FIELD ARTILLERY DOCTRINE DEVELOPMENT 1917-1945

A thesis presented to the Faculty of the U.S. Army Command and General Staff College in partial fulfillment of the requirements for the degree

MASTER OF MILITARY ART AND SCIENCE

by

SCOTT R. MCMEEN, MAJ, USA
B.A., University of Nebraska, Lincoln, 1979

Fort Leavenworth, Kansas
1991

MASTER OF MILITARY ART AND SCIENCE

THESIS APPPOVAL PAGE

Name of candidate: MAJ Scott P. McMeen

Title of thesis: Field Artillery Doctrine Development 1917-1945.

Approved by:

_____, Thesis Committee Chairman
Christopher R. Gabel, Ph.D.

_____, Member
LTC Michael T. Cnychota, M.A.

_____, Member
MAJ Gary D. Rhay, M.A.

Accepted this 7th day of June 1991 by:

_____, Director, Graduate Degree Programs
Philip J. Brookes, Ph.D.

The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other government agency. (References to this study should include the foregoing statement.)

ABSTRACT

FIELD ARTILLERY DOCTRINE DEVELOPMENT 1917-1945 by MAJ Scott R. McMeen, USA, 90 pages.

This thesis examines the development of U.S. Army field artillery doctrine from 1917 to 1945. It compares field artillery organization, liaison methods, target acquisition methods, missions, command and control principles, and fire direction techniques employed in World War I, the interwar period, and World War II.

The study reveals the remarkable continuity of the artillery doctrine developed in World War I. In spite of tremendous technological change from 1917 to 1945, World War II artillery doctrine remained very similar to the doctrine of 1918. The study concludes that the basic principles of artillery doctrine established in World War I were the basis for artillery doctrine in World War II, and will probably remain the basis for future artillery doctrine.

ACKNOWLEDGEMENTS

I wish to thank the members of my thesis committee, Dr. Christopher R. Gabel, LTC Michael T. Chychoda, and MAJ Gary D. Rhay for their invaluable assistance and insight.

I also wish to thank Dr. Boyd Dastrup, Field Artillery Branch Historian, and CPT Steve McGeorge for their assistance with research on World War I artillery doctrine.

My thanks go to the staffs of the Combined Arms Research Library at Fort Leavenworth, and the Morris Swett Technical Library at Fort Sill, Oklahoma, who provided a wealth of valuable documents and information.

Finally, I wish to thank my wife, Debra, whose advice, loving patience, and understanding made this thesis possible.

TABLE OF CONTENTS

CHAPTER 1: INTRODUCTION

One of the most important missions of any army is to develop effective doctrine. Since the emergence of professional armies in the 17th and 18th centuries, leaders have struggled to produce the most effective ways of employing military force. The search for effective doctrine has intensified in the 20th century. In this era of continuous technological change, armies have found it necessary to almost constantly reexamine their doctrine, tactics, techniques, and procedures for fighting.

This study examines the development of field artillery doctrine in the U.S. Army from 1917 to 1945. It is designed to determine whether the Army's artillery doctrine of World War II was well developed before the war, or largely improvised from combat experience. The study investigates the field artillery because it was among the most successful and effective of the Army's combat elements in World War II. Russell F. Weigley, one of the leading historians on U.S. military affairs, characterized the field artillery as "the outstanding combat branch of the American ground forces."[1] He attributed much of the artillery's success to superior doctrine:

> ...American artillery (excelled) in the ability of a single forward observer--often flying in a Piper or Stinson liaison airplane--to request and receive the fires of all the batteries within range of a target in a single, concentrated, barrage. The American guns specialized in "TOT"--time on target--concentrations of multiple batteries, or even of numerous battalions, upon designated targets for designated periods of time. To the catastrophic effects of a TOT, German prisoners gave universal testimony. On all

> fronts, artillery caused more than half the casualties of World War II battles; but the artillery was the American army's special strong suit.[2]

By examining the origins and development of a successful doctrine, the study reveals lessons which may prove useful to future doctrine development efforts.

The study begins in 1917 because World War I experience was the basis for the U.S. Army's artillery doctrine in World War II. Despite the apparent dissimilarity of the two conflicts, the continuity of doctrine between World Wars I and II is unmistakable and striking. The study shows that artillery doctrine remained remarkably similar from 1917 to 1945 in spite of great technological change. These findings suggest that as we modify our doctrine for the future, we should not lightly abandon the established methods of the past.

What exactly is meant by the term 'doctrine?' Field Manual 100-5: Operations (FM 100-5) provides the commonly accepted definition:

> An army's fundamental doctrine is the condensed expression of its approach to fighting campaigns, major operations, battles, and engagements. Tactics, techniques, procedures, orgnizations, support structure, equipment and training must all derive from it. It must be rooted in time-tested theories and principles, yet forward-looking and adaptable to changing technologies, threats, and missions. It must be definitive enough to accommodate a wide variety of worldwide situations. Finally, to be useful, doctrine must be uniformly known and understood.[3]

Note that the definition makes a distinction between doctrine on the one hand, and tactics, techniques and procedures on

the other. Doctrine is very broad and general. It does not provide specific guidance for particular tactical situations; this is the role played by tactics, techniques, and procedures. The terms are nevertheless closely related. As FM 100-5 points out, tactics, techniques, and procedures are all derived from doctrine.

While recognizing the greater precision of the FM 100-5 definition, this study uses doctrine in a more general sense. Although the study focuses primarily on doctrine as defined by FM 100-5, it deals with related topics as well. In order to discuss and compare artillery operations during the world wars, it is frequently necessary to descend to the level of tactics, techniques, and procedures. Many of these 'lower order' methods had a profound impact on artillery operations. In more than one instance, methods that could be categorized as mere 'procedures' ultimately changed tactics and doctrine. Furthermore, to categorize a particular method as doctrine, tactic, technique, or procedure is extremely difficult, and is ultimately unimportant to the thesis.

The study breaks down the doctrinal analysis into six major areas: organization of artillery units; liaison procedures and organization; target acquisition procedures and organization; field artillery missions; command and control; and fire direction. Unit organization, command and control, and missions are common features of the doctrine for any military element. The other three areas are peculiar to field artillery and bear some further explanation.

Liaison and target acquisition are subsets of artillery organization. An indirect fire system (a system of weapons that do not 'see' the targets they engage) must have separate elements to find and observe targets for them. When field artillery became an indirect fire system early in this century, target acquisition became an inherent component of artillery units. Liaison elements also became a standard feature in artillery units. The artillery's primary mission, to provide supporting fires to the infantry, demanded constant communication and coordination with the supported force. Artillery liaison parties assumed this role early in World War I, and remain a feature of current artillery doctrine. Fire direction describes the tactical employment of artillery fire itself; it is the crux of all artillery operations.

The study examines each of the six doctrinal areas at three points in time. Chapter 2 examines doctrine at the close of World War I. Chapter 3 looks at doctrine in early 1941, near the end of the interwar period. Chapter 4 analyzes artillery doctrine at the close of World War II. In addition, Chapters 2, 3, and 4 describe the background and history of major doctrinal developments during World War I, the interwar period, and World War II respectively. Chapter 5 presents the study's conclusions and findings.

CHAPTER ONE ENDNOTES

[1]Russell F. Weigley, Eisenhower's Lieutenants: The Campaign of France and Germany 1944-1945 (Bloomington: Indiana University Press) 127.

[2]Ibid., 28.

[3]U.S. Army, Field Manual 100-5: Operations, (Washington: Headquarters, Department of the Army, 1986), 6.

CHAPTER 2: WORLD WAR I

World War I brought on a revolution in tactics. The battles of 1914 quickly demonstrated the inadequacy of the belligerents' prewar tactical doctrine. While most professional soldiers recognized the increased lethality of modern weapons, they did not anticipate the complete dominance of firepower over maneuver. Modern artillery and machine guns made maneuver by infantry and cavalry nearly suicidal. The only way to advance, it was soon discovered, was to suppress the enemy's artillery and machine guns with one's own artillery and machine guns. But as we shall see, coordiating artillery support with moving infantry was very difficult to do. In this new tactical environment, armies could generate unheard-of firepower, but their tactical mobility and command and control, particularly in the offense, was little better than it had been at Waterloo.

The only immediately available relief from the effects of firepower was entrenchment. This, combined with the high ratio of forces to space on the Western Front, produced the deadlock of trench warfare.

To a large extent, it was the firepower of artillery that transformed the modern battlefield. Appropriately enough, modern warfare would completely transform artillery tactics and doctrine. Prior to the 20th century, artillery had been almost exclusively a direct fire weapon. For centuries, guns and gunners had taken up their place in line of battle and blazed away at visible targets.

This worked well enough until the introduction of high explosive shells and machine guns. If infantrymen in the open were easy to kill, artillery batteries were even more vulnerable targets. A battery position typically included not only guns and gunners, but also horses in harness, limbers, and caissons. A bursting shell or plunging bullets in the midst of all this quickly reduced batteries to chaos. In the opening battles of 1914, artillery firing from exposed positions was quickly swept away by enemy fire.[1] In order to survive, the artillery left the front lines and adopted indirect fire techniques.

Indirect fire was not new to World War I armies. Most of them had already developed procedures for indirect fire. The Japanese had made extensive use of indirect fire during the Russo-Japanese War (1904-05).[2] But these procedures were not widely practised. Prior to 1914, most artillerymen felt that indirect fire was too complicated, and probably unnecessary. Virtually all of the major powers expected the next war to be one of rapid movement, in which mobility, not firepower, would be the supreme virtue. In such a conflict, there would be no time for establishing observation posts, stringing communications wire, and performing the complex calculations required for indirect fire. But the shock of combat quickly destroyed these assumptions. The survival instinct would soon motivate even the most hidebound gunners to learn the newfangled techniques.

Three years of stalemate on the Western Front gave artillerymen the opportunity to develop effective indirect fire

support techniques. By 1917, and U.S. entry into the war, indirect fire was a highly developed art. The armies developed accurate grid maps and mastered survey techniques for determining accurate battery and observation post locations. Artillerymen learned to segregate ammunition by manufacturer's lot, to maintain uniform performance from round to round. They learned to compensate for the erosion of worn cannon tubes and resulting loss of muzzle velocity. They routinely applied corrections to compensate for the effects of weather and powder temperature. In short, procedures once regarded as prohibitively complicated became commonplace.

More importantly, the artillery learned to coordinate its efforts with the infantry. Cooperation between the various arms had been largely ignored in prewar training. But the hard school of combat rapidly forced the armies on the Western Front to find solutions to the difficult problems of fire coordination. To be sure, neither side had found a completely satisfactory system by 1917. But both sides had progressed tremendously from the days of 1914, when infantry-artillery cooperation, if it existed at all, was often a matter of pure chance.[3]

Then came the U.S. Army. The Americans had played no part whatever in the tactical revolution that began in 1914. Our most recent combat experience had been against Philippino and Mexican guerrillas, a far cry from the massed armies of the Western Front. The artillery of the Regular Army was insufficient to outfit a single division.[4] Given this, it is not surprising to learn that nearly all U.S. field artillery units that fought in World War I

were trained largely by French officers[5] and equipped with French materiel.[6] In fact, a significant portion of the American Expeditionary Force's (A.E.F) artillery support was provided by French units. During the great Meuse-Argonne Offensive, the largest American attack of the War, French units made up more than half of the corps and army artillery that supported U.S. First Army.[7] Because the U.S. Army was without experience at handling large amounts of artillery in modern war, most of the doctrinal and tactical pamphlets prepared by the U.S. War Department for the artillery were simply copies of French and British training circulars.[8] Thus, the field artillery doctrine that emerged from World War I, and would form the basis of U.S. doctrine during World War II, was largely inherited from the French and British. The doctrine that the U.S. would apply so successfully in the mobile battles of World War II, had its origins in the deadlocked trenches of 1914-1918.

I. ORGANIZATION

In organizing its artillery, the U.S. had the advantage of Allied experience. Artillery organization in World War I was designed to provide both responsiveness and flexibility. Each maneuver echelon had its own dedicated fire support. The light artillery, normally deployed well forward in support of the infantry regiments, provided the rapid response. Medium and heavy artillery, under the control of the division, corps, and army headquarters, provided the flexibility. The artillery under his

direct control was generally the commander's primary means of influencing a battle. He could use it to weight his own main effort, or help out a subordinate unit threatened by enemy action.

Divisional artillery organization paralleled the 'square' division structure used by U.S. forces throughout World War I. The division was built around two infantry brigades, each brigade consisting of two regiments of three infantry battalions each. The division had an organic artillery brigade, consisting of two light artillery regiments and one medium artillery regiment. Light and medium regiments each contained two battalions of twelve guns each. The two light regiments, equipped with French 75mm guns, normally provided close supporting fires to the two infantry brigades. The medium regiment, typically equipped with 155mm howitzers, provided additional support to the division wherever needed. But a front line division usually had much more artillery than this. The U.S. 1st Division conducted a trench raid, a small scale, limited objective attack, at Remieres, France on 11 March, 1918. For this rather modest attack, the 1st Division had the equivilent of eight artillery regiments in support, more than twice its organic amount of artillery.[9] Nor was this level of support particularly lavish. On 1 November, 1918, the V Corps artillery provided an entire regiment of light guns to support each front line <u>battalion</u> of infantry, or six times what organic artillery alone could provide.[10]

These additional assets came from corps and/or army artillery. Corps and army artillery, unlike the divisional

brigades, had no fixed structure. An Allied corps or army would receive as much additional artillery as the high command felt was necessary to support the unit's mission. Then, through a process known as organization for combat, the chief of artillery for the corps or army would assign missions to his battalions, regiments, and brigades. He would generally attach the light artillery directly to the divisions, but would keep most of the medium and heavy caliber weapons under his control. The subordinate unit with the most critical mission normally received the heaviest artillery support. Commanders were quite flexible in employing this artillery. Units were freely attached, detached, and moved from sector to sector, based on tactical need.

If the corps or army's span of control grew too large, it could form subordinate elements into 'groupings' or 'groupments.' Groupings were ad hoc organizations consisting of several artillery units brought together to perform a particular mission. During the latter half of the Meuse-Argonne Offensive, First Army formed the AISNE Grouping, consisting of a U.S. artillery regiment, a French artillery regiment, and an aviation squadron. This unit provided support to both I and V Corps in late October and early November. The field orders of the 1st Army Artillery for 9 November include a warning order for the dissolution of the AISNE Grouping, and the reassignment of the U.S. artillery regiment to III Corps.[11]

II. LIAISON

Adoption of indirect fire made liaison officers and liaison parties absolutely essential to artillery organization. Back in the direct fire days, when cannon lined up next to infantry and cavalry, liaison was a simple matter. But in World War I, with the light artillery a thousand meters or more behind the lines, and the heavier guns even further back, the artillery was now out of shouting distance. The French and British solved the problem by detailing artillery officers and a parties of communications specialists to all front line infantry units, and the Americans adopted this practice as well. Typically, infantry commanders down to battalion level had an artillery liaison officer. The liaison officer's job was to assist the infantry commander in using his artillery support effectively. He assisted the infantry in developing its indirect fire plan, and coordinated it with the artillery. He kept the artillery up to date on the infantry's location, status, and activities, and vice versa. One of his biggest responsibilities was to insure that friendly artillery fire did not endanger the infantry.[12]

III. TARGET ACQUISITION

It was quite common for liaison officers to double as observers. Observers were the most widely used target acquisition means of the war. They were another obvious requirement for an indirect fire system. They identified targets for the artillery

and corrected fall of shot. The bulk of these observers were ground observers, deployed in the front lines with the infantry. But many were aerial observers, mounted in balloons and airplanes.

Balloon observation offered some obvious advantages over ground and airplane observation. First, like the airplane observer, the balloon observer could view an immense sector to great depth. Unlike the airplane observer, he was stationary, making target locations much easier to determine. Finally, a balloon observer had telephone communications with the ground. Of course, balloons did have one serious disadvantage: their extreme vulnerability to enemy aircraft. Often, the mere approach of an enemy airplane was enough to make a balloon observer "take to his chute."[13]

Airplane observers were also subject to attack by enemy planes. Being in constant motion, they had a harder time observing targets on the ground. They communicated with the artillery through an extremely complicated and clumsy system of one way radiotelegraphy (airplane to ground station), and ground-to-air marker panels and flares.[14] Yet the value of airplane-mounted observers was immense. Airplanes had the one thing that everything else on the Western Front lacked: mobility. Airplanes could swoop directly over enemy lines and enemy rear areas to find targets. Having found the targets, they could direct artillery fires on them through radiotelegraph signal, or they could simply take pictures. Aerial photographs were among the most valuable sources of intelligence for the artillery.[15]

While ground and air observers provided the bulk of target intelligence during the war, the need to locate enemy batteries prompted some new and innovative solutions to the problem of locating hostile artillery. One of these was flash ranging, in which two or more observers at separate observation posts tried to make simultaneous observations of enemy artillery muzzle flashes. The observers measured and reported the direction to the flash, which was then plotted on a grid sheet, the intersection of the azimuths revealing the enemy battery's location. Sound ranging was also developed during World War I. Using this technique, specialists measured the difference in time of a sound wave's arrival at a series of microphones. With the speed of sound a known constant, and the locations of the microphones a known value, the battery's location could be deduced. Both techniques were employed with some success during the war. But once again, the American Army had a hard time organizing and training such units in sufficient numbers. Both the sound ranging and flash ranging section assigned to the V Corps Artillery during the Meuse-Argonne Offensive were French.[16]

The need for intelligence on enemy artillery prompted the French to develop an organization exclusively devoted to artillery target acquisition, an organization which the Americans promptly copied. In the U.S. Army, it was known as the Artillery Information Service, or A.I.S.[17] Both the corps and army artillery headquarters had an A.I.S. section, commanded by an artillery information officer, or A.I.O. The A.I.S. section at army level

distributed information received from corps to the army artillery, and gathered additional information from army sources. But most intelligence generated at this level was too old to provide useful target information, i.e. target locations that could be immediately fired on. The corps A.I.S. provided most of the immediately useable target intelligence.[18] The corps A.I.S. had only one organic asset: the sound and flash ranging sections. But it gathered target information from numerous sources, including aerial photographs, airplane, balloon, and ground observers, sound and flash ranging, signals intelligence, and the analysis of dud shells.[19] The A.I.S. also assisted in adjusting friendly fire, and disseminated meteorological information.

IV. ARTILLERY MISSIONS

The first and most obvious question doctrine must address is that of mission. Just what is it that the force is supposed to do? By 1917, Allied doctrine identified four basic artillery missions. First and foremost was the direct support mission, which included all fires delivered in proximity to and in support of front line infantry. Second, counterbattery fire encompassed all fires directed at enemy artillery, including artillery observation posts and ammunition dumps as well as battery positions. Third, interdiction fire was meant to deny the enemy access to an area or route. Harrassing fire was a variation on interdiction. It was not intense enough to completely interdict an area, but by occassionally placing fire on important routes and locations, made

life more difficult for the enemy. The fourth mission was to provide deep fires--fires on non-artillery targets beyond the main battle area.

These tasks were logically divided among the divisional, corps, and army artillery. The divisional artillery brigades, consisting primarily of light artillery, handled the direct support mission. The corps artillery, with a mix of medium and heavy calibers, had counterfire as its primary mission. The army artillery, which included super heavy railway guns and the like, provided most of the deep fires. All three echelons fired harrassing and interdiction missions, depending on the range to the target. This standard division of duties shows up clearly in artillery operations orders from the Meuse-Argonne Offensive.[20] But these rules were not hard and fast. Those same orders reveal instances of counterbattery targets assigned to division artilleries, and of a heavy artillery battery attached to the infantry for direct support.[21] Tactical need was the overriding consideration in assigning artillery units to tasks.

World War I also saw the beginnings of the artillery's 'standard tactical mission' concept. During World War II, artillery commanders used four standard tactical missions to describe a units fire support responsibilities. Units assigned a 'direct support mission' provided immediate fire support for infantry regiments and brigades. 'General support' units provided fires to support the division, corps, or army. 'Reinforcing' units supplemented the fires of a designated artillery unit. The

'general support-reinforcing mission,' as the name implies, was a combination of the previous two missions.

Three of these four missions were clearly visible in the V Corps Artillery's organization for combat of 29 October, 1918. The corps attached all of its light, and some of its medium artillery to the divisions. For this operation, each infantry battalion had an entire light artillery regiment in direct support. Next, the corps established two groupings, of four and five battalions respectively, to provide additional fire support to the corps' two attacking divisions. These groupings were under corps control, but each established direct communications with one of the divisional artillery headquarters, and provided reinforcing fires to the divisions; a general support-reinforcing mission. Next came two battalions of heavy artillery exclusively under corps control; a general support mission. Finally, First Army gave one of its heavy artillery brigades a general support-reinforcing mission in support of V Corps.[22]

V. COMMAND AND CONTROL

The static conditions of trench warfare and the primitive state of communications technology determined the nature of World War I artillery command and control. Static conditions allowed headquarters to develop and issue very detailed orders. Charts, overlays, time schedules, and detailed instructions prescribed the artillery's actions in battle. Control was highly centralized. Fire support plans were typically consolidated and approved at

corps or even army level. The majority of the targets engaged were planned targets, identified and assigned to a battery hours or even days before they were fired. This system did result in very efficient use of artillery assets, and could be very effective. On 1 November, 1918, the V Corps Artillery fired a massive preparatory bombardment on the German lines, which assisted the V Corps in advancing some eight kilometers that day, a prodigious rate by World War I standards. German prisoners of war attested to the effectiveness of the bombardment.

> Many of the prisoners captured on the 1st (of November, 1918) state that the reason they were taken is that our artillery concentrations were so effective that they were confined to their shelters and isolated in small groups. Artillery prisoners state that they were unable to serve their guns. In several instances, batteries were unable to fire a shot. There were cases of officers who were entirely cut off from communication with their troops.[23]

The system of centralized control through detailed planning did have some obvious weaknesses, however. If the attacking infantry ran into unanticipated resistance, or if the enemy artillery began firing from previously unknown locations, or if the rolling barrage got too far in front of the advancing infantry, the attack could fail. The immobile nature of telephone communications made it extremely difficult to engage unplanned targets, or modify a schedule of fires. Commanders certainly recognized the need for a more flexible and responsive system, and tried many methods for improving communications with the artillery. Radio was the obvious answer to mobile communications, but the sets available in 1917-1918 were too heavy and fragile to carry forward over no-man's

-land. Pyrotechnic signals were useful for calling in prearranged barrages and concentrations, but once again the need had to be anticipated and included in the fire plan. The only proven method for controlling artillery fires was an effective fire support plan, detailed enough to meet likely contingencies.

The artillery's desire for centralized control coupled with the infantry's desire for responsive support resulted in a dual chain of command for artillery units. Artillery at all echelons served two masters. The artillery brigade, for example, was an integral part of the division, yet its commander was answerable to both the division commander and the corps chief of artillery.[24] By the same token, the corps chief of artillery worked for both the corps commander and the army chief of artillery. At first glance, this seems a less than ideal arrangement with obvious potential for conflict. Yet the system appeared to work well. In writing his account of artillery employment in the Meuse-Argonne Offensive, Major W. E. Shepherd, chief of staff of the V Corps Artillery, had nothing but praise for the support of the First Army Artillery. The V Corps commander, Major General C. P. Summerall, was also effusive in his praise of the artillery at all echelons in that campaign.[25]

Why didn't conflicts arise between the demands of artillery and maneuver commanders? Perhaps it was due to the artillery's clear recognition of its ultimate purpose: to help the infantry achieve its mission. Given this view, the proper role of an army artillery was to help its corps reach their objectives. The role

of the corps artillery was to help the divisions reach their objectives, and so on. It was standard practice to locate artillery command posts next to the supported maneuver headquarters, with liaison at the subordinate maneuver headquarters. Hence, the views of infantry and artillery commanders were generally in close accord. In this way, the artillery achieved centralized control, yet was still responsive to the supported forces needs.

VI. FIRE DIRECTION

What guidance did doctrine provide on the actual conduct of artillery fire? This is the realm of fire direction, which "comprises the tactical employment of artillery fire to include the location and selection of targets on which to fire is to be placed, technique of delivery of fire thereon, and allocation of ammunition to fire missions.[26] In other words, fire direction determined where (which targets) to engage, what to shoot in terms of ammunition type and amount, and how to engage, e.g. fire a lot of ammunition at a target all at once, or fire it over an extended period.

The method for engaging a target was normally a function of the effect desired. U.S. doctrine identified two basic types of effects, destruction and neutralization. Destruction meant the total annihilation of the target; a desirable goal, but very expensive in terms of ammunition. Destruction fire also required fairly precise target locations.[27] Neutralization fire achieved

only temporary effects. But when properly synchronized with other actions, neutralization could be just as effective as destruction, and much easier to achieve. During an attack, for example, artillery would neutralize enemy batteries until the infantry advance was complete, thus eliminating enemy artillery from a critical phase of the battle without physically destroying the enemy guns. Orders for neutralization fire were often very precise, specifying the amount and type of ammunition to be fired, the rate of fire, and the type and number of weapons to use.[28]

In the offense, the artillery generally fired elaborate and extensive preparations. These "aimed at (a) the overpowering of the hostile artillery, and (b) the physical and moral reduction of the enemy's infantry."[29] For greatest effect, doctrine prescribed the use of massed fires, with all available artillery firing at once. The V Corps Artillery order for the attack of 1 November states: "At 'H' minus two hours, the enemy's entire front line position will be subjected to an intense bombardment by all guns at the disposal of the corps, except those required for counter battery."[30] Even the most effective preparation could not eliminate all enemy resistance, however. To supplement preparatory fires, commanders planned for additional 'on call' concentrations on likely areas of enemy resistance. Infantry commanders or artillery liaison officers could call for these fires relatively easily, by using pyrotechnic signals or code words over the telephone. These concentrations were very useful for defeating enemy counterattacks.[31]

The great failing of artillery in the offense was its inability to keep up with a rapid advance and provide continuous fire support. Once the infantry got beyond the range of the guns, artillery units had to displace forward. Artillery headquarters worked out detailed plans for moving batteries and providing continuous support.[32] But moving guns, caissons, and horses forward through trench systems and over the devastation of no-man's-land was extremely slow and difficult.[33] Once in place, artillery units had to reestablish communications, which meant installing new telephone wire with both forward elements and higher headquarters to the rear. Finally, getting ammunition forward to the new positions was a daunting challenge, not only because of the devastated terrain, but also the crush of men and vehicles trying to get forward. Artillery trucks and wagons had to compete with infantry trucks and wagons, infantry reserves, engineers, signal troops, ambulances, headquarters and other combat support troops, all competing for the same inadequate roads.

In the defense, artillery commanders planned counterpreparations--fires designed to disrupt enemy preparations and attacks. When an enemy attack was discovered, preferably just before the enemy infantry got underway, the light artillery opened a violent fire on the enemy front line works to disrupt and destroy the assaulting troops. Medium and heavy guns opened fire on enemy artillery, command posts, communications trenches, and roads, in addition to reinforcing the fires of the light artillery.[34]

For close in defense, the artillery executed 'standing barrages.' When properly executed, these created a wall of shrapnel fire between friendly positions and attacking infantry. Fires were initiated by rocket signal or telephone command from the front lines. Crews kept their pieces in constant readiness to execute these fires, so that the delay between the command to fire and rounds exploding could be measured in seconds. Unless the enemy neutralized the defending artillery, barrage fires seldom failed to stop an attack.[35]

VII. CONCLUSIONS

By November, 1918, the U.S. Army had a successful artillery doctrine. It had developed an effective artillery organization, massive enough to overwhelm its enemies, and flexible enough to adapt to changing tactical situations. It had acquired effective liaison and target acquisition elements, using the most advanced technology available. Its command and control system was well adapted to trench warfare. Detailed planning, centralized command and control, and thorough integration with the infantry were its essential characteristics.

The artillery in World War I had two chief failings: its inability to engage unplanned targets, and its lack of mobility in the offense. Between the two wars, advances in technology would provide solutions to both of these problems, and would account for the most significant changes in artillery doctrine in World War II.

CHAPTER TWO ENDNOTES

[1]J. B. A. Bailey, Field Artillery and Firepower (Oxford: Military Press, 1989), 129.

[2]Jonathan M. House, Toward Combined Arms Warfare: A Study of 20th Century Tactics, Doctrine and Organization (Fort Leavenworth: U.S. Army Command and General Staff College, 1984), 17.

[3] C. T. Lanham and Edwin F. Harding, Infantry in Battle (Richmond: Garret and Massie, 1939) 262.

[4]William J. Snow, Signposts of Experience (Washington: U.S. Field Artillery Association, 1941) 11.

[5]Ibid., 101-103.

[6]John J. Pershing, Hunter Liggett, Report of the First Army, American Expeditionary Force: Organization and Operations (Fort Leavenworth: The General Service Schools Press, 1923) 95.

[7]Ibid., 117-118.

[8]John W. Weeks, Report of the Secretary of War to the President, 1922 (Washington: Government Printing Office, 1922) 302.

[9]Memorandum, Commander, 1st F.A. Brigade to Commander, 1st Division, 12 March, 1918, Subject: Report Upon Operations of 1st F.A. Brigade During Raids Executed March 11, World War Records, 1st Division, A.E.F. (Regular): Operations Reports, 1st F.A. Brigade (Volume XIV) (Washington: War Department, 1919).

[10]Annex I to Operations Order No. 5, V Army Corps Artillery, 29 October, 1918, reprinted in an article by W. E. Shepherd, Jr., "The Employment of the Artillery--Fifth Army Corps Argonne--Meuse Operations," Field Artillery Journal 9 (April-June 1919) 177.

[11]Field Orders No. 53, 1st Army Artillery, 9 November 1918, "V Corps Monograph," Documents Collection, Combined Arms Research Library, Fort Leavenworth, Kansas (cited hereafter as CARL) No. M9403 H6 C73 G3 CID.

[12] War Department, Field Artillery Notes No. 2, (Washington: Office of the Adjutant General, August, 1917) 35-36.

[13]Horatio Rogers, World War I Through My Sights (San Rafael, CA: Presidio Press, 1976) 71-72.

[14]War Department, Field Artillery Notes No. 1, (Washington: Office of the Adjutant General, May, 1917) 71-86.

[15]W. E. Shepherd, Jr., "The Employment of the Artillery--Fifth Army Corps Argonne--Meuse Operations," Field Artillery Journal 9 (April-June 1919) 160.

[16]Ibid., 161.

[17]War Department, The Artillery Information Service, (Washington: Office of the Adjutant General, September, 1918) 7.

[18]Ibid., 8-9.

[19]Ibid., 10-11.

[20]Shepherd, "The Employment of the Artillery," 173.

[21]Memorandum No. 15, First Army Artillery, 12 November 1918, "V Corps Monograph."

[22]Shepherd, "The Employment of the Artillery," 167.

[23]Ibid., 155-156.

[24]Shepherd, "The Employment of the Artillery," 172.

[25]Ibid., 148-151.

[26]War Department, Field Manual 6-20, Field Artillery Tactics and Technique, (Washington: War Department, 1940) 111.

[27]War Department, General Notes on the Use of Artillery, (Washington: Office of the Adjutant General, November, 1917) 14.

[28]Shepherd, "The Employment of the Artillery," 169, 175.

[29]War Department, Artillery in Offensive Operations, (Washington: Office of the Adjutant General, August, 1917) 23.

[30]Shepherd, "The Employment of the Artillery," 168-169.

[31]Lanham, Infantry In Battle, 271-272.

[32]Shepherd, "The Employment of the Artillery," 174.

[33]Memorandum No. 14, First Army Artillery, 7 November 1918, "V Corps Monograph."

[34]General Notes on the Use of Artillery, 25.

[35]Russell G. Carter, The 101st Field Artillery, (Cambridge: Riverside Press, 1940) 66.

CHAPTER 3: BETWEEN WARS

Immediately following World War I, the Army began demobilizing. The national desire for a "return to normalcy" resulted in a lightning fast reduction in military strength. On 11 November, 1918, the U.S. Army's artillery had a total personnel strength of 462,163.[1] By 30 June, 1919 it had fallen to 25,519. One year later, this modest strength was halved to 12,560.[2] Nevertheless, the artillery was in considerably better shape than it had been when the war began. It had acquired substantial amounts of modern weapons and equipment, along with priceless combat experience. The artillery did a good job of recording its wartime experience. Major General William J. Snow, Chief of Field Artillery from 1918 to 1927, organized three boards of officers to research lessons learned on the Western Front, and make recommendations for the future.

The Hero Board, named for its senior officer, Brigadier General Andrew Hero, convened in December of 1918: "...to make a study of the experience gained by the Artillery of the A.E.F. and submit recommendations based upon such study."[3] The Hero Board researched numerous subjects, including organization of artillery units and staffs, types of ordnance, motor transport, communications, aerial observation, flash ranging, sound ranging, liaison, ammunition supply, maintenance, and training. The Board gathered its data by visiting veteran units and by soliciting opinions from experienced artillery commanders and other artillery

officers. Many of the Board's recommendations found their way into artillery doctrine for the next war.

The Westervelt Board, named for its senior member, Brigadier General William I. Westervelt, was perhaps the best known and most influential of the three post war boards. Its mission was more circumspect: "...to make a study of the armament, calibers, and types of materiel, kinds and proportion of ammunition, and methods of transport of the artillery to be assigned to a Field Army."[4] The Board's recommendations on artillery weapons match very closely with the materiel actually fielded during World War II. The Army eventually developed and employed seven of the eight weapons recommended by the Board. In World War I, the U.S. Army had relied almost exclusively on French materiel. In World War II, thanks largely to the work of the Westervelt Board, modern artillery pieces were available in substantial quantities before U.S. troops entered combat.[5]

The third board, also chaired by Brigadier General Westervelt, was largely ignored by the Army. This was the Trench Artillery Board, designed to do for trench mortars what the Westervelt Board had done for cannons. The Board recommended the adoption of light and medium mortars, of 160mm and 240mm caliber respectively, to supplement cannon artillery firepower in the field army. The Board also recommended creation of an independent trench artillery branch, and establishment of a trench artillery training center.[6] In the general rush to pare down the Army, however, the War Department did nothing to implement the Board's

recommendations. No existing branch was willing to accept still deeper personnel and budget cuts to provide money and manpower for an entirely new branch. As a result, large caliber mortars disappeared from the U.S. Army's inventory.

All three of the boards recognized the tremendous potential of motor transport for field artillery, and all recommended shifting from animal to motor transport. Both the Hero and Westervelt Boards recommended full motorization of medium and heavy artillery, although they stopped short of completely eliminating horse-drawn transport for light artillery. Their reservations were based solely on the inadequacy of the vehicles then available, however, and not on any desire to keep horses:

> If, after thorough experiment, a satisfactory means of traction for 75mm materiel can be found, the entire divisional regiments should be motorized. The difficulties of animal drawn artillery as developed in France are admitted by everyone. Poor type of animals, lack of replacements, lack of forage, and above all, lack of care and understanding for their horses on the part of the personnel, all combined to render the service precarious under the best conditions encountered. The last named obstacle, that is, officers and men totally inexperienced in the care of animals, will be met with whenever the American Army is expanded. In considerations of road space, forage supply for animals, serviceability under field conditions, the advantages are all in favor of the tractor...
>
> The consensus of opinion is that every piece of artillery that can be successfully adapted to motor traction should be motorized.[7]

In addition to motor transport, the Westervelt Board recommended further development of self-propelled artillery. During the war, the French achieved modest success with light guns and howitzers mounted directly on tractors. Although these weapons

were quite slow and heavy, the Board recognized the great potential of this form of artillery, which only had to park to go into action.[8] In spite of the Board's endorsement, budget constraints and lack of enthusiasm from artillery officers would prevent large-scale production of self-propelled artillery until 1942.

The Army's senior artilleryman pushed hard for expanded motorization. In 1921, Major General Snow ordered the experimental motorization of four regiments of light artillery.[9] He was forced to abandon the experiment just two years later, however, for lack of funds.[10] The artillery continued small scale experimentation with truck and tractor transport throughout the interwar period, and would eventually motorize most of its weapons.

But the peacetime Army was unwilling to completely abandon horse-drawn transport. Under peacetime conditions, horse transport was about as effective as motorized transport, and offered some unique advantages. Horses were not subject to mechanical breakdown; soldiers could obtain forage more cheaply and easily than gasoline and repair parts; and the regular army had plenty of soldiers familiar with the care and handling of horses. The great advantage of indefatigability enjoyed by motor transport over horse transport was less apparent under the less arduous conditions of peacetime training. Artillerymen continued to debate the relative merits of horse and motor well into the 1930's. As late as 1938, almost half of the regular army's artillery was still horse-drawn.[11] The 1940 edition of Field Manual 6-20 still talked about limbers, caissons, veterinary aid stations, and other matters

peculiar to horse-drawn artillery. Not until 1941, and the rapid expansion of the Army, did the truth of the Hero Board's report become apparent once again.

Just as trucks and tractors promised the artillery greater mobility, advances in radio technology promised to solve the nettling problem of communications and fire coordination in offensive combat. Artillerymen recognized the tremendous benefit radio communications would confer on artillery operations, and anxiously awaited new advances in radio technology. The following enthusiastic endorsement of radio's potential came from a 1921 issue of the Field Artillery Journal:

> Although these developments in radio will render it of enormous value to the Army as a whole, it is believed that it will be of especial and utmost importance to the the Field Artillery in particular--especially to Divisional Artillery. It is believed that the greatest problem of Divisional Artillery will be solved by the aid of Radio; i.e. the accompanying of the infantry with fire.[12]

With radio, ground observers could adjust barrages to the infantry's pace, and call for additional fires on pockets of resistance unaffected by planned fires. Aerial observers could abandon their clumsy radiotelegraph transmitters and enjoy two-way voice communications with supporting batteries, greatly speeding and simplifying aerial observation and adjustment of fire. In mobile situations, radio would eliminate the need to install wire communications, allowing artillery units to go into action almost immediately.[13]

As with motor transport, Major General Snow struggled mightily to get modern radio sets for the artillery. In 1920, he initiated a joint venture with the Signal Corps to produce a two-way radiotelephone for aerial observers.[14] The artillery continued to acquire improved radio sets throughout the interwar period, right up to the very eve of combat deployment. Not until 1942 did artillery units receive the frequency modulated (FM) radio sets that they would use with such success in World War II.[15]

In addition to technological advantages, the artillery of World War II would also enjoy a great advantage over its World War I forebears in the quality and uniformity of its training. During World War I, the Army built its artillery branch almost from scratch. American artillery units relied to a large extent on foreign expertise for their training. The foreigners, in turn, were teaching a doctrine for indirect fire support that they themselves had largely improvised in battle. As a result, U.S. units learned a wide variety of tactics and procedures.[16] Shortly after the war, Major General Snow appointed a drill regulations board to publish a common set of training regulations for field artillery units. This board produced Training Regulation 430-85, the Army's first comprehensive doctrinal manual for field artillery, in 1922.[17]

Publishing this document was certainly an important step in the growth of artillery doctrine. Equally important was the establishment of an institution to teach the doctrine. The U.S. Army's Field Artillery School at Fort Sill, Oklahoma, established

in 1911, had not been around long enough to have an appreciable impact on the Army prior to World War I. During the war, it became a major field artillery training center, and by October, 1917, was turning out trained artillery brigades for service in France[18] Had the war continued, the Army would have acquired wholly American-trained artillery units. The School gained valuable experience in mobilizing and training units, and achieved permanent status after the war. By 1940, nearly all of the Army's artillery officers, including National Guardsmen and Reservists, received their formal training at Fort Sill. This standardized training would be of great importance to the artillery of World War II, and would allow it to maintain its flexibility in spite of the increased tempo of combat.[19]

Contrary to its experience in World War I, the American Army emphasized mobile warfare in the interwar period. While most officers recognized the importance of position warfare, they tended to view it as an aberration, which may or may not be repeated in future conflicts. The Artillery School demonstrated its interest in mobile warfare by its revisions to unit organizations, and by its development of improved fire direction techniques.

During World War I, surveyors belonged to the Engineers, and meteorological sections to the A.E.F. Headquarters.[20] Given the static nature of operations, artillery units had little difficulty obtaining the necessary survey and meteorological support. In a fast-moving environment, however, these assets would have to be immediately available to be of any use. By 1937, artillery units

had organic survey and meteorological assets.[21] To improve the speed of artillery fire direction, the Artillery School introduced two major innovations: simplified observation/conduct of fire procedures, and the battalion fire direction center (FDC).

In World War I, battery commanders were generally responsible for the conduct of fire (computing the data necessary to aim artillery pieces at indirect fire targets). In theory, the battery commander occupied a command observation post, where he could observe targets through an elaborate periscope device known as the battery commander's (B.C.) scope. Using his B.C. scope and a firing table, the battery commander computed the appropriate data to aim his guns at the selected target. But because of the many variables affecting the artillery round's trajectory, it was normally necessary to 'adjust' rounds onto the target. The battery commander ordered a single gun to fire using the initial data he computed, and then observed the fall of shot. He then corrected the firing data as necessary to place the fall of shot on target. By applying this correction to data for subsequent targets in the vicinity, the battery commander could normally engage them effectively without adjustment. This system was generally adequate in static situations, but had two chief drawbacks. First, the commander could adjust only his own battery; there was no simple way for him to bring additional fires to bear on the target, or to observe for other batteries. Second, the battery commander had to observe the target.

If the battery commander could not observe the target, he followed a different procedure. He received the target location, normally in terms of map coordinates, and then performed a slow and complex set of calculations. These calculations corrected for the effects of weather, non-standard ammunition characteristics, and non-standard muzzle velocities, on the trajectory, and allowed for reasonably effective fire on the target without adjustment. This system was adequate, so long as no one was in a hurry to engage the target.[22]

Given the static nature of warfare on the Western Front, this system of fire direction worked well enough. The great bulk of artillery fires were planned in advance. Higher headquarters developed detailed target lists, and sent them to the batteries in time for them to compute accurate firing data beforehand. But this system was intolerably slow at engaging unanticipated targets. The complexity of computation procedures and the extreme difficulty of maintaining communications with advancing infantry made for huge lag times, as described by members of the post-war Infantry School staff:

> Any intervention of direct-support artillery, which has not been foreseen and prepared for, usually requires much time. And once infantry has asked for the fire, it must wait until it materializes, or run the risk of being fired on by its own artillery...
>
> Infantry requests for fire might include a statement limiting the duration of the request. If at the end of a request for fire made, say, at 9:00 a.m., the message added "Request good until 10:00 a.m.," that would mean that the artillery would not comply with the request at all if it had not been able to do so by 10:00 a.m. Then at 10:00 a.m. the infantry would be free to go ahead, if the situation had

changed, without being exposed to the fire of its artillery, or it could make a new request.[23]

Fire direction this slow was clearly inadequate for mobile warfare. In a fast moving situation, nearly all of the targets would be unanticipated, and would not remain stationary. Battery commanders often would not be in a position to observe when targets appeared. Massed fires would be needed to effectively engage many of the targets. And the supported infantry or cavalry could certainly not afford to wait an hour or more for fires to materialize. Without rapid communications and rapid fire direction, artillery was effectively out of the battle.

Radio provided the rapid communications. The sets available grew steadily more portable and reliable. Now observers could move about without reels of wire, and could communicate with several different stations. The battalion fire direction center provided more rapid and efficient fire direction. The FDC plotted all battery locations on an 'observed fire chart', and 'registered' (adjusted) the batteries onto a single target, recording the changes in firing data necessary to correct their fires. The FDC could now rapidly compute accurate firing data for any of the batteries. Anyone with a radio could call the FDC and report a target location. The FDC, in turn, converted the location into firing data for a selected battery. If the FDC considered the target important enough, it could readily compute data for all batteries and mass the battalion's fires on the target.
To enable any observer to adjust fire for any unit, the

Artillery School adapted aerial observer procedures for use by ground observers. The observer no longer computed firing data, but simply sensed the fall of shot relative to the target location. The FDC plotted these sensings on the observed fire chart, and converted them into corrected firing data for the batteries.[24] To further speed the computation of firing data, the Artillery School introduced the graphical firing table (GFT) in late 1940. Prior to the GFT, FDC personnel had to extract data from a firing table, and make several arithmatic calculations for each correction. The GFT was essentially a slide rule, from which a soldier could simply read the answer, greatly speeding computation time.[25]

With the introduction of these new fire direction techniques, the artillery made what can fairly be described as a quantum leap forward in its ability to participate in mobile warfare. Yet all of these improvements were built on World War I experience. The Artillery School did not invent new procedures for ground observers, but simply adapted procedures developed in World War I for aerial observation and correction of fire to ground observation. Likewise, the observed fire chart was not really a new idea, but simply an improvement on older ideas. The GFT was merely the latest in a steady stream of mechanical computation devices that began in World War I with the artillery ruler.[26] The battalion FDC developed logically from the artillery's desire to improve response time and maintain centralized control in mobile combat.

The key to all of these developments was the technological development of radio. Radio communications made it possible for artillery to engage targets of opportunity. Without the instantaneous communications provided by radio, improved fire direction would have been meaningless.

ARTILLERY DOCTRINE ON THE EVE OF WORLD WAR II

What exactly was U.S. artillery doctrine prior to World War II? The War Department document for field artillery doctrine was Field Manual 6-20. The Army published FM 6-20 in June of 1940, and issued a short revision (change 1) in January, 1941. This manual discussed artillery unit operations at all echelons, from battery to field army, although it emphasized brigade and lower level operations. The publication date for this revision to the manual makes a convenient point to stop and examine field artillery doctrine before World War II.

I. ORGANIZATION

At first glance, artillery organization appears to have changed significantly from World War I. The Army's adoption of the triangular division structure caused a corresponding change in the divisional artillery brigade. The division went from two medium and four light artillery battalions to one medium and three light battalions. The square division artillery was organized into regiments of two battalions each. In the triangular division, the regimental headquarters disappeared completely.

Although artillery organization changed somewhat, the basic infantry-artillery relationship and level of support remained the same. Just as in the square division, each infantry regiment had one direct support light artillery battalion.[27] The medium artillery battalion provided general support to the entire division. The ratio of medium artillery battalions to infantry regiments fell somewhat with the triangular division (1:3 vs 1:2). But with the division deployed in standard fashion, with two regiments in line and one in reserve, the ratio of medium artillery to infantry was arguably the same as in the square division. The organization of the battalions themselves was also very similar; each still consisted of three batteries of four guns each.

Corps and army artillery organization, as in World War I, was extremely flexible. FM 6-20 prescribed no fixed organization for corps or army artillery. Rather, artillery units were attached to a field army according to its tactical needs. Commanders organized the artillery for combat much as they had in World War I. The army attached artillery units to its corps, retaining some special-purpose units under its direct control. The corps, in turn, attached artillery units to its divisions according to their relative needs, retaining some artillery under its direct control.[28] To ease span of control problems, corps and army commanders still organized their artillery into groupings, or groupments, as in World War I.[29]

II. LIAISON

After World War I, the artillery clearly understood the critical importance of liaison with supported infantry. Infantry-artillery liaison, and later, armor-artillery liaison remained a major concern throughout the interwar period. During World War I, liaison parties were strictly ad hoc affairs, without prescribed organization or equipment. In 1936, the Field Artillery School published a recommended table of organization for liaison sections which included nine personnel, a radio, two field telephones, and two vehicles.[30]

The liaison officer's duties, as defined by FM 6-20, were virtually identical to those of his World War I counterpart:

> ...the liaison officer acts as artillery adviser to the supported unit commander, keeps him informed of the possibilities of artillery support, and communicates to the artillery commander the desires of the supported troops for artillery fire. In addition, the liaison officer keeps the artillery commander advised at all times of the location of the elements of the supported troops and of the enemy situation, assists in observation, and when necessary in the adjustment of fire.[31]

The direct support artillery battalion provided all front line infantry battalions with liaison sections.[32] The manual also spelled out procedures for liaison between artillery units. A medium artillery battalion attached to a division, for example, did not establish liaison with the supported infantry, but sent a liaison party to the infantry's direct support artillery battalion.[33]

III. TARGET ACQUISITION

Ground and aerial observers remained the artillery's primary means of target acquisition. But advances in radio technology made both types of observers far more effective. With regard to aerial observers, the artillery managed to implement one of its longstanding desires. During World War I, aerial observers were simply detailed from observation squadrons to work with artillery units. The aviators generally had no knowledge of artillery adjustment, and had little chance to gain proficiency, because observations duties were constantly rotated among pilots. To alleviate the problem, the Hero Board strongly recommended making aerial observers part of the artillery.[34] In early 1942, the Artillery School began its first experimental course for aerial observers.[35] The course proved to be a great success. Air observation sections soon became organic to all field artillery units, and performed invaluable service during World War II.[36]

The artillery realized another Hero Board recommendation with the creation of field artillery observation battalions and batteries.[37] These units were the descendants of the World War I Artillery Information Service, established to manage the sound and flash ranging sections formerly controlled by the corps A.I.S. Sound and flash ranging procedures had changed very little since 1918, but the sections now had improved equipment, and were much more mobile and self sufficient. The observation battalion was

completely motorized, and had organic survey, maintenance, and administrative support.[38]

IV. MISSIONS

Artillery missions described in FM 6-20 were essentially unchanged from the missions of 1918. Direct support fire was delivered in support of front line forces; counterbattery fire attacked the enemy's artillery; interdiction fire denied access to selected areas and routes; harassing fire was still designed to annoy the enemy.[39] Division of duties among the artillery echelons also remained unchanged. The division light artillery performed the direct fire mission, while the corps conducted counterfire. The army artillery attacked special hard to kill targets, counterbattery targets, and distant targets. The manual continued to emphasize flexibility, and allowed for substantial overlap in the missions assigned to the various echelons.[40]

FM 6-20 did raise some new issues, however. It contained a brief discussion of artillery in the anti-tank role. The authors of the manual did not display great enthusiasm for this mission, but they did at least provide some general guidance for using light artillery to counter enemy tanks.[41]

FM 6-20 further developed the standard tactical mission concept. The manual listed and defined two of the standard tactical missions: direct support and general support. It also mentioned, without precisely defining, the reinforcing and general support-reinforcing missions. The introduction of these terms was

a significant refinement of U.S. artillery doctrine. These terms did not change the way artillery units did business; they continued to perform the same tasks as before. But the use of common terms, with commonly understood definitions, gave commanders a more precise and efficient way of describing an artillery unit's responsibilities.[42]

V. COMMAND AND CONTROL

As discussed in chapter two, artillery command and control in World War I was based on highly centralized control, detailed planning, and a dual (infantry-artillery) chain of command. These remained the primary features of artillery command and control in 1941. The authors of FM 6-20 clearly favored centralized control and thorough planning, but recognized that the tactical situation might not always permit them.[43] They also described the infantry-artillery chain of command at some length:

> The force commander through his artillery officer makes detailed plans for the use of the artillery held under his direct control; in addition, he makes general plans for the coordinated employment of all artillery with the force. In subordinate echelons the same methods are applied. Artillery battalion commanders of direct-support battalions perfect the details of support in conference with the supported infantry commanders.[44]

VI. FIRE DIRECTION

All of the terms associated with World War I fire direction were still found in the 1940 edition of FM 6-20. Destruction and neutralization fire, preparation, counterpreparation,

concentration, and barrage (box, standing, and normal), all had the same meanings they did in 1918. The manual placed overwhelming emphasis on prearranged fires, devoting less than a page to targets of opportunity.[45] Although the artillery had vastly improved its ability to engage unanticipated targets, the authors of FM 6-20 clearly expected the majority of fires to be planned in advance of an operation, as in 1918.

VII. CONCLUSIONS

In most respects, artillery doctrine as described by FM 6-20 in 1941 was very much what it had been in 1918. Radio communications and motorization had slightly altered artillery tactics and techniques, but they had virtually no impact on the broad outlines of doctrine. In the next chapter, we will examine how this doctrine, developed under position warfare conditions, served the Army on the mechanized battlefields of World War II.

CHAPTER THREE ENDNOTES

[1]William J. Snow, Report of the Chief of Field Artillery to the Secretary of War, 1919 (Washington: Goverment Printing Office, 1919) 7.

[2]William J. Snow, Report of the Chief of Field Artillery to the Secretary of War, 1920 (Washington: Government Printing Office, 1920) 30.

[3]War Department, "Report of the Hero Board," (9 December, 1919, CARL No. AD A161 150) 1.

[4]War Department, "Report of the Westervelt Board," (23 May, 1919, CARL No. AD 951 841) 1.

[5]Constance M. Green, Harry C. Thomson, Peter C. Roots, The Ordnance Department: Planning Munitions for War, (The U.S Army in World War II: The Technical Services) (Washington: Office of the Chief of Military History, 1955) 325-326.

[6]War Department, "Report of the Trench Artillery Board," (22 March, 1919, CARL No. AD 951 851-2) 9,12-13.

[7]"Hero Board," 14-15.

[8]"Westervelt Board," 51-52.

[9]Snow, Report to the Secretary of War 1920, 25.

[10]John W. Weeks, Report of the Secretary of War to the President, 1922 (Washington: Government Printing Office, 1922) 302.

[11]Green, Munitions for War, 203.

[12]D. M. Beere, "Lessons of the War as Affecting American Artillery, Particularly Divisional Artillery," Field Artillery Journal 11 (September-October, 1921) 443.

[13]Ibid., 444-445.

[14]Snow, Report to the Secretary of War 1920, 25.

[15]George R. Thompson, Dixie R. Harris, Pauline M. Oakes, Dulaney Terrett, The Signal Corps: The Test, December 1941 to July 1943, (U.S. Army in World War II: The Technical Services) (Washington: Office of the Chief of Military History, 1957) 72-73.

[16]Weeks, Report to the President 1922, 302.

[17]Ibid., 303.

[18]William J. Snow, Signposts of Experience (Washington: U.S. Field Artillery Association, 1941) 102-103.

[19]Gregory V. Morton, "Field Artillery Support for III Corps Attack, 18-26 December 1944," (Fort Leavenworth: U.S. Army Command and General Staff College (MMAS Thesis), 1987) 72-74, 86.

[20]War Department, The Artillery Information Service (Washington: Office of the Adjutant General, September 1918) 17.

[21]War Department, Digest of Field Artillery Developments (Fort Sill: Field Artillery School Printing Plant, 1937) 15-21.

[22]Russell G. Carter, The 101st Field Artillery (Cambridge: Riverside Press, 1940) 55-61.

[23]C. T. Lanham and Edwin F. Harding, Infantry in Battle (Richmond: Garret & Massie, 1939) 23.

[24]War Department, Digest of Field Artillery Developments (Fort Sill: Field Artillery School Printing Plant, 1935) 2-9.

[25]Riley Sunderland, History of the Field Artillery School, Volume I, 1911-1942 (Fort Sill: Field Artillery School Printing Plant, 1953) 211.

[26]War Department, Notes on Construction and Use of an Artillery Ruler (Washington: Office of the Adjutant General, February 1918) 5-14.

[27]War Department, Field Manual 6-20: Field Artillery Tactics and Technique (Washington: War Department, 1940) 71 (cited hereafter as FM 6-20 (1940)).

[28]Ibid., 72.

[29]Ibid,, 78-79.

[30]War Department, Digest of Field Artillery Developments (Fort Sill: Field Artillery School Printing Plant, 1936) 32.

[31]FM 6-20 (1940), 96.

[32]Ibid., 113.

[33]Ibid., 114.

[34]"Hero Board," 15.

[35]Sunderland, Artillery School, 235.

[36]War Department, "Study #62: Gunnery (Report of the General Board, U.S. Forces, European Theater)," (4 February, 1947, CARL No. R-12885.62) 30.

[37]"Hero Board," 16.

[38]War Department, Field Manual 6-120: The Field Artillery Observation Battalion (Washington: War Department, 1939) 3.

[39]FM 6-20 (1940), 105-107.

[40]Ibid., 108, 112, 118-119.

[41]Ibid., 73.

[42]Ibid., 71.

[43]Ibid., 119.

[44]Ibid.

[45]Ibid., 102.

CHAPTER 4: WORLD WAR II

The differences between ground combat in World War I and World War II for the U.S. Army appeared immense. In 1917 and 1918, all of the Army's combat experience came from fighting a single enemy in a single theater of operations. During World War II, the Army fought in many different lands and climates, against two very different armies. The mobility of armies and tempo of combat operations increased tremendously. While elaborate trenches, barbed wire, and costly attacks characterized combat on the Western Front during World War I, World War II saw the return of mobile warfare and rapid, decisive offensives.

Given this new style of warfare, it seems reasonable to expect considerable doctrinal change between the two world wars; yet artillery doctrine remained surprisingly consistent. The war produced numerous refinements to artillery doctrine, tactics and techniques. But on the whole, artillery doctrine remained remarkably constant between wars. As discussed in the previous chapter, pre-World War II doctrine was based almost exclusively on World War I experience, with some improvements made to take advantage of superior transport and communications technology. This doctrine would serve the Army well throughout World War II, with little modification.

The Army's first engagements in North Africa in 1942-1943 largely confirmed the effectiveness of prewar artillery doctrine. At Kasserine Pass, in its first major battle with the Germans, the

American Army ignored its published artillery doctrine and suffered a humiliating defeat. During subsequent engagements, the Americans employed their artillery 'by the book' and generally achieved victory. To be sure, failure to properly employ artillery was not the only reason for American defeat at Kasserine. But improvements in artillery performance later in the battle would prove decisive in halting the German attack, and would contribute immeasureably to the success of subsequent American offensives.

At Kasserine Pass on 18 February, 1943, II Corps infantry and armor units were task-organized without regard for regimental or divisional structure, which resulted in much confusion. This confusion applied equally to the artillery organization for combat. Because the divisions and regiments were broken up, artillery commanders broke up the supporting artillery as well, placing battalions in direct support of these task forces, or simply attaching artillery directly to the task forces. In either case, the division artillery and other higher artillery headquarters could not effectively control subordinate battalions, or mass artillery fires.[1] The artillery violated one of its most cherished principles: centralized control.

Placing artillery under the direct control of infantry and armor commanders led to further problems. Armor officers in particular appeared to discount the importance of artillery fire support. Many of them felt that their tank forces could rely on organic weapons and tactical air power to provide all of their fire support needs. They seemed to regard their artillery as an

inferior form of tank, and employed it as such. As a result, armor officers often placed their artillery in exposed positions, on or near the front lines. Here, artillery could employ direct fire and assist in anti-tank defense, but could not provide effective fire support.[2] The Afrika Korps quickly disabused the II Corps of these notions. The German attack of 20 February on Kasserine Pass penetrated and defeated the poorly organized American defenses. Maldeployed artillery units came under attack and were forced to retreat or defend themselves with direct fire, leaving the infantry and armor without effective fire support.

After the fall of Kasserine Pass, II Corps units established new defensive positions east of Tebessa, and on 21 and 22 February successfully withstood subsequent German attacks. Here the American artillery performed better. Rommel himself described the U.S. artillery as devastating. But still the Americans failed to establish centralized control. Although generally effective, the artillery never managed to mass the fires of more than one battalion at a time, and thus fell well short of its potential impact.[3]

During the action at Thala, on 22 and 23 February, 1943, the American artillery finally fought 'by the book.' Here, three battalions of the 9th Division Artillery, with some attached U.S. and British batteries, helped a small British force defeat the veteran 10th Panzer Division. All of the artillery fought under a single artillery headquarters. The artillery commander made personal contact with the British force commander and integrated

his scheme of fire support with the defensive plan. By the morning of the 22d, all batteries were ready to mass their fires on the Germans. The initial German attacks drew devastating concentrations of artillery fire. The great volume and intensity of the Allied fire surprised the Germans, and led them to believe that the Allies were about to launch a counterattack. The Allies responded to all subsequent German attacks with the same heavy fires, finally causing the Germans to abandon the offensive and withdraw.[4]

The Thala battle and subsequent actions quickly reaffirmed the value of artillery firepower and the soundness of prewar artillery doctrine. As the American forces gained experience, they made much greater use of their potent artillery arm, and scrupulously observed the principles of centralized control and mass. In late March, at El Guettar, massed corps and division artillery fires defeated yet another attack by the 10th Panzer Division. At Mateur, on 23 April, the II Corps massed eleven artillery battalions under one artillery headquarters, all in support of the corps main effort.[5]

While experience in North Africa generally confirmed prewar artillery doctrine, it also led to one of the war's chief new doctrinal developments: the corps fire direction center. During the El Guettar battle, the II Corps Artillery discovered a new application for an existing command and control structure. In preparing to defend El Guettar, the corps artillery headquarters established a counterbattery net which linked the sound and flash

ranging sections, division artillery headquarters, and designated corps artillery battalions, to the counterbattery officer at the corps artillery command post. The counterbattery officer was to receive target intelligence from the sound and flash sections over the net, along with requests for counterbattery fire from the divisions. He would then assign these as fire missions to the designated corps artillery battalions. This command and control arrangement was taken directly from FM 6-20, and closely resembled standard counterbattery procedures from World War I.[6] This system worked well for its intended purpose of rapidly engaging enemy artillery, but as the battle progressed, the counterbattery officer received not only requests for counterbattery fire, but also requests for fire against armor concentrations. Although a departure from standard procedure, the counterbattery officer soon found himself ordering fires against German tanks with considerable success. In one instance, the corps artillery massed four battalions against a group of 32 German tanks, destroying or disabling 16 of them.[7]

For the action at Mateur, the II Corps redesignated its counterbattery net as the corps fire direction net. The counterbattery officer was replaced by a fire direction officer, who, with the help of the corps fire direction center (FDC), decided how to engage targets of all categories.[8] The corps FDC gave the corps artillery great flexibility. The commander now had a means of achieving centralized control and massing fires in fluid situations, without extensive fire planning. During World War I,

commanders had relied almost exclusively on prearranged fires, because of the near impossibility of massing fires on unanticipated targets. Now advances in communications technology and fire direction techniques had made the impossible commonplace. Corps fire direction centers became a standard component of the corps artillery headquarters.[9]

The World War I antecedants of field artillery doctrine remained clearly visible in the doctrine of World War II. The basic organization, missions, command and control principles, and methods of fire direction clearly had their origins in World War I. Subsequent actions in World War II did, however, introduce a number of additional doctrinal refinements, which are discussed in detail below.

I. ORGANIZATION

Artillery organization changed somewhat during the course of World War II, but the changes were generally consistent with trends apparent since World War I. The artillery battalion became fully motorized, and acquired a service battery to maintain its vehicles. The desire for full motorization had been clearly articulated by the Hero Board back in 1918, based on World War I experience.[10] Some units employed six gun batteries, particularly in the armored division artilleries, but the majority of artillery battalions retained the four-gun-battery structure of World War I.[11] The 105mm howitzer replaced the 75mm gun as the standard light artillery piece. The Westervelt Board had correctly identified all

other artillery weapons employed by the U.S. Army during World War II (see Chapter 3). In addition, the Westervelt Board had recommended the further development of self-propelled artillery, which became standard equipment for the armored divisions in 1942.[12] Field artillery battalions of all types retained the standard three-firing-battery structure. And the standard ratio of one light artillery battalion per regiment of infantry (or combat command in the armored divisions) remained the same.

As in World War I, the structure of corps and army artillery remained highly flexible. Early in the war, the War Department developed a standard field artillery brigade structure to support the 'type' corps. But this organization was introduced primarily for logistical planning purposes, and was not intended as a prescribed organization for combat.[13] In the field, commanders continued to organize artillery for combat based on tactical need. Non-divisional artillery units were freely moved between corps, attached to divisions, then detached and moved to other corps, as dictated by the tactical situation. The II Corps Artillery's organization for combat at El Guettar provides an early example of this flexibility. The corps artillery commander formed a two-battalion 'groupment' to support the 34th Division, which was widely separted from the rest of II Corp. He attached one light battalion to the 1st Infantry Division, placed a medium artillery battalion in general support of 1st Armored Division, and kept his remaining three battalions in general support of the corps.[14] Even division artilleries were detached and used elsewhere if the

situation demanded it, as was the case with the 9th Division Artillery at Thala.

The War Department further enhanced flexibility in mid-1943 when it made its most significant wartime revision to artillery organization. The Army Ground Forces Reorganization of August, 1943 did away with the fixed, World War I-style field artillery regiments and brigades, and replaced them with the flexible field artillery group and brigade headquarters.[15] The field artillery group was a purely tactical headquarters, designed to control a variable number of artillery battalions. The group was designed for maximum flexibility; it had no organic elements other than the command and signal troops necessary to run the headquarters itself. Battalions could be freely attached to and detached from groups as dictated by the tactical situation. In like manner, the field artillery brigade headquarters controlled a variable number of groups and separate battalions.[16]

Although the constant shifting of battalions among groups made for somewhat chaotic administration, the group concept proved to be very successful. Artillery officers of the 3rd and 7th U.S. Armies at a postwar artillery conference praised the group organization:

> Combat experience has shown that the flexibility provided by the present organization of non-divisional artillery was highly successful and should be retained. Flexibility should be the criterion throughout the entire structure of the artillery with an army--not only flexibility of fires, but flexibility of organization for combat. The ability to shift the weight of artillery from one corps to another in the army and from one part of the a

> corps zone to another as the situation and organization of the corps changed, had proven not only successful, but conservative in the amount of artillery required.[17]

While the field artillery group was a new organization, it had its roots in an old organizational concept. The group and flexible artillery brigade were merely refinements of the World War I artillery 'groupment.' Like the group, the groupment had been a collection of artillery units under one headquarters designated to perform a specific mission (see Chapter 2). Once the tactical need for a groupment disappeared, it had been dissolved and its components sent elsewhere to perform new missions. The groupment had been built around an existing artillery headquarters, usually a regiment or brigade. The only real differences between group and groupment were that the groupment headquarters had retained organic artillery units and performed administrative functions. The group typically controlled three or four artillery battalions, providing greater efficiency than the old two-battalion artillery regiment, and greater flexibility.[18]

The flexibility of the group organization had fortunate consequences not only in battle, but also in overseas and intertheater deployment. Because of the constant shortage of Allied shipping, commanders had to take advantage of all available cargo space, even if that meant breaking up larger units and shipping them in pieces. This is precisely the fate suffered by many artillery groups. While the War Department intended for group headquarters to deploy with the same battalions they trained with in the U.S., shipping schedules frequently separated units. Upon

arrival in theater, the battalions were attached to new group headquarters. [19]

This constant shuffling of battalions among groups and division artilleries led to many administrative problems, but caused surprisingly few tactical and technical ones.[20] The standardized training program developed and administered by the Army Ground Forces proved extremely valuable in this regard. Group headquarters and newly attached battalions could function effectively together on short notice because they had a common base of experience. The odyssey of a non-divisional artillery battalion during the Battle of the Bulge provides a typical example of the flexibility made possible by uniform training. On 19 December, 1944, the 179th Field Artillery Battalion was part of the 177th Field Artillery Group. The 177th Group was engaged near Saabruecken, Germany, in general support of XII Corps. That same day, the 179th was attached to III Corps and ordered north. The battalion executed a 150 mile winter road march to join its new parent corps, and was then further attached to the 193d Field Artillery Group. Its new mission was general support to the 26th Infantry Division. By 22 December, although it had had no previous experience with III Corps or the 26th Infantry Division, the 179th was in position, supporting the corps attack.[21]

II. LIAISON

The role of the artillery liaison officer in World War II remained essentially unchanged from his role in World War I. The

division artilleries still allocated one liaison officer and party to every infantry battalion. Liaison parties became larger and better equipped, however, as recommended by the Hero Board in 1918,[22] and by the Field Artillery School in 1936.[23] Liaison officers continued to assist infantry (and armor) commanders in employing their supporting artillery; the main difference between wars was the speed with which liaison officers could coordinate fires. With the miracle of radio, liaison officers could make artillery support much more timely and effective.

This difference is readily apparent in the relief of Bastogne in December, 1944. LTC Creighton Abrams, commanding the 37th Armored Battalion of Combat Command R, 4th Armored Division, organized an assault on the town of Assenois, Belgium; the last enemy position between III Corps and the garrison of Bastogne. Through his artillery liaison officer, Abrams concentrated three battalions of light and a battery of medium artillery on the enemy position. The intense artillery fire effectively suppressed the defenders, and allowed Abrams' forces to break through and establish contact with elements of the 101st Airborne Division. Total planning time for this attack, from warning order to execution, was 30 to 45 minutes; a far cry from the Western Front during World War I, where attacks with full artillery support could take days or even weeks to organize.[24]

Procedures for liaison among artillery units remained as prescribed by prewar doctrine,[25] and as practiced by most artillery commands during World War I.[26] Non-divisional artillery placed in

support of a maneuver unit, be it a corps, division, or regiment, continued to establish liaison with the maneuver unit's habitually associated artillery unit, rather than direct to the maneuver headquarters.

III. TARGET ACQUISITION

As in World War I, ground and aerial observers were the artillery's most common target acquisition asset. The prewar doctrine for aerial observers, based heavily on World War I experience, proved highly successful. Prewar doctrine produced aerial observer procedures for ground observers (normally referred to as 'forward observer procedures' in World War II accounts), also based on World War I experience and also very effective. But in one respect, reliance on World War I experience played the artillery false. Prewar doctrine failed to recognize the greatly increased demand for ground observers that emerged during World War II.

Two factors created this demand for more observers. First, units required more observers to adequately cover the wider frontages they typically occupied. Second, the vastly improved communications technology and improved fire direction procedures of World War II not only made fire coordination much easier; they caused a great increase in requests for fire. During World War I, infantry requests for fire on targets of opportunity resulted in interminable delays. During World War II, these requests were typically fired in minutes. With such improved service, the

infantry's appetite for artillery fires expanded considerably. Infantry commanders down to company level wanted their own artillery observers.[27]

The division artillery was not staffed to provide forward observer parties in the required amounts. Prewar organizations did not contain any designated forward observers. Battery commanders simply detailed personnel from their units to form forward observer parties, in much the same way that liaison parties had been detailed during World War I (see Chapter 2). Although the forward observer concept had been around for many years before the war, the artillery community had not exactly embraced it wholeheartedly. Before combat experience taught them otherwise, most battery commanders expected to perform conduct of fire personally, from a command observation post near the front lines, just as in World War I. Forward observer methods were seen as a supplementary technique, to be employed in circumstances where conduct of fire by the commander was impractical. A survey given II Corps artillery units following the Sicily Campaign demonstrated that this prewar attitude still prevailed in 1943. The survey asked commanders how many fire missions had been conducted using "standard conduct of fire methods" versus "forward observer methods." The results of the survey, hovever, revealed an overwhelming preference for forward observer methods. Under combat conditions, artillerymen found that "standard conduct of fire methods" were impractical most of the time.[28]

With the need for forward observer parties clearly established, direct support artillery batteries struggled hard to form three forward observer parties per battery; enough to provide all rifle companies with their own observer.[29] Non-divisional artillery often helped by contributing forward observers. The supported infantry helped as well by observing and adjusting artillery fires on its own. A forward observer who served in the Anzio beachhead reported that infantrymen conducted half of the artillery fire missions in his sector.[30] Nevertheless, forming and maintaining so many forward observers imposed a great strain on the direct support artillery; a problem which the War Department did little to alleviate. Not until October 1944 did it authorize forward observer parties for direct support artillery. This helped some, but not much, as the War Department authorized only one party per battery.[31] In its post war report, the European Theater General Board recommended that direct support artillery batteries receive three forward observer parties.[32]

Although prewar doctrine failed to provide sufficient ground observers, it produced a superb system for aerial observers. In mid-1942, the War Department authorized an air observation section for all field artillery battalions and higher headquarters.[33] Organic artillery aerial observers, first recommended by the Hero Board back in 1918, proved to be an unqualified success. As in World War I, aerial observers, or air observation posts (air OPs) as they were generally known, were often the most valuable source

of target information available, particularly where terrain hindered ground observation.[34]

The L4 Piper Cub aircraft of the air OP sections proved extremely valuable for other purposes as well. Air OPs often provided aerial reconaissance to advancing columns, and allowed commanders and other key leaders to personally view the situation from the air.[35] Air OPs assisted with such tasks as route reconaissance, traffic control, control of tactical air strikes, aerial photo reconaissance, adjusting naval gunfire,[36] suppression of enemy air defenses,[37] evacuating casualties,[38] and even laying communications wire![39]

Wartime experience did cause one minor change to air OP employment doctrine. Rather than keep their air OP sections dispersed with the battalions, most division artilleries and field artillery groups consolidated all of their L4s at a single division or group airfield, where an artillery air officer developed a single patrol schedule to support the entire command. This arrangement eliminated much duplication of effort, and greatly simplified logistical support of the air sections, while remaining responsive to the needs of individual battalions. Commanders could still direct their organic air OPs to fly specific missions, if desired.[40]

Much like the air OP, the field artillery observation battalion's organization and doctrine did not change significantly during the war.[41] The basic function of the observation battalion, providing counterbattery target intelligence to the corps artillery

through sound and flash ranging methods, was identical to the basic function of the Corps Artillery Information Service during World War I. The utility of sound and flash ranging diminished somewhat during World War II, because operations were less static in nature. Nevertheless, sound ranging remained an important source of target intelligence, and a valuable method for adjusting friendly artillery fire, particularly during periods of limited visibility.[42] Flash ranging continued to be useful for locating certain types of weapons, particularly the German Nebelwerfer rocket launcher.[43]

The observation battalion provided other valuable services as well. Its large number of survey parties extended artillery survey control throughout the corps area of operations, providing accurate position and directional data to the artillery battalions, and greatly improving the accuracy of their fire. The meteorological (MET) section, a part of the observation battalion's headquarters battery since 1939, further improved accuracy by providing ballistic weather data.[44] As discussed in Chapter 3, the artillery of World War I had to get MET and survey support from non-artillery agencies. The observation battalion proved an efficient organization for controlling these assets for artillery use in mobile operations.

IV. MISSIONS

The basic missions of the artillery changed little between 1918 and 1945. The direct support mission remained the artillery's

preeminent concern. Counterbattery fire, interdiction fire, harrassing fire, and deep fire all had substantially the same definitions and purposes as in 1918. The division of duties among artillery echelons remained similar as well: division artillery concentrated on direct support; corps artillery performed counterbattery. Only the army artillery's role changed significantly.

As anticipated in the 1940 edition of FM 6-20, the role of the army artillery echelon diminished considerably from World War I.[45] In 1918, army commanders had kept a large amount of artillery under their direct control. During World War II, army commanders attached nearly all of their artillery to their subordinate corps; they seldom kept any under their direct control. The increased frontages occupied by World War II armies exceeded the range capabilities of even the longest range weapons, making artillery at army level impractical. The army artillery headquarters continued to play an important fire coordination role, however. During the Normandy breakout in July, 1944, First Army allocated all of its artillery to the various corps headquarters, but it directed the VIII and XIX Corps to position their artillery where it could support the VII Corps attack, and instructed all corps to assist with the VII Corps' artillery preparation.[46]

First Army's orders for the Normandy breakout also contained instructions for an entirely new artillery mission, prompted by the growth of tactical air power during World War II. To protect friendly planes flying close support missions from enemy

anti-aircraft fire, U.S. artillery began firing 'anti-flak' missions. Air OP's proved particularly useful for this work, as they were in an excellent position to spot the fire from enemy flak batteries and direct friendly artillery onto the hostile guns.[47] First Army directed all corps artilleries to maintain anti-flak patrols with L4 aircraft when friendly air bombardment was underway.[48]

The standard tactical mission concept continued to mature throughout World War II. By 1944, operation orders reflected the use of the four standard tactical missions still used by the U.S. Army today (direct support, general support, reinforcing, and general support--reinforcing).

V. COMMAND AND CONTROL

The principles of artillery command and control, first developed and tested in World War I, survived World War II remarkably intact. Centralized control, detailed planning, and dual infantry-artillery control continued to characterize artillery operations in World War II. The importance of centralized control and detailed planning decreased in highly mobile battles. But when fighting on stabilized fronts against organized defenses, detailed fire planning and centralized control remained just as important as in World War I.

The artillery support for Ninth Army's crossing of the Roer River in February, 1945 closely resembled artillery operations of 1918. For several days prior to D-Day, the XIII Corps Artillery

executed a harassing and interdiction program, designed to retard enemy defensive preparations. On D-Day, all divisional and corps artillery fired an intense preparation, expending some 60,000 rounds against selected targets. Ninth Army's subordinate corps established highly centralized control for the operation. In addition to three heavy battalions under army control, the corps artilleries kept over half of the non-divisional artillery in a general support, or general support--reinforcing role (30 of 56 available battalions).[49] The corps also made use of the division artilleries of their reserve divisions, attaching them to the assault divisions or placing them in general support. By way of contrast, the V Corps during the Meuse-Argonne Offensive of 1918 kept only a fourth of its artillery under corps control (11 of 38 battalions).[50]

First Army's use of fire support during OPERATION COBRA in July of 1944 displayed even greater centralization and detailed planning. On this occasion, heavy bombers supplemented artillery support, pulverizing a 6,000 yard-wide segment of the enemy lines. First Army Artillery issued detailed planning guidance to its subordinate corps artilleries, and gave each of them specific instructions for assisting VII Corps, the army's main attack. The corps artilleries planned counterbattery fires and 'oncall' fires to support the divisions. The division artilleries planned preparation fires in their respective zones, and requested additional fires from corps as required. Organization for combat was even more centralized than for the Roer River Operation. The

corps artilleries kept two thirds of the available artillery (33 of 51 battalions) under their control.[51]

During exploitation and pursuit, the need for centralized control and massed fires diminished. In pursuing the Wehrmacht from the Seine to the Siegfried Line, the artillery abandoned centralized control and detailed planning in favor of responsiveness. First Army left all of its heavy artillery west of the Seine, and attached the bulk of its light and medium artillery directly to the divisions. With these attachments and their organic artillery, the divisions easily overcame the weak resistance encountered.[52] This change did not represent a change in doctrine, however. The 1940 edition of FM 6-20 anticipated circumstances under which artillery command and control would best be decentralized.[53] In highly mobile situations, against a disorganized enemy defense, massed artillery fire was simply not needed.

The system of dual infantry-artillery (and armor-artillery) control remained very similar to the system used in World War I. Artillery commanders still placed the artillery command post next to the infantry command post. The artillery continued to serve both the supported infantry or armor unit and the next higher artillery headquarters. The post war edition of FM 6-20, published in May, 1948, described a dual control system very much like the dual chain of command of the 1940 edition. The 1948 edition placed greater emphasis on 'bottom-up' control, however. Because of the improved communications and target acquisition capabilities of

front line units in World War II, commanders at lower echelons acquired much greater control over fire direction and fire planning. Higher echelons generally designed the fire support scheme to suit the front line unit's needs; a 'bottom-up' system of control. During World War I, primitive communications and limited target acquisition assets had dictated that corps and army develop fire plans and control fires through rigid schedules; a 'top-down' system of control.[54]

VI. FIRE DIRECTION

The improved technical fire direction procedures developed during the interwar period fully demonstrated their value during World War II. Using these methods, the artillery was able to mass fires against targets of opportunity with great success. Early experience in North Africa taught commanders that they could mass fires at a much higher level than anticipated before the war. By mid-1944, published doctrine caught up with practice in the field, and described the role of the corps FDC.[55] During World War I, commanders had depended almost entirely on prearranged fires, because shifting fires during an engagement was nearly impossible. During World War II, commanders had the means to shift fires at will. Fires against targets of opportunity became more common than planned fires. The experience of the VIII Corps Artillery in supporting the Normandy Breakout demonstrated this great change in fire direction procedures between the wars. During the first two

days of COBRA, the VIII Corps fired 82 planned and 632 unplanned missions.[56]

Tactics for engaging and massing fires on targets of opportunity became more sophisticated as well. Third Army developed a procedure known as 'serenade' for engaging lucrative targets of opportunity.[57] If the target was moving, or immediate fires were needed, the corps FDC ordered all available artillery battalions to engage the target immediately. If the target was stationary, the corps FDC would designate a 'time on target' (TOT). All battalions opened fire on the target so that their rounds would explode in the target area at the designated TOT time. When properly executed, the simultaneously exploding rounds blanketed the target, giving enemy soldiers no chance to take cover, and maximizing casualties. XIX Corps of Ninth Army improved on this procedure while supporting Ninth Army's advance to the Roer River in November, 1944. The corps artillery synchronized the TOT time with the advance of maneuver forces, so that the corps artillery fired the TOT just minutes before attacking elements overran the target area.[58]

While procedures for engaging targets of opportunity changed immensely, fire planning procedures remained virtually the same. Units continued to develop preparations to support the attack. Preparations had the same purpose as in 1918: "to overpower the enemy artillery and establish clear superiority at the point of attack" (quote from FM 6-20, 1948).[59] For greatest effect, all available tubes participated in the preparation. During the Roer

River crossing in February, 1945, First and Ninth Army employed anti-aircraft artillery, tank destroyers, tanks, and cannon companies as well as field artillery.[60] To supplement scheduled fires, units made extensive use of 'oncall' fires. The 8th Division's fire plan for the Roer Crossing included nearly 600 'oncall' targets.[61] In the defense, units continued to plan counterpreparation--fires designed to disrupt enemy attacks before they got underway.[62] Defenders still employed the World War I 'standing barrage' to provide close-in fire support to defensive positions. The terminology changed, however, to "barrage in support of the final protective line."[63]

VII. CONCLUSION

Overall, combat experience in World War II had a limited impact on artillery doctrine. Most changes in doctrine were simply improvements on the 1918 version. The field artillery group and flexible brigade were certainly major changes to artillery organization, but they were clearly based on the old 'groupment' system. The U.S. Army improved artillery liaison in World War II by formalizing and augmenting the system that it inherited from the Allies in World War I. The primary target acquisition systems used in World War II were all present during World War I, and employed in much the same way. Improvements in forward observer, air observer, and sound and flash procedures and organization were based largely on World War I experience. Suppression of enemy air defenses joined the artillery's list of missions in 1943, but other

artillery missions were basically unchanged from those of 1918. Command and control principles remained much the same between wars.

The only major changes to artillery doctrine came in the area of fire direction. The field artillery acquired a capability to engage and direct massed fires on targets of opportunity that it simply had not possessed in 1918. But without modern radio technology, this improvement would have been impossible. Doctrine for planned fires, on the other hand, an aspect of fire direction not much affected by radio technology, remained much the same as it had been in 1918.

Combat experience in World War II largely confirmed the principles of artillery fire support established in World War I. Changes in doctrine generally resulted from improved technology rather than new ideas. The American artillery's experience in Europe from 1943 to 1945 is perhaps best summarized by Major J.B.A. Bailey in his book, Field Artillery and Firepower:

> Artillery tactics in North West Europe 1944-45 saw few innovations, rather confirmation that the principal components of fire support developed in the First World War had become orthodoxy, and that in mobile operations the gun could master the tank. The firepower generated was often less than in the First World War, but its effect was enhanced by better target acquisition, centralized command and control (sic), greater control at low level, and greater accuracy.[64]

CHAPTER FOUR ENDNOTES

[1]David W. Hazen, "Role of the Field Artillery in the Battle of Kasserine Pass," (Fort Leavenworth: U.S Army Command and General Staff College (MMAS Thesis), 1973) 152-153.

[2]Ibid., 144-145.

[3]Ibid., 153.

[4]Ibid., 132.

[5]A. J. Rance, "Corps Artillery, How It Was Employed," Field Artillery Journal 12, Volume 33 (December, 1943) 887.

[6]War Department, Field Manual 6-20: Field Artillery Tactics and Technique (Washington: War Department, 1940) 104-105.

[7]Rance, "Corps Artillery," 887.

[8]Ibid.

[9]War Department, Field Manual 6-100: Tactics and Technique of Division Artillery and Higher Echelons (Washington: War Department, 1944) 45.

[10]War Department, "Report of the Hero Board," (9 December, 1919, CARL No. AD A161 150) 14-15.

[11]War Department, "Study #59: Organization and Equipment of Field Artillery Units (Report of the General Board, U.S. Forces, European Theater)," (4 February, 1947, CARL No. R-12885.59) 12.

[12]War Department, "Report of the Westervelt Board," (5 May, 1919, CARL No. AD 951 841) 51-52.

[13]In early 1942, War Department planners used the 'type' corps and 'type' army organizations as a basis for calculating the number of non-divisional units that would be needed to support a given number of divisions. For every three divisions, the War Department planned to build a corps headquarters, and a standard allotment of combat, combat support, and combat service support units. For every three corps, planners would organize an army headquarters with additional support troops. The 'type' corps and army were scrapped in the Army Ground Forces reorganization of August, 1943, largely at the urging of General McNair, who favored 'pooling' of all non-divisional units. For a complete discussion, see Dr. Robert R. Palmer's Reorganization of Ground Troops for Combat (Army Ground Forces Study #8) (Washington: Historical Section--Army Ground Forces, 1946).

[14]Rance, "Corps Artillery," 886-887.

[15]Palmer, Reorganization of Ground Troops, 50-51.

[16]Ibid.

[17]War Department, "Study #65: The Field Artillery Group (Report of the General Board, U.S. Forces, European Theater)," (4 February, 1947, CARL No. R-12885.65) 17.

[18]Palmer, Reorganization of Ground Troops, 50-51.

[19]"Study #65," 4.

[20]Ibid., 8.

[21]Gregory V. Morton, "Field Artillery Support for III Corps Attack," (Fort Leavenworth: U.S. Army Command and General Staff College (MMAS Thesis), 1987) 24, 42-44.

[22]"Hero Board," 16.

[23]War Department, Digest of Field Artillery Developments (Fort Sill: Field Artillery School Printing Plant, 1936) 32.

[24]Morton, "III Corps Attack," 26-28.

[25]FM 6-20 (1940), 114.

[26]"Hero Board," 673.

[27]"Study #59," 4.

[28]Memorandum, Headquarters II Corps, Office of Artillery Officer, 19 August 1943, Subject: Field Artillery Report Covering Period 10 July to 17 August, 1943 (CARL Historical Documents Collection, World War II, Box No. 62, Item No. 338, Section V (MICROFILM)) 2.

[29]"Study #59," 4.

[30]Dale Van Hyning, "FO Comments from the Beachhead," Field Artillery Journal 34 (July, 1944) 403.

[31]John E. Coleman, "Trends in Field Artillery Organization and Equipment," Field Artillery Journal 34 (October, 1944) 693.

[32]"Study #59," 43.

[33]War Department, "Study #66: Organic Field Artillery Air Observation (Report of the General Board, U.S. Forces, European Theater)," (4 February, 1947, CARL No. R-12885.66) 1-2.

[34]War Department, "Study #64: Field Artillery Gunnery (Report of the General Board, U.S. Forces, European Theater)," (4 February, 1947, CARL No. R-12885.64) 4.

[35]"Study #66," 3.

[36]Ibid., 9-10.

[37]War Department, "Study #61: Field Artillery Operations (Report of the General Board, U.S. Forces, European Theater)," (4 February, 1947, CARL No. R-12885.61) 15-16.

[38]Memorandum, Headquarters II Corps, 27.

[39]Gordon J. Wolf, "Emergency Wire Laying by Liaison Airplane," Field Artillery Journal 34 (August, 1944) 566-567.

[40]"Study #66," 2-3.

[41]The opening pages of the 1939 and 1945 editions of Field Manual 6-120, which deal with organization and mission, are nearly identical.

[42]War Department, "Study #62: The Field Artillery Observation Battalion (Report of the General Board, U.S. Forces, European Theater)," (4 February, 1947, CARL No. R-12885.62) 2-3.

[43]Ibid., 8.

[44]War Department, Field Manual 6-120: The Field Artillery Observation Battalion (Washington: War Department, 1939) 2.

[45]FM 6-20 (1940), 72.

[46]"Study #61," 46.

[47]Hughes Rudd, "When I Landed the War Was Over," in A Sense of History, ed. Byron Dobell (Boston: Houghton Mifflin, 1985) 749-754.

[48]"Study #61," 15-16.

[49]Ibid., 39-42.

[50]Operations Order No. 5, V Army Corps Artillery, 29 October, 1918, reprinted in an article by W. E. Shepherd, Jr., "The

Employment of the Artillery--Fifth Army Corps Argonne--Meuse Operations," Field Artillery Journal 9 (April-June, 1919) 167.

[51]"Study #61," 16-17.

[52]Ibid., 30-34.

[53]FM 6-20 (1940), 72.

[54]War Department, Field Manual 6-20: Field Artillery Tactics and Technique (Washington: War Department, 1948) 101.

[55]FM 6-100, 45.

[56]"Study #61," 21.

[57]"Study #64," 43-44.

[58]"Study #61," 28.

[59]FM 6-20 (1948), 87-88.

[60]"Study #61," 45, 50.

[61]Ibid., 50.

[62]FM 6-20 (1948), 92.

[63]"Study #61," 67.

[64]J. B. A. Bailey, Field Artillery and Firepower (Oxford: Military Press, 1989) 206.

CHAPTER 5: CONCLUSIONS

What can we conclude about the history of artillery doctrinal development from 1917 to 1945? First, the artillery doctrine of World War II was drawn primarily from combat experience in World War I. The basic principles of organization, liaison, and command and control were scarcely altered between 1917 and 1945. Target acquisition methods employed in the two world wars remained remarkably similar. The missions performed by the artillery remained identical, excepting the addition of 'anti-flak', or 'suppression of enemy air defense' mission in World War II. Second, artillery doctrine was well developed before the outbreak of World War II. Combat experience in World War II did prompt some changes to organization, tactics, and procecures. But the basic doctrinal framework with which the artillery entered the war remained virtually unchanged.

The only substantial developments in artillery practice came in the area of fire direction. During World War II, the artillery acquired the ability to rapidly engage and mass fires on unscheduled targets; a capability it simply did not have during World War I. As discussed in Chapter 3, improvements in communications technology made this possible. In short, artillery doctrine did not change much from the previous war, and those changes that did occur resulted primarily from new technology.

What lessons, if any, can be drawn from the artillery's doctrinal development experience? The obvious lesson seems to be: do not abandon past experience lightly. Things that worked well in the past will generally provide a sound basis for building future doctrine. To be sure, doctrine developers must try to anticipate the effects of technological change, and update doctrine accordingly. They must not rigidly adhere to previous experience when faced with new conditions. But basic doctrinal principles, it appears, retain their validity for some time, even in light of great technological change.

As the Army struggles to produce artillery doctrine for the next century, it is again confronted with massive technological change. The Multiple Launch Rocket System (MLRS), for example, represents an incredible leap in capability. In addition to the great range and lethality of its munitions, the MLRS has an onboard position azimuth determining system, an automated fire direction computer, and digital burst communications. The artillery's latest self-propelled howitzer, the M109A6, has many of the same features. Both systems will soon be equipped with 'smart' munitions, capable of locating and destroying targets on their own. In addition, the Army continues to develop the Automated Field Artillery Tactical Data System (AFATDS); a multi-node automated command, control, and communications system that promises to greatly improve the responsiveness and flexibility of artillery fire support. In light of such technological advances, is field artillery doctrine due for a major overhaul?

The artillery's experience from 1917 to 1945 suggests that doctrinal change based on new technology will be modest. Certainly these new systems will produce new tactics, techniques, and procedures, but basic doctrinal principles are likely to retain their validity. The Army's 'Air-Land Battle Future,' a projection of future doctrine, envisions the artillery performing much the same role that it does today. The artillery will continue to provide fire support for maneuver forces, neutralize enemy fire support systems, provide interdiction fires, and engage deep targets. Given the constancy of its missions, the artillery's current organization, liaison, fire direction, and command and control principles will probably retain their validity.

Does this lesson of doctrinal continuity apply to other branches as well? Does the history of doctrinal development in the other combat arms reflect the same lack of change, or was the artillery's experience unique? Let us briefly examine doctrinal development in the Army's other branches during World War II.

Doctrine for tank destroyer forces changed immensely during the course of the war. Initially, doctrine called for tank destroyers to be employed in mass, in pure formations, to halt massed enemy armor. Units in the field quickly learned that tank destroyers were most effective when dispersed and integrated into combined arms teams.[1] Unlike the artillery, the tank destroyers were an entirely new branch, one that did not exist in World War I. Their doctrine, written just before U.S. entry in World War II, had never been battle-tested. It turned out to be based on a faulty

perception of enemy tactics. The massed all-tank attacks that the tank destroyers were supposed to counter never materialized, because the Germans never employed their armor in this fashion.[2]

Army Air Force doctrine for close air support also underwent significant changes during the course of the war. Like the tank destroyer, close air support was something new; the Army had no close air support doctrine to speak of before World War II.[3] If we look at close air support between 1945 and 1990, however, the continuity of doctrine is just as striking as that of the artillery between 1918 and 1945. The system of forward air controllers, air liaison officers, and air force cells in army headquarters has remained much the same since 1945. Procedures for planned and immediate air requests in the Vietnam and Persian Gulf Wars did not change substantially from procedures used during the dash across France in 1944, in spite of the tremendous technological advances since World War II.

Armor doctrine certainly changed between 1918 and 1940. Tank forces participated in World War I, but only in an infantry support role. Improvements in motor vehicle technology following World War I gave the tank greater mobility, protection, and firepower, and inspired officers to elevate armor to the status of an independent combat branch. The Army Ground Forces organized armored divisions to conduct blitzkrieg-style warfare. Infantry divisions would attack to punch a hole in the enemy lines, then the armored divisions would rush through the gap and exploit.[4]

That was the theory, anyway. In practice, the U.S. Army used its infantry and armored divisions almost interchangeably, and tank employment retained many of the features of 1918. The day-to-day mission of most U.S. Army tank battalions in Northwest Europe was not blitzkrieg, but infantry support, just as it had been in World War I. The majority of tank battalions were attached to infantry divisions, where they provided mobile firepower and protection.[5] The armored divisions made frontal assaults just like the infantry divisions, and both infantry and armored divisions were used in exploitation and pursuit. The successful armored attacks of 1944-45 were really not very different from the British tank attack at Cambrai in November, 1917. The British at Cambrai used three brigades of heavy tanks, closely supported by infantry, artillery, and aircraft to create a big hole in the German lines.[6] This same combined arms 'formula' would remain the key to tactical success in World War II.

Of all the combat arms, the infantry was perhaps the least affected by technological change between wars. Infantry doctrine also displayed the least change from World War I. Fire and maneuver remained the essence of infantry doctrine.[7] The lessons of Infantry in Battle, a collection of World War I vignettes on infantry operations compiled by the Infantry School between the world wars, remained extremely valuable and relevant for the training of infantry leaders in World War II (As of this writing, Infantry in Battle was still issued to students attending the U.S. Army Command and General Staff College). Doctrinal continuity, it

seems, was a consistent theme for all of the Army's combat elements.

What is the explanation for this continuity? How is it that doctrine developed for the positional warfare of World War I remained valid and effective for the mobile campaigns of World War II? The explanation is very simple; the American experience in the two world wars was much more similar than is generally perceived. The combat operations of 1943 to 1945 in fact bore a great resemblance to those of 1918.

By the end of World War I, both sides had developed successful offensive tactics and restored a measure of mobility to the battlefield. The U.S. Army conducted all of its large scale operations during 1918, and did not experience the truly deadlocked conditions of 1915 through 1917. Mobility never reached the levels of World War II, however, because of the much greater density of forces on the Western Front, and the primitive nature of motor transport and communications technology available during World War I. Combat operations during World War II included great bursts of mobility, but the bulk of the war was fought on relatively stable fronts. The Normandy campaign prior to the St. Lo breakout, for example, was very static in nature, characterized by limited attacks, modest advances, and heavy casualties. When the Allied pursuit ended in September, 1944, the war again assumed a very static character, and stayed that way until the next big breakthrough in the spring of 1945. The Allied success in rupturing the German front in World War II was probably due as much

to the decreased density of the German defense as to improved technology or doctrine. Had the Germans been able to make peace with the Russians, and concentrate the bulk of their forces in France, as they had done in 1918, they might have made a decisive Allied breakthrough impossible.

Conflicts between conventional armed forces since 1945 have not deviated substantially from the patterns established in World Wars I and II. Our most recent combat experience in the Persian Gulf closely resembled the great encirclement battles of 1944 and 1945, complete with long lines of prisoners streaming to the rear. Precision-guided munitions, while prompting changes in tactics and procedures, have not fundamentally altered the nature of combat operations. Doctrine writers can continue to draw on experience from the world wars, confident that these lessons will be of value in preparing for future conflicts for some time to come.

Doctrine writers must also consider human nature. Armies are notoriously reluctant to abandon tried and true ways of doing things, as illustrated by the artillery's reluctance to abandon animal transport, or to fully adopt forward observer procedures, or to push the development of self-propelled artillery. Generally, only combat experience will make an army throw out its old doctrine and adopt new ideas. In peacetime, new doctrine must be introduced gradually, and built upon the foundation of the old. A new doctrine that retains the workable features of the previous doctrine will be much better received and much more easily taught

and assimilated than one that throws out the old precepts and starts from scratch.

History in this century shows that successful doctrines of the future will be built on past experience. As we struggle to produce a winning doctrine for the next war, our point of departure must be the among lessons of the past.

CHAPTER FIVE ENDNOTES

[1]Christopher R. Gabel, Seek, Strike, Destroy: U.S. Army Tank Destroyer Doctrine in World War II (Leavenworth Papers No. 12) (Fort Leavenworth: U.S. Army Command and General Staff College, 1985) 69.

[2]Ibid.

[3]Eric Larrabee, Commander in Chief: Franklin Delano Roosevelt, His Lieutenants, and Their War (New York: Harper & Row, 1987) 469-470.

[4]Russell F. Weigley, Eisenhower's Lieutenants: The Campaign of France and Germany 1944-1945 (Bloomington: Indiana University Press, 1981) 19.

[5]Ibid.

[6]Jonathan M. House, Toward Combined Arms Warfare: A Survey of 20th Century Tactics, Doctrine, and Organization (Fort Leavenworth: U.S. Army Command and General Staff College, 1984) 29.

[7]Weigley, Eisenhower's Lieutenants, 25.

BIBLIOGRAPHY

1. Unpublished Documents

Hazen, David W., "Role of the Field Artillery in the Battle of Kasserine Pass." MMAS Thesis, U.S. Army Command and General Staff College, Fort Leavenworth, Kansas, 1973.

Morton, Gregory V., "Field Artillery Support for III Corps Attack, 18-26 December, 1944." MMAS Thesis, U.S. Army Command and General Staff College, Fort Leavenworth, Kansas, 1987.

Shafer, Jeffrey L., "Fire Support Employment in the Rhine River Crossing at Remagen, Germany." MMAS Thesis, U.S. Army Command and General Staff College, Fort Leavenworth, Kansas, 1987.

War Department, "V Corps Monograph (First Army and V Corps operations orders, 23 October through 11 November, 1918)." Documents Collection, Combined Arms Research Library, Fort Leavenworth, Kansas (hereafter sited as CARL) No. M9403 H6 C73 G3 CID.

War Department, "Report of the Hero Board." 9 December, 1919, CARL No. AD A161 150.

War Department, "Report of the Trench Artillery Board." 22 March, 1919, CARL No. AD 951 851-2.

War Department, "Report of the Westervelt Board." 23 May, 1919, CARL No. AD 951 841.

War Department, "Study #59: Organization and Equipment of Field Artillery Units (Report of the General Board, U.S. Forces, European Theater)." 4 February, 1947, CARL No. R-12885.59.

War Department, "Study #61: Field Artillery Operations (Report of the General Board, U.S. Forces, European Theater)." 4 February, 1947, CARL No. R-12885.61.

War Department, "Study #62: The Field Artillery Observation Battalion (Report of the General Board, U.S. Forces, European Theater)." 4 February, 1947, CARL No. R-12885.62.

War Department, "Study #64: Field Artillery Gunnery (Report of the General Board, U.S. Forces, European Theater)." 4 February, 1947, CARL No. R-12885.64.

War Department, "Study #65: The Field Artillery Group (Report of the General Board, U.S. Forces, European Theater)." 4 February, 1947, CARL No. R-12885.65.

War Department, "Study #66: Organic Field Artillery Air Observation (Report of the General Board, U.S. Forces, European Theater)." 4 February, 1947, CARL No. R-12885.66.

Weathersby, Russell A., "The Field Artillery Group in Support of the Corps and Field Army, 1942-1953." MMAS Thesis, U.S. Army Command and General Staff College, Fort Leavenworth, Kansas, 1965.

2. Government Documents

Gabel, Christopher R. Seek, Strike, Destroy: U.S. Army Tank Destroyer Doctrine in World War II (Leavenworth Papers No. 12). Fort Leavenworth: U.S. Army Command and General Staff College, 1985.

House, Jonathan M. Toward Combined Arms Warfare: A Survey of 20th Century Tactics, Doctrine, and Organization. Fort Leavenworth: U.S. Army Command and General Staff College, 1984.

Palmer, Robert R. Reorganization of Ground Troops for Combat (Army Ground Forces Study #8). Washington: Historical Section--Army Ground Forces, 1946.

Snow, William J. Report of the Chief of Field Artillery to the Secretary of War, 1919. Washington: Government Printing Office, 1919.

Snow, William J. Report of the Chief of Field Artillery to the Secretary of War, 1920. Washington: Government Printing Office, 1920.

Sunderland, Riley. History of the Field Artillery School, Volume I, 1911-1942. Fort Sill, OK: Field Artillery School Printing Plant, 1953.

U.S. Army. Field Manual 6-20, Field Artillery Employment. Washington: Department of the Army, 1948.

U.S. Army. Field Manual 100-5: Operations. Washington: Headquarters, Department of the Army, 1986.

War Department, Artillery in Offensive Operations. Washington: Office of the Adjutant General, 31 August, 1917.

War Department. The Artillery Information Service. Washington: Office of the Adjutant General, 17 September, 1918.

War Department. Digest of Field Artillery Developments. Fort Sill, OK: Field Artillery School Printing Plant, 1935.

War Department. Digest of Field Artillery Developments. Fort Sill, OK: Field Artillery School Printing Plant, 1936.

War Department. Digest of Field Artillery Developments. Fort Sill, OK: Field Artillery School Printing Plant, 1937.

War Department. Field Artillery Notes No. 1. Washington: Office of the Adjutant General, 9 May, 1917.

War Department. Field Artillery Notes No. 2. Washington: Office of the Adjutant General, August, 1917.

War Department. Field Manual 6-20, Field Artillery Employment. Washington: War Department, 1940.

War Department. Field Manual 6-40, Field Artillery Gunnery. Washington: War Department, 1942.

War Department. Field Manual 6-100, Tactics and Technique of Division Artillery and Higher Echelons. Washington: War Department, 1944.

War Department. Field Manual 6-120, The Field Artillery Observation Battalion. Washington: War Department, 1939.

War Department. Field Manual 6-120, The Field Artillery Observation Battalion. Washington: War Department, 1945.

War Department. General Notes on the Use of Artillery. Washington: Office of the Adjutant General, 12 November, 1917.

War Department. Notes on Construction and Use of an Artillery Ruler. Washington: Office of the Adjutant General, February, 1918.

War Department. World War Records, 1st Division, A.E.F. (Regular): Operations Reports, 1st F.A. Brigade (Volume XIV). Washington: Office of the Adjutant General, 1919.

Weeks, John W. Report of the Secretary of War to the President, 1922. Washington: Government Printing Office, 1922.

3. Books

Bailey, J. B. A., Field Artillery and Firepower. Oxford: Military Press, 1989.

Batchelor, John, and Ian Hogg, Artillery. New York: Ballantine, 1973.

Bidwell, Shelford, Artillery Tactics, 1939-1945. London: Almark, 1976.

Blumenson, Martin, Breakout and Pursuit. (The U.S. Army in World War Two, European Theater). Washington: Government Printing Office, 1961.

Carter, Russell G., The 101st Field Artillery. Cambridge, MA: Riverside Press, 1940.

Dobell, Byron, ed. A Sense of History: The Best Writing from the Pages of American Heritage. Boston: Houghton Mifflin, 1985.

Green, Constance M., Harry C. Thomson, Peter C. Roots, The Ordnance Department: Planning Munitions for War. (The U.S. Army in World War II: The Technical Services). Washington: Office of the Chief of Military History, 1955.

Lanham, C. T., and Edwin F. Harding, Infantry in Battle. Richmond, VA: Garret and Massie, 1939.

Larrabee, Eric, Commander in Chief. Franklin Delano Roosevelt, His Lieutenants, and Their War New York: Harper and Row, 1987.

MacDonald, Charles B., The Last Offensive (The U.S. Army in World War Two, European Theater). Washington: Government Printing Office. 1973.

Palmer, Robert R., Bell I.Wiley, and William R. Keast, The Procurement and Training of Ground Combat Troops. The U.S. Army in World War Two, Army Ground Forces. Washington: Government Printing Office, 1948.

Rogers, Horatio, World War I Through My Sights. San Rafael, CA: Presidio Press, 1976.

Snow, William J., Signposts of Experience. Washington: U.S. Field Artillery Association. 1941.

Thompson, Goerge R., Dixie R. Harris, Pauline M. Oakes, Dulaney Terrett, The Signal Corps: The Test, December 1941 to July 1943. (U.S. Army in World War II: The Technical Services). Washington: Office of the Chief of Military History, 1957.

Weigley, Russell F., Eisenhower's Lieutenants: The Campaign for France and Germany, 1944-1945. Bloomington: Indiana University Press, 1981.

4. Periodicals

Beere, D. M., "Lessons of the War Affecting American Artillery, Particularly Divisional Artillery," Field Artillery Journal 11 (September-October, 1921) 427-452.

Coleman, John E., "Trends in Field Artillery Organization and Equipment," Field Artillery Journal 34 (October, 1944) 693.

Rance, A. J., "Corps Artillery, How It Was Employed," Field Artillery Journal 33 (December, 1943) 886-888.

Shepherd, W. E., Jr. "The Employment of the Artillery--Fifth Army Corps Argonne--Meuse Operations," Field Artillery Journal 9 (April-June 1919) 148-182.

Van Hyning, Dale, "FO Comments From the Beachhead,"Field Artillery Journal 34 (July, 1944) 403-404.

Wolf, Gordon J., "Emergency Wire Laying By Liaison Airplane," Field Artillery Journal 34 (August, 1944) 566-567.

INITIAL DISTRIBUTION LIST

1. Combined Arms Research Library
   U.S. Army Command and General Staff College
   Fort Leavenworth, Kansas 66027-6900

2. Defense Technical Information Center
   Cameron Station
   Alexandria, Virginia 22314

3. Dr. Christopher R. Gabel
   Combat Studies Institute
   USACGSC
   Fort Leavenworth, Kansas 66027-6900

4. LTC. Michael T. Chychoda
   School for Command Preparation (TCDC)
   USACGSC
   Fort Leavenworth, Kansas 66027-6900

5. MAJ Gary D. Rhay
   Combat Studies Institute
   USACGSC
   Fort Leavenworth, Kansas 66027-6900

6. Morris Swett Technical Library
   U.S. Army Field Artillery School
   Fort Sill, Oklahoma 73503-5001

7. Dr. Boyd Dastrup
   Field Artillery Branch Historian
   U.S. Army Field Artillery School
   Fort Sill, Oklahoma 73503-5001