. LXXXVIII, no. 3 (May-June 1945): 17-19. For an appreciation of the antiaircraft, antitank, and often hand to hand fighting antiaircraft units sometimes participated in during the Battle of the Bulge, see the exploits of the 863rd Automatic Weapons Battalion located with the 99th

Infantry Division on Kalterherbert-Elsenborn Road in William Krzton and Warren Tyson, "The 863rd AAA AW Battalion in the Battle of the Bulge," *Coast Artillery Journal*, vol. LXXXVIII, no. 4 (July-August 1945): 35-40.

¹³¹Ibid., 20; and Antiaircraft Command, "AAA vs Luftwaffe: 1 January 1945," *Coast Artillery Journal*, vol. LXXXVIII, no. 5 (September-October 1945): 49.

¹³²Christianson, "Triple A," 39.

¹³³Kintner, "AW in Europe," 20.

¹³⁴Michael Doubler, *Closing with the Enemy: How GIs Fought the War in Europe, 1944-1945*, (Lawrence, KS: University of Kansas Press, 1994), 159-160. Ken Hechler, *The Bridge at Remagen: The Amazing Story of March 7, 1945*, (Missoula, MT: Pictorial Histories Publishing Company, 1993).

¹³⁵Semmens, *The Hammer of Hell*, 43-44; Christianson, "Triple A," 40.

¹³⁶E. Hamlin Turner, "The AA Defense of Remagen Bridgehead," *Coast Artillery Journal*, vol. LXXXVIII, no. 3 (May-June 1945): 20.

¹³⁷Doubler, *Closing with the Enemy*, 164; United States Army Air Defense School, *Air Defense: An Historical Summary*, 4 vols., (Fort Bliss, TX: U.S. Army Air Defense School, 1965), 2: 159-160; Christianson, "Triple A," 40.

¹³⁸United States Army Air Defense School, *Air Defense*, 2:158. The jets flew in low, between 1000 and 2000 feet, and because of their speed were wholly inaccurate bombers. None of their munitions hit the bridge. It is unknown if any were shot down by antiaircraft artillery, although given the barrage fire, some were surely damaged.

¹³⁹Doubler, *Closing with the Enemy*, 164; David E. Pergrin and Eric Hammel, *First Across the Rhine: The 291st Engineer Combat Battalion in France, Belgium, and Germany*, (New York: Ballantine Books, 1989), 266.

¹⁴⁰United States Army Air Defense School, *Air Defense*, 2:158. Charles MacDonald's figures are slightly less (109 destroyed and 36 damaged out of a total of 367 attacking German aircraft), but cover a shorter period (8-16 March). See Charles B. MacDonald, *The Last Offensive*, United States Army in World War II, The European Theater of Operations, (Washington, DC: Government Printing Office, 1973), 227-228.

¹⁴¹Doubler, *Closing with the Enemy*, 165.

¹⁴²Doubler, *Closing with the Enemy*, 185. For specific recommendations see, and Report of the General Board, United States Forces, European Theater, "Organization, Equipment, and Tactical Employment of the Armored Division." Study no. 48. File no. R

320.2/3; and Report of the General Board, United States Forces, European Theater, "Organization, Equipment, and Tactical Employment of the Infantry Division." Study no. 15. File no. R 320.2/9.

¹⁴³United States Army Air Defense School, *Air Defense*, 2:216.

¹⁴⁴Christianson, "Triple A," 44.

¹⁴⁵Antiaircraft Command, "The 90 Millimeter Sniper," *Coast Artillery Journal*, vol. LXXXVIII, no. 4 (July-August 1945): 28-31.

¹⁴⁶Christianson, "Triple A," 44-45.

¹⁴⁷For more on the Japanese suicide pilots, see Naito Hatsuho, *Thunder Gods: The Kamikaze Pilots Tell Their Story*, (New York: Kodansha International/USA Ltd, 1989); and Rikihei Inoguchi, Tadashi Nakajima, and Roger Pineau, *The Divine Wind: Japan's Kamikaze Force in World War II*, (Annapolis, MD: U.S. Naval Institute, 1958).

¹⁴⁸Roy E. Appleman, James M. Burns, Russell A. Gugeler, and John Stevens, *Okinawa: The Last Battle*, United States Army in World War II, The War in the Pacific, (Washington, DC: Government Printing Office, 1984), 473-474 and 489. For the effect of kamikaze pilots on U.S. Navy operations, see Samuel Eliot Morison, *Victory in the Pacific, 1945*, History of United States Naval Operations in World War II, vol. XIV, (Edison, NJ: Castle Books, 2001), 115-282 passim.

¹⁴⁹United States Army Air Defense School, *Air Defense*, 2:276-284; and United States Strategic Bombing Survey (Pacific), Naval Analysis Division, *The Campaigns in the Pacific*, (Washington, DC: Government Printing Office, 1946), 326-328.

¹⁵⁰*Ibid.*; and "Kamikaze," *ADA Magazine* (May-June 1994), 58-62.

¹⁵¹AAC, 209-211

CHAPTER 11 – CONCLUSION: LEGITIMACY, LEGACY, AND LESSONS ON INNOVATION

¹Lyman L. Lemnitzer, "We Move Ahead," *Antiaircraft Journal*, vol. LXXXXVII, no. 6 (November-December 1954): 3 quoted in Larry Addington, "The U.S. Coast Artillery and the Problem of Artillery Organization, 1907-1954," *Military Affairs*, vol. 40, no. 1 (February 1976): 1-6.

²Allan R. Millett, "The United States Armed Forces in the Second World War," in *Military Effectiveness, Vol. III, The Second World War*, ed. Allan R. Millett and Williamson Murray, (Boston: Allen & Unwin, 1988), 47.

³Ibid., 52; Greenfield, Palmer, and Wiley, *The Organization of Ground Combat Troops*, 203.

⁴Greenfield, Palmer, and Wiley, *The Organization of Ground Combat Troops*, table facing page 161.

⁵Joseph A. Green, "To the Members of the Coast Artillery Association," *Coast Artillery Journal*, vol. LXXXVII, no. 6 (November-December 1944): frontpiece.

⁶Ibid.

⁷Patton's and McNair's comments are taken from extracts of letters cited in AAC, 214 and 217.

⁸The phrase "schoolhouse of war" belongs to Michael Doubler who analyzes the Army's learning capability as it evolved from North Africa, to Normandy, and through the war in the European Theater of Operations. See Michael Doubler, *Closing with the Enemy: How GIs Fought the War in Europe, 1944-1945*, (Lawrence, KS: University of Kansas Press, 1994), 265-299.

⁹Ibid.

¹⁰Ibid.

¹¹George R. Thompson and Dixie R. Harris, *The Signal Corps: The Outcome, United States Army in World War II, The Technical Services*, (Washington, DC: Government Printing Office, 1966), 472 and 474.

¹²Doubler, *Closing with the Enemy*, 284.

¹³Patricia Rhodes. "Interview with Brigadier General (Retired) Jack Rogers." *ADA Magazine* (May-June 1994): 47-48, 67-71.

¹⁴See Doubler, *Closing with the Enemy*, 285-286 and Report of the General Board, United States Forces European Theater. "Organization, Equipment, and Tactical Employment of the Infantry Division," Study no. 15, 1-16.

¹⁵Jonathan M. House, *Toward Combined Arms Warfare: A survey of 20th Century Tactics, Doctrine, and Organization*, Research Survey No. 2, Combat Studies Institute, (Fort Leavenworth, KS: U.S. Army Command and General Staff College, 1984), 147; also "The New Infantry, Armored, and A/B Divisions," issued by U.S. Army Ground Forces, 24 January 1947, located in the Combat Arms Research Library (CARL), Fort Leavenworth, Kansas.

¹⁶Addington, “The U.S. Coast Artillery and the Problem of Artillery Organization, 1907-1954,” 5; and Weigley, *History of the United States Army*, 495-496.

¹⁷*Ibid.*