

Maneuvering to Mass Fires: How Interwar Field Artillery Developments Enabled the Allies to Blend Maneuver and Firepower to Defeat the Axis Through Combined Arms Operations

A Monograph

by

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14. ABSTRACT The period between the First and Second World Wars was a time of incredible military advancement, which included significant advancements to the US Army's field artillery component. The period witnessed the birth of the field artillery "trinity" composed of the forward observer, fire direction center, and gun line. The "trinity" and advancements associated with it allowed for an unprecedented level of flexibility, responsiveness, and firepower, especially when compared to the field artillery of the First World War. These advancements resulted in the US Army shifting to combined arms operations after initial setbacks in North Africa, using the technique of maneuvering to mass fires. This technique emphasised destroying the enemy, to include armored formations, with artillery, rather than with direct fire systems, a situation which demonstrated the subordination of maneuver to firepower. This study captures how the US Army used its artillery during the Second World War and the field artillery capabilities it relied on. The study then demonstrates that there are significant shortfalls between interwar and current artillery development and capabilities between then and now.					
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Abstract

Maneuvering to Mass Fires: How Interwar Field Artillery Developments Enabled the Allies to Blend Maneuver and Firepower to Defeat the Axis Through Combined Arms Operations, by MAJ Erick D Buckner, US Army, 66 pages.

The period between the First and Second World Wars was a time of incredible military advancement, which included significant advancements to the US Army's field artillery component. The interwar period witnessed the birth of the field artillery "trinity" composed of the forward observer, fire direction center, and gun line. The "trinity" and advancements associated with it allowed for an unprecedented level of flexibility, responsiveness, and firepower compared to the field artillery of the First World War. These advancements resulted in the US Army shifting to combined arms operations after initial setbacks in North Africa, using the technique of maneuvering to mass fires. This technique emphasized destroying the enemy, to include armored formations, with artillery, rather than with direct fire weapons systems, demonstrating the subordination of maneuver to firepower.

This study captures how the US Army developed its artillery during the interwar period, how it employed its artillery during the Second World War, and whether there are any significant shortfalls between interwar and current artillery development and capabilities.

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Acronyms

ADP	Army Doctrine Publication
AEF	American Expeditionary Force
BCT	Brigade Combat Team
CARL	Combined Arms Research Library
CTC	Combat Training Center
DATE	Decisive Action Training Environment
DPICM	Dual Purpose Improved Conventional Munition
FDC	Fire Direction Center
FM	Field Manual
GMLRS	Guided Multiple Launch Rocket System
HE	High Explosive
JAM-GC	Joint Concept for Access and Maneuver in the Global Commons
MRSI	Multi-Round Simultaneous Impact
NTC	National Training Center
OC/T	Observer Coach Trainer
OPFOR	Opposing Force
SADARM	Search and Destroy Armor Munitions
TR	Training Regulation

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Introduction

The inter-war period between the First and Second World Wars was a time of incredible military advancement. Some military theorists advocated for maneuver warfare at the expense of artillery and sought to prevent the sort of positional warfare that characterized the First World War. Air power came into its own as both a member of the combined arms team and as a strategic asset. Later described as the “Blitzkrieg,” the early German victories over Poland and France seemingly vindicated the works of maneuver theorists, who sought to discard the experience of the First World War as an aberration. The Second World War, viewed from the lens of popular thought, invokes images of massive tank battles, fleets of aircraft, and wildly popular armored warfare leaders like George Patton and Erwin Rommel. However, it was neither the maneuver of mechanized forces nor the firepower of bombers alone that brought victory to the United States during the Second World War.

Inter-war field artillery developments within the United States Army allowed the Army to blend maneuver and firepower to win the Second World War through combined arms operations. With lessons learned from the First World War codified into doctrine and serving as the guiding light, inter-war field artillery development resulted in the modern “trinity” of the field artillery – the observer, the fire direction center, and the gun line, each providing the characteristics required to support combined arms operations. Field artillery employment doctrine and the “trinity” provided revolutionary levels of flexibility, responsiveness, and firepower that allowed the field artillery to perform missions to greater effect, to include the suppression of enemy forces to restore mobility, and deep fires to include counter-battery and interdiction. Interwar developments further enabled the re-birth of a method not normally seen used since the early days of the First World War – that of maneuvering to mass fires, an employment technique that

became a staple of US Army combined arms operations during the Second World War.¹ The Second World War “marked the high point in the history of American artillery, best characterized by rapid movement, timely and accurate target location, massing of fires, and flexibility of control.”²

Modern Relevance

The US Army struggles to execute combined arms operations successfully in the modern Decisive Action Training Environment (DATE). Published trends originating from the US Army’s Combat Training Centers (CTCs) point to a lack of basic proficiency. According to one report by a squadron Observer Coach Trainer (OC/T) at the National Training Center (NTC), “squadron staffs (regularly) fail to incorporate the direct support (to the squadron) battery into the squadron scheme of maneuver.”³ Fire support rehearsals are typically the first events to be cut in the face of time constraints, field artillery personnel are not often included in combined arms rehearsals, and squadron-level fire support rehearsals often exclude field artillery assets that have direct support relationships to squadrons. Another frequent observation is that field artillery assets are often not positioned far enough forward to execute deep fires as desired by the maneuver commander.⁴

A maneuver-centric mentality coupled with a tendency to rely on non-organic fire support assets, such as fixed and rotary wing aircraft, permeates senior leadership, borne from experiences during both Iraq wars and the war in Afghanistan, where non-organic assets were

¹ Michael Doubler, *Closing With The Enemy: How GIs Fought the War in Europe, 1944-1945* (Lawrence, KS: University Press of Kansas, 1994), 13-14.

² Janice E. McKenney, *The Organizational History of Field Artillery: 1775-2003* (Washington, DC: US Government Printing Office, 2007), 157.

³ Joseph Sanders, “How Can the Cavalry Squadron Increase the Responsiveness of Field Artillery Fires?” *Newsletter: Decisive Action Training Environment at the National Training Center, Volume IV* (September 2016), 47-52.

⁴ *Ibid.*, 47-52.

abundant.⁵ This mentality results in the de-emphasis of artillery, which leads to the subordination of firepower to maneuver. Interviews conducted by members of the Fires Center of Excellence Capability Development and Integration Directorate with future battalion and brigade commanders rotating through the pre-command course at Fort Leavenworth reveal as much. The majority of future battalion and brigade commanders interviewed indicated, “massing (fires) above the battery level will be limited (in the future)” and that during combined arms maneuver, “the first thought is that fixed or rotary wing forces will (provide) support.”⁶ Perhaps the most damning indicator of the maneuver-centric mentality at the Army’s highest levels was the move to eliminate the division artillery in the first decade of the 21st century, and the half-hearted effort to resurrect it without any organic field artillery battalions or command relationship over the division’s field artillery battalions.

The disregard for field artillery and reliance on non-organic fire support assets contributed to the disaster in the Shahi-Kot Valley, Afghanistan during Operation Anaconda in 2002. The 3rd Brigade, 101st Airborne Division did not deploy its organic field artillery assets to theater. As a result, no field artillery was available to support the operation. Relying on non-organic fire support assets, a planned fifty-five minute aerial preparation lasted only one minute due to coordination issues. In addition, an AC-130 on station fired on a friendly Afghan column, killing a US soldier. The enemy, using artillery and mortars, put US forces on the defensive. During the secondary operation near Takur Ghar, no field artillery assets were present to provide either preparatory or suppressive fires against enemy elements, contributing to the crash of a CH-

⁵ Lance Booth, “King No More,” *Military Review* (May-June 2013), 73.

⁶ Fires Center of Excellence Capability Development and Integration Directorate, “How do We Define Massing Fires?” *Field Artillery Journal* (March-April 2014), 24.

47 and the deaths of seven US soldiers.⁷ Unfortunately, a lack of field artillery would contribute to further disasters, such as at Wanat.⁸

With its focus on the wars in Iraq and Afghanistan, the US Army sought advancements in precision while neglecting anti-armor, range, and massed fire capability. The cannon and rocket systems of other North Atlantic Treaty Organization (NATO) member states and potential near-peer adversaries such as Russia and China outrange and/or outgun the cannon and rocket systems of the US Army. Both of the US Army's 155mm artillery pieces, the M109A6 Paladin and M777 towed howitzer, are equipped with 39-caliber cannon tubes, as compared with the 52-caliber pieces of other nations, to include China, that allow for greater range. Neither US howitzer is capable of Multi Round Simultaneous Impact (MRSI), in which one gun is capable of landing several artillery rounds on a single point at the same time, as other foreign howitzers are able to accomplish. One howitzer with MRSI capability has the same firepower as an entire battery of M109A6 howitzers, not accounting for cannon tube temperature, wear, and other considerations. US Army rocket artillery fares better in the international arena than US Army cannon artillery, but if trends continue, US Army rocket artillery will also be at a disadvantage. The rocket artillery of both China and Russia are able to outrange US Army Guided Multi Launch Rocket System (GMLRS) rockets, although GMLRS rockets are more accurate.⁹ In the twenty first century, there has been no serious development or fielding of munitions such as Sense and Destroy Armor (SADARM) or laser-designated rounds capable of engaging heavily armored moving targets. The US Army field artillery may be losing the ability to use Dual Purpose

⁷ John J. McGrath, *Fire For Effect: Field Artillery and Close Air Support in the US Army* (Fort Leavenworth, KS: Combat Studies Institute Press, 2010), 150.

⁸ Combat Studies Institute, *Wanat, Combat Action in Afghanistan, 2008* (Fort Leavenworth, KS: Combat Studies Institute Press, 2010). Additional field artillery assets, with proper planning to account for firing in mountainous terrain, would potentially have bolstered defenses significantly. In the defense of COP Kahler, AH-64s had to travel an hour to come on station to provide support, 227.

⁹ Josh Gordon IV, *Comparing U.S. Army Systems with Foreign Counterparts* (Santa Monica, CA: RAND Corporation, 2015), 19-33.

Improved Conventional Munitions (DPICM), an effective anti-armor capability. Although the United States is not a signatory of the 2008 Convention on Cluster Munitions, the Department of Defense is no longer procuring Dual Purpose Improved Conventional Munitions (DPICM) warheads and is phasing them out of the inventory.¹⁰

The US Army cannot rely on the US Air Force for fire support. In a near peer competitive environment, or even in one where an enemy has a modicum of air-to-air or surface-to-air capability, the Army will find itself providing for its own fire support as the Air Force executes extensive counter-air and counter surface-to-air missions to gain air superiority. The reliability and effectiveness of air power relative to field artillery is also questionable, considering limitations owing to weather, coordination, payload, and firepower versus massed artillery battalions.

The juncture in which the US Army field artillery finds itself is not historically unique. According to JBA Bailey, author of *Field Artillery and Firepower*, “at different periods of history, artillery has been seen either as the decisive arm on the battlefield or...as the arm which merely supports the frontline troops who will decide the outcome of the battle.”¹¹ Interestingly, the attitude toward artillery in 1914 was strikingly similar to today’s outlook, where the European armies “regarded artillery as an accessory rather than an essential arm, supporting infantry in mobile operations.”¹² The French, in 1914, “had a fanatical belief in the offensive” consisting of a “headlong assault,” while disregarding the necessity for firepower.¹³ As a result, they suffered

¹⁰ Congressional Research Service, *Cluster Munitions: Background and Issues for Congress*, by Andrew Feickert and Paul Kerr, April 29, 2014, accessed 18 October 2016, <https://fas.org/sgp/crs/weapons/RS22907.pdf>.

¹¹ JBA Bailey, *Field Artillery and Firepower* (Iffley, Oxford: Military Press, Ltd., 1989), 5.

¹² Ibid., 33. During the First World War at Belleau Wood, the 2d Division (US) took heavy casualties after attempting to use primarily infantry alone to penetrate the German trench line, and achieved success only with significant artillery support. See Janice McKenny, *The Organizational History of Field Artillery: 1775-2003*, 120 and Mark E. Grotelueschen, *Doctrine Under Trial: American Artillery Employment in World War I* (Westport, CT: Greenwood Publishing Group, 2001), 52-53.

¹³ Ibid., 125.

a grievous amount of casualties at the outset of the war. Despite the dominance of artillery in the First World War, similar attitudes about field artillery dominated the interwar period, when both J.F.C. Fuller and Liddel Hart discounted the role of artillery in mechanized warfare.¹⁴ As a result, in 1939 the consensus was that maneuver had finally taken primacy over the firepower of artillery, an error for which the Allies, and later the Germans, would pay dearly. British Prime Minister Winston Churchill, believing the cannon to be relevant no longer, declared, “Renown awaits the commander who first in this war restores artillery to its prime importance upon the battlefield, from which it has been ousted by heavily armored tanks.”¹⁵

Artillery has a tendency to lose relevance during times of peace, only to become dominant during times of war. Despite the US Army having excellent training centers with instrumentation and visual effects to replicate artillery fires against opposing forces (OPFOR), limitations to fires replication remain. At US Army CTCs, fire markers and instrumentation, while effective, are limited in their abilities to demonstrate the effects of artillery fires. In a field training exercise that does not include live fire, “many false lessons are learned, because the realism of live fire is forfeited, and artillery play is usually controlled by an umpiring staff.”¹⁶ Indeed, CTCs may contribute to a maneuver-centric culture, the effects of which are more tangible.

¹⁴ Dan C. Fullerton, “Bright Prospects, Bleak Realities: The U.S. Army’s Interwar Modernization Program for the Coming of the Second World War” (PhD Dissertation, University of Kansas, 2006), 10.

¹⁵ Fred K. Vigman, “The Theoretical Evaluation of Artillery After World War I,” *Field Artillery Journal* (January-February 1976), 23.

¹⁶ JBA Bailey, *Field Artillery and Firepower*, 15.

Research Question

The research question this study attempts to answer is two-fold. The first question seeks to determine how the interwar period contributed to the US Army field artillery's development and how those developments contributed to the US Army's execution of combined arms during the Second World War. The second question seeks to determine whether there are any field artillery capabilities necessary for the successful execution of combined arms that were resident in the US Army during the Second World War that are not resident in today's Army.

This study does not assume that modern combined arms warfare retains all of the same characteristics as the Second World War. Marc Bloch, French veteran of the First and Second World Wars, when analyzing the French collapse of 1940 in his work *Strange Defeat*, pondered whether French military officers of the time were "incapable of thinking in terms of a new war."¹⁷ For the modern US Army, perhaps the opposite is true; US Army professionals are thinking of new wars consisting of extremely complex environments, requiring the development of concepts like "Multi-Domain Battle" to support the Joint Concept for Access and Maneuver in the Global Commons (JAM-GC). However, as the US Army implements future concepts, it must know how to do the basic blocking and tackling required of a combined arms team, where no one arm wins battles.

Interwar Development

International Backdrop

Interwar military theory, "dominated by airpower and armored warfare enthusiasts," tended to discount the role of combined arms and field artillery, with deleterious effects for Britain and France during the initial stages of the Second World War.¹⁸ The British found

¹⁷ Marc Bloch, *Strange Defeat* (New York, NY: W.W. Norton and Company, Inc., 1983), 36.

¹⁸ John Mosier, *The Blitzkrieg Myth* (New York, NY: HarperCollins Publishers, 2003), 8.

themselves at one extreme, with their experiences of the First World War forming the foundation of their position. The British used tanks successfully to shatter German lines in 1917 and 1918 at the battles of Cambrai, Amiens, and Soissons.¹⁹ As a result, during the interwar period, British military theorists emphasized the “armored idea” or “indirect” approach, consisting of breakthroughs and penetrations into an enemy’s rear area to attack enemy morale, cause confusion, and “turn a tactical advantage into a strategic one.”²⁰ Both J.F.C. Fuller and Liddell Hart discounted the future role of artillery, with Hart questioning the continued relevance of the field gun.²¹ The tank, as advocated by Fuller and Hart, would “supplant, rather than serve alongside” field artillery.²² Britain was not the only Allied nation to disregard combined arms.

The French Army stood on the opposite side of the spectrum, relying on their First World War experience to shape interwar development. The French determined that Methodical Battle, “a doctrine that subordinated all considerations to (the ability) to protect, at all times, the entire infantry with a curtain of artillery fire,” was the key to winning future wars.²³ As a result, the French Army nurtured its artillery arm. Unfortunately, as French field artillery doctrine developed, “they accepted a dangerous degree of rigidity within their system of command and control.”²⁴ The centralization of French artillery at corps and higher proved inflexible, rendering

¹⁹ James S. Corum, *The Roots of Blitzkrieg* (Lawrence, KS: University Press of Kansas, 1992), 22. British attacks involving tanks breached German defenses on several occasions in 1917 and 1918. At Cambrai, the British took 4,200 German prisoners; at Amiens, 16,000 prisoners; at Soissons, 25,000 prisoners.

²⁰ Matthew Cooper, *The German Army: 1933-1945* (Chelsea, MI: Scarborough House/Publishers, 1978), 145.

²¹ Dan C. Fullerton, “Bright Prospects, Bleak Realities,” 7.

²² Bruce I. Gudmundsson, *On Artillery* (Westport, CT: Praeger Publishers, 1993), 116.

²³ *Ibid.*, 115.

²⁴ Robert A. Doughty, “French Operational Art 1888-1940,” in *Historical Perspectives of the Operational Art*, ed. Michael D. Krause and R. Cody Phillips (Washington, DC: Center of Military History, 2007), 91.

the French artillery unable to support the exploitation of tactical level successes when they arose. France also built a large tank force, producing greater numbers of arguably superior tanks than the Germans between 1935 and 1940. However, the inflexibility of the French artillery system and problems with infantry-tank-artillery cooperation hindered their ability to conduct combined arms successfully.²⁵

The German Armed Forces entered the Second World War with a doctrine that adhered to the principle of combined arms. Like the French and British Armies, the Wehrmacht applied the lessons of the First World War to shape interwar development. The intellectual atmosphere fostered by Hans von Seeckt allowed for healthy debate and analysis. The Germans, with a critical eye, either applied or discarded new theoretical developments, and those of J.F.C. Fuller were no exception. Heinz Guderian “played a central role in the development of the panzer division of the 1930s” while influenced by the ideas of Fuller.²⁶ Guderian, also influenced by the legacy of von Seeckt and the Reichswehr, emphasized combined arms and *Auftragstaktik*. The resulting German Panzer Division, a combined arms formation, “had its own organic reconnaissance, infantry and artillery components, even its own supply columns and bridging trains” and was arguably “the most important military innovation in the interwar period.”²⁷

²⁵ John Mosier, *The Blitzkrieg Myth*, 51-58. The French Army entered the Second World War with more tanks than the Wehrmacht, rendering questionable J.F.C Fuller’s statement that the Maginot Line drained precious resources from French production, contributing to the fall of France in 1940. The Maginot Line did what it was designed for, channeling the German Army to the north.

²⁶ James S. Corum, *The Roots of Blitzkrieg*, 137. Corum contends that there are three serious misconceptions in the mass of books written after the Second World War regarding Germany’s armored development. The first is that “Heinz Guderian was virtually the sole creator of Germany’s armored forces and doctrine.” The second is that “Guderian and other armor enthusiasts had to struggle against a reactionary high command and General Staff.” The final is that “German armor doctrine was a direct development of ideas taken from British military theorists.” Corum makes the case that Hans von Seeckt made the greatest impact on German interwar development, 136-143.

²⁷ Robert M. Citino, *The German Way of War* (Lawrence, KS: University Press of Kansas, 2005), 254. The Panzer Division was designed to be a “self-contained combined arms team, in which tanks were backed up by other arms brought up, as far as possible, to the tanks’ standards of mobility,” 254.

The firepower of field artillery and close air support played a vital role in German fighting methods during the Second World War. Guderian theorized the artillery would play a supporting role to suppress weapons systems, screen and obscure with smoke, and isolate portions of the battlefield.²⁸ As a result, the combined arms tactics of the Wehrmacht handily defeated the British and French who both struggled to execute combined arms. Interwar historian Dr. Dan C. Fullerton contends, “British and French mechanized forces, while actually possessing more tanks and even superior weapons and equipment...were consistently out-classed and out-manuevered by massed German forces that were more balanced and better led.”²⁹ In 1940, German armored divisions had an artillery to maneuver battalion ratio of 2:3, while British armored divisions had an artillery to maneuver battalion ratio of 1:4.³⁰ The German victories of 1940 demonstrated the superiority of combined arms.

The First World War

The First World War was an artillery war. Eighty percent of American casualties were the result of artillery fire.³¹ Fifty-eight percent of British casualties were the result of artillery fire.³² According to historian Mark Groteleuschen, “Artillery helped establish trench warfare in late 1914, was a major factor in maintaining trench warfare from 1915 through 1917, and in

²⁸ Bruce I. Gudmundsson, *On Artillery*, 119-120.

²⁹ Dan C. Fullerton, “Bright Prospects, Bleak Realities,” 17. What makes the Wehrmacht’s victory more astounding is that “of the roughly 3,300 German tanks committed to battle, more than 2,100 were of the Mark I and II types...only 800 or so were of the Mark III or IV variety which could be described as the only real “battle tanks,” (p. 17.) Combined arms overcame superior equipment. In addition, at Arras, the British had a 3:1 tank to infantry ratio, while the German Panzer divisions had a 1:1 tank to infantry ratio – a far more balanced combined arms force.

³⁰ James F. Dunnigan and Albert A. Nofi, *Dirty Little Secrets of World War II* (New York, NY: William Morrow, 1994), 143. The Germans maneuver to artillery ratios were the most balanced of the three western European powers.

³¹ Allen J. Greer, “Artillery Missions and Doctrines,” *The Field Artillery Journal*, (May-June 1937), 194.

³² Chris Bellamy, *Red God of War: Soviet Artillery and Rocket Forces* (Oxford, England: Brassey’s Defense Publishers, 1986), 1.

1918...played a primary role in returning a measure of mobility to the battlefield.”³³ Each side desperately sought to restore mobility to the battlefield and experimented with artillery to do it. According to British Brigadier General A.L. Pemberton, “the object of the artillery (in the First World War) in the attack must be to neutralize the enemy defenses for just so long as to assist the other arms to maintain their mobility and offensive firepower.”³⁴ In order for the infantry to maneuver, massive artillery bombardments and barrages were required. An American observer in France commented, “Artillery has reached such a position of importance that successful attack or defense is impossible without it.”³⁵ The same observer went on to say, “Infantry officers do not hesitate to say that infantry should not leave its trenches until artillery preparation has really smashed all targets...also, the infantry can advance only so far as their artillery can escort them with fire.”³⁶

The Allied armies learned how to fire to enable maneuver. In October of 1916, the French used scheduled, centrally controlled rolling barrages for the infantry to follow closely, resulting in a “dramatically successful attack at Verdun.”³⁷ The rolling barrage subsequently became a staple of operations. The American Expeditionary Force (AEF) relied on a similar formula. The AEF combat instructions of 1918 from General Pershing emphasized the importance of the rolling barrage in trench warfare.³⁸ During its time in Europe, AEF artillery

³³ Mark E. Groteleuschen, *Doctrine Under Trial*, i.

³⁴ A.L. Pemberton, *The Development of Artillery Tactics and Equipment* (London: The War Office, 1950), 2.

³⁵ Mark E. Groteleuschen, *Doctrine Under Trial*, 3.

³⁶ *Ibid.*, 3.

³⁷ Robert A. Doughty, “French Operational Art 1888-1940,” in *Historical Perspectives of the Operational Art*, 83. French General Robert G. Nivelle devised the first rolling barrage of the war and coined the slogan, “The artillery conquers; the infantry occupies.” His barrages required intricate timetables and allowed for some degree of infantry-artillery coordination in an era without radios. Subsequent operations after Verdun would not see the same level of success, resulting in Nivelle’s relief from command and replacement by Pétain, 82-86.

³⁸ Pershing, “Combat Instructions,” *AEF Circular*, (September, 1918), 2.

would conduct massive artillery bombardments, followed by a rolling barrage to enable infantry to maneuver. Finally, the artillery would rapidly displace forward to provide additional close support to the infantry.³⁹

The First Army employed this technique to great effect in the Meuse-Argonne region. In accordance with the 1914 Field Service Regulations suggesting the use of heavy artillery for counter-battery work, I and III Corps artillery suppressed German artillery positioned to the east of the Meuse and in the Argonne forest. 2,700 guns fired a three-hour artillery preparation followed by a rolling barrage hugged by the infantry. As soon as was feasible, the artillery displaced forward to continue providing close support.⁴⁰

Despite the dominance of field artillery during the First World War, the inflexibility of the artillery often rendered it ineffective. The use of indirect fire was relatively new and reliant on primitive forward observation and gunnery computation techniques that hindered infantry-artillery cooperation. Field guns and howitzers had limited mobility and ability to traverse. Communication technology was poor. The artillery plan dictated to the maneuver plan. Reliant on schedules and timetables, the inflexible nature of the artillery often prevented it from adjusting to exploit the success of the infantry. The US Army would address these problems during the interwar period.⁴¹

³⁹ Boyd L. Dastrup, *King of Battle: A Branch History of the U.S. Army's Field Artillery* (Fort Monroe, VA: US Army Training and Doctrine Command, 1992), 166-167.

⁴⁰ U.S. Army Center of Military History, *American Armies and Battlefields in Europe* (Washington, DC: US Government Printing Office, 1992), 173; Field Service Regulations of the United States Army, 1914 (Washington, DC: War Office, 1914), 82. By the evening of September 26, the Americans held the first German position, and drove salients into the German lines on both sides of Montfaucon. When there was adequate infantry-artillery coordination, artillery was extremely effective. American artillery fire was so well coordinated at Cantigny that it received the praise of General Pershing. See Janice McKenney *The Organizational History of Field Artillery, 1775-2003*, 120.

⁴¹ John R. Walker, *Bracketing the Enemy* (Norman, OK: University of Oklahoma Press, 2013), 27. A reliance on strict timetables and scheduled fires, combined with a lack of modern communications technologies, primitive observation techniques separating the observer from the infantry, and primitive fire direction techniques, rendered the artillery in the First World War extremely inflexible.

Doctrinal Development

Field Artillery and Combined Arms

The US Army and field artillery community immediately went to work identifying and rectifying deficiencies noted from the First World War. The US Army convened a number of boards that proposed solutions. They included the Hero, Westervelt, Lassiter, and Superior Boards. The boards, despite covering a range of topics to include materiel capability, had enormous implications for doctrine and influenced the US Army Field Service Regulation of 1923, which effectively became the capstone document of First World War experience. As a result, the 1923 regulations clearly outlined the role of artillery at different echelons, the importance of combined arms, and field artillery missions. Field artillery employment doctrine changed very little between 1923 and 1939; so little that one may say the US Army went to war in 1942 guided by the Field Service Regulation of 1923. The result was a far more responsive, flexible, and destructive combat arm.

The Westervelt Board of 1918, also known as the Caliber Board, focused on Artillery materiel but also had doctrinal implications.⁴² It outlined the missions and responsibilities of field artillery at different echelons in order to recommend the equipment required to accomplish each mission. The board outlined the future role of divisional artillery. In the defense, division artillery's responsibility was counter-preparation fire against the opposing division's infantry. It was also to annihilate attacking enemy formations at points of emergence. On the offense, the division artillery was to fire to enable maneuver through preparatory fires and barrages. The board examined the need for accompanying cannon for infantry and concluded that the infantry required them to destroy enemy strong points. The bottom line is that the role of division artillery

⁴² The Hero Board, which preceded the Westervelt Board, submitted recommendations for future organizational and materiel for the branch. It assigned similar responsibilities to each echelon, to include the Division Artillery. Instead of making a recommendation for Army artillery, it recommended the formation of a General Artillery Reserve. See "Report of the Hero Board," General Headquarters, AEF (1918-1919), located in the Morris Swett Technical Library, Fort Sill, OK 73503.

was to focus fires on enemy forces in contact or about to enter contact with friendly maneuver forces. In other words, division artillery provided tactical, not operational level fires.⁴³

The Westervelt Board addressed the mission of the corps artillery in relation to division artillery. Corps artillery, not divisional artillery, was the element principally responsible for counter-battery fires. This was in large part because the corps was equipped with the means to detect enemy firing positions through sound ranging techniques. The corps artillery was also responsible for harassing and interdiction fires against enemy sustainment assets. The board gave army artillery the responsibility of augmenting division and corps artillery when the necessity arose, and for executing long-range interdiction, harassing, neutralization, and destruction fires.⁴⁴ The main point is that these echelons were responsible for reinforcing the divisional artillery when necessary while handling all interdiction and counter-battery requirements. Corps and Army artillery were to focus primarily on operational level fires.⁴⁵

In 1920, the Field Artillery journal published a study combining lessons learned by the AEF. It outlined the roles of division, corps, and army artillery and closely matched the Westervelt report. Division artillery was responsible for tactical fires, while corps and army reinforced the division when necessary and provided counter-battery and operational level fires.⁴⁶

The study recognized the importance of combined arms. It recognized the inflexibility of artillery during the war and emphasized the need for close infantry-artillery cooperation during wars of movement, calling it “indispensable between the combat arms” and that “due to the lack

⁴³ “Study of the Armament and Types of Artillery Matériel to be Assigned to a Field Army,” *The Field Artillery Journal* (July-August 1919), 294-298.

⁴⁴ *Ibid.*, 297-298.

⁴⁵ The corps was also responsible for tactical level fires against enemy divisional artillery and when required to reinforce division artillery.

⁴⁶ “An Artillery Study Made in the A.E.F.,” *The Field Artillery Journal* (January-February 1920), 57.

of cooperation, many tragic incidents are to be ascribed.”⁴⁷ However, the study explicitly cautioned against parceling out the artillery among the infantry commands, the result of which would be to lose the ability to concentrate fires. To increase infantry-artillery cooperation, the study recommended the creation of a mobile accompanying gun capable of rendering immediate close support to infantry commanders.⁴⁸ It also emphasized the importance of combined arms training, exclaiming, “Our training, both in tactics and in technic, must be based on wars of movement, since this type of warfare alone is productive of decisive results.”⁴⁹

The study addressed the employment of indirect fires. To support wars of movement, the study emphasized an “aggressive and intensive employment” across the entire depth of the enemy’s formation, to include front line troops and rear areas.⁵⁰ Close supporting fires, counter-battery, and long-range (deep) fires were the legacy missions carried over into subsequent field service regulations and iterations of Field Manual (FM) 100-5.

The US Army Field Service Regulation of 1923 codified the lessons from the First World War. The roles of division and corps artillery as described in the post-war boards and AEF artillery study were included in the regulation. The primary mission of divisional artillery was the direct support of the infantry. Corps artillery had the responsibility for counter-battery work. The 1923 regulation did not specifically address army artillery, but did address General

⁴⁷ Ibid., 53.

⁴⁸ Ibid., 55. The study theorized that tractorized divisional artillery with armor be provided as necessary to provide close support to the infantry, much in the same manner of the tank destroyers and self-propelled howitzers of the Second World War.

⁴⁹ Ibid., 58.

⁵⁰ Ibid., 56-57. This is strikingly similar to the Soviet method of Deep Battle as developed by G.S. Isserson and others. Contending that artillery had only grown in importance since 1918, Isserson held that modern battle was a “combined arms undertaking” where the artillery must engage the enemy throughout its depth. Artillery fire was critical to enable the maneuver of tanks, which were extremely vulnerable to anti-tank defenses. See Richard W. Harrison, *Architect of Soviet Victory in World War II: The Life and Theories of G.S. Isserson* (Jefferson, NC: McFarland & Company, Inc. Publishers, 2010), 60-121

Headquarters truck artillery, assigning it the principle mission of “executing in connection with strategic concentrations for the attack of fortified positions.”⁵¹

The 1923 regulations emphasized the importance of combined arms. Stating, “No one arm wins battles,” the regulations went further, emphasizing, “The combined employment of all arms is essential to success.”⁵² To support the infantry, the regulation codified the three missions of the artillery; close support, counter-battery, and interdiction. Close support entailed “contribut(ing) to the power of movement of the entire force,” blending maneuver and firepower.⁵³ Note the description does not limit the role of close supporting fires as firing to enable maneuver. The regulations codified the attack of defensive positions in depth, as described in the AEF study.

The 1923 regulations specifically addressed the flexibility of artillery, perhaps with its past inflexibility in mind. Despite not having yet the technological means to realize fully its contents, the regulations assigned the artillery a high degree of flexibility as a “consequence of its great range.”⁵⁴ The flexibility of the artillery, the regulation went on to state, “makes possible the concentration of large masses of artillery under a common fire direction.”⁵⁵ The 1923 regulations enabled flexibility through organization. The regulations outlined the benefits of decentralized artillery with supporting relationships in certain situations, where units desired increased responsiveness or extended command and control rendered concentrations impracticable.

⁵¹ Field Service Regulations of the United States Army, 1923 (Washington, DC: Government Printing Office, 1923), 16.

⁵² Ibid., 11. The Regulations also emphasized that the “coordinating principle” guiding the employment of the combined arms team was the infantry mission.

⁵³ Ibid., 14.

⁵⁴ Ibid., 14.

⁵⁵ Ibid., 14. It was not until the 1930s that new observation and fire direction procedures developed. These developments resulted in responsive, flexible, and destructive characteristics attributed to the artillery during the Second World War.

However, the regulations were quick to point out that the artillery commander must retain the ability to concentrate the entirety of a large unit's firepower by resuming control.⁵⁶ The next section of this study touches on this in detail.

The artillery section of the field service regulations changed very little between 1923 and 1939. Like the 1923 regulation, FM 100-5 of 1939 kept faith in combined arms, stating, "No one arm wins battles. The combined action of all arms and services is essential to success."⁵⁷ Close supporting fire, counter-battery fires, and interdiction fires remained the primary missions of the artillery, although counter-battery fires and interdiction constituted one mission. Division artillery's primary focus was to support the infantry and cavalry, although the 1939 regulation stipulated it was to assist the corps artillery in counterbattery. This required heavier artillery with longer range in the division artillery. The primary mission of corps artillery was counter-battery and long-range interdiction, but also to reinforce division artillery. Army artillery was to conduct interdiction while reinforcing corps when necessary. The 1939 regulation emphasized the importance of centralization, but conceded there may be requirements to decentralize in certain scenarios. The division of labor and emphasis on centralization remained intact.⁵⁸

The 1923 Field Service Regulations, without yet any significant developments beyond motorization, fostered the characteristics of responsiveness, flexibility, and destructiveness that described US Army field artillery during the Second World War. Codified missions for each echelon created a division of labor, enabling focused fires. While corps artillery and higher focused fires to conduct counter-battery and interdiction missions, the focused fires of division artillery made it more responsive and flexible for the infantry, while increasing the destructive

⁵⁶ Ibid., 15.

⁵⁷ Field Manual (FM) 100-5, *Operations* (Washington, DC: Government Printing Office, 1939), 5. The paragraph on combined arms is nearly a direct lift, although the 1939 version is less verbose.

⁵⁸ This is not to say that the 1923 Field Service Regulation was identical to the 1939 publication of FM 100-5. However, most differences pertaining to the role of field artillery in combined arms were descriptive, not prescriptive in nature.

power of divisional artillery fires by concentration and mass. The assignment to division artillery of the responsibility for tactical level fires enabled true combined arms integration with the infantry, avoiding the mistake of the French system of over centralization. The regulation guided capability development by providing a road map for materiel and technique development, resulting in the “trinity” of the field artillery – the forward observer, fire direction center, and gun. Although nearly twenty years would go by, the US Army Field Service Regulations of 1939 included very few changes to the field artillery’s role in combined arms. Likewise, there were very few changes between the 1939 and 1941 versions of FM 100-5.

Organization

The field artillery underwent significant organizational changes during the interwar period. These changes enhanced the responsiveness, flexibility, and destructiveness of the artillery through the grouping of field artillery battalions to add weight to certain efforts when necessary.

Organizational changes followed the general trend in the US Army to adopt a more “lightweight” organizational structure that was more maneuverable. In 1929, Assistant Chief of Staff, G-3, Major General Frank Parker, reported that European armies were developing in a manner to bring an unprecedented level of maneuver to the battlefield. The resulting Triangular Division of 1940 replaced the square divisional construct in an effort to provide a more mobile structure.⁵⁹ The new construct led to the elimination of the field artillery brigade and subordinate regiments, replacing it with corps and divisional artillery, through which the corps and division artillery commanders exercised command and control.⁶⁰ All field artillery battalions within the

⁵⁹ “Sixty Years of Reorganizing for Combat: A Historical Trend Analysis,” *Combat Studies Institute Report No. 14* (Leavenworth, KS: US Army Command and General Staff College, 2000), 3. In 1920, General Pershing recognized the immobility of the square division, recommending “an elastic and mobile three-unit system.” The 1936 Modernization Board, placing priority on redesigning the infantry division, endorsed the triangular concept. The Army tested the Triangular Division in Texas in 1937, modified in in 1940 (due to recommendations primarily by Brigadier General McNair), and implemented it.

⁶⁰ Janice E. McKenney, *The Organizational History of Field Artillery: 1775-2003*, 148.

division belonged to the division artillery commander. The infantry division artillery of July 15, 1943 consisted of three direct support 105mm battalions and one general support 155mm battalion, available to support the three infantry regiments.⁶¹ One of the recommendations made by Lieutenant General Leslie McNair who served on the 1936 Modernization Board was to create a tactical headquarters to facilitate the pooling of field artillery battalions for a single purpose.⁶² As a result, the Army created the field artillery group headquarters to control non-divisional field artillery battalions, while corps artillery was responsible for controlling the field artillery group headquarters.⁶³

The new construct created an incredible amount of flexibility. Armies and corps transferred non-divisional field artillery across the battlefield laterally between field artillery groups in a “plug and play” fashion when necessary. In addition, non-divisional artillery battalions transferred between field artillery groups provided regular vertical reinforcement, bringing to bear an unprecedented amount of firepower when needed. For example, during the invasion of Normandy, three field artillery groups consisting of twelve field artillery battalions supported each corps in the 1st Army.⁶⁴ During the offensive in Normandy against Villiers-Fossard, 3rd Armored Division’s Combat Command A was supported by seventeen battalions of

⁶¹ Sixty Years of Reorganizing for Combat: A Historical Trend Analysis,” *Combat Studies Institute Report No. 14*, 8.

⁶² Janice E. McKenney, *The Organizational History of Field Artillery: 1775-2003*, 176. General McNair was an advocate for “pooling” resources to support lean and agile divisional structures. According to McNair, it was not necessary that all required assets were organic to a division; it was only necessary to provide the assets when needed, similar to how the US Army conducts modern task organization of modular forces. See Mark T. Calhoun, *General Leslie J. McNair: Unsung Architect of the US Army* (Lawrence, KS: University Press of Kansas, 2015).

⁶³ John J. McGrath, *Fire For Effect: Field Artillery and Close Air Support in the US Army* (Fort Leavenworth, KS: Combat Studies Institute, US Army Combined Arms Center), 66-67.

⁶⁴ Charles E. Hart, “Artillery with an American Army in Europe,” *The Field Artillery Journal* (January-February 1947), 25.

artillery.⁶⁵ General Depuy, reflecting on his experiences with artillery during the war, stated, “At the Saar and afterwards, it was not unusual for me as a battalion commander to be supported by five or six battalions of artillery anytime I needed it.”⁶⁶

Retained through the interwar period was the idea of centralizing artillery assets. The experiences of the Second World War confirmed the necessity of centralization to maximize the destructive characteristic of artillery. As a result, there was little change between the 1923 and 1944 versions of FM 100-5 regarding centralization. The 1923 version stated, “Higher artillery commanders, retain, as far as practicable, the power to resume centralized control, except in cases where artillery elements have been attached to infantry units by superior authority.”⁶⁷ The 1944 version of FM 100-5 stated that “whenever the situation permits, both direct support and general support artillery be retained under centralized control. Field artillery operates most effectively in this manner.”⁶⁸ Borne of the runaway success of massed artillery fires in North Africa against the Wehrmacht, “a cautious qualification crept into the section of artillery. Concentrations of artillery fire are regulated to bring the greatest possible volume of fire on objectives of decisive importance at the critical moments of the attack.”⁶⁹ The US Army had learned in North Africa the power of massed artillery in the support of combined arms.

⁶⁵ Michael Doubler, *Busting the Bocage: American Combined Arms Operations in France, 6 June – 31 July 1944* (Fort Leavenworth, KS: Combat Studies Institute, US Army Command and General Staff College, 1994), 53.

⁶⁶ Romie L. Brownlee and William J. Mullen III, *Changing an Army: An Oral History of General William E. Depuy, USA Retired* (Washington, DC: Government Printing Office, Date Unknown), 49.

⁶⁷ Field Service Regulations of the United States Army, 1923, 14.

⁶⁸ Field Manual (FM) 100-5, *Operations* (Washington, DC: Government Printing Office, 1944), 11.

⁶⁹ Fred K. Vigman, “The Theoretical Evaluation of Artillery after World War I” *The Field Artillery Journal* (January-February 1976), 38.

The retained organizational construct contributed to the increased destructive firepower and effectiveness of artillery by allowing the division commander to retain control over all divisional artillery. It facilitated the concentration of fire at single points, also known as massing. Corps and division artillery massed fires through the execution of time-on-target (TOT) missions providing an unprecedented amount of firepower to bear against enemy positions. Massing fires increased the probability of direct and near hits by artillery rounds and increased the amount of shrapnel per square foot, not to mention the moral and psychological effect on human beings within or near the target area. After the war, General Depuy spoke in support of division artillery control over all divisional field artillery battalions, expressing, “the Germans still make an artillery battalion organic to a brigade. That’s not a good system.”⁷⁰

Maneuver to Mass Fires

Interwar thought and development contributed to the re-emergence of an old combined arms technique – that of maneuvering to mass fires. In effect, as one soldier recalled, to “never send an infantryman in to do a job that an artillery shell can do for him.”⁷¹ In Europe, it was last seen used by the Germans in a technique called the “Kesselschlacht,” or “cauldron battle,” and consisted of the “decisive maneuver of double envelopment ending with the annihilation of the enemy.”⁷²

Considering trench warfare as an anomaly, field artillery theorists envisioned a future that included wars of movement. In 1919, Lieutenant Colonel John Anderson wrote in an article for *The Field Artillery Journal* that the Army was justified in returning to training that emphasized

⁷⁰ Romie L. Brownlee and William J. Mullen III, *Changing an Army: An Oral History of General William E. Depuy, USA Retired*, 49.

⁷¹ John Ellis, *Brute Force: Allied Strategy and Tactics in the Second World War* (New York, NY: Viking Penguin, 1990), 427.

⁷² Matthew Cooper, *The German Army: 1933-1945*, 271.

maneuver, rather than positional warfare, because “the tendency during the closing weeks of the war was a return to those methods.”⁷³ Those methods he was referring to are those of movement, described in doctrine during the First World War. The focus on future wars of movement carried over into the 1930s. As developments continued that granted the artillery more maneuverability, then Brigadier General Lesley McNair, during the mid-1930s, thought there to be too great an emphasis on close supporting fires. McNair believed that “the key to success lay in massing fires on decisive points...requiring centralized control, great flexibility in delivery, considerable range, and good communications.”⁷⁴ The emphasis by leaders such as McNair kept the artillery on a track that allowed it to maintain pace with maneuver and harness the power of the “trinity” to provide decisive effects.

Maneuvering to mass fires, as executed in the Second World War, combined the strengths of maneuver and firepower. Maneuvering to fire consisted of maneuvering in a fashion to engage and destroy the enemy primarily with artillery fire. Although not explicitly mentioned in the 1941 version of FM 100-5, the US Army used it repeatedly during the war. Maneuvering to mass fire addressed the problem of the “empty” battlefield. Maneuver “increase(d) effective military pressure...to reduce the enemy’s area of deployment.”⁷⁵ This occurred frequently when the US Army surrounded and attacked the various axes of several different salients created by the German Army after the Normandy landings. When maneuvering to build pressure, “forces and

⁷³ John Anderson, “Are We Justified in Discarding Pre-War Methods of Training?” *The Field Artillery Journal* (April-June 1919), 230.

⁷⁴ Janice E. McKenney, *The Organizational History of Field Artillery: 1775-2003*. 145-146.

⁷⁵ James J. Schneider, *Vulcan’s Anvil: The American Civil War and the Foundations of Operational Art* (Fort Leavenworth, KS: School of Advanced Military Studies, US Army Command and General Staff College, 1992), 19. The author, discussing modern battlefield conditions, asserts that “armies act like fluids creating great fronts of pressure.” $P_m = F_m/A_m$, where P_m = Pressure, F_m = Military Force, and A_m = Battlefield Area. An attacker increases his effective pressure by “reduc(ing) the defender’s area of deployment,” rendering the defender more vulnerable to fire. The defender can deploy in a manner to increase pressure as well, such as using terrain that forces the attacker to concentrate, by entrenching, and by creating a large reserve, 17-20.

terrain become a unified whole,” increasing the concentration of enemy forces, rendering them vulnerable to massed artillery fires.⁷⁶ US Army operations in North Africa are replete with several examples of maneuvering to use terrain to concentrate the enemy, rendering US artillery fire more decisive. Concentrating forces penalized the Germans. German penetration and breakthrough attempts using “Blitzkrieg” style tactics failed every time in the face of overwhelming US firepower, which US maneuver enhanced by building pressure.

Maneuvering to mass fires saved lives by shifting the decisive action to the field artillery. When the decisive action is the destruction of the enemy through artillery fires, “the relationship between attrition and maneuver can be established. Maneuver is subordinate to attrition, but maneuver gives attrition its fundamental effectiveness.”⁷⁷ This is in contradiction to what maneuver warfare theorists advocate, which is to fire to enable maneuver.⁷⁸ When maneuvering to mass fire, “the purpose of maneuver is to gain a position of advantage relative to the opponent,” in order to “deliver overwhelming, violent, attrition.”⁷⁹

Veterans of the Second World War considered the concept of maneuvering to mass fires a decisive contributor to victory. In Normandy, “fire to maneuver turned into one of maneuver to fire; instead of using fire to fix the enemy and maneuver to destroy him, troops maneuvered to

⁷⁶ Ibid., 38.

⁷⁷ Ibid., 19. The author states that this is the case in the modern battlefield, not just when using a technique of maneuvering to fire.

⁷⁸ While maneuver warfare theorists acknowledge the importance of fires, “what is different in maneuver warfare is the relationship between fire and maneuver. In maneuver warfare, the object of maneuver is not to position fires for the ultimate destruction of the enemy. Ideally, fires are used to create conditions which support decisive maneuver – that is, movement of combat forces in relation to the enemy to destroy his will to resist.” See Richard D. Hooker Jr., “Ten Myths About Maneuver Warfare,” in *Maneuver Warfare: An Anthology*, ed. Richard D. Hooker Jr. (Novato, CA: Presidio Press, 1993), 80.

⁷⁹ William F. Owen, “The Manoeuvre Warfare Fraud.” *Small Wars Journal*, (2008): accessed November 5, 2016, <http://smallwarsjournal.com/blog/journal/docs-temp/95-owen.pdf?q=mag/docs-temp/95-owen.pdf>. The author argues that the concept of Maneuver Warfare, “first advocated in the early 1980s...based its wide acceptance largely on ignorance and a lack of intellectual rigor.”

find the enemy and then called in...artillery to destroy him.”⁸⁰ One soldier recalled, “we let the artillery fight as much as possible,” while another (an observer) recalled that “at the smallest resistance, the infantry stops and retires, and a new artillery bombardment takes place in order to stamp out remaining opposition.”⁸¹ An officer who took part in Operation Flashpoint as part of the 9th US Army recalled, “There was no real fight. The artillery had done the job for us.”⁸² General Depuy, reflecting on his wartime experience as a battalion commander, concluded that his primary role “was that I moved the forward observers of the artillery across France and Germany.”⁸³ Finally, consider the words of General Raymond Barton, commander of the 4th Division in Normandy, “I repeatedly said it was more a matter of infantry supporting artillery than artillery supporting infantry...(soldiers) never wanted to attack unless we could put a cub in the air...positions were taken or held solely due to time on targets.”⁸⁴

Maneuvering to mass fires did not replace the artillery’s role of firing to enable movement and maneuver. Throughout the Second World War, the artillery suppressed enemy positions through direct suppressive fires or through rolling barrages. Counter-battery fire silenced enemy artillery assets, preventing them from engaging friendly infantry. Maneuvering to mass fire and firing to enable movement occurred at the same time, enabled by the division of labor between the different echelons. Corps artillery would silence enemy artillery while a

⁸⁰ John Ellis, *Brute Force: Allied Strategy and Tactics in the Second World War*, 385. Ellis was referencing Chester Wilmot’s *The Struggle for Europe*, which summarized American methods in Normandy. “American infantry tended to transpose the doctrine of fire and manoeuvre into one of manoeuvre and fire; instead of using fire to fix the enemy and manoeuvre to trap and destroy him, troops manoeuvred to find the enemy and then called in aerial and artillery firepower to try and destroy him.”

⁸¹ *Ibid.*, 384-385.

⁸² *Ibid.*, 427. Operation Flashpoint involved the crossing of the Rhine River.

⁸³ Peter Mansoor, *The GI Offensive In Europe* (Lawrence, KS: University Press of Kansas, 1999), 262. Mansoor concluded, “Although the infantryman was essential to take and hold ground, he was not the primary killing instrument of the American Army in the ETO...the victory belonged to the combined-arms team-not to any one part of it.”

⁸⁴ H.W. Blakely, “Artillery in Normandy,” *The Field Artillery Journal* (March-April 1949), 54.

portion of corps or a portion of both corps and division artillery would suppress suspected or known enemy positions.

The division of labor between division, corps, and army enabled firing to maneuver and maneuvering to fire simultaneously. Maneuvering to mass fires did not mean the infantry ceased movement. As artillery was firing, the infantry continued to advance around and toward enemy positions. The Wehrmacht recognized these American tactics. In a report dated October 23, 1944, the Army Group B Intelligence section described American operations characterized by “exceptionally strong use of equipment and preservation of manpower...exceptionally strong massing of artillery, lavish expenditures of munitions. Before attacks begin, (the American artillery executes) systematic, lengthy artillery preparations. Infantry and tanks advance behind a heavy curtain of mortar and machine gun fire. The artillery is divided into three groups. The first group supports the main attack with a rolling barrage; the second fires in support of individual calls for fire from the infantry...the third conducts counter-battery...infantry advances only after strongpoints are neutralized...the attack goes according to a well-timed and organized plan...less value is placed on initiative than on coordinated fire support.”⁸⁵ The field artillery did it all at once.

Field Artillery Capability Development during the Interwar Period

Lessons learned from the First World War and enshrined in the doctrine of 1923 guided capability development, resulting in the “trinity” of the field artillery – the forward observer, fire direction center, and the gun line, granting the artillery levels of responsiveness, flexibility, and destructiveness rarely seen before.

⁸⁵ Peter Mansoor, *The GI Offensive in Europe*, 184. According to the author, “In the eyes of the enemy, Allied material superiority enabled American and British forces to execute devastating attacks while remaining cautious with their soldiers’ lives.” However, it was not purely material superiority, but also superior employment of artillery. The new characteristics of the field artillery “trinity” developed during the interwar, especially in the area of fire direction, enabled an incredible massing of fires and could make up for a material inferiority. Using artillery instead of men to destroy the enemy saved lives and underscored the value the US Army placed on the infantry soldier.

Forward Observation

During the First World War, the battery commander was responsible for fulfilling the roles of both the observer and for computing gunnery solutions. This technique hindered responsiveness and flexibility as infantrymen often lacked the ability to shift fires or adjust barrages.⁸⁶ The battery commander was required to place himself between the target and gun line to facilitate communication, preventing him from moving with the assaulting force. Although forward observation officers were often stationed in the infantry trenches, primitive means of communication like hand signals and vulnerable telephone wires limited how far observers could advance. This rendered the artillery often unable to communicate effectively with the infantry or adjust fire as necessary to exploit tactical gains.⁸⁷ Consequentially, most artillery fires during the First World War were unobserved, resulting in a great deal of fratricide.⁸⁸

The post-war boards sowed the seeds that eventually germinated during the interwar with the separation of the battery commander from observation duties. Although the Hero Board stated that artillery liaison was satisfactory during the war, both the Hero and Superior boards attributed deficiencies with infantry-artillery cooperation to a lack of liaison personnel and limited means of communication, while noting the importance of infantry-artillery cooperation. As a result, both boards made recommendations to increase liaison and emphasized the importance of the infantry-artillery team.⁸⁹ The ground was laid for the liaison to become the forward observer.

⁸⁶ John R. Walker, *Bracketing the Enemy*, 27.

⁸⁷ Frank Ratliff, "The Field Artillery Fire Direction Center – Its Past, Present, and Future" *The Field Artillery Journal* (May-June 1950), 116-119.

⁸⁸ John R. Walker, *Bracketing the Enemy*, 4.

⁸⁹ Report of the Hero Board," General Headquarters, AEF (1918-1919), located in the Morris Swett Technical Library, Fort Sill, OK, 16. The board recommended increasing the rank of Chief of Liaison to each regiment to captain, the doubling in strength of liaison officers and detachments provided, sufficient wire and telephone equipment be provided, and that "all junior officers of both infantry and artillery perform frequent short tours of duty with the other branch." The board heavily stressed the necessity of fostering the infantry-artillery team.

Creative artillery officers in the gunnery department at the field artillery school understood the possibilities of liaison personnel acting as forward observers. In the late 1920s, they developed new techniques that divorced the battery commander from the role and created the role of forward observer with modern techniques.⁹⁰ By 1940, Field Manual 6-20, *Field Artillery Field Manual: Tactics and Technique* codified the new observation construct. Several diagrams were included that mirrored those found in the *Digest of Field Artillery Developments* of 1935. The diagrams detailed observers co-located with infantry elements, with a fire mission architecture leading straight to the field artillery battalion headquarters. (See Figure 1)

⁹⁰ Frank Ratliff, "The Field Artillery Fire Direction Center – Its Past, Present, and Future" *The Field Artillery Journal*, 116-118. The author assigns chief credit to the observation and FDC developments to former Directors of the Department of Gunnery of the Field Artillery School, Majors Carlos Brewer and Orlando Ward, and then to Major General H.L.C. Jones, who, as a battalion commander with the 2d BN, 77th FA, tested many of the ideas.

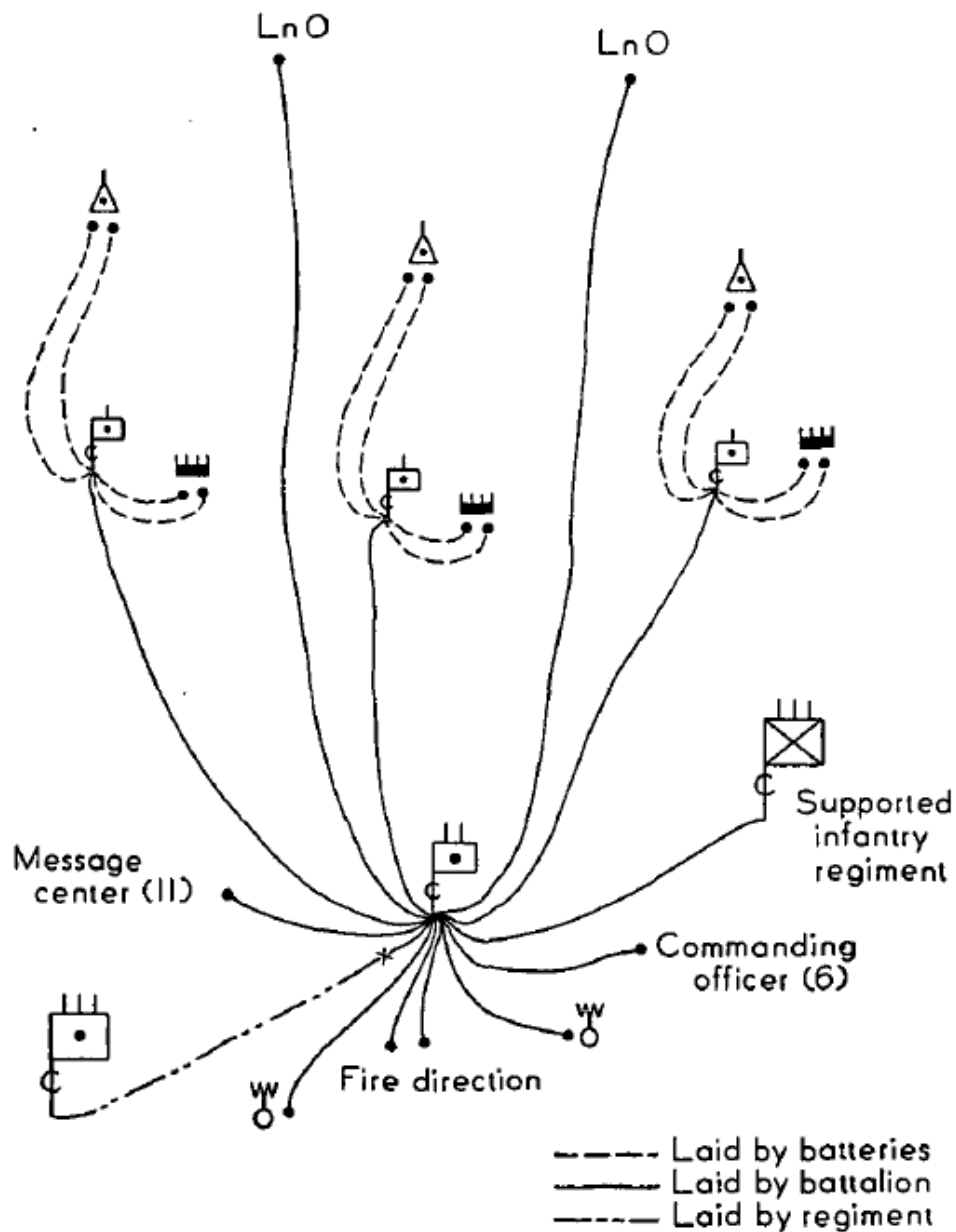


Figure 1: Fire mission architecture using liaison personnel to observe. Field Artillery Field Manual (FAFM) 6-20, *Tactics and Technique* (Washington, DC: War Department, 1941), 84.

The infantry-artillery team was reborn. The process of adjusting fires, now the only duty of the observer, was simplified and limited to sensing.⁹¹ Dedicated observers and liaison

⁹¹ The Field Artillery School, *Digest of Field Artillery Developments* (Fort Sill, OK: Printing Plant, 1935), 12-13. The Digest states that if the observers are fully employed, "there normally will be more observers than batteries." This created the need for centralized tactical fire direction at the battalion

personnel allowed for far greater responsiveness and flexibility. Liaison personnel populated the front lines acting as forward observers and were able to stay with the infantry to call for fires immediately upon contact and to shift fires. Field artillery battalions exploited the radio for improved communication between the observers and the fire direction center. On the Island of New Georgia during the Second World War, improved infantry-artillery coordination improved the execution of First World War style rolling barrages, and made the use of artillery possible in the jungle.⁹² It also allowed for the combined arms technique of maneuvering to mass fire, as forward observers attacked with artillery immediately upon contact and maintained fire until it destroyed or neutralized the enemy. During Operation Cobra, the attempt to break out into France after the Normandy landings, observers rode in the lead tanks and called in artillery fire upon contact.⁹³ Infantry-artillery coordination reached a new high during the Second World War.

Aerial Observation

The Hero and Superior Board took a hard look at aerial observation during the First World War and found it to be unsatisfactory. The Hero Board placed much of the responsibility on the Air Service, stating, “It seems that the personnel of the Air Service did not in general realize that their primary duty is that of observation” and that “the making of aces has been lauded too much – the work of observers, not enough.”⁹⁴ Thus began a twenty-plus-year struggle between the Army Air Corps and Field Artillery Branch over control of air observation platforms.

level. Tactical fire direction included making decisions as to which missions take precedence. It also included determining what firing unit would execute the fire mission.

⁹² John R. Walker, *Bracketing the Enemy*, 73. Rolling barrages on New Georgia began “close to the infantry and moving ahead 500 yards in increments of 50-100 yards. When the troops followed closely, they typically incurred few, if any, casualties.”

⁹³ Michael Doubler, *Busting the Bocage*, 58.

⁹⁴ Report of the Hero Board,” General Headquarters, AEF (1918-1919), 36.

Contending against an Army Air Corps infected with parochialism and the majority of the Army budget, field artillery leaders ultimately prevailed in time for the Second World War.⁹⁵

In 1939, Major General Robert Danford, then Chief of the Field Artillery, began a full court press for the artillery to gain control of aerial observation assets. In the May-June 1939 edition of *The Field Artillery Journal*, three articles and one editorial appeared advocating for the importance of aerial observation. One article emphasized the need for artillery control over aerial observation, citing General Charles Summerall, who advocated for artillery control over aerial observation assets.⁹⁶ Another article explored using a primitive helicopter as a platform.

Lieutenant Colonel John Wogan contributed an article for the February 1941 edition of *The Field Artillery Journal* advocating for artillery control over aerial observation assets, even arguing that the program would save money in the end by conserving the amount of artillery ammunition fired by reducing the need to adjust fire. The artillery community's concern was understandable considering that most artillery missions from the First World War were unobserved, and that many artillery officers, to include Wogan, were not happy with the performance of the air service during that war.⁹⁷

The Louisiana Maneuvers of 1940 and 1941 demonstrated the need for dedicated aerial observation platforms. William Ford, an artillery officer who also piloted aircraft in his spare time, shared his experiences from the Louisiana Maneuvers in an article for *The Field Artillery*

⁹⁵ Edgar F. Raines, Jr, *Eyes of Artillery: The Origins of Modern U.S. Army Aviation in World War II* (Washington, DC: Center of Military History, 2000), 15. The author outlines the struggle between an Air Corps, backed by substantial budgets and emphasis from the highest levels, against the Field Artillery, which, in the eyes of interwar theorists, had lost importance. In 1931, the budget of the Air Corps was nearly thirty-six *million* dollars. The infantry received close to sixty-six *thousand* dollars. The Field Artillery received nearly twenty-one *thousand* dollars.

⁹⁶ H.W. Blakeley, "We Must See With Our Own Eyes" *The Field Artillery Journal* (May-June 1939): 215. General Summerall stated, "All aerial observers must be composed of artillery personnel and must absolutely be under the control of the artillery. We shall never get successful results by the methods that have been pursued in this war (the First World War)."

⁹⁷ John Wogan, "Air Observation of Artillery Fire" *The Field Artillery Journal* (February 1941), 115-116. The total savings for increasing observed fires by only ten percent amounted to a division saving \$21,235 per day.

Journal titled “Wings for Santa Barbara,” in which he described the difficulty encountered establishing suitable observation posts due to the terrain (after pointing out that not all terrain resembles that of Fort Sill.) As a result, the artillery struggled to provide adequate fires. He went on to suggest each field artillery battalion receive an organic light airplane manned by a trained field artillery observer.⁹⁸ General Danford read the article and used the maneuvers to further his case. After General Danford submitted his appeal directly to the Secretary of War, the Field Artillery acquired its aircraft in 1942.⁹⁹ William Ford would go on to run the Department of Air Training, the forerunner to the modern US Army Aviation School.

In the end, the Army assigned two aircraft to every field artillery battalion headquarters and two aircraft to the division artillery headquarters.¹⁰⁰ (See Figure 2) By the end of the war, ground forces owned over 1500 planes.¹⁰¹ Adjustments made from aircraft were more accurate than ground based observers, as deviations sensed in the air were more accurate than as sensed from the ground. This enabled aerial observers to fire immediately for effect, as opposed to ground observers, who had to adjust with several salvos.¹⁰² Aerial observation enabled the observation of enemy positions in defilade. Aerial observers detected enemy firing batteries, allowing for pro-active counter-battery fires.¹⁰³

⁹⁸ William Ford, “Wings for Santa Barbara” *The Field Artillery Journal* (April 1941): 232-234.

⁹⁹ Edgar F. Raines, Jr, *Eyes of Artillery*, 80. Several variants of aircraft were tested during successful proofs of concept, thanks to the technical competence individuals like Ford and other hobbyists. For additional details see pages 57-83.

¹⁰⁰ John J. McGrath, *Fire For Effect*, 67.

¹⁰¹ Edgar F. Raines, Jr, *Eyes of Artillery*, 3.

¹⁰² The Field Artillery School, *Digest of Field Artillery Developments*, 18.

¹⁰³ Aerial observers enabled proactive counter-fires as opposed to reactive counter-fires. Reactive counter-fires were conducted after the enemy has already fired, and friendly forces were reliant on sound and visual techniques to determine the location of enemy firing units.



AN L-4 WITH A FAIRCHILD K-24 AERIAL CAMERA MOUNTED FOR OBLIQUE PHOTOGRAPHS TAKES OFF FROM THE ANZIO BEACHHEAD, 1944.

Figure 2: L-4 Aircraft. The Army assigned each field artillery headquarters within the division two organic aircraft, for a total of ten. Photograph from Edgar F. Raines, Jr, *Eyes of Artillery: The Origins of Modern U.S. Army Aviation in World War II*, 176.

During the Second World War, aerial observation proved its worth. Artillery observers conducted more fire missions than did ground observers during the Second World War.¹⁰⁴ In Normandy and in the Pacific, where terrain greatly limited the visibility of ground observation, weather permitted aerial observation, and the Allies achieved air superiority, aerial observers achieved “universally excellent results.”¹⁰⁵ However, just as with any aerial platform, weather was a limiting factor that prevented the use of aerial observation platforms. For example, on June 13, 1944, weather prevented aerial observers from supporting the 2nd Armored Division’s attack

¹⁰⁴ John R. Walker, *Bracketing the Enemy*, 5.

¹⁰⁵ Michael Doubler, *Busting the Bocage*, 38.

toward Carentan, a situation which, according to Lieutenant Colonel Carl Hutton, limited the division's success that day.¹⁰⁶

The Fire Direction Center

The development of the Fire Direction Center (FDC) revolutionized the employment of artillery. The FDC made artillery more responsive, flexible, and destructive by enabling the artillery to mass several batteries, battalions, and even divisions, in a timely manner. In effect, it allowed the infantry-artillery team to place an unprecedented amount of firepower on a single point against targets of opportunity.

Fire direction methods used during the First World War were time consuming and relatively unresponsive. The battery was the basic firing unit. The battery commander, using complex instruments and mathematical computations, performed the roles of both the observer and gunnery computer. His computations translated the position of the target in relation to the battery into gunnery solutions. After laying the battery, the commander occupied his chosen observation post. For the rapid preparation of fire, the first step was to determine the direction of fire, site (altitude differential between target and battery), and range. To accomplish this, he measured a series of angles between the target areas, gun positions, and aiming point, allowing him to send commands to the battery (See Figure 3). The battery commander's telescope, aiming circle, and prismatic compass allowed him to measure horizontal angles and site. Field glasses and range finders assisted him with observation and to measure range.¹⁰⁷

¹⁰⁶ Edgar F. Raines, Jr, *Eyes of Artillery*, 210.

¹⁰⁷ Training Regulation (TR) No. 430-85, *Field Artillery: Gunnery for Field Artillery* (Washington DC: War Department, 1930), 30-70. Determining the firing angle (the clockwise horizontal angle from the target (T) to the aiming point (P)) was a means of determining direction to fire. The commander determined it mechanically using instruments like the battery commander telescope and aiming circle or through computations.

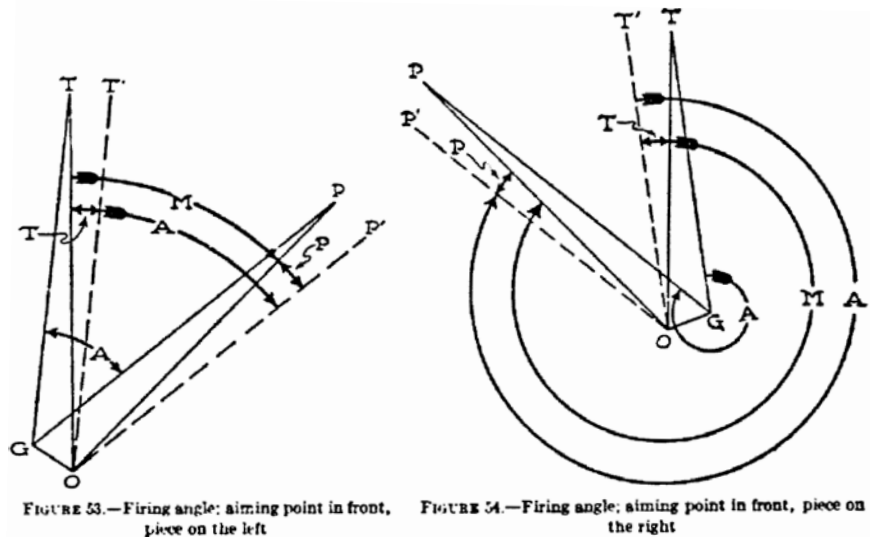


Figure 3: Computation of the Firing Angle (A), Training Regulation (TR) No. 430-85, *Field Artillery: Gunnery for Field Artillery*.

After determining the direction of fire, site, and range, the battery commander accounted for non-standard deviations, to include projectile weight, powder lot, and meteorological data. He then applied these corrections to his initial computations and converted his computations into a gunnery solution for the battery. The Data Correction Sheet was a tool used by the commander to account for non-standard conditions, and to compute the ultimate firing solution sent to the battery (See Figure 4). The final firing solution included an adjusted tube quadrant elevation and deflection. Each battery commander was responsible for computing the firing solution for his battery in this manner or in others as outlined in Training Regulation (TR) 430-85.¹⁰⁸

¹⁰⁸ Training Regulation (TR) No. 430-85, *Field Artillery: Gunnery for Field Artillery*. The TR also includes procedures for deliberate, rather than rapid preparation for fire. The commander used them if sufficient preparation time was available.

DATA CORRECTION SHEET									
Date		193		Time		M. Org.		Target	
Type of Piece		Projectile		Powder Lot No.		Charge		Fuze	
Basic Data		Zone Symbols		Message		Wind Components			
Alt. Btry. =	ft.	Max. Ord. in hundreds of ft.	Line of message	3.	Direction of Wind =			
Alt. Tgt. =	ft.	0 to 6	1	Alt. of M.D.P. =	00 ft.	Direction of Fire = (—)			
Map Range =	yds.	6 to 15	2	Temp. =	°F.	Chart Direction =			
Max. Ord. =	ft.	15 to 30	3	Wind Dir. =	000°	Range Wind for 1 m/h =			
Dir. of Fire =	000°	30 to 45	4	Wind Vel. =	m/h	Cross Wind for 1 m/h =			
Front of Tgt. =	yds.	45 to 60	5	Density =	%				
		60 to 90	6	Btry. ... 00 ft. {above}	MDP				
		90 to 120	7	{below}					
		120 to 150	8						
		+ 100 ft. alt. = - .3 % density							
		+ 100 ft. alt. = - .2 °F temp.							
EFFECTS									
RANGE					DEFLECTION				
Known Values		*Position and Matériel		Weather		Known Values		Effects yd.	
Map Range	00 yds.	+	-	+	-	Drift	+	-	
*Position	ft.					DE			
*Wt. of Proj.	f/s					Cross wind	m/h		
Pow. Temp.	°F.					Cant (R/L = +)			
*V	f/s					TOTAL			
Cor. Density	%					NET EFFECT			
Cor. Temp.	°F.					The correction is Left if Effect is (—), Right if (+).			
Rn. Wind	m/h								
TOTAL									
NET EFFECT									
CORRECTIONS									
RANGE					DEFL. TION				
					No. 4 No. 3 No. 2 No. 1				
Map Range					Deflection				
Correction					Shift				
In. Range					Def. Difference				
In Elev.					Uncorrected Def.				
Adj. Range					Correction (R) or (L)				
Adj. Elev.					Initial Deflection				
Rn. error					Adj. Deflection				
(Note: The sign of V-change will be minus if Adjusted Range is greater than Initial Range.)					DE-change = (Initial Defl. — Adjusted Defl.)				
V-change = $\left(\frac{\text{Range error} \times 10}{\text{Rn. change for 10 f/s @ Map Rn.}} \right)$					(Note: The sign of DE-change will be minus if Adjusted Deflection is to Left of Initial Deflection.)				
V-change =					Old DE =				
Old V =					New DE =				
New V =									
FINAL CORRECTIONS (Barrage or Concentration)									
Net Weather Correction, Range = (±)					Defl. Correction = (R) (L)				
Elev. Correction = (±)					(Cross Wind)				
(At Initial Range)									

Figure 4: The Data Correction Sheet. Training Regulation (TR) No. 430-85, *Gunnery for Field Artillery* (Washington, DC: War Department, 1930).

These procedures hindered the massing of more than one battery. If the battalion wished to mass all firing batteries onto one target area, each battery commander would go through the

process of calculating the gunnery solution for his battery. If no maps were available and the battery commander could not visually acquire the target, the process took even longer, as each individual battery had to adjust onto the target. Unreliable communications between the battery commanders and the battalion staffs exacerbated the problem. Battalion staffs, responsible for target designation (also referred to as tactical fire direction), struggled to communicate information to the battery commanders who often could not see the targets.¹⁰⁹

The development and approval of the FDC concept took over ten years. Between 1929 and 1935, two directors of the Fort Sill Department of Gunnery, Majors Carlos Brewer and Orlando Ward, developed the FDC. Their methods were subsequently tested by Major General H.L.C. Jones, then the battalion commander of 2d Battalion, 77th Field Artillery. Jones later served as the director of the Gunnery Department and further pushed the idea of the FDC. Initially rejected by the War Department in 1939, the War Department subsequently adopted the FDC in 1941 after a demonstration for the Chief of Staff of the Army, General George C. Marshall. The demonstration massed the fires of four artillery battalions. Subsequent demonstrations included the use of only one observer and no map.¹¹⁰ The FDC turned the battalion into the basic firing unit responsible for conducting both tactical and technical fire direction.¹¹¹

Having the battalion as the basic firing unit created several advantages. First, it allowed for the battalion to mass fires faster than before. The battalion FDC computed the gunnery

¹⁰⁹ Frank Ratliff, "The Field Artillery Fire Direction Center – Its Past, Present, and Future" *The Field Artillery Journal*, 116-119; Michael D. Grice, *On Gunnery* (Charleston, SC: Booksurge Publishing, 2009), Chapter 5.

¹¹⁰ Boyd L. Dastrup, *Cedat Fortuna Peritis: A History of the Field Artillery School* (Fort Leavenworth, Kansas: Combat Studies Institute Press, US Army Combined Arms Center: 2011), 89-90.

¹¹¹ Tactical Fire Direction includes the prioritization of targets, allocation of firing units, and method of engagement to achieve specific effects. Technical Fire Direction includes computing the gunnery solution used by a field artillery piece to engage a target. See Field Manual (FM) 3-09, *Field Artillery Operations and Fire Support* (Washington, DC: Headquarters-Department of the Army, 2014), 1-44.

solutions for each battery, as opposed to each battery commander, with methods, such as the observed fire chart and modern call for fire, that were more efficient. Second, it cut the need for battalion observation posts to communicate with the battery commander to acquire the target. Calls for fire would now come directly to the battalion FDC from the observer, which computed the firing data, removing one link in the call for fire architecture. Third, one observer could now adjust the fires of an entire battalion, without relying on battery commanders. Fourth, observers, equipped with radios, were now free to move with the infantry without regard to maintaining communication with the battery commander. This fostered infantry-artillery teamwork. Finally, when adequate maps were unavailable, battalions were able to mass without each individual battery adjusting on the target.¹¹²

The battalion FDC used new fire direction tools that were far more efficient than previous methods. These include the observed fire chart and the graphical firing table. The observed fire chart was the graphical tool that enabled the FDC to compute gunnery solutions for the batteries. First, FDC computers plotted a common base point on a 1/20,000 grid sheet (Figure 5). The base point was a known point observers used to shift fires from onto identified targets. FDC computers used registration data from each battery to plot battery locations on the chart, with each battery recording base deflection on the base point. Observers had the option to either use check concentrations (recorded known points), the recorded base point, or map coordinates in the call for fire. A sample call for fire from an observer would appear as, “Base point, 500 right, 400 over, target description, can observe.” The FDC would then use the observed fire chart to compute deflection and range setting for the batteries.¹¹³

¹¹² The Field Artillery School, *Digest of Field Artillery Developments* (Fort Sill, OK: Printing Plant, 1935), 1-8.

¹¹³ *Ibid.*, 8-24.

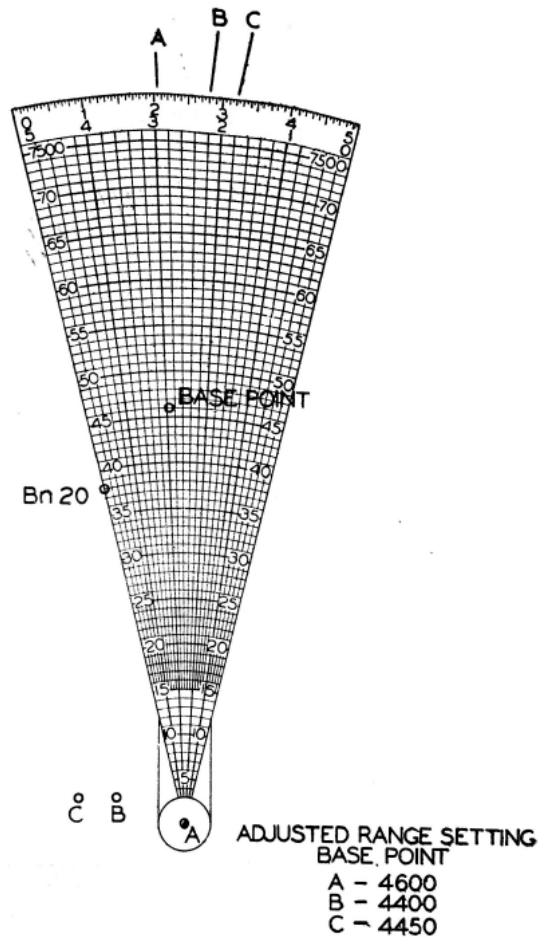


Figure 5: The Observed Fire Chart and Adjustment Fan – Plotting a target from adjusted data. The adjusted solution for Battery A on Bn 20 is “Base deflection left 205, adjusted range (setting) 3800”. The Field Artillery School, *Digest of Field Artillery Developments*, 13.

Division FDCs replicated the technique, allowing for the massing of multiple battalions. This allowed for the conduct of tactical fire direction at the division, which entailed the prioritization of targets in accordance to battlefield realities and needs. This allowed the division to determine which targets required the massed fires of several battalions. Field artillery aerial observation platforms acquired wide-angle photos, used in the construction of 1:20000 gridded firing charts. When survey was not available, the division artillery selected an artillery check point, ideally in the center of the target area on an easily identifiable landmark. Next, each battalion FDC plotted the division artillery check point on their observed fire charts. One battery

per battalion would register on the check point. The division FDC used the reported deflection differential between the registering battery's base point and division check point to plot the battery on the division chart. The information for the other batteries included on the battalion's chart was then included on the division chart. The result was a working chart at the division FDC and a fire possibilities chart, showing each battalion's sector of fire.¹¹⁴ (Figure 6)

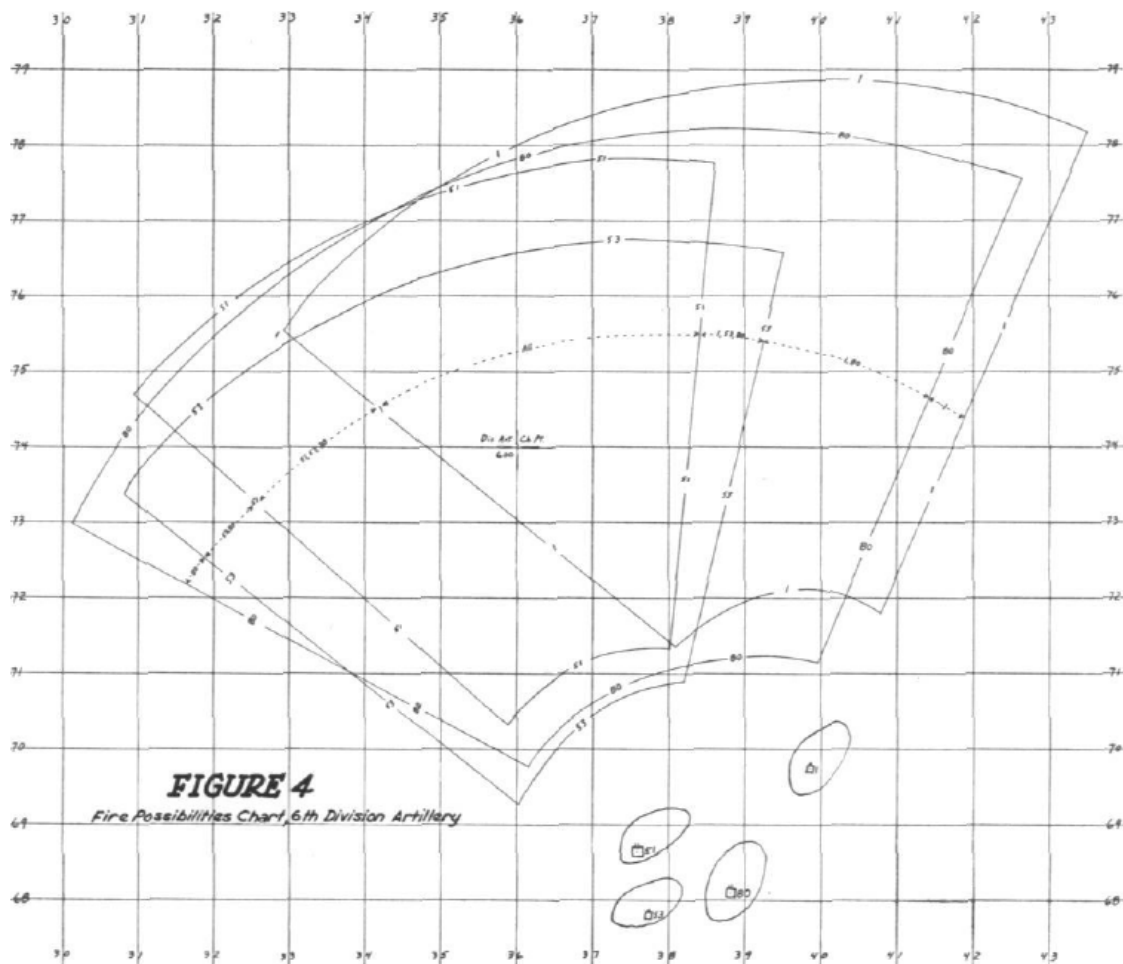


Figure 6: Fire Possibilities Chart, 6th Division Artillery. E.B. Gjelsteen, "Fire Direction Technique for Groupment and Division Artillery" *The Field Artillery Journal*, 193.

¹¹⁴ E.B. Gjelsteen, "Fire Direction Technique for Groupment and Division Artillery" *The Field Artillery Journal* (March 1942), 184-194.

The FDC enabled outstanding artillery support throughout the war. Commanders were able to mass an almost unlimited number of field artillery battalions to devastate the enemy. On March 11, 1942, General MacArthur stated, “The strong effect of massing artillery fire, using a fire direction center connected with all observation posts available, has been proven beyond question...in many situations that seemed desperate, the artillery has been a most vital factor.”¹¹⁵ By 1945, Field Manual (FM) 6-40, *Field Artillery Gunnery* codified the new equipment, methods of fire direction, and the lessons learned from the war; techniques that resemble those in use today.¹¹⁶

Field Artillery Piece Development

The field artillery became more mobile and more powerful during the interwar period. Developments in motorization and mechanization allowed the field artillery to maintain pace with the infantry and cavalry. Truck-towed field artillery and self-propelled field artillery replaced the horse drawn gun carriages and caissons of the First World War. At the same time, the field artillery became more powerful. Larger caliber field pieces replaced the 75mm gun. The effect on combined arms was enormous; the artillery, moving with the infantry, could respond immediately with destructive force.

US Army field artillery pieces during the First World War lacked the ability to support mobile warfare. The guns lacked mobility and had limited traverse and quadrant elevation capability. As a result, they struggled to maintain pace with the infantry and had limited zones of fire. The French 75mm gun served as the primary field piece for the AEF. Its box style trail

¹¹⁵ Frank Ratliff, “The Field Artillery Fire Direction Center – Its Past, Present, and Future” *The Field Artillery Journal*, 119.

¹¹⁶ Field Manual (FM) 6-40, *Field Artillery Gunnery* (Washington, DC: War Department, 1945). The development of more precise instruments and instruments that reduced fire mission processing time accompanied the development of the observed fire chart. An example is the Graphical Firing Table. The graphical firing table was a logarithmic instrument used as a “shortcut” that replaced conducting calculations by hand.

limited the range of the gun to traverse and elevation of the cannon tube. Speed of traverse and elevation were limited. The carriages were limited to speeds of fifteen miles per hour or less, towed by horses or slow moving tractors. Other artillery pieces used by the AEF, such as the 4.7-inch gun and 155mm howitzer had similar limitations.¹¹⁷

The Westervelt Board recognized the artillery's limitations. The board's recommendations, although not immediately fulfilled, led to the transformation of the field artillery. The board called for a higher caliber howitzer of at least 105mm to serve as the light field gun. The board recognized the success of the 155mm howitzer and recommended for its retention. For heavy artillery, the board recommended higher calibers, such as the 8-inch howitzer with a range of at least 35,000 yards. The board recommended a suitable accompanying gun for the infantry. Regarding zones of fire and mobility, the board recognized the need for new carriages and self-propelled artillery. The board recommended that new field pieces have the ability to traverse 360 degrees and fire at a quadrant elevation of at least 65 degrees. Recognizing international developments, the board saw value in the split-trail type carriage that offered increased ability to traverse and elevate. The board emphasized heavily the need for motorized artillery towed by both tractors and trucks. It specified the characteristics of trucks, tractors, and trailers recommended for development.¹¹⁸

Throughout the next two decades, the US Army experimented with means of transportation and gun carriages. Although several concepts were tested, none would enter production until the early 1940s. There was a strong baseline to start with; the Army had begun building self-propelled artillery, trucks, and tractors during the First World War, although the AEF never employed them. Intended to motorize 75mm batteries, efforts included loading guns

¹¹⁷ G.M. Barnes, "Division Artillery in the Next War" *The Field Artillery Journal* (May-June 1919): 239-240.

¹¹⁸ "Report of a Board of Officers Convened to Make a Study of the Armament and Types of Artillery Materiel to be Assigned to a Field Army" (Washington, DC: War Department, 1919).

on special trailers for movement and towing the guns using artillery tractors and heavy-duty trucks (Figure 7). Caterpillar gun mounts were in production that mounted eight-inch, 240mm, and 155mm guns to create self-propelled artillery.¹¹⁹

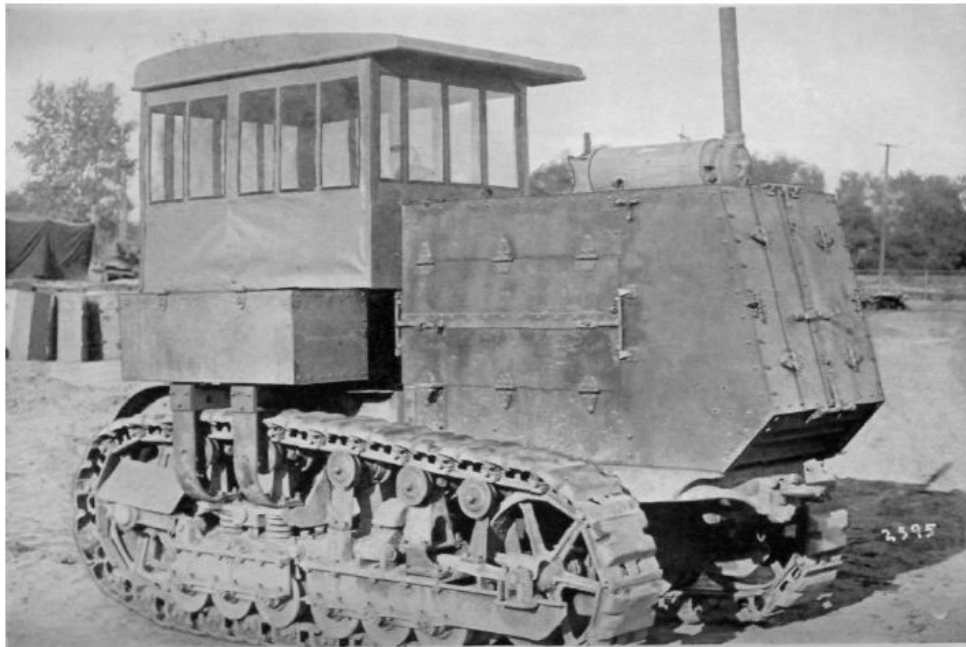


Figure 7: 10-ton tractor designed to tow artillery during the First World War. The US Army never employed it during the war. W.R. Conolly, “Motor Transportation for Artillery” *The Field Artillery Journal*, 265.

After the US Army Chief of Staff approved the Westervelt Board’s recommendation for a 105mm howitzer, the department and field artillery started development using captured German 105mm pieces. In the mid-1920s, the Field Artillery Board tested a 105mm howitzer at Fort Bragg, North Carolina. One of the howitzers was on a split-trail carriage. Although an improved box style carriage was selected in the interim, work on split-trail carriages continued.¹²⁰ The Army developed a 75mm pack howitzer on three separate carriages, to include the M3, a carriage

¹¹⁹ W.R. Conolly, “Motor Transportation for Artillery” *The Field Artillery Journal* (July-August 1919): 255-275. The article was based on a lecture given by the author at the Center of Artillery Studies, Treves, Germany, April 19, 1919.

¹²⁰ “Report of the Chief of the Field Artillery for 1923-1924” *The Field Artillery Journal* (March-April 1925), 135-137.

with split-trail capability. The 75mm pack howitzer served in the Second World War and beyond. However, the pack howitzer did not meet all specifications set out by the Westervelt Board, requiring further development.¹²¹

Although starved for funding, the field artillery continued to press for improvements in accord with the recommendations of the Westervelt Board. The Watertown Arsenal experimented with and developed new carriages in order to meet the board's requirement for a weapon capable of high-speed tow, 360-degree traverse capability, and at least 60-degree tube elevation. The results were the T2 and T3 carriages. They had tires, split trails, greater angles of traverse, improved quadrant elevation, and the capability to establish in a 360-degree firing mode with the wheels removed, for an emplacement time of four minutes. With the wheels still on, it was able to fire in a 90-degree arc, improving emplacement time to one minute. Panoramic sights, gunner's quadrants, and simplified trunnions increased the speed at which the gunners laid the piece and adjusted during fire. The T3 was capable of mounting both a 75mm and 105mm tube.¹²² (Figure 8) To meet the requirement for a self-propelled piece, the technicians placed the T3 on the back of a truck and maintained the ability to conduct 360-degree operations.¹²³ This type of split-trail carriage had great advantages over box style carriages. Since the cannon was mounted on a pintle on the split-trail carriage rather than on the axle of the box style carriage, it had a greater ability to traverse and elevate (Figure 9).

¹²¹ "The Annual Report of the Chief of the Field Artillery – 1931" *The Field Artillery Journal* (November-December 1931), 588-589

¹²² G.M. Barnes, "Division Artillery in the Next War" *The Field Artillery Journal* (May-June 1930), 239-255.

¹²³ G.M. Barnes, "75mm Gun Mount, T3, on 6-Wheel Truck Mount" *The Field Artillery Journal* (November-December 1930), 666-670.



Figure 8: T3 gun mount in 90 degree firing mode. The split trail setup allowed for greater traverse and tube elevation than a box trail setup allowed. G.M. Barnes, "Division Artillery in the Next War" *The Field Artillery Journal*, Frontispiece.

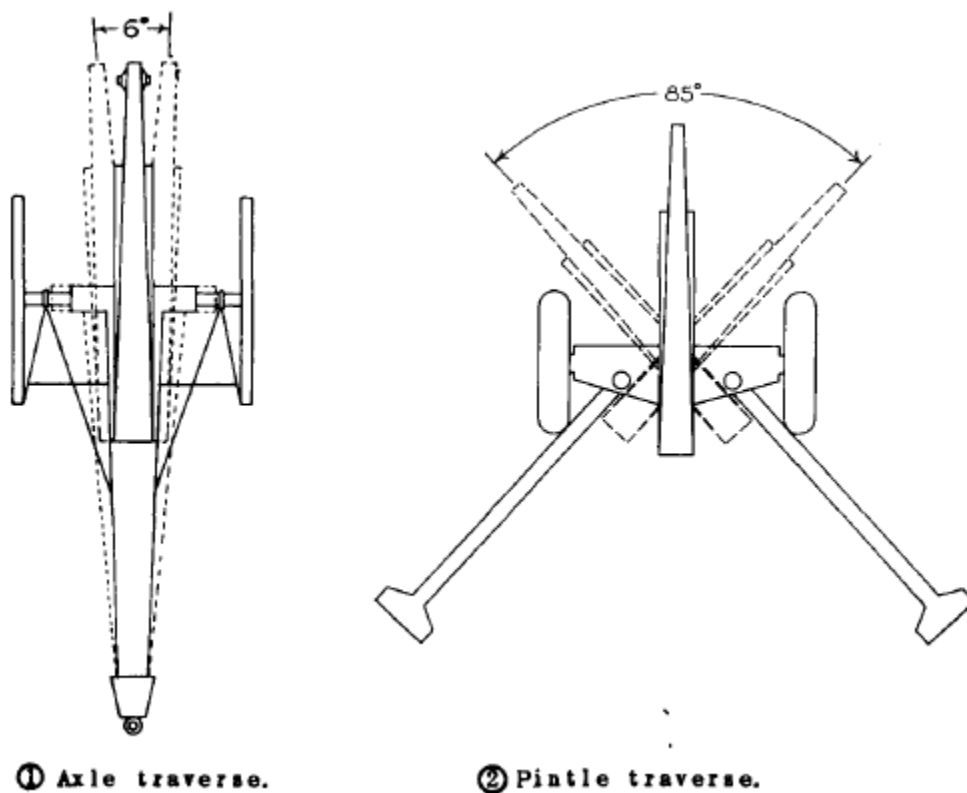


Figure 9: A box style carriage on the left and split-trail style carriage on the right. Note the improved ability to traverse and elevate afforded by using a cannon mounted on a pintle and split trail carriage. *Fundamentals of Field Artillery* (Fort Sill, OK: Field Artillery School, 1942), 19.

By the end of 1940, all of the major recommendations made by the Westervelt Board were under manufacture for mass production. At the division level were included, but not limited to, the M1 105mm howitzer and M1 155mm howitzer which shared the same chassis. The M1 105mm howitzers were direct support assets, while the M1 155mm howitzers were general support assets controlled by the division artillery. The 105mm and 155mm M1s were also located in non-divisional artillery battalions. At the corps level were included the M2 155mm gun “Long Tom,” and the M1 8-inch howitzer, both of which shared the same carriage. The M1 8-inch gun and M1 240mm howitzer “Black Dragon” shared the same chassis and made up the Army’s heavy artillery. These heavy artillery pieces were also located in non-divisional artillery battalions. These heavy pieces, while not as mobile or quick to emplace, were mobile enough to operate in the mountainous Italian terrain. Each infantry regiment was equipped with a regimental cannon company comprised of M3 105mm snub-nosed howitzers for close support. Paratroopers were equipped with 75mm and 105mm pack howitzer of both box and split-trail variants. Animals and quarter-ton trucks moved the M1A1 pack howitzer. Paratroopers were able to dismantle the M1A1 and drop it from aircraft. The M12 155mm self-propelled gun preceded the M7 “Priest,” a self-propelled artillery piece with a 105mm howitzer tube. These self-propelled pieces saw extensive service in Europe.¹²⁴

This new family of artillery pieces was able to range farther, offered increased mobility, and had the ability to better traverse and elevate. Range increased by an average of almost 5,000 yards between 1938 and 1943. The longest shooters were now able to reach out to beyond 20,000

¹²⁴ Frank E. Comparato, *Age of Great Guns* (Harrisburg, PA: The Stackpole Company, 1965), 123-125; Ian Hogg, *The Guns 1939-45* (New York, NY: Ballantine Books, 1970), 40-47; John H. McDonald, “The Cannon Company: A World War II Solution to the Close Support Problem of the 1990s” (SAMS Monograph, US Army Command and General Staff College, 1988), 9-11.

yards in 1943, and in one case, beyond 30,000 yards, versus 18,000 yards in 1938.¹²⁵ Mobility went from an average of fifteen miles an hour to over thirty. The fast emplacement times and flexibility of traverse and elevation made these guns fare more responsive and flexible than the artillery of the First World War. Advances in propellant, fuses, and munitions increased the safety, range, reliability, and destructiveness of field artillery fires.¹²⁶ Shared chassis and cannon tubes reduced strain on the logistical system. The gun-line finally caught up with developments in observation and fire direction, allowing it to maintain pace with the infantry.

Field Artillery in North Africa

North Africa was the crucible that re-taught the US Army the importance of combined arms. Although FM 100-5 advocated for combined arms, inexperience, lack of training opportunity, and branch school instruction set the stage for early defeats. During the “race for Tunis,” following the Operation Torch landings, the Allies attempted to imitate “Blitzkrieg” tactics against the German combined arms force, instead of first building up combat power. The outcome was initial defeat at Kasserine.¹²⁷ However, by the end of the campaign, the US Army conducted combined arms effectively and learned the importance of field artillery integration. US Army field artillery performed superbly from the outset due to interwar developments and continued interaction with the infantry.¹²⁸

¹²⁵ The average ranges listed were computed using the ranges in yards from various tables in the source. The longest ranging ammunition for each piece was used in the calculation. See Boyd L. Dastrup, *King of Battle*, 202, 237.

¹²⁶ Advances in fuses reduced premature bursts, duds, and were standardized to fit all calibers by 1940. New propellant developed greatly reduced flash from the bore. The old power produced a flash visible for miles. See Frank E. Comparato, *Age of Great Guns*, 93-95.

¹²⁷ John Ellis, *Brute Force*, 296. In the battles near Tebourba, American tanks executed what amounted to “cavalry charges...isolated and unsupported.”

¹²⁸ Michael Doubler, *Closing with the Enemy*, 15. The tank school still taught to employ tanks in mass, rather than in concert with the infantry.

After his defeat at El Alamain, Field Marshall Erwin Rommel focused his attention west. His initial intent was to force the Allies from Tunisia. After a series of German attacks, the Allies found themselves retreating and taking up defensive positions. The Allies established defensive positions near Sbiba to the east, to the north of Kasserine Pass near Thala, and to the west near Djebel El Hamra. Field artillery played a decisive role at each location, displaying the capabilities gained during the interwar.

The first action occurred to northeast of Kasserine by Sbiba, where the 21st Panzer Division under the command of Hans-George Hildebrant conducted an armored thrust north along highway 71. Allied field artillery twice repulsed German attacks near Sbiba. Hildebrant, “attempting to storm Allied ridge positions, attacked w/ infantry while artillery held down the defenders. Forty tanks made a wide sweep around the flank to envelop the village (Sbiba) from the rear and to cut the road leading north.”¹²⁹ It was here the artillery displayed enormous flexibility and destructiveness, massing fires quickly against enemy tanks coming from an unexpected direction. The guns “fired with disturbing accuracy... rendering it (the attack) ineffective and irresolute, mainly as a consequence of the volume and accuracy of artillery.”¹³⁰ One American soldier described the effect of 105mm shells on tanks as “taking shoe boxes and shoving them flat.”¹³¹

In the west, Rommel instructed the Afrika Korps, under the command of General Karl Robert Max Beulowius, to block the roads west to Tebessa and conduct an armored thrust north to Haidra. Combat Command B (CCB) of the 1st Armored Division had taken up defensive

¹²⁹ Martin Blumenson, *Kasserine Pass* (New York, NY: The Berkeley Publishing Group, 1983), 251.

¹³⁰ *Ibid.*, 251.

¹³¹ Rick Atkinson, *An Army at Dawn: The War in North Africa, 1942-1943* (New York, NY: Henry Hold and Company, 2002), 378.

positions along the Djebel El Hamra, a series of hills running north to south, intersected in the middle by the road leading to Haidra. Immediately to the south, elements of the 1st Infantry Division defended the Bou Chebka Pass. The Americans repulsed the initial German attack, using the terrain to establish defensive positions in conjunction with registered howitzers. The howitzers massed fires on the forty German tanks, destroying at least ten tanks.¹³² The Afrika Korps attempted one more attack against this position by flanking to the south, striking the seam between the CCB and 1st Infantry Division, only to be repulsed again by the artillery. Directed by the 1st Infantry Division Artillery commander, Brigadier General Clift Andrus (later to command the 1st Infantry Division), the Division's artillery repulsed the attack, sending the Afrika Korps into retreat. One battalion, the 27th Field Artillery, "fired more than 2,000 rounds, and others were nearly as prodigal."¹³³ "The German troops were astonished by the flexibility and accuracy of American artillery, which knocked out a good many...German and Italian tanks."¹³⁴

It was on highway 17 where "the final act played out."¹³⁵ Observing the difficulties had by the Afrika Korps in the west, Rommel decided to attack north with the 10th Panzer, consisting of approximately "fifty tanks, 2500 infantrymen, and thirty guns" through Thala.¹³⁶ Suffering from a series of defeats, Allied forces at Thala fielded obsolete tanks, consisted of green units, and lacked fire support. In what was one of the most dramatic moments of the war, the 9th Division Artillery, commanded by Brigadier General Le Roy Irwin, arrived at approximately 8 p.m. on Sunday, February 21st. The 9th Division Artillery, consisting of three battalions and two

¹³² Ibid., 380. The Americans lost one tank.

¹³³ Ibid., 381.

¹³⁴ Martin Blumenson *Kasserine Pass*, 266-267.

¹³⁵ Rick Atkinson, *An Army at Dawn*, 382.

¹³⁶ Ibid., 384.

cannon companies, conducted a 735 mile forced march from western Algeria to Thala, moving through horrendous weather to include blizzard conditions. Upon arrival, the artillery established in firing positions throughout the night and immediately began massing artillery fire against the 10th Panzer until Monday evening, causing the 10th Panzer to call off the attack and withdraw south through the Kasserine Pass. This action earned the 9th Division Artillery the Distinguished Unit Citation.¹³⁷ In effect, “the battle of the Kasserine Pass ended that Monday morning of the 22nd with the opening volleys of Irwin’s artillery pieces.”¹³⁸

The Allies conducted a slow, methodical movement south through the Kasserine pass after successfully defending Thala. Their form of maneuver was conducive to the destruction of enemy forces through massed fires immediately upon identification. Placing the infantry on the high ground to enable the visual acquisition of enemy forces, forward observers co-located with the infantry and tanks, while “the tanks and artillery stayed on the floor of the plain.”¹³⁹ The advance through the valley to and into the Kasserine pass represented a technique the US Army would use many times again – instead of committing troops to direct fire action first, they would attempt to destroy the enemy with artillery fire.

A month after the battle of Kasserine Pass near El Guettar, maneuvering to mass fires played a central role. Colonel C.C. Benson, commanding what was known as the Benson Force that equated to half an armored division, was ordered to conduct operations in conjunction with the 1st Infantry Division. Benson’s plan was to attack with tanks, supported by ten battalions of field artillery allocated by II Corps, to place pressure on the Germans, opposite of the British Eighth Army. Colonel Benson ordered one of his infantry platoon leaders escort three artillery

¹³⁷ Robert C. Baldridge, “How Artillery Beat Rommel After Kasserine” *The Field Artillery Journal* (May-August 2002): 48-51. Peter Mansoor, *The GI Offensive in Europe*, 90.

¹³⁸ Martin Blumenson *Kasserine Pass*, 287.

¹³⁹ *Ibid.*, 293-295.

observers, riding in tanks, to high ground approximately two miles forward. Forward observers covered the whole front. “As soon as enemy machine gun fire opened up, the artillery cracked down on it...it was an excellent example of cooperation between infantry, tanks, tank destroyers, and artillery.”¹⁴⁰ The American attack used a reconnaissance-strike technique that maneuvered forward observers to identify and destroy enemy targets with massed artillery fire.

The II Corps artillery supported other maneuver elements around El Guettar. II Corps used its established counter-battery switchboard to mass fires against tank formations. In one instance, forward observers co-located with advancing elements identified targets and called on corps artillery to mass fires on thirty-two German tanks, destroying sixteen. On another occasion, the corps artillery, consisting of 158 field pieces, was capable of massing ten tons of High Explosive (HE) every minute, not including divisional artillery. Air observation played an important role as well.¹⁴¹ The US Army continued to build pressure against the Germans until the end of fighting in North Africa, forcing them to consolidate in order to destroy the Germans by fire.¹⁴²

US Army combined arms defeated Erwin Rommel, considered by modern maneuver warfare advocates as a master maneuverist. The US Army maneuvered to identify and concentrate enemy forces to destroy them with firepower. Lessons learned from North Africa

¹⁴⁰ C.C. Benson, “Some Tunisian Details” *The Field Artillery Journal* (January 1944), 2-3. One captured German soldier inquired whether the American artillery was belt or clip fed.

¹⁴¹ A.J. Rance, “Corps Artillery: How it Was Employed” *The Field Artillery Journal* (December 1943), 886-888. Aerial observation was critical to spotting enemy field artillery near El Guettar.

¹⁴² During the Sedjenane Valley campaign, the infantry, accompanied by forward observers, continued to maneuver to take key terrain that allowed for effective observation of enemy forces and rear areas. In one example, after the 39th infantry secured Hill 406, forward observers directed the 26th field artillery to fire over four thousand rounds into the German rear area, causing the Germans to pull off key terrain. In an example of firing to maneuver, the 1-60th infantry attacked, with bayonets fixed, protected by a rolling artillery barrage, “opening the way to Bizerte.” Maneuvering to mass fires and firing to enable maneuver often complemented each other. See Peter R. Mansoor, *The GI Offensive in Europe*, 93-98.

were carried forward into Europe where the field artillery played an equally, if not more, decisive role.

Field Artillery in Europe

The field artillery played a decisive role in European Theater of Operations (ETO). Massed, concentrated artillery fires, made effective by pressure applied by maneuver, routinely repulsed and destroyed German mechanized formations. During offensive operations, artillery at higher echelons struck simultaneously at targets just outside of direct fire range of friendly infantry and targets in the enemy's rear, while division artillery and reinforcing battalions provided close support. According to Michael Doubler, "By the summer of 1944, the field artillery had proven itself the most brilliant performer in the American combined arms team."¹⁴³

The US Army, upon landing at Normandy, encountered terrain it had not trained for or expected. The terrain, characterized by "small hills, narrow rivers, and steep valleys" restricted mobility and observation.¹⁴⁴ Perhaps the greatest obstacles encountered were compartmentalized plots of farmland, separated by hedgerows, serving as barriers to movement and observation, also known as "bocage." The Germans established excellent defensive positions tied to the terrain. "In Normandy, there were no gaps; the First US Army had to create one through the use of mass and firepower."¹⁴⁵

Aerial observation became critical for identifying targets and massing fires. Each division within the First Army had ten L-4 Piper Cubs or L-5 Stinson Sentinels and additional craft resided at the corps level.¹⁴⁶ Upon VII Corps landing and moving to establish the

¹⁴³ Michael D Doubler, *Closing With the Enemy*, 19.

¹⁴⁴ Michael D. Doubler, *Busting the Bocage*, 12-13.

¹⁴⁵ Peter Mansoor, *The GI Offensive in Europe*, 160.

¹⁴⁶ Michael D. Doubler, *Busting the Bocage*, 37.

beachhead, field artillery air officers established airfields and set conditions for aerial observation operations. The 4th Infantry Division Artillery eliminated two German artillery batteries within thirty minutes of commencing air operations, eliminating all skepticism for the concept of organic artillery aircraft.¹⁴⁷ Aerial observers flew directly over enemy positions in the bocage to locate enemy positions. The planes played a key role in reconnaissance, where the Third Army used L-4 planes to “reconnoiter ahead of the division’s columns.”¹⁴⁸ The planes were so effective that “German artillery batteries were reluctant to fire for fear of revealing their location and exposing themselves to American counter-battery fire.”¹⁴⁹ The responsiveness and availability of the aircraft to serve as forward observation platforms for artillery fire resulted in “universally excellent” results that complemented the ability of the fire direction center to mass fires.¹⁵⁰

To secure the Contentin peninsula, the US Army combined arms team maneuvered to destroy the enemy with field artillery. The Germans, finding themselves in a similar situation as at Bizerte in Northern Africa, faced a broad allied front with their backs against the coast. This included elements of the German 77th, 91st, 243rd, and 709th divisions. The 9th Infantry Division secured the most western route to Cherbourg on the peninsula while the 79th Infantry Division and the 4th Infantry Division secured the central and eastern routes, respectively. Forced to concentrate as maneuver space became limited, the German 77th Division attempted a breakout in the 9th Infantry Division’s sector. The 9th Division Artillery massed fires in support of the 60th Infantry Regiment, leaving a five mile stretch of road littered with destroyed German vehicles and dead.¹⁵¹ In Normandy, “American infantry tended to transpose the doctrine of fire

¹⁴⁷ Edgar F. Raines, Jr, *Eyes of Artillery*, 204-205.

¹⁴⁸ *Ibid.*, 213.

¹⁴⁹ Michael D. Doubler, *Busting the Bocage*, 38.

¹⁵⁰ *Ibid.*, 38.

¹⁵¹ Peter Mansoor, *The GI Offensive in Europe*, 144.

and maneuver into one of maneuver and fire; instead of using fire to fix the enemy and maneuver to trap and destroy him, troops maneuvered to find the enemy and then called in aerial and artillery firepower to try to destroy him.”¹⁵²

Operation Cobra occurred after US forces secured the town of St. Lo, whose purpose was to facilitate a break out south from the restricted terrain of the bocage to more open terrain. The US VII Corps commanded by Major General Joseph Collins comprised the main effort. Opposing the VII Corps was the German Seventh Army, with the Panzer Lehr Division front and center to the south of VII Corps, commanded by General Fritz Bayerlein. In a few short days, the Panzer Lehr Division ceased to exist.¹⁵³

VII Corps brought massive amounts of firepower to bear against the Lehr Division. With air coordination proving disastrous and ineffective (Army Ground Forces Commander General McNair was killed by friendly air), VII Corps relied on field artillery. First US Army allocated nine battalions of 8-inch guns, five battalions of 155mm howitzers, and seven battalions of 105mm howitzers to VII Corps. VII Corps centralized control of the 1st Infantry Division Artillery, and the division artillery of the 2nd and 3rd Armored Divisions. The total hardware available amounted to forty-three field artillery battalions. The effects were overwhelming and “Two days later, Bayerlein walked away from the battlefield, alone.”¹⁵⁴

¹⁵² John Ellis, *Brute Force*, 385. During the fight for St. Lo, elements of the 29th Division, at approximately fifty percent strength, maneuvered to secure the town, which was key terrain due to the intersection of eight roads and one railroad. The unit commander, Colonel Glover Johns remarked, “The town was being held by the artillery, really, as the infantrymen were little more than guards for the observation posts.” Artillery repeatedly halted German counter-attacks. Maneuvering to secure key terrain and observation posts allowed the Americans to exploit the German doctrine of immediate counterattack by destroying German attacking elements with artillery barrages. See Peter Mansoor, *The GI Offensive in Europe*, 157-158.

¹⁵³ Steven J. Zaloga, *Operation Cobra 1944: Breakout From Normandy* (New York, NY: Osprey Publishing Ltd, 2001), 31-39.

¹⁵⁴ Peter Mansoor, *The GI Offensive in Europe*, 166.

After the Allies began the breakout and activated the Third US Army commanded by General George Patton, the Germans counterattacked in what was known as Operation Luttich. The objective of the German Army Group B was to restore its lines near Avranches. The follow-on objective was to cut off the Third Army from the remainder of Allied forces. What followed was the destruction of most of the German 7th Army in the battle of the Falaise Gap, with the exception of those elements that escaped after the Allies failed to complete the encirclement. It was another demonstration that armored thrusts had no chance against overwhelming firepower. The order by Hitler was “the death warrant of the German army in the west.”¹⁵⁵

Once again, the US Army maneuvered on the operational and tactical levels to positions of relative advantage, concentrating the Germans to destroy them with overwhelming firepower. Before the Germans counter-attacked, US forces had maneuvered to key terrain around the city of Mortain. This included Hill 317, which was held by elements of the 1st Infantry Division, and later, the 30th Infantry Division, which bore the brunt of the counter-attack. The 2nd SS Panzer Division “surged through Mortain” and isolated elements of the 2nd Battalion, 120th Infantry on Hill 317.¹⁵⁶ The battalion, supported by both ground and aerial forward observers, called in devastating artillery strikes, and was able to defend the hill for over five days before relief. On the 9th of August, the 30th Division as a whole came under intense German artillery fire. Aerial observers “directed thirty counterbattery missions in one hour,” eventually silencing the German artillery.¹⁵⁷ Later, artillery fire directed by observers on Hill 317 effectively halted the drive by 2nd SS Panzer down Route 177. The 30th Divisional Artillery consisted of over twelve field artillery battalions, to include heavily artillery, all of it brought to bear in defense of Hill 317 and

¹⁵⁵ John Mosier, *The Blitzkrieg Myth*, 232; Martin Blumenson, *Breakout and Pursuit* (Washington, DC: Center of Military History, 1993), 457-459.

¹⁵⁶ Martin Blumenson, *Breakout and Pursuit*, 466.

¹⁵⁷ Edgar F. Raines, Jr, *Eyes of Artillery*, 218.

elsewhere. This was while the gunners had to fight often as riflemen to prevent their battery positions from being overrun.¹⁵⁸ Not only was Hill 317 defended successfully, artillery destroyed a good number of German elements in retreat. Observers directed fire on retreating elements and “the burning columns could be seen for miles in all directions...the slaughter continued all day.”¹⁵⁹ The defense of Hill 317 was an excellent example of maneuvering to positions of relative advantage to destroy opposing forces with artillery fire.

For the rest of the war, the US Army continued to dominate using field artillery in support of combined arms operations.¹⁶⁰ German mobility was no longer possible in the face of such firepower. At one point, captured German veterans of the eastern front testified that “American artillery (was) more powerful and devastating than Soviet artillery.”¹⁶¹ This is quite a statement, considering how the Soviet Army was heavily reliant on its artillery and was known as the “Red God of War.”¹⁶²

Conclusion and Recommendations

First World War experiences shaped the course of interwar development. Doctrine retained the roles of division, corps, and army artillery, enabling a division of labor that allowed

¹⁵⁸ Alwyn Featherston, *Saving the Breakout: The 30th Division's Heroic Stand at Mortain* (Novato, CA: Presidio Press, 1993), 133.

¹⁵⁹ Ibid., 200.

¹⁶⁰ The 90th Infantry Division, while attempting to close the Falaise Gap, used artillery to devastate German elements attempting to escape the pocket. The 90th Infantry Division, in conjunction with the Poles, maneuvered to mass fires in the spirit of the Prussian cauldron battle at Chambois, encircled German forces. Eleven battalions of artillery caused massive destruction, causing 8,000 casualties, destroying 220 enemy tanks, 160 self-propelled guns, and 700 field guns. The scene was described as a “valley of death,” and according to 90th Infantry Division historians, “never in history had artillery enjoyed such a field day.” Peter Mansoor, *The GI Offensive in Europe*, 170-173.

¹⁶¹ Michael D. Doubler, *Busting the Bocage*, 29.

¹⁶² Historian Chris Bellamy titled his book about the Soviet Artillery, *Red God of War*. Stalin allegedly called the artillery the “God of War.” The Russians, before, during, and after the period of the Soviet Union, continually emphasize the role of Artillery. See Chris Bellamy, *Red God of War: Soviet Artillery and Rocket Forces*.

the US Army to attack enemy formations throughout their depths. The return of mobile warfare near the end of the First World War encouraged flexible artillery carriages, motorization, and mechanization that greatly increased the artillery's mobility. The reliance on firepower during the war encouraged the building of even greater caliber guns and howitzers. Limited effectiveness of artillery to exploit success during the war created awareness regarding gunnery and observation techniques.

The field artillery experienced a giant leap forward during the interwar. Improved fire direction techniques allowed for the creation of the field artillery "trinity," consisting of the observer, the fire direction center, and the gun line. New fire direction techniques allowed for faster computation, the use of forward observers in place of the battery commander, and the massing of an almost unlimited number of battalions. Forward observers populated the front and, using simpler observed fire techniques, brought fire to bear against enemy forces almost immediately upon acquiring targets. One observer was able to control the fires of several battalions if needed. Aerial observation platforms enabled the artillery to fire against targets unobservable from the ground and executed the majority of fire missions. Split trail carriages allowed for greater traverse and elevation, making each piece far more flexible and responsive. The mobility of field guns and self-propelled guns allowed the field artillery to maintain pace with the infantry and tanks. Field artillery groups allowed for enormous organizational flexibility and the shuffling of field artillery battalions to execute reinforcing missions where required. This allowed for unprecedented concentrations of massed artillery fires.

Interwar advances enabled the US Army combined arms team to maneuver to destroy enemies with massed artillery fires. The field artillery did more than suppress enemy positions to enable movement and maneuver. The infantry-tank-artillery team maneuvered to positions of relative advantage with good observation in order to attempt the destruction of enemy forces with massive concentrations field artillery. Often, the result was the unprecedented preservation of life

and limb relative to enemy combat power and the answer to enemy armored thrusts. The purpose of maneuver became the identification and concentration of enemy forces to enhance the effectiveness of firepower. Firepower also enabled movement and maneuver; field artillery and mortars at each friendly echelon struck the enemy throughout its depth simultaneously. The important point is that divisional artillery was responsible primarily for close support, while other echelons either reinforced divisional artillery or struck deep. The US Army did not win the war using techniques advocated by modern maneuver warfare theorists who see firepower as a means merely to enable maneuver; it won using overwhelming firepower to destroy enemy forces in a combined arms construct.

Despite an interwar environment that minimized the future role of artillery in favor of armor and air power, the US Army ended up with a force capable of combined arms precisely because of interwar developments in field artillery. Although FM 100-5, *Operations* emphasized combined arms, not all branch schools followed suit, with the Armor school advocating for massed tank attacks. The Army Air Corps had a disproportionate size of the budget, leaving the other arms with a miniscule amount of resources. These inconsistencies resulted in initial defeat in North Africa. The field artillery with its new capabilities dominated the battles around the Kasserine, highlighting the importance of combined arms.

The contest between the US and German armies during the Second World War was between two combined arms formations. The Wehrmacht, inheriting the Prussian tradition of maneuvering to encircle and destroy enemy forces with firepower, handily defeated the non-combined arms oriented forces of Britain and France in 1940. However, when faced by another combined arms force armed with artillery that had superior gunnery techniques, observation techniques, organizational flexibility, and greater mobility, the Wehrmacht was at a decided disadvantage. The US Army maneuvered to mass fires faster and better than the Wehrmacht.

Recommendations

Recent international developments in the Ukraine and in the Far East highlight the necessity for a capable combined arms force. Modern adversaries, with advanced air defense systems and quantitative advantages in air power, necessitate extensive counter-air and counter enemy air-defense measures by the US Air Force. This, combined with the limitations of close air support, requires a strong field artillery force capable of providing for most of the US Army's fire support needs.

The field artillery must be able to provide sustained, massed concentrations of fire. Artillery fires are most effective when concentrated. This requires a division artillery construct that has both command and control over the field artillery battalions in each division. Under the current division artillery construct, field artillery battalions remain organic to the Brigade Combat Teams (BCTs). This construct is unacceptable for a variety of reasons. The current construct sets as default a decentralized method of control. When divisional artillery must mass, command or support relationships will require a change. This may also happen at an unforeseen point in battle after BCT commanders already created plans that rely heavily on artillery fires. However, this action would be even more disruptive than task organizing one BCT's reconnaissance squadron or combined arms battalion to another BCT. Staffs must tightly manage the forecasting and distribution of field artillery ammunition to accomplish fire support and field artillery tasks. Staffs must also manage field artillery positions based on technical fire direction (gunnery) considerations, terrain, and airspace usage. Successful tactical fire direction requires the expenditure of certain amounts of ammunition to achieve desired effects. As such, planning for field artillery requires centralization to continually mass fires as part of a concerted plan at division.

Field artillery assets must adhere to a division of labor. Commanders should expect divisional fires to provide tactical level fires only. Division artillery should not be required to dilute its effectiveness with the provision of both operational and tactical level fires. Division artillery reinforced with FAB assets must focus on close support of the infantry and armored force. In turn, FAB assets must focus on both reinforcing divisional artillery and striking throughout an enemy's depth. In both North Africa and in Europe during the Second World War, it was not uncommon for one infantry battalion to be supported by several field artillery battalions. If division artillery must today provide operational level fires, infantry battalions will not receive the same level of support as during the Second World War. In line with the same logic, re-purposing field artillery assets to provide additional air defense capability is a mistake if it means allocating existing assets and field artillery formations an additional mission.

The US Army's field artillery requires more firepower to contend against potential adversaries. For example, in the Russian Army, each brigade has four artillery battalions organic.¹⁶³ A US Army BCT has organic one field artillery battalion. The Division Artillery has no organic field artillery capability. During the Second World War, Division Artillery included an additional battalion to provide general support or reinforcing fires. The US Army must allocate each division artillery command additional organic field artillery battalions; preferably one rocket and one howitzer. This would serve to give each Division Artillery the destructive capacity of MLRS and the sustained rate of fire capacity of a cannon battalion. This would also allow corps level artillery (provided by FABs) to retain assets for operational level fires.

Field artillery firepower must see a qualitative increase in addition to a quantitative increase, as was seen during the interwar period. Current potential adversary systems have greater caliber cannon tubes than the current 155mm cannon tubes fielded by the US Army,

¹⁶³ This includes one rocket battalion, two howitzer battalions, and one anti-tank battalion. Source: Dr. Lester Grau and Mr. Chuck Bartles, *Foreign Military Studies Office* (Fort Leavenworth, KS: 2016).

resulting in greater range. For the purposes of counterbattery and striking throughout an enemy's depth, the US Army must equip its 155mm howitzers with cannon tubes of larger caliber, to at least 52 caliber. This would bring US capability more in line with both allies and potential adversaries. In addition, US howitzers must be capable of Multi-Round Simultaneous Impact (MRSI) to place additional tonnage on modern armored vehicles.

Improved munitions represent another important qualitative necessity. Modern tanks and armored vehicles are far superior to those during the Second World War, diminishing the effectiveness of current conventional and improved conventional munitions. Experience from the Second World War demonstrates that the force will also rely on the field artillery to destroy tanks and armored vehicles. The US Army must reinvest in programs such as Seek and Destroy Armor Munitions (SADARM) and improved laser designated munitions to strike armored, moving targets from the top. The Department of Defense (DOD) must retain DPICM as a capability, critical to the destruction of enemy armor.

The Second World War demonstrated the necessity for aerial observation platforms organic to field artillery units. Unmanned Aerial Vehicles (UAVs) are best suited to fill this role today. Field artillery battalions and Division Artillery commands must be equipped with a capability at least that of a RQ-7 Shadow. The field artillery cannot rely on the Air Force, Army attack aviation, or intelligence assets to observe indirect fires. Those assets often have other missions and tasks that may conflict with missions to observe, rendering dedicated observation platforms far more effective.

The field artillery has continually transformed itself to remain relevant. New technologies allow for an unprecedented level of precision and destructiveness. The US Army must invest in these technologies in order to enable modern transformation. With new investment and new technologies, the sky is the limit with how effective artillery can become.

The US Army must go forward with an understanding that the purpose of maneuver is to render its fires more effective. This entails planning operations in a fashion to concentrate enemy formations by maneuvering in order to destroy them with indirect fire and other fire support assets. Conducting extensive direct fire engagements must be avoided where possible and only conducted after enemy forces are attrited substantially by field artillery. This requires staffs to plan maneuver, fires, and sustainment together, not separately. The fires plan must not be seen as always subordinate to the maneuver plan. The overall plan must position the combined arms team in positions to destroy enemy forces with indirect fires. The result has been and will be the preservation of American lives.

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