TRADOC BRANCH HISTORY SERIES

KING OF BATTLE

A BRANCH HISTORY OF THE U.S. ARMY'S FIELD ARTILLERY

BY BOYD L. DASTRUP



OFFICE OF THE COMMAND HISTORIAL
UNITED STATES ARMY TRAINING AND DOCTRINE COMMAND

TRADOC Branch History Series

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by
Boyd L. Dastrup



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Cover Photo: Gun crew of the 25th Infantry Division fire a 105-mm. howitzer on North Korean positions, near Uirson, Korea, August 1950.

(All photographs courtesy Field Artillery and Fort Sill Museum)

Foreword

In an initiative taken in 1983 to promote and record the history of the arms and services in the United States Army, the commander of the Training and Doctrine Command (TRADOC), General William R. Richardson, directed the establishment of professional historical programs in TRADOC's Army branch schools by creation of Army historian positions on the staffs of the school commandants. A compelling need of most Army branches was for an accessible, documented history of their origins and evolution, a need which the Army's Chief of Military History recognized in a 1986 letter to branch chiefs. It has been difficult, given the limited resources for the historical program, to balance the need for branch histories against other pressing requirements — production of annual command histories, teaching military history, historical support to commanders and their staffs, and other demands on the historian's time. Nevertheless, the strong desire of the U.S. Army Field Artillery Center for a branch history led to early inauguration of a project at Fort Sill, Okla. to accomplish that aim.

Written by Dr. Boyd L. Dastrup, Field Artillery Branch Historian, ***King of Battle: A Branch History of the U.S. Army's Field Artillery***, is the first volume in the TRADOC Branch History Series. Based on primary sources and a wide study of secondary literature, the volume provides a comprehensive historical summary of the development of field artillery in the U.S. Army since colonial times. The study focuses on the tactical, organizational, materiel, and training lessons learned — both those of wartime action and those of peacetime planning — in the larger framework of American military policy and strategy from the origins of the branch in European warfare to the modern artillery of the 1980s. Dr. Dastrup deserves praise for the magnitude of his achievement, which was not done without untold long hours of weekend and evening work over a period of many years.

The volume was skillfully edited for publication by Dr. Susan Canedy, Archivist in the TRADOC Office of the Command Historian. Mr. John Romjue, Chief of Historical Studies and Publication, also played a key role in guiding the volume through the publication process. And thanks are due to the panel of scholars, noted in the preface, that made suggestions to the author. This examination of the development of a major element of the Army fighting force provides an important contribution to the study of combined arms warfare and to the institutional history of the U.S. Army.

HENRY O. MALONE, JR., Ph.D.
Chief Historian
Training and Doctrine Command

Author's Preface

As a combat arm, the US Army's field artillery has played a critical role on the battlefield. Beginning with the American Revolution, the field artillery has furnished the other combat arms with fire support to allow them to maneuver. However, the history of the field artillery is more than recounting accomplishments during battle. It also involves peacetime activities. During years of peace, foundations were laid that contributed to the successes or failures in combat.

Between 1775 and 1980 the US Army's field artillery experienced profound technological, tactical, doctrinal, and organizational progress during times of potential or actual hostilities. At the same time, improvements lagged when a threat to national security did not exist even though field artillery officers of vision tried to maintain steady progress. As a result, periods of rapid and slow advancement alternated over the years. This field artillery branch history discusses the evolution of technology, tactics, doctrine, and organizations with training and operations examined where appropriate. It provides scholars, students of military history, and Army officers and noncommissioned officers a place to begin the study of the "King of Battle."

The inspiration for this work lies with Brigadier General (later Major General) Thomas J. P. Jones, then Assistant Commandant, US Army Field Artillery School, Fort Sill, Oklahoma. In 1983, he expressed the desire to have a branch history of the field artillery that would cover the evolution of weapons, tactics, and organization. Early in 1984, he added a historian to the staff of the Field Artillery School for that purpose. His successor, Brigadier General (later Major General) Raphael J. Hallada, also recognized the need for a branch history, and when he became commandant of the school and chief of the Army's field artillery branch in 1987, General Hallada continued support for completion of the project.

In the course of writing this book, I have become indebted to many. I would like to thank Professor Robin Higham, Professor Gunther Rothenberg*; Dr. Edgar F. Raines, Jr.*; Dr. David F. Trask*; Dr. Larry M. Kaplan; Dr. Susan Canedy; Mr. John Romjue*; Mr. Richard Weinert*; and Mr. Lynden Couvillan for reading the entire manuscript and making helpful comments. I would also like to thank Dr. John P. Langellier, Dr. James V. Anzulovic, Dr. Lynn L. Sims, Dr. Jesse H. Stiller, Dr. Charles H. Cureton*, Colonel Rod Paschall*, Brigadier General Harold W. Nelson, Colonel Roger L. Bernhardi, Lieutenant Colonel David Cejka, Lieutenant Colonel Martin W. Andresen, and Captain James Brenner for reading portions of the manuscript and providing their advice. I would also like to thank Dr. H. O. Malone, Jr.* for providing support from the US Army Training and Doctrine Command's Historical Office. All of these people helped me clarify issues and avoid mistakes that I might otherwise have made.

My thanks also goes to the archivists at the National Archives and to the librarians of the Morris Swett Library at the US Army Field Artillery School. In the latter group, Martha Relph, Lester Miller, and Sandra Brown were particularly helpful. I would like to thank the

* Members of TRADOC Publication Review Panel

archivists in the Fort Sill Museum Archives for their assistance, especially Linda Roper.

Finally, I want to thank my wife, Karen, for supporting me in this effort.

I, however, take full responsibility for any errors in fact and conclusion in the book.

December 1990

Boyd L. Dastrup
Fort Sill, Oklahoma

Chapter I

BIRTH PAINS: 1775-1783

Drawing upon European and colonial artillery practices, American colonists developed an effective field artillery during the American Revolution. At the start of the war, they had a motley collection of cannons and equipment and inadequately trained artillerists. As a part of improving the Continental Army, the colonists reduced the number of artillery pieces in use, created artillery regiments, organized artificer companies to maintain artillery equipment, adopted new tactics, and initiated formal training. In a few short years the American colonists produced a field artillery comparable to its European counterpart that was the result of several centuries of evolution.

European and Colonial Background

Fascinated with the explosiveness of gunpowder, Europeans introduced gunpowder artillery in the thirteenth century. Initially, they employed siege artillery to batter down castle walls and garrison pieces to defend against a besieging army. Before long, Europeans started deploying artillery of various sizes on the battlefield and dividing their cannons into siege, field, and garrison artillery. Light, mobile cannons with firepower (true field artillery) specifically designed to be maneuvered in battle, however, did not appear until the middle of the eighteenth century.

Dissatisfied with the small, wooden cannons of the late thirteenth century that threw one-inch iron balls or stones or crossbolts and lacked power to shatter castle walls, Europeans developed the bombard early in the fourteenth century. The bombard had a conical-shaped barrel made out of wooden staves and held together with iron rings. Desiring even more powerful siege artillery, Europeans later constructed bombards of varying sizes out of wrought-iron staves that were held in place with iron rings. These bombards were served by civilian gun crews, who were hired as they were needed, and used undependable fine gun-powder, called serpentine powder, which was a mixture of saltpeter, sulphur, and charcoal, as a propellant. Because of the tendency of wrought-iron bombards to explode and the laborious task of producing them, Europeans searched for more reliable siege weapons.

In the mid-fourteenth century Europeans discovered that the method employed for casting church bells could be utilized for making bombards. Using molds to form a hollow cylinder, bell makers, who had the only experience in casting metal objects, began casting bronze bombards.

Even though bronze bombards were stronger, more reliable, and more powerful than their wrought-iron counterparts, their gigantic sizes (often thirty inches in diameter and fifteen to twenty feet in length) made them immobile. For example, the bombards that Mohammed II of Turkey employed to breach Constantinople's walls in 1453 were cast on the spot because it was easier to transport raw materials and molds than to move a finished bombard. Nevertheless, clumsy bombards battered down castle walls and slowly replaced the trebuchet, a huge rock-thrower, as the primary siege weapon of European armies.[1]

In their quest for mobile siege artillery, Europeans of the early fifteenth century turned to cast-bronze cannons. These cannons used granulated black powder that was more explosive and dependable than serpentine powder. The cannons also had thick, strong walls to contain the explosion, were eight to thirteen feet long with bores of one to six inches, and were easier to transport than the huge bombards. Equally important, bronze cannons fired iron cannonballs that fit tightly in the bore and propelled rounds along powerful, flat trajectories.[2]

About the same time Europeans improved the mode of transporting their artillery. Through the mid-fifteenth century armies dragged their cannons on sleds and lashed their bombards to heavy carriages that were not much more than beams mounted on an axle and two crude solid wood wheels. In the 1450s the Swiss introduced carriages with oversized wagon wheels connected by a stout axle, upon which the cannon rested, and extended curved timbers called trails. The trails not only facilitated moving the cannon but also dug into the ground to help counteract the recoil. Equipped with this type of carriage, armies could pull siege cannons cross country with relative ease. For example, Charles VIII of France invaded Italy in 1494-95 with a siege train of forty guns of various sizes mounted on mobile, horse-drawn carriages. Each cannon had trunnions (knobs) that fit into sockets on the carriage to permit elevating the cannon tube more easily than lashing the cannon to the carriage allowed. Using his artillery, Charles VIII destroyed any castle or fortification that opposed him. Equally important, his bronze cannons made stone-throwing bombards obsolete and set the standard for other Europeans to follow.[3]

Soon after, Europeans added the mortar, a short, thick-walled cannon, to assist siege cannons. The mortar was mounted on a heavy wooden base and had a high trajectory to permit

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1. William H. McNeill, *The Pursuit of Power: Technology, Armed Force, and Society since A.D. 1000* (Chicago: The University of Chicago Press, 1982), pp. 83-88; Bernard and Fawn Brodie, *From Crossbow to H-Bomb* (Bloomington, In: Indiana University Press, 1973), pp. 44-51; Phillip H. Stevens, *Artillery Through the Ages* (New York: Franklin Watts, Inc., 1965), pp. 11-17; Oliver F.G. Hogg, *Artillery: Its Origin, Heyday, and Decline* (Hamden, Ct: Archon Books, 1970), pp. 34-36; Lynn Montross, *War Through The Ages*, rev. ed. (New York: Harper and Row, Publishers, 1960), pp. 178-80; Philippe Contamine, *War in the Middle Ages*, trans. by Michael Jones, (London: Basil Blackwell, 1984), pp. 142-46.

2. Montross, *War Through The Ages*, p. 180; McNeill, *The Pursuit of Power*, pp. 87-88; Stevens, *Artillery Through the Ages*, pp. 11-17; Brodie, *From Crossbow to H-Bomb*, pp. 44-53; Contamine, *War in the Middle Ages*, p. 145; Hogg, *Artillery*, p. 93.

3. Montross, *War Through The Ages*, pp. 186, 207; Hogg, *Artillery*, pp. 98-99; Stevens, *Artillery Through the Ages*, pp. 18-19; H.C.B. Rogers, *A History of Artillery* (Secaucus, NJ: The Citadel Press, 1975), p. 24; McNeill, *The Pursuit of Power*, pp. 87-88; Hogg, *English Artillery: 1326-1716* (London: Royal Artillery Institution, 1963), p. 10; Geoffrey Parker, *The Military Revolution: Military Innovation and the Rise of the West, 1500-1800* (Cambridge: Cambridge University Press, 1988), pp. 9-10; Robert L. O'Connell, *Of Arms and Men: A History of War, Weapons, and Aggression* (New York: Oxford University Press, 1989), p. 119.

lobbing explosive bombs into fortifications. Together, the bronze cannon and mortar gave armies an effective combination of siege weapons.[4]

To counter siege weapons Europeans armed their castles with cannons. Composed of varying calibers and sizes and mounted on carriages that were even less mobile than those being used for siege artillery, garrison or fortress artillery directed fire against the besieger's cannons and anyone trying to assault the walls. However, light cannons positioned on the high walls of medieval castles could not reach long-range siege pieces, while heavier weapons lifted up onto the ramparts shook the wall's foundation with their recoil, weakened the wall, and made breaching easier. As a result, castles were generally not fortified with artillery that offset siege cannons. This allowed the attacker to position siege artillery in the open and batter the defender with impunity. Seeking to restore balance between the besieger and besieged, Europeans slowly modernized their castles. During the sixteenth century, they started building fortresses with thick walls that sloped from bottom to top so that cannon-balls would glance off harmlessly, with emplacements for heavy artillery, and with bastions and outworks so that the defenders could throw artillery crossfire upon the enemy.[5]

The development of heavily armed fortifications in the sixteenth and seventeenth centuries stimulated serious efforts to improve siegecraft. Requiring protection from garrison cannons, attackers constructed zigzag trenches from their main lines towards the fortification with emplacements for artillery at key points. In the 1670s Sebastian de Vauban, a French military engineer, made siege warfare a fine art. Rather than besieging a fortress by digging zigzag trenches, he attacked a fortification through a series of parallel trenches connected by zigzag trenches. His system allowed more artillery to be used and dominated siegecraft for the next 150 years.[6]

In the meantime, artillery appeared on the battlefield. During the Battle of Crecy in 1346, the English employed wooden pieces. These small cannons fired lead or iron balls and iron bolts, lacked carriages, and were placed on the ground. As a result, the English could not move their artillery around to support the infantry. Eighty years later, John Ziska of Bohemia employed medium-sized bombards on four-wheeled carts to blast enemy formations during the Hussite Wars of the 1420s and 1430s. During the Battle of Formigny in 1450, the French placed their artillery on the flanks of their infantry line and hit the attacking English with enfilade fire. At the Battle of Castillon in 1453, the French poured murderous enfilade fire from various sizes of bronze cannons on the assaulting English. Even though the English, French, and Bohemians employed artillery on the battlefield, cannons of the time lacked sufficient mobility to be maneuvered with the infantry, were used in fixed positions, and served by civilian crews. Moreover, if a cannon could be pulled along with a marching army, it could be deployed against enemy troops. Because of this practice, Europeans did not assign their cannons specific roles to perform

4. Montross, *War Through The Ages*, p. 180; McNeill, *The Pursuit of Power*, pp. 87-88; Stevens, *Artillery Through the Ages*, pp. ll-17; Brodie, *From Crossbow to H-Bomb*, pp. 44-53; Contamine, *War in the Middle Ages*, p. 145; Hogg, *Artillery*, p. 94.

5. Frank E. Comparato, *Age of Great Guns: Cannon Kings and Cannoneers Who Forged the Firepower of Artillery* (Harrisburg, Pa: The Stackpole Company, 1965), pp. 7-8; McNeill, *The Pursuit of Power*, pp. 91-95; Contamine, *War in the Middle Ages*, pp. 201-07.

6. McNeill, *The Pursuit of Power*, p. 128; Christopher Duffy, *Siege Warfare: The Fortress in the Early Modern World, 1494-1660* (London: Routledge and Kegan Paul, 1979), pp. 22, 52, 54, 71, 84, 93-95, 98.

according to their weight and size.[7]

During the latter years of the fifteenth century, the French introduced lighter and more mobile cannons. They mounted bronze cannons on two-wheeled, horse-drawn carriages and developed the limber, a two-wheeled vehicle that was attached to the trails of the carriage for transport and mobility. In his Italian campaigns of 1494-95, Charles VIII employed light cannons mounted on the latest carriages and medium cannons mounted on four-wheeled carts to defeat the Italians at the Battle of Fornova in 1495. During the battle, the French not only moved their artillery more quickly than the Italians could move their heavy, oxen-drawn cannons but also had gun crews trained in rapid loading and traversing. Almost two decades later, the French utilized carriage-mounted cannons to blast the Spanish right with enfilade fire at the Battle of Ravenna in 1512. In 1515 at the Battle of Marignano, the French used carriage-mounted artillery to defeat the Swiss. Deploying their cannons in static positions, the French devastated massed Swiss pikesmen. During the last decade of the fifteenth century and the first two decades of the sixteenth century, the French demonstrated the effectiveness of artillery against enemy personnel, but they lacked true field artillery. The French persisted employing their cannons interchangeably in siege work or on the battlefield and lacked the organization and tactics to maneuver their artillery on the battlefield. Even so, the French successes with their cannons in battle encouraged other Europeans to recognize that only lighter cannons were suitable to support the field army.[8]

Attitudes of the last half of the sixteenth century prevented introducing true field artillery. Oriented towards siege warfare rather than warfare of movement, armies positioned cannons of various sizes in front of the infantry line to fire a few preliminary salvos. As the action developed, the artillery remained silent and stationary because Europeans lacked the inclination to cast light, powerful cannons specially designed for use on the battlefield and to create tactics and organizations for maneuvering artillery. As a result, European artillery did not play a major role in battle.[9]

Composition of the gun crew further restricted maneuvering the artillery. Artillerymen worked their trade by judgement and experience. Through the early seventeenth century, the gun crew was civilian and generally consisted of the gunner and an assistant. Together, they loaded, aimed, and fired the cannon. Civilian drivers transported the cannons to the battlefield with their animals, unhitched, and left, while soldiers borrowed from the infantry dragged the artillery around the battlefield. Often, untrained infantry fired the cannons as needed.[10]

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7. Hogg, *English Artillery*, pp. 196-200; Stevens, *Artillery Through the Ages*, p. 14; Rogers, *A History of Artillery*, p. 43; Montross, *War Through The Ages*, pp. 180, 181, 186, 187, 190, 207; Contamine, *War in the Middle Ages*, pp. 198-200; M.G.A. Vale, "New Techniques and Old Ideals: The Impact of Artillery on War and Chivalry at the End of the Hundred Years War," in C.T. Allmand, ed., *War, Literature, and Politics in the Late Middle Ages* (New York: Barne and Noble Books, 1976), p. 67.

8. Montross, *War Through The Ages*, pp. 208-10, 273; Rogers, *A History of Artillery*, pp. 24, 26-27.

9. Hogg, *Artillery*, pp. 24-25, 100-01; Hogg, *English Artillery*, p. 40; Albert Manucy, *Artillery Through the Ages: A Short Illustrated History of Cannon, Emphasizing Types Used in America* (Washington: Government Printing Office, 1949), p. 6; McNeill, p. 166; Rogers, *A History of Artillery*, pp. 35-36; Montross, *War Through the Ages*, pp. 238, 273; B.P. Hughes, *Firepower: Weapons Effectiveness on the Battlefield, 1630-1850* (London: Arms and Armour Press, 1974), p. 14.

10. Christopher Duffy, *The Military Experience in the Age of Reason* (New York: Atheneum, 1988), pp. 231-32; Harold L. Peterson, *Round Shot and Rammer* (Harrisburg, Pa: Stackpole Books, 1969), pp. 30-32.

Understanding the importance of mobility and the need for firepower on the battlefield, King Gustavus Adolphus of Sweden restructured his artillery in the 1620s. He placed civilian gun crews under army officers for better control and drilled them to fire their weapons rapidly and accurately. He also created a permanent artillery regiment of six companies, which was the first such organization in Europe, and assigned his artillery a specific function according to size and weight. The King designated 24-pounders as siege artillery, 12-pounders as artillery of position or field artillery, and 4-pounders as battalion guns. With the help of Lennart Torstensson, colonel general of the Swedish artillery, Gustavus simplified his artillery by reducing the number of calibers of cannons and by deciding that only mobile guns would support the field army. To complement the 12-pounder Gustavus later added a 9-pounder as a field gun. As the reforms indicated, the King recognized that artillery was a separate combat arm, that field artillery was a distinct branch of artillery, and that artillery could play an important role on the battlefield. Tactically, Gustavus organized his mobile cannons (4-, 9-, and 12-pounders) into two major divisions. He formed his 9- and 12-pounders into batteries of five to ten guns on elevations behind the infantry line and kept them under central control to prepare for the infantry attack by massing fire on the enemy in a preliminary bombardment. He attached two 4-pounders served by three men and pulled by one horse to each battalion for close support and for massing fire at critical times and places during battle. His cannons used solid or round shot, case shot or canister (a can filled with scrap metal or iron balls), and cartridge ammunition (a bag or case holding the complete powder charge and in some cases containing the projectile). By eliminating the need to ladle powder into a chamber between shots and providing consistently measured powder charges, cartridge ammunition increased the rate of fire and accuracy. In fact, Gustavus' gun crews could fire eight rounds for every six that musketeers could fire.[11]

During the Thirty Years' War (1618-1648), Gustavus' ability to maneuver his artillery and concentrate it produced devastating results. At the Battle of Breitenfeld in Saxony in 1631, for example, the General of the Catholic League, Count Tilly, had heavy cannons that each required fourteen horses to move. As a result, Tilly's artillery remained in static positions throughout the battle and failed to support the infantry effectively. In contrast, Gustavus moved his 4-pounders around at will following the opening bombardment from his artillery of position. For the first time in history, a commander actually had the ability to shift his artillery to keep pace with the movements of the infantry and cavalry. In doing so, the King clearly demonstrated the utility of artillery on a mobile battlefield and established the precedent of permanently attaching light artillery pieces to the infantry.[12]

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11. Manucy, *Artillery Through the Ages*, p. 7; Comparato, *Age of Great Guns*, p. 9; Stevens, *Artillery Through the Ages*, pp. 21-26; Rogers, *A History of Artillery*, pp. 39-41; Hughes, *Firepower*, pp. 15, 75; De La Barre Dupargo, *Elements of Military Art and History*, trans,. by Brigadier General George W. Cullum (New York: D. Van Nostrand, 1863), pp. 141-42; Joseph Jobe, ed., *Guns: An Illustrated History* (New York: Graphic Society, 1971), p. 60. Many contemporary observers refer to the use of grape-shot, which consisted of large iron balls held together with a mesh netting, in the field. Although grapeshot was employed by light guns on ships, it was not utilized by field armies for the most part because it damaged the bores of bronze field cannons. Most authorities on field artillery agree that the term "grape" was used loosely and probably described heavy canister as opposed to light canister.

12. Stevens, *Artillery Through the Ages*, pp. 23-26; Hughes, *Firepower*, p. 74; B.P. Hughes, *Open Fire: Artillery Tactics from Marlborough to Wellington* (Chichester, Sussex, Eng: Antony Bird Publications Ltd, 1983), pp. 37-38.

Even so, the King still did not introduce true field artillery. His light four-pounders were mobile but lacked firepower because of the low weight of their projectile, while his 9- and 12-pounders were too heavy to be maneuvered easily and remained stationary during combat. Gustavus lacked an artillery piece with firepower and mobility. Notwithstanding this, Gustavus' recognition of the need for light, mobile artillery to fill special missions represented a critical breakthrough.

Following Gustavus' example, many Europeans improved their artillery. During the rest of the seventeenth century, they abandoned the practice of designating a piece by a name, such as a minion or culverin, and began to identify it by the weight of the projectile that it threw to reduce confusion. With exception of the Swedes, Europeans still did not assign their cannons specific functions according to size and weight. For the most part, generals dragged a motley collection of artillery into battle to serve as guns of position for the preliminary bombardment of the opposing army. Even though Gustavus' battalion guns proved to be useful, European armies did not adopt them immediately. Years passed before battalion guns became permanently attached to the infantry for close support in most European armies.[13]

The French and Dutch, in the meantime, introduced some of the most far-reaching reforms in the latter decades of the seventeenth century. Louis XIV of France formed a regiment specifically for artillery duty in 1671 and founded the first artillery school in Europe in 1690. By establishing a school, Louis XIV started sweeping away some of the mysteries of artillery through education while militarizing his artillerymen at the same time. The King's active interest in artillery and numerous wars prompted the French to invent the elevating screw to facilitate changing the elevation of the barrel without moving the carriage. Another improvement, the prolonge, a system of ropes, permitted artillery men to pull their cannons over difficult terrain. Finally, Louis XIV's artillery had a priming tube filled with powder to ignite the charge in the chamber and make firing safer. Seeing the need for an artillery piece with the capability of throwing a projectile over a wall or firing canister or shot against troop formations, the Dutch developed the howitzer in the 1690s. The addition of the howitzer gave armies high-trajectory mortars, flat-trajectory cannons (referred to as guns after the mid-eighteenth century), and medium-trajectory howitzers as artillery pieces.[14]

During the eighteenth century, Europeans continued upgrading their artillery. After being appointed by the King of France to bring order to French artillery, General Jean-Florent de Valliere, an artillery man in the French army, reduced the number of patterns and calibers to eliminate confusion. In 1732 he standardized French cannon calibers as 4-, 8-, 12-, 16-, and 24-pounders and added 8- and 12-inch mortars. He also specified lengths, proportions, and weights for each and even decreed the methods of manufacture. All cannons of the same caliber were to be alike regardless of their function. Interestingly, Valliere designed his artillery system to fight from fixed positions and did not clearly designate his cannons as field, garrison, or siege artillery. Similarly, in the 1740s Prince Joseph Wenzel von Liechtenstein, Director General in the

13. Hughes, *Open Fire*, pp. 39-40; Peterson, *Round Shot and Rammers*, pp. 31-33; Parker, *The Military Revolution*, pp. 23-24, 33-35.

14. Brodie, *From Crossbow to H-Bomb*, p. 53; Rogers, *A History of Artillery*, pp. 52; Manucy, *Artillery Through the Ages*, pp. 9, 32, 56; Peterson, *Round Shot and Rammers*, p. 36.

Hapsburg army, transformed Austrian artillery. At the same time the Russian Master General of the Ordnance, Peter Ivanovich Shuvalov, was rationalizing Russian artillery. Liechtenstein and Shuvalov established artillery schools for practical and theoretical instruction, published textbooks and comprehensive regulations, held annual training camps, organized testing grounds, and militarized the gun crew. In short, they turned their artilleries into military professions. Equally important, Prince Liechtenstein outlined approved patterns for field artillery of maneuverable 3-, 6-, and 12-pounders and supplemented them with light howitzers.[15]

Yet, artillery support on the battlefield did not undergo any significant changes through the mid-eighteenth century. Generally, armies had ample supplies of artillery. Artillery of position (usually 6- to 12-pounders) support depended upon carefully siting the guns prior to battle as they were still too heavy to be moved easily. If this was done with foresight, the cannons could play a role by massing fire on the enemy. For the most part, battalion guns (3- and 4-pounders) were permanently issued to the infantry and were manhandled by either artillerists or infantrymen during the advance for close support. However, the low weight of their projectiles limited their effect.[16]

In the meantime, new manufacturing methods made producing light, powerful cannons more practical. In 1740 Jean Maritz of Switzerland adopted a new way for constructing bronze cannons. Rather than manufacturing cannons by pouring molten metal into a form to create a hollow cylinder, he cast a solid cylinder and then drilled the bore to improve its uniformity. Accurately centered bores, produced by Maritz's method, made cannons safer since the gun metal was of the same strength and thickness on every side of the explosion. Equally important, drilling the bore permitted cannon manufacturers to reduce windage, the space between the projectile and the bore. As a result, a smaller charge could propel a projectile. This meant that cannons did not require thick tubes and could be lighter and more maneuverable.[17]

While Maritz worked to improve the casting of cannons, Benjamin Robins of England made gunnery scientific. Based on his work, he published *New Principles of Gunnery* in 1742. In his book he explained the advantage of elongated projectiles, the value of rifling, and the impact of air resistance on the flight of a cannon ball and urged armies to adopt rifled ordnance and firearms because they were more accurate than smoothbore weapons. Nevertheless, Europeans did not equip their armies with rifled artillery because they lacked the technology to make such artillery a reality, and years passed before it was introduced.[18]

Building upon the technological advances of the early eighteenth century, Frederick the Great of Prussia reformed his artillery. On his accession to the throne in 1740, Frederick found his army equipped with a motley collection of cannons. Although he divided his cannons into siege artillery, field artillery, and battalion guns and formed his artillery into regiments for training, administration, and movement onto the battlefield, Frederick dispersed his battalion guns on the

15. McNeill, *The Pursuit of Power*, pp. 166-67; Peterson, *Round Shot and Rammers*, pp. 33, 48-51; Gunther E. Rothenberg, *The Art of Warfare in the Age of Napoleon* (Bloomington, In: Indiana University Press, 1980), pp. 15, 25; Rogers, *A History of Artillery*, pp. 35-36; Hughes, *Firepower*, p. 80; Duffy, *The Military Experience in the Age of Reason*, p. 232.

16. Rothenberg, *The Art of Warfare in the Age of Napoleon*, p. 15.

17. McNeill, *The Pursuit of Power*, pp. 167-70.

18. Rogers, *A History of Artillery*, pp. 59, 64; Brodie, *From Crossbow to H-Bomb*, p. 101.

battlefield. This practice left the artillery regiment with nothing but heavier guns for massing in batteries as artillery of position. At Mollwitz in 1741, Frederick placed his heavier guns forward of the infantry center, parcelled out his battalion guns along his line, and had difficulties maneuvering his cannons against the Austrians. Impressed with the inability to employ his artillery effectively, Frederick increased the number of battalion guns (3- to 6-pounders) and formed his field artillery (generally 12-pounders) into batteries of twelve guns each along his line. In addition, Frederick adopted howitzers to hit reverse slopes and shell enemies behind fortifications.[19]

Like Gustavus Adolphus, Frederick believed that mobility was a key to success on the battlefield. Influenced by this, he found that field artillery, often called foot artillery, was too slow because the cannoneers walked beside the draft animals that pulled the cannons. He introduced horse artillery in 1759, in which the gunners were soldiers and rode on the horses that pulled the cannons for more rapid movement. By doing this, he divided his field artillery into foot and horse artillery. Frederick organized his horse artillery into batteries of light guns (primarily 6-pounders) and howitzers with crews of forty five men each. Although Frederick's horse artillery was suited to support the cavalry, it also provided a mobile reserve for moving quickly around the battlefield as needed and established a precedent that other European armies soon imitated. Generally, Frederick sent his horse artillery ahead of the infantry. Gunners would dismount about five hundred paces from the enemy line and then move forward on foot, pushing their guns ahead of them, firing rapidly, and during the latter part of their attack, using canister. They continued pressing forward until they reached point blank range, meaning that they were so close that they did not have to elevate their gun tubes to hit the enemy. Frederick's infantry then rushed through the artillery line and stormed the enemy position. By forming his field artillery into batteries and creating horse artillery, Frederick the Great played a critical role in the development of field artillery.[20]

While Frederick introduced lighter guns, improved the organization of his artillery, and adopted new tactics to enhance firepower, his contemporaries usually did not move their artillery during battle, but carelessly distributed it along the infantry line, and frequently did not have any cannoneers to serve the artillery. As a result, their guns often sat idle during the heat of battle.[21]

Influenced by Frederick the Great and impressed with the Austrians' system of artillery, Jean Baptiste de Gribeauval, an artilleryman, revamped French artillery under the direction of the King of France. Between 1763 and 1767 he systematically redesigned everything associated with the artillery. Gribeauval introduced a screw device for adjusting gun elevation precisely, a new sight to estimate accurately where a shot would hit before firing, and cartridge ammunition for rapid firing. Moreover, he separated French guns into field, siege, garrison, and coast artillery and designed them and their carriages accordingly. For field artillery he adopted 4-, 8-, and

19. Robert B. Asprey, *Frederick the Great: The Magnificent Enigma* (New York: Ticknor and Fields, 1986), p. 285; Stevens, *Artillery Through the Ages*, pp. 28-29, 51-52; Rothenberg, *The Art of Warfare in the Age of Napoleon*, p. 25; Hughes, *Firepower*, p. 94; Hughes, *Open Fire*, p. 40.

20. Asprey, *Frederick the Great*, p. 509; Stevens, *Artillery Through the Ages*, pp. 27-33; Rogers, *A History of Artillery*, pp. 53-57; Manucy, *Artillery Through the Ages*, pp. 10-11; Rothenberg, *The Art of Warfare in the Age of Napoleon*, pp. 24-25; Hughes, *Firepower*, pp. 95-96.

21. Comparato, *Age of Great Guns*, p. 12; Rothenberg, *The Art of Warfare in the Age of Napoleon*, p. 25; Stevens, *Artillery Through the Ages*, pp. 27-33; Rogers, *A History of Artillery*, pp. 53-57; Manucy, *Artillery Through the Ages*, pp. 10-11.

12-pounders and a 6-inch howitzer. He also reduced the weight of the gun barrel and the carriage by fifty percent and employed four horses to pull 4- and 8-pounders and six horses to draw 12-pounders. In addition, Gribeauval used a flask carriage, developed a limber with a tongue to permit hitching the horses abreast rather than single file and an ammunition wagon (called a caisson), introduced interchangeable parts and iron axles, adopted an ammunition box that rode on the carriage between the flasks to supply the gun until the ammunition wagon arrived, and utilized shot, canister, and shell designed to burst over the target. Although Gribeauval's system greatly increased the rate of fire and mobility of the field artillery, opposition by a group of conservative French artillery officers delayed the introduction of the new system until 1776 when Gribeauval became Inspector General of Artillery in the French army.[22]

Gribeauval also made organizational reforms. Rather than using civilian teamsters, he employed soldiers to drive the horses. Moreover, the gun crew practiced to unlimber, position, aim, and fire to attain the precision necessary to fire rapidly and accurately and drilled to work harmoniously with other crews as a team to smother the enemy with an overpowering volume of fire. At the same time Gribeauval established schools to teach theoretical aspects of gunnery and tactics. Because of Gribeauval's reforms in field artillery organization, training, and materiel, French field artillery became more closely integrated with the infantry and cavalry than it had ever been and became the model for other field artilleries to follow.[23]

The technological and organizational advances of the Austrians, French, Prussians, Russians, and English during the middle decades of the eighteenth century produced true field artillery. For the first time, powerful, mobile field pieces appeared. They had the capabilities of keeping pace with changing tactical requirements and delivering a huge volume of fire from effective ranges of approximately one thousand yards with shot and three hundred to four hundred yards with canister. Generally, the gun crew was composed of four professional gunners. They loaded, aimed, and fired the cannon, while assistants from the infantry hauled the field piece around the battlefield under the direction of the professional gunners. The gun crew and assistants also served under the direction of artillery officers, who commanded a single gun, a pair, or a battery of four to six field pieces.[24]

Although technology had greatly improved field artillery, it still hindered providing close support. Guns and howitzers were direct fire weapons. Cannoneers had to see their target to hit it. As a result, friendly infantry, as it advanced, often covered the artillery's line of sight, and this forced firing to cease. Nevertheless, the inaccuracy and limited effective ranges (approximately fifty yards) of muskets dictated battle tactics. To compensate, commanders drilled their soldiers to march instep, fire in unison, and reload quickly, formed their infantrymen shoulder-to-shoulder in elongated lines, and employed mass volley fire. Commanders stationed cavalry on the wings of the infantry to counter enemy cavalry, positioned their field artillery of of 6-, 8-, and 12-pounders on hills overlooking the battlefield, moved these field guns as needed, and sited their battalion guns

22. McNeill, *The Pursuit of Power*, pp. 170-71; Peterson, *Round Shot and Rammers*, pp. 51-54, 74; Manucy, *Artillery Through the Ages*, p. 11-12; Rothenberg, *The Art of Warfare in the Age of Napoleon*, pp. 25-28.

23. McNeill, *The Pursuit of Power*, pp. 170-71.

24. Duffy, *The Military Experience in the Age of Reason*, p. 235.

between the infantry battalions for close support during the infantry advance. An artillery duel generally opened the battle to knock out the opponent's cannons to allow the infantry to attack unopposed and to soften up the enemy infantry. Nevertheless, artillerymen preferred to conserve their ammunition for the main mission of repelling enemy infantry and cavalry. On the offensive, cannoneers employed their pieces to break up enemy infantry and provide counterbattery fire as required.[25]

As the Europeans developed field artillery, the American colonists struggled to use artillery in the New World. Upon establishing settlements, the colonists faced the twin threat posed by Indians and the imperial powers of France and Spain and had to develop some kind of military system for defense. Drawing upon their English heritage, they turned to the militia. Colonial laws stipulated that able-bodied males between certain ages had to serve in the militia and furnish their own weapons. The militia was based upon universal and obligatory service and organized into units by county or township. However, the local unit seldom fought as a unit. Rather, it served as a training and mobilization base from which individuals were selected by a commander for duty in an improvised unit in active operations. When the Indian threat receded in an area, militia service generally declined in importance. In response, training days, which were initially devoted to learning the techniques of European style warfare and not Indian warfare, usually became festive occasions. This caused militia efficiency to decline. In some counties and towns volunteers kept the militia spirit alive by creating formations of their own, purchasing uniforms, and preparing for battle. These units came to be known as volunteer militia in contrast to the common militia where everyone served.[26]

The militia learned early about the need to adapt artillery tactics to new conditions. While the dense forests and broken terrain of North America made towing artillery cross country difficult, the Indians' hit-and-run tactics further discouraged its use. The elusive native Americans did not offer good targets for artillery fire. After all, the Europeans utilized artillery to attack massed troop formations on the open battlefield, which did not exist in North America. The colonists, therefore, depended upon muskets and other light arms to fight Indians because these weapons did not slow down a column operating in the wilderness as artillery would have.[27]

The dense forests and broken terrain of North America compelled the colonists to limit their artillery to siege operations along the coasts or large rivers or to arm forts. For example, in the 1560s French Huguenots armed Fort Caroline near present day Jacksonville, Florida, with artillery.

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25. Rothenberg, *The Art of Warfare in the Age of Napoleon*, pp. 14-15; William E. Birkhimer, *Historical Sketch of the Organization, Administration, Materiel and Tactics of the Artillery, United States Army* (James J. Chapman, 1884, reprinted by Greenwood Press, 1968), p. 10, hereafter cited as *Historical Sketch*; Jac Weller, "The Artillery of the American Revolution," *Military Collector and Historian*, Fall 1956, p. 97; Philip J. Haythornthwaite, *Weapons and Equipment of the Napoleonic Wars* (Poole, England: Blandford Press, 1979), p. 64; Louis de Tousard, *American Artillerist's Companion* (1809, reprinted by Greenwood Press, 1968), pp. III-15; Hughes, *Firepower*, p. 103.

26. Russell F. Weigley, *History of the United States Army* (New York: Macmillan Publishing Company, Inc., 1967), pp. 4-10; Allan R. Millett and Peter Maslowski, *For the Common Defense: A Military History of the United States of America* (New York: The Free Press, 1984), pp. 1-6; Maurice Matloff, ed., *American Military History* (Washington: Office of the Chief of Military History, US Army, 1969), pp. 28-30; Douglas E. Leach, *Arms for Empire: A Military History of the British Colonies in North America, 1607-1763* (New York: The Macmillan Company, 1973), pp. 9-38.

27. Peterson, *Round Shot and Rammers*, pp. 17, 36.

In 1587 the English fortified Roanoke Island with cannons and later mounted artillery on their fort at Jamestown. In 1638 colonists established the Ancient and Honorable Artillery Company of Boston to train the militia to use artillery to bombard or defend a fortress. During King George's War (1744-1748), for example, American colonists and the British mounted a daring expedition to capture Louisburg, a heavily armed French fortress. Located on Cape Breton Island, Louisburg controlled the approaches to the St. Lawrence River and served as a base for French privateers operating against British and New England shipping. After arriving and unloading siege artillery and mortars, the Ancient and Honorable Artillery Company along with three companies of the English Royal Artillery Regiment laid siege along European lines to Louisburg and the Grand Battery, a detached fortification that helped defend the city. After enduring seven weeks of bombardment and a tight British naval blockade, the French capitulated. Action at Louisburg, therefore, gave the colonists first-hand experience employing artillery in siege warfare.[28]

During the French and Indian War (1755-1763), the combatants' heavy reliance on artillery to hold or seize fortresses provided the American colonists with a further appreciation of artillery. At the outbreak of hostilities, the colonists established the Philadelphia Artillery Company in 1755 and later formed the Charleston Artillery Company in 1757. After being trained by British artillerymen on field and siege guns, some members of these companies even participated in sieges against the French. Although towing artillery through dense North American forests was arduous, the British dragged some pieces with them on overland expeditions to bombard French fortresses. In 1755 Major General Edward Braddock pulled field and siege artillery with him to batter down the heavy French palisades at Fort Duquesne. Unexpectedly, Braddock's advance force of British regulars collided with the French before reaching the fort. Despite being jolted by canister from British 6-pounders, the French quickly outflanked the advance party and caused it to abandon its artillery and retreat. As it was rushing up to assist, the main body bumped into the advance party. This along with heavy fire from the concealed enemy created confusion and terror and influenced Braddock's army to flee in defeat. Three years later, General James Abercromby of the British army planned to use siege artillery to crush the French at Fort Carillon on Lake Champlain. After trundling his artillery cross country, he ferried it across Lake George, left it where he landed, and continued his push to Fort Carillon. Accepting the word of an inexperienced engineering officer, who reported that the French defenses at Fort Carillon were susceptible to a frontal attack without an artillery preparation, Abercromby attacked with only infantry. Lacking sufficient firepower to break through the heavily armed French positions, Abercromby's army of British regulars and colonials suffered a disastrous defeat. The following year, General Jeffrey Amherst hauled siege cannons with him,blasted the French in Fort Carillon, and compelled them to yield the stronghold. After blowing up the fort, the British rebuilt it and renamed it Fort Ticonderoga.[29]

In the summer of 1758, the British assembled a force armed with field and siege artillery to

28. Peterson, *Round Shot and Rammers*, pp. 13-17, 37; Manucy, *Artillery Through the Ages*, p. 9; Leach, *Arms for Empire*, pp. 126, 232-41; Weller, "Revolutionary War Artillery in the South," *Georgia Historical Quarterly*, 1962, p. 253; Birkhimer, *Historical Sketch*, p. l; Weller, "The Artillery of the American Revolution," p. 101.

29. Leach, *Arms for Empire*, pp. 357-58, 364-66, 427-32, 457; Birkhimer, *Historical Sketch*, p. l; Fairfax Downey, *Sound of the Guns: The Story of the American Artillery* (New York: David McKay Company, Inc., 1955), pp. 20, 288.

drive the French out of North America. Following the seizure of Louisburg, the British floated their army by ship down the St. Lawrence to Quebec, which was set atop steep cliffs and was heavily fortified with cannons. After realizing that a bombardment would not break the French defense, the British commander, General James Wolfe, navigated his ships past the French guns and led his forces up a steep, narrow path up the cliffs to the Plains of Abraham. Once all of his artillery was in place, he intended to besiege the French. Knowing that his defenses facing the plains were weak and could not withstand a siege, the French commander, Louis Joseph, Marquis de Montcalm, marched his troops out of the fortress to face the British before they could lay siege. Disciplined British regulars maneuvered their two 6-pounders with the infantry, blasted French formations with canister and small arms fire, and forced Montcalm's troops to retreat. The battle represented the only engagement during the French and Indian War where armies maneuvered against each other on the open battlefield.[30]

As the warfare in North America in the seventeenth and eighteenth centuries indicated, American colonists gained little valuable experience with field artillery tactics and organization. Operations against Indians precluded using artillery of any kind, while siege work to seize key fortresses dominated the wars between the British and French. Because of their participation in King George's War and the French and Indian War, the colonists received valuable training and experience and understood the significance of artillery in general, especially siege artillery. However, they did not know how to employ field artillery properly on the eve of the American Revolution.

The American Revolution: The Opening Campaigns, 1775-1776

Using whatever field and siege artillery that they could collect, American colonists initiated military action against Great Britain, one of Europe's most powerful countries. In 1775 two unequal military forces opposed each other. To put down the growing rebellion centered in Boston, the British commander, General Thomas Gage, had infantry regiments of fully equipped and disciplined regulars who had been trained to fight in rigid lines and to volleyfire on the open battlefields of Europe. The general also had dragoons (mounted infantry), four warships that each carried sixty guns or more, and trained field artillery companies to serve his guns of position and battalion guns. Equally important, the general could draw upon Great Britain's vast economic resources to sustain a war effort. To oppose the British, the colonists only had militia that included the entire combat strength of the colonies and had limited economic backing. Equally important, the colonists had little experience managing large forces needed for action against the British army.[31]

Following the confrontations at Lexington and Concord, the colonists geared for possible armed conflict. They started manufacturing gunpowder, making uniforms, mobilizing militia, organizing those called up into field companies, drilling troops, and collecting small arms and artillery. Most artillery pieces had pitted bores and were in poor condition. In June 1775 the Massachusetts legislature organized an artillery regiment under the command of Colonel Richard

30. Leach, *Arms for Empire*, pp. 421-26, 450-53, 458-64.

31. William M. Wallace, *Appeal to Arms: A Military History of the American Revolution* (New York: Harper and Brothers Publishers, 1951), pp. 1-12; Christopher Ward, *The War of the Revolution*, ed. by John R. Alden (New York: The Macmillan Company, 1952), pp. 24-31; Weller, "The Artillery of the American Revolution," p. 101.

Gridley, who had gained fame for effectively handling artillery during the siege at Louisburg in 1745. Modelled on the British system, Gridley's regiment had one colonel, one lieutenant colonel, two majors, one surgeon, two surgeon's mates, one adjutant, one quartermaster, two cadets, four conductors (persons who supervised depots, magazines, or groups of wagons), one storekeeper, two clerks, a company of artificers (skilled workmen) to provide maintenance, and ten authorized companies (nine were actually organized). Each company was composed of three officers, four sergeants, four corporals, six bombardiers to prepare the ammunition, six gunners to load and aim the artillery piece, thirty-two matrosses to assist the gunners, one drummer and two fifers, and had four guns. At the siege of Boston, an artillery company from Rhode Island commanded by Major John Crane consisted of six officers, two sergeants, four corporals, two bombardiers, four gunners, four musicians, and seventy-four matrosses with four guns joined Gridley's regiment.[32]

Even before a military force could be fully organized, colonists from New England laid siege to the British at Boston. Realizing the political and psychological necessity of holding the city, the commander of the British fleet in the port of Boston, Admiral Samuel Graves, urged Gage to fortify Charleston peninsula or Dorchester Heights overlooking the bay to prevent the colonists from bombarding the British from those locations. Gage agreed, but the colonists also knew the importance of the peninsula and moved first. On 16 June the colonists built fortifications on Breed's Hill, and Colonel Gridley, the overall colonial artillery commander and an experienced military engineer, designed the defensive works. Incredibly, he failed to provide gun platforms or pierce the walls for embrasures. As a result, when the field artillery of six pieces arrived with Major Scarborough Gridley, Captain Samuel Trevett, and Captain John Callender, they had to blast gaps through the earthworks to create fields of fire.[33]

Acting on the advice of the British council of war, General Gage directed Major General William Howe to launch a frontal assault against the colonial fortifications. On the eighteenth of June, Howe formed his command in two lines. To cover his deployment and advance Howe opened fire from eight field pieces and howitzers but soon had to stop because his 6-pounders had been supplied with solid shot for 12-pounders by mistake. Howe's gun crews switched to canister and then pushed their guns and howitzers forward. Even though broken terrain prevented the field artillery from keeping up with the infantry and providing effective support, Howe pressed on. Heavy musket fire from the redoubt on the hill, reserved until the British had reached within one hundred feet of the colonial lines, stopped the first British charge.[34]

Undeterred by this setback, Howe resumed his offensive.Without fire support from field guns, Howe made a second frontal assault and failed once more. After being forced to retreat twice, Howe ordered a third attack. This time the British placed their field artillery in positions to enfilade

32. Don Higginbotham, *The War of American Independence, 1775-1783* (New York: Macmillan Company, 1971), pp. 58-65; John R. Alden, *The American Revolution* (New York: Harper and Row Publishers, 1954), pp. 21-26; Robert K. Wright, Jr., *The Continental Army* (Washington: Center of Military History, United States Army, 1983), pp. 13-14, 17, 433-38; Birkhimer, *Historical Sketch*, pp. 1-2; Ward, *The War of the Revolution*, p. 55.

33. Wallace, *Appeal to Arms*, pp. 34-35.

34. Wallace, *Appeal to Arms*, pp. 39-41; Ward, *The War of the Revolution*, pp. 88-91, 96-97; Alden, *The American Revolution*, pp. 38-39; Higginbotham, *The War of American Independence*, pp. 73-77; William Heath, *Memoirs* (Boston: J. Thomas and E.T. Andrews, 1798, reprinted by New York Times and Arno Press, 1968), pp. 12-13.

the colonists with canister. Unable to resist the third charge because they ran out of ammunition, the colonists retreated and left behind five of their six field pieces. Knowing that the colonists had lost most of their artillery, the British dismissed any future colonial threat in Boston.[35]

Although colonial infantry units displayed gallantry at Breed's Hill, colonial artillery performance led to disciplinary action. Brigadier General Israel Putnam of the Connecticut militia caught John Callender and Scarborough Gridley as they were fleeing from the entrenchment on Breed's Hill after firing a few rounds to stop the first British charge and ordered them back up the hill. As soon as Putnam had left, Callender and Gridley claimed once more that they were out of ammunition and retreated again. Because of this action, John Callender was dismissed for disobedience and cowardice. He later reenlisted and redeemed himself. Gridley was charged with cowardice but was acquitted. Colonel Gridley was also absent from Breed's Hill during most of the battle and did not coordinate the efforts of his subordinates. As a result, the colonists did not have a unified effort from their artillery and did not have the capabilities of employing artillery effectively.[36]

In June 1775 the Continental Congress created the Continental Army consisting mainly of the provincial regiments in Boston and those assembling to protect New York City and Ticonderoga from attack. Congress appointed Lieutenant General George Washington as commanding general. Soon after the fighting at Breed's Hill, Washington assumed command and set out to improve the Main Army's fighting capabilities. Besides constructing more and better fortifications, the colonists reorganized their artillery.[37] Upon arriving in Boston, Washington immediately removed Colonel Gridley for incompetence and offered command of the artillery at Boston to two different senior officers, who were veterans of Louisburg. Explaining that they were too old, they declined and recommended Henry Knox. A bookseller in Boston, Knox had voraciously read John Muller's *Treatise of Artillery* (1755), which was the basic text for English artillery, and Benjamin Robins' *New Principles of Gunnery* (1742) and had received artillery training under British instructors as a member of the Boston Train of Artillery in the 1760s. Unable to find anyone more qualified, Washington urged the Continental Congress to appoint Knox as chief of the artillery. Learning that artillery officers and men did not want to serve under Gridley, Congress accepted Washington's recommendation in November 1775 by making Knox chief of artillery for the Continental Army. Concurrently, Washington and Congress restructured the artillery as a part of a general reorganization of the Continental Army. In November 1775 they combined Gridley's regiment and Crane's company into a single regiment with one colonel, two lieutenant colonels, two majors, one chaplain, one adjutant, one quartermaster, one surgeon, one surgeon's mate, one drum major, one fife major, and twelve companies. Each company had five officers, four sergeants, four corporals, six bombardiers, six gunners, two musicians, and thirty-two matrosses and was assigned to the Main Army under the command of Knox. Bombardiers, gunners, and matrosses were all privates, but

35. Alden, *The American Revolution*, pp. 38-39; Higginbotham, *The War of American Independence*, p. 76; Downey, *Sound of the Guns*, pp. 24-27; Ward, *The War of the Revolution*, pp. 96-97; Wallace, *Appeal to Arms*, pp. 35, 45.

36. Ward, *The War of the Revolution*, pp. 96-97; North Callahan, *Henry Knox: General Washington's General* (New York: A.S. Barnes and Company, 1958), p. 34; Downey, "Birth of the Continental Artillery," *Military Collector and Historian*, Fall 1955, pp. 6-7.

37. John C. Fitzpatrick, *The Writings of George Washington*, Vol. III (Washington: Government Printing Office, 1931), pp. 322, 331, 332, hereafter cited as *Writings*.

gunners and bombardiers were specialists, who received higher pay. Interestingly, Washington and Knox formed a composite regiment of field, siege, and garrison artillery and distributed companies to man specific fortifications or batteries or to serve with infantry units and did not make a distinction among the various kinds of artillery and their functions.[38]

Meanwhile, Congress and Washington acquired more cannons because the Main Army lacked sufficient artillery to lay siege to the British at Boston. In 1775 and 1776 Congress procured bronze and iron smoothbore artillery patterned after British cannons from foundries in Connecticut and New York.[39] In the meantime, Washington accepted Knox's plan to obtain artillery pieces from those captured by the colonists at Fort Ticonderoga in May 1775. Upon reaching the fort early in December 1775, Knox and his detachment chose fifty-nine pieces, including three huge 13-inch mortars, howitzers, and a number of 9-, 12-, and 18-pounders. Lacking wheeled vehicles and using sleds pulled by oxen and horses, Knox and his men dragged the artillery from Fort Ticonderoga to Lake George, loaded them on barges, and floated them down to the head of the lake. Knox and his men then hauled the artillery on sleds through the deep snow of New York and New England to Boston where they placed the pieces on the hills surrounding the British garrison and fleet. Beginning on 2 March 1776, the colonists bombarded the British with field and siege artillery. Colonial cannons toppled chimneys, destroyed buildings, damaged British barracks, and concealed the construction of a redoubt on Dorchester Heights from which the colonists could bomb the British at close range. To relieve his precarious position General Howe knew that he had to storm the colonial position or abandon Boston. Rather than making a potentially disastrous frontal assault, similar to those at Breed's Hill, Howe disabled the cannons and mortars that he could not remove by driving spikes into their vents to prevent them from being fired and sailed from the city on 17 March for Halifax, Nova Scotia.[40]

Although the physical destruction wreaked by the cannonade influenced Howe to leave, the sheer surprise also hastened his retreat. A captured British soldier informed the colonists that the cannonade had shocked the British. They thought that the colonists did not have enough artillery to launch a bombardment of such intensity or duration. Although the colonial siege was not particularly effective against British defensive works, it reaffirmed to both sides that artillery could have a tremendous impact. Artillery not only destroyed property but also morale.[41]

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38. Stevens, *Artillery Through the Ages*, p. 37; Birkhimer, *Historical Sketch*, pp. 2-3, 332-33; Wright, *The Continental Army*, pp. 40-42, 52-53, 62; Ward, *The War of the Revolution*, p. 141; Higginbotham, *The War of American Independence*, pp. 108-12; Callahan, *Henry Knox*, pp. 34-35.

39. Peterson, *Round Shot and Rammers*, pp. 38, 41, 60; John Muller, *A Treatise of Artillery* (London: 1768), pp. 104-18; Birkhimer, *Historical Sketch*, pp. 226-27.

40. Ward, *The War of the Revolution*, pp. 123-24; Wallace, *Appeal to Arms*, p. 61; Fitzpatrick, *Writings*, III, p. 375; Higginbotham, *The War of American Independence*, p. 105; Heath, *Memoirs*, pp. 32, 33, 35; Douglas S. Freeman, *George Washington*, Vol. IV (New York: Charles Schribner's Sons, 1951), pp. 27-31, 33, 37, 40, 44, 47-49, 50-51, 55-56; Erna Risch, *Supplying Washington's Army* (Washington: Center of Military History, US Army, 1981), pp. 357-58; Saxe Cummins, ed., *Basic Writings of George Washington* (New York: Random House, 1948), pp. 210-13, 219-20, hereafter cited as *Basic Writings*; Downey, "Birth of the Continental Army," p. 69.

41. Fitzpatrick, *Writings*, III, p. 375; Higginbotham, *The War of American Independence*, p. 105; Freeman, *George Washington*, IV, pp. 27-31, 33, 37, 40, 44, 47-49, 50-51, 55-56; Risch, *Supplying Washington's Army*, pp. 357-58; Cummins, *Basic Writings*, pp. 210-13, 219-20.

Knowing that the colonists would have difficulties fighting the British on the open battlefield, Washington revamped the Continental Army's order of battle early in August 1776 to give his field artillery a more prominent role. Drawing upon his experience of dragging heavy artillery pieces through the wilderness of New York and New England, where roads did not exist, Knox insisted that artillery could stay abreast of the infantry on the march.[42] Persuaded by Knox's achievement and the construction of light, mobile artillery carriages, Washington instructed his commanders to attach two to four light guns directly to the infantry as battalion guns. In doing so, Washington imitated the Europeans and comprehended that the infantry and artillery had to fight a coordinated effort. The decision to attach foot artillery to the infantry demonstrated Washington's sensitivity to the infantry. By doing this Washington would provide the infantry with more firepower and a means of keeping terrifying British bayonet charges from reaching untrained militia and partially trained Continental infantry. Battalion guns could also break up enemy formations since they would be on line with the infantry at the beginning of a battle and could give the colonists a psychological advantage.[43]

Before Washington could implement his new order of battle, he had to defend New York City.[44] Washington divided his forces between Manhattan Island and Long Island, which made them more vulnerable to the larger British army and navy and would allow the colonists to be defeated in detail.[45] When Howe crossed from Staten Island to Long Island late in August 1776 with twenty thousand men and forty artillery pieces, the senior colonial commander on Long Island, Major General Israel Putnam, had four thousand men and twenty-eight cannons at Brooklyn Heights and another three thousand men on the Heights of Guana.[46] Along the Heights of Guana, Putnam positioned Lord Charles Stirling (William Alexander of New Jersey) with eight hundred men to protect Gowanus Pass, placed Major General John Sullivan with sixteen hundred men and four field pieces between Flatbush Pass and Bedford Pass to prevent British movement through those passes, and lightly guarded Jamaica Pass with nearly five hundred troops. When Howe discovered the situation at Jamaica Pass, he directed a vigorous secondary assault of infantry supported by field artillery against Stirling on the colonial right. Although Stirling formed a line of battle, the British easily beat the colonists as Howe's main attack outflanked Sullivan's position and forced him to withdraw. Hastily retreating back to Brooklyn Heights, many colonists threw away their muskets and abandoned their field pieces. Pressed by Howe, Washington and his army moved from Long Island to Manhattan Island before the British could lay siege. From there, the colonists eventually abandoned 146 artillery

42. Callahan, *Henry Knox*, pp. 42, 56.

43. Fitzpatrick, *Writings*, VIII, pp. 100, 357, 460; Fitzpatrick, *Writings*, VI, pp. 266, 454; Fitzpatrick, *Writings*, IX, p. 24, 125; Fitzpatrick, *Writings*, V, p. 406; Fitzpatrick, Writings, XII, pp. 74-75; Wright, *The Continental Army*, pp. 97, 104; Callahan, *Henry Knox*, p. 76; Weller, "The Artillery of the American Revolution," p. 97; Weller, "Revolutionary War Artillery in the South," p. 261.

44. Ward, *The War of the Revolution*, pp. 202-15.

45. *Ibid.*

46. Enoch Anderson, *Recollections* (Wilmington, De: The Historical Society of Delaware, 1896, reprinted by New York *Times* and Arno Press, 1971), p. 21; Ira D. Gruber, "America's First Battle: Long Island, 27 Aug 1776," in Charles E. Heller and William A. Stofft, *America's First Battles: 1776-1965* (Lawrence, Ks: University Press of Kansas, 1986), pp. 20-21.

pieces and 2,800 muskets and escaped north to White Plains, New York, before crossing into New Jersey and later Pennsylvania.[47]

Long Island demonstrated the difficulty that the colonists had employing field cannons against a conventional force. When the fighting intensified along the collapsing American right, Putnam belatedly rushed two field guns to the front to stop the British onslaught, but it was too late. Equally important, Sullivan had field cannons, but his subordinates positioned them behind temporary fortifications and had no intention of maneuvering them against the Hessians. The Battle of Long Island illustrated the colonists' tendency to use their field artillery as siege or garrison weapons since they left most of their pieces at Brooklyn Heights and placed four out of the six cannons that they did move from the Heights behind temporary fortifications. After all, the colonists' strength was fighting behind entrenchments or cover of some kind and not maneuvering field artillery with the infantry. At the same time, Long Island reaffirmed Washington's wisdom of attaching the artillery to the infantry.[48]

During the time that Washington was fighting the British in Boston and New York, Congress tried to export the revolution to Canada. Emboldened by the seizure of Fort Ticonderoga by irregulars under the leadership of Colonel Ethan Allen of the Green Mountain Boys and Colonel Benedict Arnold, Congress directed New York to raise an army to defend the colony and invade Canada and placed Major General Philip Schuyler in command. In July 1775 Congress made Schuyler's army an element of the Continental Army, later known as the Northern Army. Early in September, Brigadier General Richard Montgomery, Schuyler's second in command, launched the invasion of Canada with some siege artillery from Fort Ticonderoga. After reaching St. Johns and entrenching, Montgomery besieged the British fort there with siege cannons and Captain John Lamb's Independent Company of New York Artillery of field artillery that had just joined the expedition. Necessity dictated using field guns in a siege artillery role at St. Johns because Lamb's company was the only artillery unit that could be mustered to provide extra artillery support for the campaign. Although the lengthy bombardment ruined the fort, the lack of supplies finally caused the British to capitulate. Montgomery then marched overland to Montreal with only Lamb's artillery for support and captured the town without a fight.[49]

Almost simultaneously, Washington organized an expedition to seize Quebec. Lacking any artillery, Brigadier General Benedict Arnold, who commanded the colonial force, could only blockade the city and harass the inhabitants with sniper fire. In December Montgomery joined Arnold. When the British refused to surrender, the colonists futilely bombarded Quebec's sturdy walls with Lamb's 6- and 12-pounders because they had nothing better. The British responded with 32-pounders to put the colonists' pieces out of action. Realizing that a siege would be

47. Ward, *The War of the Revolution*, p. 215; Callahan, *Henry Knox*, pp. 67-69; Higginbotham, *The War of the American Independence*, pp. 154-63; Alden, *The American Revolution*, pp. 97-103; John B.B. Trussell, Jr., "Captain Hamilton of the Artillery," *Field Artillery Journal*, Jan 1950, p. 27.

48. "An Account of the Battle of Long Island," *South Carolina and American General Gazetter*, 2 Oct 1776, in Henry P. Johnston, *The Campaign of 1776* (Brooklyn: The Long Island Historical Society, 1878), pp. 58-60; Callahan, Henry Knox, p. 68; Ward, *The War of the Revolution*, p. 215.

49. Wright, *The Continental Army*, pp. 40-42, 337-38.

impossible, the colonists assaulted the town. British cannon fire and musketry, however, forced the colonists to withdraw. Even though the attack failed, the colonists continued blockading Quebec until the spring of 1776 when the British fleet arrived. This compelled the colonists to retreat towards Montreal and eventually out of Canada back to Fort Ticonderoga.[50]

As the siege of Boston, the action on Long Island, and the invasion of Canada revealed, the colonists generally did not use field artillery as it was intended to be employed. With the exception of the attempt to employ two field guns properly on Long Island, the colonists utilized their field artillery to bombard or defend fortifications. At Quebec they learned that field pieces were not sufficiently powerful to batter down sturdy walls and lacked sufficient range to duel heavy garrison guns. At this stage of the American Revolution, the colonists had field artillery weapons but lacked gun crews trained to maneuver their pieces on the battlefield.

Building an Artillery: 1776-1777

Prodded by the inability to employ their field pieces effectively, the colonists led by Washington and Knox reformed their artillery in 1776-77 by obtaining French artillerists, organizing more artillery regiments, and creating artificer companies to maintain artillery materiel. Simultaneously, they fought the British. The Main Army, which was commanded by Washington, defeated the British at Trenton and Princeton, New Jersey, but lost at Brandywine and Germantown near Philadelphia, while the Northern Army under Major General Horatio Gates defeated a strong British army at Saratoga, New York.

In the summer of 1776, Washington began his search for qualified European officers and noncommissioned officers to staff his artillery regiments and train his cannoneers. Even before the disaster at Long Island, Washington complained about the need for trained artillery officers and noncommissioned officers. Later in November 1776, Washington wrote that a regiment of artillerists with "approved and experienced officers" should be obtained if possible because the Continental Army still suffered from a shortage of artillery experts.[51] To overcome this glaring weakness Washington insisted upon procuring artillerists from France or Holland.[52]

Washington's urgings produced action. Advised by Pierre Caron de Beaumarchais and Jean Baptiste de Gribeauval, who was the foremost artillery expert in Europe in the eighteenth century, Silas Deane, one of three American representatives to France, awarded a contract to Philip Tronson de Coudray in 1776 to make him General of the Artillery and Ordnance with the rank of major general. Coudray and his entourage reached America in the spring of 1777 and immediately caused a controversy over the proposed ranks that some French artillerymen would assume in the Continental Army. Deane had promised the French that they would hold ranks senior to colonial artillerists. Although Washington was grateful for the appearance of the French, he did not appreciate giving them senior ranks. After a debate over the wisdom of honoring Deane's contracts with the French, Congress eventually commissioned Coudray as Inspector General of Ordnance and

50. Alden, *The American Revolution*, pp. 52-58; Wallace, *Appeal to Arms*, pp. 72-87; Ward, *The War of the Revolution*, pp. 181-201.

51. Fitzpatrick, *Writings*, V, p. 352; Fitzpatrick, *Writings*, VI, pp. 280-82.

52 Fitzpatrick, *Writings*, VI, pp. 280-82.

Military Manufactories late in the summer of 1777. Coudray's untimely drowning in September 1777 as he was trying to ford the Schuykill River as the Main Army fled from Brandywine, however, abruptly ended the controversy over the ranks being distributed to the French.[53]

Despite the apparent setback, Washington reaped the benefits of having French artillerists. In June 1777 he sent French artificers to Springfield, Massachusetts, where the colonists had a cannon foundry, to improve colonial production of iron cannons. Nevertheless, domestic production continued to be disappointing. A shortage of materials and loss of artisans and laborers, who were called to active militia duty, limited production, offset the expertise of the French, and forced the colonists to depend on foreign artillery, especially French. At the same time,Washington dispatched artillerists to the Main Army's camp to train the colonists to maneuver their field pieces with the infantry.[54]

Although some Frenchmen returned to France in November 1777 after de Coudray's death, they still had rendered valuable services by helping train colonial gun crews. The addition of the French artillerymen formed, therefore, an important juncture in the development of field artillery for the Continental Army. Prior to mid-1777, Knox depended on his own and others' limited experience and British literature. The French gave Knox and Washington a cadre of skilled veterans.[55]

The disastrous defeats in New York in August 1776 also compelled Congress to reorganize the Continental Army. In September 1776 it decided that the Army needed eighty-eight infantry battalions and determined that it had to investigate Knox's recommendations to improve the artillery. Aware that the Continental Army's artillery was inadequately organized, Knox urged Congress to form five artillery battalions, also called regiments.[56] Knox also proposed establishing academies to teach the theory and practice of war to artillerists. If Congress failed to do this, the Army would not have qualified cannoneers.[57] Moreover, Knox suggested constructing laboratories to make artillery materiel and to cast cannons, howitzers, and mortars to make the colonists less dependent upon foreign sources for artillery. In essence, Knox argued that the improvisation of 1775-76 was insufficient. To defeat the British the colonists had to be better organized, trained to perform the intricate movements required for maneuvering field artillery on the battlefield, and self-sufficient in artillery materiel. Although Congress agreed that only a body of trained and disciplined regulars could successfully oppose the British and their Hessian allies, it did not create any academies. The pressing requirement for more men and military campaigns took precedent. The institution of formal training came later at Valley Forge in the winter of 1777-78 and Pluckemin, New Jersey, in the winter of 1778-79. Nevertheless, the dismal performance of the

53. Fitzpatrick, *Writings*, VIII, p. 323; Morris Swett, "The Forerunners of Sill," *Field Artillery Journal*, Nov 1938, p. 457.

54. Weller, "The Artillery of the American Revolution," p. 98; Wright, pp. 104-05; Birkhimer, *Historical Sketch*, p. 275; Fitzpatrick, *Writings*, VIII, p. 323; Robert B. Douglas, ed., *The Chevalier du Pontgibaud, a French Volunteer of the War for Independence* (Paris: Charles Carrington, 1898), pp. 43, 47; James A. Huston, *The Sinews of War: Army Logistics, 1775-1953* (Washington: Office of the Chief of Military History, US Army, 1966), pp. 22-23.

55. Birkhimer, *Historical Sketch*, pp. 374-76.

56. Birkhimer, *Historical Sketch*, pp. 4-6; Peter Force, *American Archives*, Vol. II (Washington: Peter Force and M.St. Clair Clarke, 1843), p. 1314.

57. Callahan, *Henry Knox*, p. 75; Force, American Archives, II, p. 1314.

Main Army in New York had convinced Congress that independence could not be won with a citizen army. As a result, Congress conceded that a regular army composed of long-term enlistees had to be formed. In September 1776 it authorized the Continental Army to enlist additional soldiers for the duration of the war so that training and discipline could be improved.[58]

Aware that the proposed eighty-eight battalions of infantry were insufficient, Congress started enlarging the Continental Army late in 1776. On 27 December it promoted Henry Knox to Brigadier General of the Artillery and authorized Washington to raise 110 battalions of infantry and 3 regiments of artillery. Each artillery regiment would have field, siege, and garrison artillery and have three field grade staff officers and twelve companies, while each company would be composed of three officers, six sergeants, six corporals, six bombardiers, six gunners, one drummer, one fifer, and twenty-eight matrosses. Besides furnishing balanced crews for two to six pieces, Washington's and Knox's actions created direct support companies of light field pieces to serve as battalion guns and established siege, garrison, and park artillery companies. Although the regiment's structure was a composite of different kinds of artillery companies, tactics stressed employing light, mobile cannons as foot artillery for close support with the ideal armament consisting of six-pounders. However, Washington and Knox did not rule out using field guns in siege work if necessary and, therefore, proposed employing field artillery in a multi-purpose role.[59]

While the Main Army had settled down into winter quarters in 1776-77, officers of the old Continental Artillery Regiment (Gridley's/Knox's) of 1776, which had been disbanded on 1 January 1777, scoured the countryside for veterans for cadres and new recruits to fill out the ranks. Colonel John Crane, who had received artillery training from British artillerymen as a member of the Boston Train of Artillery in the 1760s, formed one; and Colonel John Lamb created another. Washington and Knox also planned to organize a third regiment by using Colonel Thomas Proctor's Pennsylvania artillery companies as the nucleus and by supplementing them with new companies from New Jersey and Maryland. Before Washington and Knox could act, Pennsylvania organized a ten-company regiment under the command of Colonel Proctor early in 1777 and afterwards transferred it to the Continental Army in the summer of 1777. These three regiments along with the artillery regiment organized late in 1776 in Virginia under Colonel Charles Harrison gave the Continental Army four regiments in 1777. As chief of artillery, Knox commanded all four regiments through their commanders. He provided instruction on personnel management, organization, materiel, tactics, and training and directed the affairs of the artillery with the Main Army in person. Yet, during battle the local commander usually positioned the field artillery and gave artillerymen orders since Knox was generally with Washington and the Main Army.[60]

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58. Callahan, "Henry Knox: American Artillerist," in George A. Billias, ed., *George Washington's Generals* (New York: William Morrow and Company, 1964), p. 244; Wright, *The Continental Army*, pp. 91-92; Callahan, p. 71; Weigley, *History of the United States Army*, p. 63; Wright, "Nor is Their Standing Army to be Despised," in Ronald Hoffman and Peter J. Albert, eds., *The Military Character of The American Revolution* (Charlottesville, Va: University Press of Virginia, 1984), p. 55; Force, *American Archives*, II, p. 487.

59. Wright, *The Continental Army*, pp. 98-99, 104; Weigley, *History of the United States Army*, p. 67; Fitzpatrick, Writings, VI, p. pp. 40-103; Force, *American Archives*, II, p. 675.

60. Wright, *The Continental Army*, p. 102, 146-47; Worthington D. Ford, ed., *Journals of the Continental Congress*, Vol. VIII (Washington: Government Printing Office, 1907), pp. 865-66; Fitzpatrick, *Writings*, XIV, p. 294.

Concurrently, Washington and Congress directed the formation of companies of artificers to furnish better maintenance of artillery materiel. Ordered by Washington in January 1777, Colonel Benjamin Flowers raised three companies of artificers to serve in the field with the artillery or to work in laboratories in Philadelphia and Carlisle, Pennsylvania. In the meantime, Knox enlisted three companies of artificers. Together, Flowers' and Knox's artificers made and repaired belts, drums, ammunition wagons, axletrees, limbers for traveling forges, wheel barrows, sponges, rammer heads, powder casks, muskets, tools, and musket balls, to mention but a few. To centralize responsibility for ordnance, munitions, military equipment, and repair of weapons, Congress created the Artillery Artificer Regiment in 1778 with Flowers as commander and placed all artificers except for those in the field under his direction.[61]

In the middle of the reforms, Washington attacked the Hessians at Trenton, who along with their British allies had gone into winter quarters, to bolster sagging American morale with a success on the battlefield. Washington's decision to attack Trenton provided the first real opportunity to employ the tactics of attaching light artillery to an infantry battalion. On the night of 25-26 December 1776, the colonists ferried eighteen field pieces over the Delaware River and attached two to four cannons to each infantry brigade. This gave the colonists battalion guns since the brigade commander then distributed his artillery to each battalion. Yet, this concentration of artillery with Washington deviated from standard artillery practices of the day because most European commanders usually allotted two to three cannons per one thousand foot soldiers. In contrast,Washington and Knox had three times the normal number for several key reasons. First, most armies considered artillery to be the wet-weather weapon because muskets could be fired only when completely dry. Realizing that December weather could bring storms and render his muskets unusable, Washington chose to rely heavily upon field artillery. Second, towing along an unusually large number of pieces was a psychological move. The presence of artillery in large quantities was crucial because Washington's infantry had not yet indicated that it could fight except behind fortifications.[62]

Upon arriving at Trenton, Knox placed his field artillery at the ends of the major streets. Deploying his cannons at pointblank range and firing canister, Knox's battery commanders, one of whom was Captain Alexander Hamilton, established fire superiority from the opening moments of the engagement and forced the Hessians to retreat. By massing artillery fire on the enemy's infantry—a tactic practiced by the colonists throughout the war as well as counter battery fire, the artillery cleared the way for colonial infantry charges. Even though the battle lasted less than one hour, it produced the first colonial triumph since the siege of Boston. Trenton also vindicated Knox's argument that artillery could keep pace with the infantry on the march. Because

61. Wright, *The Continental Army*, p. 136; Risch, *Supplying Washington's Army*, pp. 327-29. At the time Benjamin Flowers was also the Commissary General of the Military Stores (July 1776-April 1781), with responsibility for receiving and issuing ordnance stores. In this capacity he oversaw artillery materiel at the arsenals, laboratories, and magazines. Eventually, the Commissary General of the Military Stores obtained control over the artificer companies except for those serving in the field with the Continental Army and evolved into the Ordnance Corps.

62. Callahan, "Henry Knox: American Artillerist," p. 246; Weller, "The Artillery of *The American Revolution*," p. 97; Wright, *The Continental Army*, pp. 97, 104; Weller, "Guns of Destiny: Field Artillery in the Trenton-Princeton Campaign, 25 December 1776-January 1777," *Military Affairs*, Spring 1956, pp. 7-11; Comparato, *Age of Great Guns*, p. 177.

field artillery in the form of foot artillery was present at the start of the battle, the colonists displayed an imposing force from the outset. Nevertheless, the colonists did not maneuver their cannons. They kept them stationary and blasted Hessian soldiers as they tried to form battle lines in the streets.[63]

Emboldened by success, Washington returned a second time to Trenton. Reacting swiftly to the defeat at Trenton, the British rushed up reinforcements and trapped Washington. Rather than fighting, Washington escaped during the night and surprised a small British garrison at Princeton on 3 January 1777. Although the colonists were hit hard by enemy field artillery fire and musket volleys, Captain David Neil's battery of two French 4- pounders poured canister onto the British before being captured. In the meantime, Captain Joseph Moulder's battery of two French 4-pounders opened fire with canister and drove the British back with the help of determined infantry charges. As the British were retreating, Hamilton's battery joined the action. A well placed round of shot from one of Hamilton's pieces hit Nassau Hall, where some British soldiers had taken refuge, and influenced the British to surrender. Trained cannoneers had demonstrated their ability to the support the infantry and reaffirmed the need for the infantry and the artillery to fight a coordinated effort. As such, Princeton represented a milestone in the development of the field artillery. For the first time in the American Revolution, gun crews had employed their field pieces as field artillery.[64]

Several months after the Battle of Princeton, the colonists began the campaigning season. Because of the difficulty of coordinating their plans back and forth across the Atlantic Ocean through Lord George Germain, the Secretary of State of American Colonies, Major General John Burgoyne and Howe developed strategies that precluded cooperating with each other. Burgoyne intended to move down the Hudson River from Canada and join Major General Barry St. Leger, who would move east from Fort Oswego. With help from Howe, who would push up the Hudson River, they would capture Albany. Howe projected leaving a small garrison at New York and leading a major expedition into Pennsylvania to capture the colonial capital at Philadelphia. When Washington realized that Burgoyne and Howe would not be combining their forces, he quickly led the Main Army westward to protect Philadelphia and positioned his command and Proctor's artillery regiment ment near Chad's Ford on Brandywine Creek. Proctor placed his heavier field pieces on high ground as guns of position and the lighter ones on line with the infantry as battalion guns. When the British appeared on Washington's front, Proctor's cannons poured solid shot and canister into the enemy's ranks and forced the British to respond with counterbattery fire.[65]

This assault kept Washington occupied on his front and allowed Lord Charles Cornwallis, a

63. Wright, *The Continental Army*, p. 104; Ward, *The War of the Revolution*, pp. 293-305; Callahan, *Henry Knox*, pp. 80-90; Callahan, "Henry Knox: American Artillerist," pp. 246-47. During the American Revolution, American artillerists used the terms, "grapeshot and canister," interchangeably so it is difficult to determine exactly what type of ammunition was being used. They probably employed canister more since grapeshot damaged bronze artillery's bore and was seldom used by even European armies.

64. Ward, *The War of the Revolution*, pp. 312-16; Downey, *Sound of the Guns*, pp. 43, 48, 49; Callahan, *Henry Knox*, pp. 76-77, 94-96; Wright, "Nor is Their Standing Army to be Despised," p. 57.

65. Ward, *The War of the Revolution*, pp. 342-52; Callahan, *Henry Knox*, pp. 76-77.

subordinate of Howe, to attack Washington's lightly defended right wing. Once Washington learned about Cornwallis' move, he dispatched Major General John Sullivan with nearly ten thousand men and a portion of Proctor's artillery. Cornwallis opened fire with his artillery and caused the colonists to counter with cannons that had been deployed on line with the infantry. Under a barrage of artillery fire from four British 12-pounders, Sullivan's line gave way. Even though colonial field pieces slowed down the enemy's advance to permit Sullivan to regroup, heavy British artillery and musket fire finally forced the colonists to withdraw from the battlefield. Meanwhile, British infantry, six 12-pounders, four howitzers, and several light field guns bombarded Washington at Chad's Ford and compelled the general to retire. Although the colonists lost, Washington reported that the field artillery delivered well-aimed fire and that cannoneers stayed by their pieces until they had been shot down or forced to flee.[66]

When Howe resumed his move to capture Philadelphia, Washington counterattacked by using using four columns to hit the British at Germantown. The battle began when Sullivan's column bumped into British patrols. As the patrols were being driven back, Sullivan unleashed a cannonade of canister. While the British withdrew, they resourcefully left six companies of infantry in the Chew House, a large stone house owned by Benjamin Chew, to form a rear guard. Advised by Knox that the house would be a hostile stronghold on his rear, Sullivan held back a portion of his command to neutralize the house as he continued pressing the attack with the rest. Knox threw his field artillery in a circle around the house and pounded it with canister and solid shot. Yet, artillery fire did little damage to the sturdy, massive walls because Knox's 3- and 6-pounders were simply too light to be used as siege cannons. Knox misused his field artillery and demonstrated his failure to learn the lessons of Quebec. The bombardment of the Chew House, a heavy fog along the four mile long battle front that hampered communications between Washington's four columns, and the panic caused when Major General Nathanael Greene's column and Sullivan's command fired on each other because of the confusion of combat persuaded Washington to withdraw from Germantown with the British in possession of the field.[67]

At Brandywine and Germantown in October 1777, Washington used tactics practiced in Europe to fight the British on the battlefield. Without sufficient training and expertise the colonists did not have the skills to maneuver their field artillery and infantry. With the prestige of the capital at stake, Washington could not allow Howe to capture Philadelphia without a fight even if it meant competing on Howe's terms.

While Washington fought to save the capital, Burgoyne started down the Hudson River armed with forty-two light and heavy artillery pieces. Upon reaching Fort Ticonderoga, Burgoyne positioned a battery of heavy cannons on a mountain overlooking the fort. Awed by the British battery, other artillery, and the Indians accompanying Burgoyne, the colonists withdrew without defending the fort. Notwithstanding this impressive British victory, colonial militia began turning out in large numbers to avenge the atrocities committed by Burgoyne's Indian allies and severely

66. Ward, *The War of the Revolution*, pp. 352-53; Alden, *The American Revolution*, pp. 23-24; Higginbotham, *The War of American Independence*, pp. 185-86; Callahan, "Henry Knox: American Artillerist," p. 249; Roger Lamb, *Journal Occurances* (Dublin: Wilkson and Country, reprinted by New York *Times* and Arno Press, 1969), pp. 6, 7, 10, 19, 21.

67. Callahan, *Henry Knox*, pp. 120-21; Ward, *The War of the Revolution*, pp. 366-71; Higginbotham, *The War of American Independence*, pp. 186-87.

contested the British advance by felling trees and destroying bridges. In addition, Burgoyne experienced supply shortages as he moved farther from his base in Montreal. Two detached columns searching for supplies even suffered a disastrous defeat at the hands of the militia in Bennington, Vermont. By September 1777 the growing Northern Army under Major General Horatio Gates, a British army veteran, who had replaced Schyuler in August, the loss of men, and shortages of supplies prevented the British from reaching Albany. Rather than admitting defeat and returning to Canada, Burgoyne continued pushing towards Albany.[68]

Late in September 1777, Burgoyne halted within two miles of the fortifications at Bemis Heights. After being stopped by the colonists in fierce fighting at the Battle of Freeman's Farm, Burgoyne resumed his offensive but suffered many reversals.[69] Early in October 1777, Burgoyne learned that Clinton would not be able to help. Gates' army also added to Burgoyne's plight. It grew larger as reinforcements poured into Bemis Heights. By the first week of October, Burgoyne was in a precarious situation. Rations were diminishing daily. Reinforcements were unavailable. Equally important, winter was approaching, and the British could not spend it in hastily constructed entrenchments near Saratoga. Rejecting advice from subordinates to retreat to Canada, Burgoyne chose to push on to Albany with fifteen hundred men, two 12-pounders, six 6-pounders, and two howitzers. A strong colonial resistance led by Gates forced the British at the Battle of Bemis Heights, also known as the Second Battle of Freeman's Farm, to withdraw to Saratoga.[70]

At Saratoga a portion of Crane's artillery regiment and Lieutenant Colonel Ebenezer Stevens' Provisional Artillery Battalion perched on the hills poured artillery fire upon the enemy that had taken refuge behind light field fortifications. Given the nature of these defenses, colonial field artillery had sufficient power to make Burgoyne's position untenable. Explaining the seriousness of the situation, Sergeant Roger Lamb of the British army recorded in his journal, "Roaring of cannon. . .were heard constantly by day and night."[71] Aware of the futility of his position, Burgoyne surrendered on 17 October 1777. Ironically, artillery defeated him in two ways. On the one hand, Burgoyne's heavy artillery and baggage train slowed down his advance from Canada and gave Gates time to prepare his defenses, to recruit replacements for the Northern Army, and to gather additional militia. On the other hand, Crane's and Stevens' artillery made Burgoyne's position at Saratoga perilous because the colonists could concentrate fire at will.[72]

Saratoga, therefore, represented a significant achievement. For the first time, the colonists had defeated the British on the battlefield, but they used tactics that favored them. Whereas the British relied heavily upon field artillery and close-rank military formations, the colonists depended upon skirmishers and sharpshooters, who fired from cover, and did not attempt to maneuver

68. Higginbotham, *The War of American Independence*, pp.188-94; Lamb, *Journal Occurances*, p. 158.

69. William L. Stone, trans., *Memoirs of Major General Friederich Riedesel* (Albany, NY: J. Mansell, 1968), pp. 151-61, hereafter cited as *Memoirs*.

70. Ward, *The War of the Revolution*, pp. 521-31; Stone, *Memoirs*, pp. 160-61; Lamb, *Journal Occurances*, p. 163.

71. Lamb, *Journal Occurances*, p. 166.

72. Stone, *Memoirs*, p. 170; Alden, *The American Revolution*, p. 148; *A State of the Expedition from Canada* (London: 1780, reprinted by New York *Times* and Arno Press, 1969), Appendix, pp. 84, 93; Wright, *The Continental Army*, pp. 338-39.

their cannons with the infantry at Freeman's Farm and Bemis Heights. Rather, the colonists employed their field pieces in static positions at Saratoga to bombard the British. Interestingly, the colonists successfully used their light guns as siege artillery. Yet, the colonists did not employ their field artillery to batter down fortress walls but utilized it to fire solid shot and canister into the British defensive works.[73]

Between August 1776 and the Battle of Saratoga in the fall of 1777, the Continental Army's field artillery underwent significant changes. During those years, Washington and Knox increased the number of artillery regiments, divided them into companies for field, siege, or garrison duty, improved tactics by attaching battalion guns to the infantry, and trained gun crews to maneuver their light cannons with the infantry. As a result, colonial artillerymen effectively employed their pieces to support the infantry in combat. Even so, the tendency still existed to utilize field artillery in siege work if required.

From Valley Forge to Yorktown

Following the defeats at Brandywine and Germantown in the fall of 1777, Washington retired to Valley Forge to prepare for the coming campaigning season. With help from French artillery officers and noncommissioned officers, Knox, and Congress, Washington invigorated the field artillery even more.

As difficult as winter quarters of 1777-78 were, Army and congressional reforms changed the character of the field artillery. With assistance from the French, Knox trained gunners from portions of the three Continental Army artillery regiments to an acceptable standard. Using a formal program of instruction, Knox drilled his cannoneers. Each man of the normal fourteen-man crew of a 6-pounder had a number and had to perform a specific task rapidly at an exact time. The first six crew members worked the drag rope, also called the prolonge, to maneuver the piece and were less skilled. The other eight members of the crew had to know how to sponge, load, ram, aim, and fire their piece. Number seven stood at the right of the muzzle with the sponge and rammer to push home the round and to sponge out the bore after a shot. Number eight positioned himself on the opposite side of the muzzle and placed the ammunition in the bore. Number nine stood at the right of the breech, thumbed the vent to prevent smoldering pieces of cartridge bags from being forced up into the vent and to help create a suction when the sponge was withdrawn to help extinguish any sparks that might have survived the sponging, and primed the cannon by sticking a priming tube filled with a mixture of gunpowder, saltpeter, and sulphur in the vent or by pouring loose powder into the vent. Number seven sponged and rammed, while number ten held the lighted portfire, a thin cylindrical case of paper that contained a quick-burning composition of gunpowder, saltpeter, and sulphur, and fired the piece by touching the portfire to the primer in the vent. Number eleven manned the handspike that fitted into a socket in the trail transom to point the gun in the direction ordered by the officer in charge. Number twelve held the water bucket, the linstock with its lighted wick that was used to light the portfire or fire the cannon, and a spare portfire to supply number ten a portfire upon demand. Number thirteen carried the ammunition from number fourteen's supply and handed it to number eight for inserting in the muzzle. Number fifteen held the limber horses and also oversaw the ammunition. Since casualties during battle would deplete the number of

73. J.F.C. Fuller, *Decisive Battles of the USA* (New York: Thomas Yoseloff, Inc., 1942), p. 42..

men, each man on the gun had to know the duties of every other member of the crew and had to be able to perform the tasks if necessary. Constant drilling and training instilled confidence in veterans and raw recruits alike and developed a professional field artillery to support the infantry that was being strenuously trained by Major General Frederick Wilhelm von Steuben, a veteran of the Prussian army. Although recruits filled the artillery's ranks in 1778, they benefited from training that their predecessors did not have before campaigning.[74]

As he formed a competent force of field artillerymen, Knox revamped the Main Army's artillery train. Since the beginning of the war, Knox had struggled with a collection of ill-assorted French, British, and American cannons and used whatever artillery that he had on hand. To eliminate the confusion Knox determined that four 3-, 4-, and 6-pounders would be attached to each brigade as battalion guns and that general support artillery for the brigades would be composed of two 24-pounders, four 12-pounders, four 8-inch and eight 5.5-inch howitzers, ten 3- and 4-pounders,and ten 6-pounders. For reserve artillery to augment or replace brigade or general support artillery, Knox designated thirty 3-, 4-, and 6-pounders, two 12-pounders, and one 24-pounder. Moreover, brigade, general support, and reserve artillery would be composed of bronze, usually called brass, since they burst less easily than iron cannons. In addition, iron 18-, 24-, and 32-pounders, and 13-inch mortars and brass 5.5-, 8-, and 10-inch mortars would form the siege artillery. Knox's measures reduced the field artillery from fifteen to seven calibers and siege artillery from twelve to seven calibers. Altogether, the reform gave Knox thirteen calibers of cannons since the 24-pounder was used as a siege and field piece. By assigning artillery a certain function according to size and caliber and determining the desired metal for the cannons, Knox standardized colonial artillery and imitated the Europeans. Despite recognizing the need for specialization, Knox planned to employ light field guns in siege work if necessary and trained each gun crew on field, siege, and garrison artillery to provide flexibility. By doing this Knox envisioned employing field artillery in a multi-purpose role and did not intend to restrict its use to infantry support on the battlefield.[75]

Congress revamped the artillery regiments on 27 May 1778 as part of an overall reorganization of the Continental Army. Although Congress retained four artillery regiments and wanted twelve companies in each, it cut the number of field grade staff officers to lower costs. This reduction slowed down promotions even more than they had been in the past, discouraged officers from seeking commissions in the artillery, and caused some to leave the artillery. In practice, however, Harrison's, Lamb's, and Crane's regiments had twelve companies in 1778, while Proctor's had eight in 1778. In 1779 Harrison's regiment became the lst Continental Artillery Regiment. Lamb's was redesignated the 2nd Continental Artillery Regiment. Crane's became the 3rd Continental Artillery Regiment, while Proctor's regiment was named the 4th Continental

74. Tousard, *American Artillerist's Companion*, pp. 130-44; Wright, *The Continental Army*, pp. 125, 252; Callahan, "Henry Knox: American Artillerist, "pp. 54-55; Weller, "The Artillery of *The American Revolution*, " p. 101; Petersoon, *Round Shot and Rammer*, pp. 64, 66.

75. Weller, "Revolutionary War Artillery in the South," p. 253; Wright, *The Continental Army*, p. 150; Birkhimer, *Historical Sketch*, pp. 275-76; Fitzpatrick, *Writings*, VI, p. 323; Fitzpatrick, *Writings*, VIII, p. 158; Callahan, *Henry Knox*, p. 142; Huston, *The Sinews of War*, p. 98; Wright, *The Continental Army*, p. 104; Comparato, *Age of Great Guns*, p. 177.

Artillery Regiment. In 1780 Congress reformed the artillery to give each regiment ten companies.[76]

While the Continental Army was being rebuilt, the British changed commanders and policy. In March 1778 Lord George Germain replaced Howe with Major General Sir Henry Clinton. Germain instructed Clinton to ravage the New England coast and permitted him to hold or abandon Philadelphia, depending on circumstances. Later in March after the British had heard about the American French alliance, the British decided that Clinton should leave Philadelphia, and even New York if required, because of the threat that the French fleet posed to his exposed communications lines.[77]

Learning that the British army was withdrawing from Philadelphia to New York, Washington pursued it with the Main Army and New Jersey militia and finally caught Clinton on 28 June 1778 near Monmouth Court House in New Jersey. Major General Charles Lee had orders to strike Clinton's rear guard with the under standing that Washington's main body would support him. Expecting an attack, Clinton vigorously hit Lee. After several unsuccessful probes and without faith in the Continentals' ability to fight British regulars, Lee retreated to Monmouth Court House under the cover of heavy canister fire from his brigade pieces.[78]

To prevent a complete rout Washington established a defensive line after taking personal command of the battle. Knox took command of the field artillery and placed Chevalier de Plessis second in command. To enfilade the attacking British with canister, Knox positioned his field pieces on the wings of Washington's line. On the colonial left Lieutenant Colonel Edward Carrington's cannons blasted the British and engaged enemy artillery in a duel. On the opposite wing Chevalier de Plessis raked the British.[79] Observing Knox's artillery fire from brigade and reserve pieces, Colonel Henry Laurens of the Main Army noted, "The enemy was prevented from advancing on us, and confined themselves to cannonade with a show of turning our left flank."[80] Inspired by artillerymen's destructive fire on the enemy's lines and their ability to shift their pieces rapidly, colonial infantry made repeated assaults on the British. Together, the infantry and field artillery forced Clinton to retreat. Washington ordered two brigades to advance on the British flanks with the intention of attacking the front when the time was propitious. Nevertheless, darkness set in and allowed Clinton to escape to New York before Washington could resume his offensive.[81]

At Monmouth the colonists successfully utilized conventional European field artillery and infantry tactics. Monmouth showed that the colonists could fight a conventional battle, that short

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76. Wright, *The Continental Army*, pp. 126-27, 149-50; Callahan, *Henry Knox*, p. 142; Fitzpatrick, *Writings*, XII, pp. 31, 459; Peterson, *Round Shot and Rammers*, pp. 38-42, 48-54.

77. Alden, *The American Revolution*, p. 197.

78. Frank Moore, *Diary of The American Revolution*, Vol. II (New York: Charles Schribner, 1860, reprinted by New York *Times* and Arno Press, 1969), p. 197; Wright, *The Continental Army*, p. 150.

79. Callahan, *Henry Knox*, pp. 144-46.

80. John Laurens, *Army Correspondence of Colonel John Laurens in the Years 1777-78* (New York: 1867), p. 197, hereafter cited as *Correspondence*.

81. Moore, *Diary of The American Revolution*, II, pp. 67-68; Laurens, *Correspondence*, p. 198; Ward, *The War of the Revolution*, pp. 580-86; Callahan, *Henry Knox*, pp. 144-46.

but intensive training could produce positive results, and that the field artillery was a respectable force. Summing up the artillery's performance and bragging at the same time, a Continental Army soldier, Frank Moore, wrote in his journal, "Our troops behaved with the greatest bravery, and opposed the flower of the British army. Our artillery was well served and did amazing execution."[82]

Disillusioned by the stalemate in the North, the defeat at Monmouth, and the lack of support from the northern Tories, the British turned their attention to the southern colonies after 1778. However, the colonists never established a separate artillery organization in the southern theater such as Knox had done. There was simply not enough artillery. As a result, Continental artillery rarely exceeded two batteries in battle. Frequently, only a single piece took part. In such an arrangement an artillery officer took orders from the commander of the force to which he was attached. Moreover, the colonists employed gun crews trained on field artillery weapons to man siege pieces when necessary, depended upon soldiers to drive the horses, and used the horses to maneuver the guns on the battlefield rather than matrosses as was the practice in the Main and Northern Armies. In emergencies the drivers mounted the horses to bring the gun into action faster.[83]

In 1778 the British opened major offensives in the South. In December 1778 the British captured Savannah, Georgia, after a siege. Seventeen months later in May 1780, Clinton's army of fourteen thousand troops overwhelmed Major General Benjamin Lincoln's army of fifty-five hundred men composed of Continentals and militia in Charleston, South Carolina. Sophisticated artillery cross fire and ricochet fire from field, garrison, and siege weapons from elements of Harrison's Artillery Regiment and the North Carolina Continental Artillery Company hampered British siege operations and forced the enemy to take forty-two days to defeat the colonists.[84]

Following the victory at Charleston, Clinton sailed for New York and left Lord Cornwallis to secure North and South Carolina. To stop any further British penetration into South Carolina, the colonists commanded by Major General Horatio Gates moved to block Cornwallis. In the early hours of 16 August 1780, near Camden, South Carolina, Gates attached his seven field guns to the infantry and engaged the British in an artillery duel. Supported by six light field pieces, the British infantry overpowered the undisciplined colonial militia. This exposed the Continentals' left to a flanking movement and threw the reserves into disorder. Gates attempted to rally his militia, but he failed. Without support from the militia and an artillery commander to direct the artillery, the Continentals retreated, reformed, and attacked; but British bayonet charges

82. Moore, *Diary of The American Revolution*, II, p. 68.

83. Robert E. Lee, *Memoirs of the War in the Southern Department of the United States by Henry Lee* (New York: University Publishing Company, 1869, reprinted by New York Times and Arno Press, 1969), p. 82, hereafter cited as Memoirs; Banastre Tarleton, *A History of the Campaign of 1780 and 1781 in the Southern Provinces of North America* (London: 1787, reprinted by the New York *Times* and Arno Press, 1968), pp. 103-09, hereafter cited as *A History of the Campaign of 1780 and 1781*; William Moultrie, *Memoirs of The American Revolution*, Vol. II (New York: David Longworth, 1802, reprinted by New York Times and Arno Press, 1969), p. 234; Weller, "Revolutionary War Artillery in the South," pp. 261, 263.

84. Alden, *The American Revolution*, pp. 227-28, 231; Wright, *The Continental Army*, p. 155. Bernhard A. Uhlendorf, ed. and trans., *The Siege of Charleston* (Ann Arbor, Mi: University of Michigan Press, 1938), pp. 45, 49, 56; Wright, *The Continental Army*, p. 336.

finally compelled the colonials to retire from the field in defeat and leave all of its cannons on the battlefield.[85]

Despite a colonial victory at King's Mountain, in which the colonists did not have any artillery, the colonial cause reached a nadir following the defeat at Camden. To alter the colonial direction of the war in the South, Congress replaced Gates with Major General Nathanael Greene as commander of the Southern Army. When he assumed the post, Greene found only sixteen hundred troops with more than a third of them militia and elements of Harrison's and Proctor's artillery regiments.[86]

Even though Greene knew that he could not fight the British, he still took to the offensive. He detailed one group under Brigadier General Daniel Morgan to the southwest and led the remainder of the army to the southeast to help Brigadier General Francis Marion's guerrillas. Following Morgan's victory at Cowpens, achieved without any field artillery support, Greene joined forces with Morgan. After maneuvering his army in the Virginia-North Carolina area to avoid fighting Cornwallis, Greene took up a position with his field artillery attached to the infantry at Guilford Court House, North Carolina, on 16 March 1781.[87]

After an artillery duel the British assaulted the colonists. The attack swept the first two colonial lines but stalled at the third line when Captains Samuel Finley's and Anthony Singleton's companies of two 6-pounders each started pouring canister onto the British. Frustrated by the inability to shatter the colonists, Cornwallis ordered his field artillery to fire canister over the heads of his own troops into the enemy. The canister tore apart British and colonial lines and eventually caused Greene to withdraw from the battlefield. Although the colonists clearly lost the Battle of Guilford Court House, the British only earned a Pyrrhic victory. Because the heavy casualties compounded the problem of the already dwindling manpower, Cornwallis' army had to withdraw to the coast to refit.[88]

As Cornwallis moved toward the coast, Greene marched southward to reclaim the Carolinas and Georgia. At Hobkirk Hill, South Carolina, in April 1781, Lord Rawdon, who had replaced Cornwallis, attacked Greene's army. Greene positioned his three field pieces in the center of his line and masked them with infantry. Believing that the colonists lacked field pieces, the British charged. As Lord Rawdon's men advanced, Greene moved his Continental infantry aside and fired canister onto the British. The British recoiled from a hail of fire but resumed their charge. Panic spread among the colonists. As he abandoned the field, Greene pushed his field guns down a hill into a morass to hide them from the British. Even though Greene retreated in defeat, his artillery, which had been attached to the infantry, inflicted heavy casualties on the British. Four

85. Moore, *Diary of The American Revolution*, II, p. 312; Tarleton, *A History of the Campaign of 1780 and 1781*, pp. 107-08; Moultrie, *Memoirs of The American Revolution*, II, p. 234.

86. Wright, *The Continental Army*, pp. 336-41; Alden, *The American Revolution*, p. 235.

87. Alden, *The American Revolution*, p. 237; Moultrie, *Memoirs of The American Revolution*, II, pp. 236, 258-68; Moore, *Diary of The American Revolution*, II, p. 274; Lee, *Memoirs*, pp. 226-31.

88. Moore, Diary of *The American Revolution*, II, p. 401; Lee, *Memoirs*, pp. 277-79; Higginbotham, *The War of American Independence*, p. 270; Ward, *The War of the Revolution*, pp. 784-93, Weller, "Revolutionary War Artillery in the South," pp. 265-66.

months later in September, Greene attacked the British at Eutaw Springs, South Carolina. Using two 6-pounders and two 3-pounders, Greene drove the British into a brick building and captured two British 6-pounders in the process. Two colonial pieces and two captured British guns were turned on the building, but the inability of the light artillery to pierce the brick walls combined with fire from British infantry and artillery hampered the attack. Even though the British eventually drove Greene from the battlefield with a strong counterattack, the colonial general once again inflicted serious casualties on the enemy force.[89]

Tactics employed in the South during the American Revolution differed significantly from those in the North. Imitating their European contemporaries, northern commanders adopted the combination of musket and bayonet-armed infantry, cavalry, field artillery, and light infantry. Nevertheless, the colonists made several important adaptations. Because of the dense woods, Washington and other colonists minimized cavalry shock tactics as a means to rout the opposing forces although they used horse soldiers for reconnaissance, screening, outpost fighting, and pursuit. In addition, the colonials possessed fewer and lighter artillery pieces than the British did. Despite modifications, Washington and his generals in the North basically fought as their European counterparts did in the eighteenth century. Linear formations and siege operations dominated the major battles in the North.[90]

Combat in the South assumed a different form than in the North. Because the militia composed a large portion of the southern forces and lacked training and discipline, Greene, Morgan, and partisan leaders utilized small arms and hit-and-run tactics. The use of irregular warfare, therefore, minimized the need for field artillery. With the exception of the Battles of Camden, Guilford Court House, Hobkirk's Hill, and Eutaw Springs, where field artillery was utilized effectively, southern commanders did not employ artillery as a decisive weapon.

Yorktown provided the last opportunity for artillery to demonstrate its capabilities. After unsuccessfully engaging Greene, Cornwallis eventually marched into Virginia to conquer it. In July 1781 after a few inconclusive fights with the colonists, Cornwallis set up camp at Portsmouth and later moved to Yorktown. It was a secure haven only as long as the British navy commanded the seacoast and British artillery controlled the surrounding hills.

While Cornwallis built fortifications at Yorktown, Washington waited for the French navy to appear and assist him in a combined attack on Clinton's army in New York City. In August Admiral Francois Comte de Grasse arrived at Newport, Rhode Island, with twenty warships and convinced Washington to assault Cornwallis. Leaving part of his troops at New York to deceive Clinton, Washington along with Jean Comte de Rochambeau's army marched overland to Virginia as de Grasse sailed to the peninsula. Additional forces under Brigadier General Anthony Wayne and the Marquis de Lafayette joined Washington near Yorktown late in the summer of 1781. In the meantime, de Grasse's and Louis Comte de Barras' fleets forced the British fleet off Yorktown to retire and isolated Cornwallis in the process.[91]

89. Weller, "Revolutionary War Artillery in the South," pp. 265-66; Wallace, *Appeal to Arms*, pp. 240-42; Ward, *The War of the Revolution*, pp. 802-08, 823-34.

90. Weller, "Irregular But Effective, Partisan Weapons and Tactics in *The American Revolution*, Southern Theater," in Higginbotham, ed., *Military Analysis of the Revolutionary War* (Millwood, NY: KTO Press, 1967), p. 132.

91. Lee, *Memoirs*, pp. 489-90.

The French and colonists then laid siege to the British army at Yorktown along the lines developed by Vauban. Early in October 1781, they began investing Cornwallis' position with siege and field artillery from the 2nd and 4th Continental Artillery Regiments. Together, colonial and French artillery fire crushed British defenses. Unable to withstand the pounding of artillery fire, Cornwallis capitulated on 19 October 1781. As in previous sieges, the colonists employed field guns and took advantage of gun crews that had received training in field and siege work. Two years later in 1783, the British and colonists signed a peace treaty to end a war that earned the American colonies their independence.[92]

Although Washington and Knox transformed the Continental Army's artillery from a motley collection of men and weapons into a skilled fighting force, they did not employ field artillery exclusively to support the infantry as European armies were doing. They employed their field artillery as multipurpose weapons and trained their gun crews to man siege, garrison, and field guns. Field artillery weapons existed, but field artillery as a distinct branch of artillery did not.

92. Ward, *The War of the Revolution*, pp. 886-96; Wallace, *Appeal to Arms*, pp. 246-62.

Table 1

SELECT LIST OF CANNONS IN THE SIXTEENTH CENTURY

Name	Weight in Pounds	Caliber in Inches	Weight of Shot
Basiliske	9,000	8.75	60
Cannon-Royal	8,000	8.0	63
Cannon	7,000	8.0	60
Demi-Cannon	6,000	6.5	30
Cannon-Serpentince	5,500	7.5	53
Bastard Cannon	4,500	7.0	41
Culverin	4,000	5.5	18
Cannon-Perrier	3,500	6.0	24
Bastard-Culverin	3,000	4.0	7
Minion	1,100	3.25	4.5
Falcon	800	2.5	2
Falconet	500	2.0	2
Robinet	200	1.25	1

Source: O.F.G. Hogg, *Artillery: Its Origin, Heyday, and Decline* (Hamden, Ct: Archon Books, 1970), pp. 53-54.

Table 2

VALLIERE AND GRIBEAUVAL SYSTEMS OF FIELD ARTILLERY

VALLIERE

Caliber	Length in Calibers	Weight in Pounds
4-Pounder	25	1,150
8-Pounder	24	2,100
12-Pounder	23	3,200

GRIBEAUVAL

Caliber	Length in Calibers	Weight in Pounds
4-Pounder	18	600
8-Pounder	18	1,200
12-Pounder	18	1,800

Source: John Muller, *A Treatise of Artillery* (London, 1757), P. X; Louis de Tousard, *American Artillerist's Companion* (Philadelphia, 1809), p. 15; Harold L. Peterson, *Round Shot and Rammers* (Harrisburg, Pa: Stackpole Books, 1969), P. 48; Ltr, Col Decius Wadsworth, Chief of Ordnance, to Secretary of War, 13 Jan 1820, in Stephen V. Benet, *A Collection of Annual Reports and Other Important Papers relating to the Ordnance Department* Vol 1 (Washington: Government Printing Office, 1878), p. 59.

Chapter II

FIELD ARTILLERY AND THE NEW NATION: 1784-1815

Between 1784 and 1815 the War Department took various steps to maintain its field artillery. Although limited budgets, surplus stocks of field guns and howitzers from the American Revolution, and the questionable quality of cannons being produced in the United States hindered progress, the War Department organized artillery regiments, developed training programs, relied upon foreign expertise, and introduced new technology and tactics.

Years of Peace

Following the American Revolution, the United States struggled to find the appropriate military organization to defend the country. Although George Washington supported some type of militia, he advised Congress to form a permanent force of four regiments of infantry and one regiment of artillerists and artificers to patrol the frontiers and defend against Indian depredations. Lacking money and fearing a standing army, Congress disregarded Washington's proposal. In June 1784 it ordered Henry Knox, the senior officer in the Army, to discharge all but fifty five men at West Point and twenty-five men at Fort Pitt to guard the military stores at those places.[1] Breaking up the Continental Army extinguished any possible ties and traditions between the Army of 1784 and the Continental Army. At best, a tenuous link existed between the artillerists stationed at West Point under Brevet Major John Doughty and the Continental Army. Some had served in Doughty's company that had descended from Alexander Hamilton's Provincial Company of Artillery of the Colony of New York during the American Revolution.[2]

In the meantime, activities by small hostile bands of Shawnee, Kickapoo, and Miami Indians pressured Congress to raise regiments to end the Indian raids into Kentucky, Tennessee, and Pennsylvania. In June 1784 Congress directed New Jersey, New York, Pennsylvania, and Connecticut to raise men from their militias to form a provisional force of one regiment of

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1. William E. Birkhimer, *Historical Sketch of the Organization, Administration, Materiel and Tactics of the Artillery, United States Army* (James J. Chapman, 1884, reprinted by Greenwood Press, 1968), pp. 22-23, 349, hereafter cited as *Historical Sketch*; James R. Jacob, *The Beginning of the U.S. Army, 1783-1812* (Princeton, NJ: Princeton University Press, 1947), p. 14; Russell F. Weigley, *History of the United States Army* (New York: Macmillan Publishing Company,1967), pp. 80-81.

2. Weigley, *History of the United States Army*, pp. 80-81.

infantry of eight companies and one artillery battalion (two companies) of 21 officers and 229 enlisted men. Only Pennsylvania met its assigned quota. As a result, Congress was unable to do anything about the Indian problems.[3]

In the spring of 1785, Congress renewed its efforts to raise the eight companies of infantry and battalion of artillery for duty on the frontier. It made Lieutenant Colonel Josiah Harmar of Pennsylvania, who had become the senior ranking officer when Henry Knox retired from the Army to become the Secretary of War in 1784, the commander of the small force and charged him to recruit men from his home state. Meanwhile, Congress enlisted men from New Jersey, New York, and Connecticut along with those from Pennsylvania for three years or unless discharged sooner to form a standing army. The First Regiment, as it was named, was divided into eight infantry companies and two artillery companies with one captain, one lieutenant, four sergeants, three corporals, three bombardiers, three gunners, one drummer, one fifer, and thirty-five matrosses in each artillery company and with Doughty and Captain William Ferguson as commanders of the artillery companies.[4]

The regiment and its string of forts stretching from Fort Franklin on the Upper Allegeheny River to Fort Steuben near Louisville to Fort Knox near Vincennes failed to stop confrontations between the Indians and advancing white civilization. Prompted by Indian raids and Shay's Rebellion, an internal revolt against taxation, in October 1786 Congress authorized enlisting 1,340 more men for a term of not more than three years. With the existing regiment the 1,340 men would give the United States an army of 2,040. Equally important, Congress gave Knox permission to organize the artillery as a separate battalion. In January 1787 Knox made Major John Doughty the artillery commander.Yet, the depressed state of the country's finances compelled Congress to stop the recruiting and direct Knox to discharge everyone in April 1787 except those in the two artillery companies that were retained to guard West Point and the Springfield arsenal. By the time that Knox had complied with Congress' instructions, the United States had only Harmar's regiment of eight companies of 595 infantrymen and Doughty's battalion of artillery of four companies. Each artillery company was composed of one captain, two lieutenants, four sergeants, four corporals, two musicians, and sixty privates to serve as bombardiers and cannoneers and to manhandle the piece on the battlefield.[5]

Because of the serious situation along the Ohio River, Knox urgently requested Congress to raise seven hundred men to replace the 1785 enlistees, whose terms of service would expire in 1788. Knox explained that the country required an army to protect the frontier from Indian raids, to

3. Jacob, *The Beginning of the U.S. Army, 1783-1812*, p. 16; Weigley, *History of the United States Army*, pp. 82-83; Birkhimer, *Historical Sketch*, pp. 22-23; William A. Ganoe, *The History of the United States Army* (New York: D. Appleton-Century Company, 1942), pp. 91-92.

4. Worthington C. Ford, ed., *Journals of the Continental Congress* Vol. XXVIII, (Washington: Government Printing Office, 1907), pp. 223-24, 240-41, 243, 247-48, hereafter cited as *Journals*; Weigley, *History of the United States Army*, p. 83; Birkhimer, *Historical Sketch*, p. 24.

5. Ford, *Journals*, XXXII, pp. 32, 39, 57, 61, 153, 158, 159, 255; Clarence E. Carter, ed., *The Territorial Papers of the United States* (Washington: Government Printing Office, 1934), pp. 33-34; *Annals of Congress*, 1st Congress, col. 62; Rpt, Henry Knox,10 Aug 1789, *American State Papers, Military Affairs (ASPMA)*, I, pp. 5-6; Birkhimer, *Historical Sketch*, pp. 24-25, 352.

prevent intrusions on public lands, and to facilitate surveying and selling of land to reduce the public debt. Reacting to Knox's advice and the Indian problems in the Ohio country, Congress resolved in October 1787 to raise seven hundred men for a period of three years. Upon completion of the recruiting, the United States had one infantry regiment of eight companies under Harmar and a battalion of artillery of four companies under Doughty to guard the frontier. Each artillery company had one captain, two lieutenants, four sergeants, four corporals, two musicians, and sixty privates. Later in 1789, Congress adopted Harmar's regiment and Doughty's battalion as the Army of the United States. With the exception of the two artillery companies that had been recruited in 1787 to guard West Point and the Springfield arsenal, the Army occupied a series of forts on the frontier with artillerymen serving as infantry and manning guns in the forts as an additional duty.[6]

Continuing to search for the proper military system and provide for the common defense, Congress asked Knox to write a plan for a permanent military force. In January 1790 he presented his ideas to Congress.[7] Knox advised Congress that the country required a strong military to defend itself against foreign enemies and domestic unrest as recent events had demonstrated. He wanted a small corps of well-disciplined and well-informed artillerists, engineers, and infantry to form a standing army to protect the frontier, magazines, and arsenals. As a concession to those favoring the militia, Knox added, "An energetic national militia is to be regarded as the critical security of a free Republic; and not a standing army, forming a distinct class in the community."[8] He recommended that all able-bodied males between the ages of eighteen and sixty be enrolled in the militia.[9]

As Congress debated Knox's proposals, President George Washington maneuvered to end the Indian forays into Pennsylvania, Tennessee, and Kentucky. Unable to stop the raids through diplomacy, in June 1790 Secretary Knox authorized Harmar, now a brigadier general, to take a force composed of regulars and militia to campaign against the Miami Indian confederation living along the Maumee River in the Ohio. Harmer's two-pronged offensive ended in disaster. Major John Hamtramck's column showed little resolution and returned without accomplishing anything. Meanwhile, Harmar's column of militia, regulars, and Major William Ferguson's foot artillery company with its three small bronze pieces (most likely 3- or 6-pounders) plunged into the dense woods in September 1790. When Harmar arrived in Miami country in mid October, he burned deserted villages and simultaneously dispatched Colonel James Trotter with a group of three hundred militia to find the Indians. After marching only a few miles and killing two Indians, Trotter returned without any further information. Displeased with Trotter, Harmar then detailed Colonel John Hardin with the same three hundred militia, but the Indians totally surprised Hardin and inflicted a disastrous defeat on him on 19 October 1790.[10]

6. Birkhimer, *Historical Sketch*, pp. 24-25, 191, 352-53.
7. *Annals of Congress*, 1st Congress, col. 2088-90.
8. *Ibid.*, col. 2090.
9. *Ibid.*, col. 1146.
10. *Ibid.*

Although Harmar's defeat graphically demonstrated the liability of using inexperienced and untrained militia, it also reaffirmed the limited use of field artillery in offensives against Indians in densely wooded terrain. Since Harmar intended to employ his artillery pieces to bombard Indian villages, he kept them with the main body of his army, did not attach any cannons to Trotter's or Hardin's advance parties, and did not have any intentions of maneuvering his artillery to support the infantry. Consequently, none of Harmar's field pieces even fired a shot in anger. Although Harmar's action did not alter his view of the importance of field artillery for arming frontier garrisons or cannonading Indian villages, it caused most Army officers to wonder if they should even bother towing ordnance with them when they campaigned against Indians. Harmar's expedition suggested that foot artillery only slowed down an army and did not have sufficient mobility to be used in the field.[11]

After learning about Harmar's defeat, Knox sent another military force into the Ohio to revive the government's prestige and to stop the Indian raids.[12] In March 1791 Congress authorized the formation of an additional regiment of infantry and permitted the President to call out two thousand militia.[13] After he had received command of a force of militia and regulars, Major General Arthur St. Clair, the governor of the Northwest Territory and also a Revolutionary War veteran, launched his punitive campaign from Fort Washington, present-day Cincinnati. Establishing routine defenses on 3 November 1791, St. Clair encamped for the night with no thoughts for security even though his scouts had sighted Indians in the vicinity that day. He formed his men into two lines of infantry of two battalions each with Ferguson's company of foot artillery with its three 3-pounders, three 6-pounders, and three 5.5-inch howitzers between the infantry battalions on each line.[14]

On the morning of 4 November, approximately one thousand Indians startled St. Clair's sleeping army. They stunned the militia, who fled back to the main body. Although shot and canister from the field pieces and musket fire stopped the Indians short of the main line, the spirited attack soon extended along the entire front line with its focus centering on the artillery. Since artillery fire and musketry made little impact on the Indians, the cohesion of St. Clair's army disintegrated rapidly at the Battle of the Wabash.[15] Even though the soldiers fought tenaciously, St. Clair could not retain his precarious position and retreated back to Fort Washington.[16]

St. Clair's defeat reinforced the hazards of employing field pieces in the wilderness against Indians. Deployed in conventional infantry formations, St. Clair's army fought an enemy that

11. Fairfax Downey, *Indian Wars of the U.S. Army* (New York: Doubleday, 1963), p. 35; Weigley, *History of the United States Army*, p. 91; Richard G. Knopf, ed., *Anthony Wayne: A Name in Arms* (Pittsburgh: University of Pittsburgh Press, 1960), p. 172.

12. Jacob, *The Beginnings of the U.S. Army*, 1783-1812, pp. 68, 71.

13. Francis Prucha, *Sword of the Republic* (New York: Macmillan Publishing Company, 1969), p. 24.

14. *Annals of Congress*, 2nd Congress, col. 1055-56.

15. *Annals of Congress*, 2nd Congress, col. 1055-56; Ebenezer Denny, *Military Journal of Major Ebenezer Denny, An Officer in the Revolutionary and Indian Wars, with an Introductory Memoir* (Philadelphia: Lippincott, 1959), pp. 165-67, hereafter cited as *Military Journal*; William H. Guthman, *March into Massacre* (Philadelphia: McGraw-Hill, 1975), pp. 238-39.

16. *Annals of Congress*, 1st Congress, col. 2090.

utilized surprise, close cover, and skirmish tactics and did not offer good targets for artillery fire. St. Clair's experience, therefore, reaffirmed that field pieces should only be used to defend forts and not be utilized in mobile Indian warfare.[17]

Harmar's and St. Clair's defeats discredited guns and howitzers in offensive operations in the field. Observing that field artillery was not used in Harmar's campaign and did not prevent St. Clair's rout, many Army officers drew the conclusion that employing field artillery in Indian warfare was unproductive and unnecessary.[18]

Besides the nature of Indian warfare, which made using field pieces difficult, the lack of qualified cannoneers also hurt St. Clair's force. Even though the Army had stocks of iron and bronze smoothbore cannons and ammunition that consisted of canister, shot, and shell, artillerymen had served primarily as infantry on the frontier since 1784. This situation caused the veterans of the American Revolution, who were still in the Army, to lose their skills and prevented recruits from receiving proper training.[19]

Cognizant of the need for a military force to stop the Indian depredations and restore peace, Congress finally devised plans for a militia and standing army. In May 1792 Congress passed a militia act that required every able-bodied male citizen between the ages of eighteen and forty-five to enroll in the militia. Each state also had to arrange its militia into divisions, brigades, regiments, battalions, and companies. Even though Congress granted the states power to regulate their militias, the states had to form at least one company of grenadiers, light infantry, or riflemen for every battalion and one company of artillery and one troop of horse cavalry for each division. According to theory, the militia would comprise the bulk of the combat forces for the United States and be the resource to draw upon to protect the frontier from the Indians and prevent settlers from intruding into the territories indiscriminately.[20]

Later in December 1792, Congress organized the Legion of the United States as a standing army. The Legion had field grade staff officers, which included one major commandant of a battalion of artillery, and four sub-legions. Each sub-legion was composed of staff, one troop of dragoons, two battalions of infantry, a battalion of riflemen, and a company of artillery that had one captain, two lieutenants, four sergeants, four corporals, two musicians, ten artificers, and forty privates and was armed with 6-pounders and 5.5-inch howitzers. Each sub-legion had 1,230 men and combined infantry, cavalry, and field artillery into one fighting unit to make the Legion a miniature army.[21]

While the government negotiated with the Indians to appease easterners, who thought that

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17. *Annals of Congress*, 2nd Congress, col. 1056; Prucha, *Sword of the Republic*, P. 26; Denny, *Military Journal*, pp. 165-67.

18. *Annals of Congress*, 2nd Congress, col. 339, 1052-60; Jacob, *The Beginnings of the U.S. Army, 1783-1812*, p. 68; Prucha, *Sword of the Republic*, p. 22; Denny, *Military Journal*, p. 107; Knopf, *Anthony Wayne*, p. 172.

19. Birkhimer, *Historical Sketch*, pp. 27-28, 191.

20. Annals of Congress, 2nd Congress, col. 339, 1392-93.

21. Weigley, *History of the United States Army*, p. 92; Prucha, *Sword of the Republic*, p. 30; Francis B. Heitman, *Historical Register and Dictionary of the United States Army* (Washington: Government Printing Office, 1903), p. 50, hereafter cited as *Historical Register*; Ganoe, *The History of the United States Army*, p. 112.

aggressive frontiersmen had caused the violence, the Legion's commander, Major General Anthony Wayne, prepared for combat. Upon assuming command in 1792, Wayne learned quickly that he had inherited a weak army. Using Steuben's *Regulations for the Order and Discipline of the Troops of the United States*, which had been written in the winter of 1778-79, Wayne drilled the main body at Pittsburgh and Legionville, as Brigadier General James Wilkinson trained the rest at Fort Washington. By 1793 the Legion of the United States differed significantly from Harmar's and St. Clair's armies. It was a disciplined army, something that Harmar and St. Clair did not have because Congress, President Washington, and the public wanted immediate results. Aware of inability of his artillerists to use their field pieces, Wayne obtained the services of Colonel John Proctor, commander of the 4th Continental Artillery Regiment during the American Revolution. Over a period of months, Proctor drilled Wayne's gun crews to maneuver their field pieces and to fire rapidly.[22]

Although 6-pounders and 5.5-inch howitzers had fallen into disfavor for campaigning in the field, Wayne insisted upon using the 3-inch howitzer against the Indians. In a series of letters to Secretary Knox in 1792 and 1793, Wayne outlined plans to show that the howitzer could be employed against Indians in the wilderness or mountainous country because the tube and carriage weighed between 212 and 224 pounds and could be easily transported by a pack horse. Moreover, the howitzer fired canister and shell that burst into small fragments over the target if the fuse were properly set. Thus, the 3-inch howitzer had unprecedented mobility and firepower to support the Army in Indian warfare and could be deadly when served by trained crews. As his correspondence with Knox suggested, Wayne favored employing field artillery as a potentially decisive weapon against the Indians.[23]

Supported by militia and Major Henry Burbeck's battalion of artillery of four trained companies, Wayne marched out in 1793 to punish the Indians that had been raiding from the Ohio into the United States. To provide supplies and reinforcements Wayne built forts at twenty-five mile intervals along his line of march and armed them with field pieces. From these strongholds the Legion defended itself during the winter of 1793-94.[24] Late in the summer of 1794, Wayne began the last leg of his journey. Before he arrived at Fort Miami, about five hundred Indians assaulted the Legion's advance party and forced it to retreat to the main body that was following. Under attack the Legion formed into two lines in a thick woods with fallen timbers to its front, which made deploying cavalry impossible and gave the enemy excellent cover.[25] Confronted by musket

22. Prucha, *Sword of the Republic*, p. 34; Knopf, *Anthony Wayne*, pp. 14-15; Lee Sheperd ed., *Journal of Thomas Taylor Underwood: An Old Soldier in Wayne's Army* (Cincinnati: The Society of Colonial Wars in the State of Ohio, 1945), pp. 3, 1516; Jacob, *The Beginning of the US Army, 1783-1812*, pp. 158-59; Report, Military Force in 1794, *ASPMA*, I, p. 67; Birkhimer, *Historical Sketch*, pp. 27-28; Knopf, *Anthony Wayne*, pp. 171, 172, 179.

23. Knopf, *Anthony Wayne*, pp. 171, 172, 179; Don H. Berkbile, "The 2 3/4-inch U.S. Howitzer, 1792-1793," *Military Collector and Historian*, Spring, 1961, p. 5.

24. Jacob, *The Beginning of the U.S. Army, 1783-1812*, pp. 168-69.

25. Ltr, Wayne to Secretary of War, 28 Aug 1794, *American State Papers, Indian Affairs (ASPIA)*, p. 491; Dwight L. Smith, ed., *From Greeneville to Fallen Timbers: A Journal of the Wayne Campaign* (Indianapolis: Indiana Historical Society, 1952), p. 279; Sheperd, *Journal of Thomas Taylor Underwood*, p. 18; Lieutenant Boyer, *A Journal of Wayne's Campaign* (Cincinnati: John F. Uhlhorn, 1866), pp. 7-8.

fire, canister from 3-inch howitzers being served by Captain John Price's company of trained artillerists, and bayonet charges, the Indians fled to Fort Miami with hopes of obtaining help from the British. Unwilling to risk fighting the Americans, the British refused to assist the Indians. Commenting on his decisive victory, Wayne wrote Major William Campbell, the commander of Fort Miami, that American small arms had beaten the Indians at Fallen Timbers. Unable to be maneuvered over the broken terrain covered with fallen trees and keep up with the infantry charges, the 3-inch howitzers, however, did not make a significant impact on the outcome of the battle.[26]

Although Fallen Timbers confirmed the desirability of a regular army on the frontier and reinforced the importance of a trained militia, the battle also sealed the fate of the foot artillery in mobile, offensive operations. During the remaining years of the 1790s and early years of the 1800s, the Army did not tow field pieces with the infantry when it campaigned against Indians. Light 3-pounders, 6-pounders, and 5.5-inch howitzers, which were the standard armament for field artillery units of the time, weighed between 250 and 650 pounds, were still too awkward to be utilized effectively in Indian warfare, and seemed to have little value on the frontier except to protect forts. As a result, the Army depended on the infantry when it fought Indians, employed field cannons served by inadequately trained artillerists or untrained infantry to arm frontier forts, and employed artillerists as infantry.[27]

As the Indian peril receded into the background, the Americans soon found themselves involved in European conflicts. By 1794 Revolutionary France's efforts to enlist the cooperation of the United States in its fight against Great Britain and the willingness of some Americans to respond favorably pushed the United States towards a conflict with Great Britain. Even though war was unlikely, many Americans resented British raiding expeditions along the Atlantic Coast. Prompted by this, the United States took measures to improve its coastal defenses. Although government artificers continued making carriages and other artillery materiel, the government relied upon private foundries for cannons. In 1794 the government signed contracts with Hope Furnace in Rhode Island and a foundry in Cecil County, Maryland, for iron 24- and 32-pounders for coastal fortifications.Two years later, Secretary of the Treasury Alexander Hamilton let another contract for iron 12-pounders to the owners of the Maryland foundry. By 1798 privately-owned foundries in nearly all of the states were producing cannon of varying sizes, calibers, and quality.[28]

As steps were taken to ensure adequate supplies of artillery, in May 1794 Congress passed an act to reorganize the Army's artillery. Besides providing funds to build strong forts of

26. Ltr, Wayne to Secretary of War, 28 Aug 1794; Knopf, *Anthony Wayne*, pp. 354-55; "William Clark's Journal of General Wayne's Campaign," *Mississippi Valley Historical Review*, Dec 1914, pp. 418-44; Birkbile, "The 2 3/4-inch U.S. Howitzer, 17921793," p. 5; Smith, *From Greeneville to Fallen Timbers*, pp. 292-93.

27. Birkhimer, *Historical Sketch*, pp. 113, 191.

28. James L. Stokesberry, "The Army and the Development of Technology," in Robin Higham and Carol Brandt, eds., *The United States Army in Peacetime* (Manhattan, Ks: Military Affairs/Aerospace Historian Publishing, 1975), p. 151; James Huston, *The Sinews of War: Army Logistics, 1775-1953* (Washington: Office of the Chief of Military History, 1966), pp. 94-95; Merritt Roe Smith, *Harpers Ferry Armory and the New Technology: The Challenge of Change* (Ithaca, NY: Cornell University Press, 1977), p. 28; Ltr, Secretary of War to Louis Tousard, 12 Nov 1800, Ltrs Sent by Secretary of War, 1800-1829, RG 107, National Archives. Although Congress authorized the President to acquire a site for a national foundry for artillery in 1798, the expense of such a venture prompted President John Adams to forego creating a national foundry. This left private foundries to produce cannons.

earthwork and masonry redoubts along the Atlantic Coast, the act created the Corps of Artillery and Engineers to garrison the seaboard forts, authorized the Corps to absorb the old artillery regiment, and permitted the President to use the Corps on the frontier or the coast as he saw fit. This meant that artillerists had to be able to man both field and coast artillery. As outlined by the act, the Corps' artillery would consist of four battalions each of one major, one adjutant, one paymaster, one surgeon's mate, and four companies. Each artillery company would have one captain, two lieutenants, two cadets, four sergeants, four corporals, sappers, miners, ten artificers, two musicians, and forty-two privates. Under the direction of the President, the Army started moving gun crews and field pieces from the frontier to existing seaboard fortifications because the country lacked sufficient heavy guns and men to protect the coasts and began building fortifications.[29]

Although Jay's Treaty of 1794 temporarily restored amicable relations with Great Britain, the treaty caused relations with France to deteriorate. As a result, the War Department continued stripping the Legion of the United States of field guns and cannoneers for coastal defense. Feeling the pinch caused by this action, General Wayne complained in 1795 that he had lost part of his artillerists, that he did not have enough guns to take to the field, and that he had to juggle field pieces among his various forts.[30]

Realizing that the country did not have any properly trained artillerymen, the May 1794 act made provision for developing artillerists to serve in field and coast artillery units. Prompted by Washington, Secretary Hamilton, and Secretary Knox, the act attached cadets to the Corps of Artillerists and Engineers for the purpose of instruction and training. The act also established a school at West Point to escape reliance upon foreigners for technical expertise in artillery and engineering.[31] Four years later in 1798, West Point had not produced a body of trained artillerists because of inadequate funding.[32]

The crisis with France in 1798, precipitated by the XYZ Affair, prodded Congress to reorganize the artillery again. In April 1798 Congress created the Regiment of Artillerists and Engineers to augment the Corps of Artillerists and Engineers. The regiment would be composed of twelve artillery companies each of one captain, two lieutenants, four sergeants, four corporals, forty-two privates, sappers, miners, ten artificers, and two musicians. The creation of the regiment gave the Army twenty eight artillery companies for duty on the frontier or coasts. Subsequently, a congressional act in 1798 made the Corps of Artillerists and Engineers the First Artillery Regiment, while the artillery regiment organized in 1798 became the Second Artillery Regiment.[33]

Notwithstanding these reforms, the state of American field artillery in 1798 contrasted remarkably with its counterpart in Europe. American field artillery had an ill-assorted collection

29. John C. Fitzpatrick, *The Writings of George Washington*, Vol. XXXIII, (Washington: Government Printing Office, 1931), p. 356, hereafter cited as *Writings*.

30. Birkhimer, *Historical Sketch*, p. 27; Weigley, *History of the United States Army*, pp. 97-99.

31. Stephen Ambrose, *Duty, Honor, Country* (Baltimore: The Johns Hopkins University Press, 1966), p. 11; Knopf, *Anthony Wayne*, p. 429.

32. Ambrose, *Duty, Honor, Country*, pp. 11-12; Ltr, McHenry to Sewell, 28 Jun 1798, in Rpt, McHenry, 24 Dec 1798, *ASPMA*, I, p. 125; Birkhimer, *Historical Sketch*, pp. 31, 353; *Annals of Congress*, 6th Congress, col. 826, 829.

33. Birkhimer, *Historical Sketch*, pp. 30-31, 354-55.

of cannons, while artillerymen served primarily as infantry, occasionally manned light guns, and faced dual service with either field or coast artillery companies. Moreover, American field artillery consisted solely of foot artillery.[34]

Seeking more mobility on the battlefield than foot artillery offered, the Europeans introduced horse artillery in the 1790s. After experimenting with horse artillery for many years, the French army adopted horse artillery as an independent, elite corps in 1794. Each battery had six to eight pieces, usually 6- to 8-pounders and a light howitzer, and consisted of four officers and seventy-two men. In the meantime, the British also acquired horse artillery. As combat action in the 1790s indicated, horse artillery effectively supported an attack or covered a retreat. However, it was also expensive and influenced the British, French, and other Europeans to retain foot artillery as the major portion of their field artillery.[35]

The last three decades of the eighteenth century also witnessed a significant change in field artillery tactics. Because of the mobility of Gribeauval's field artillery system, Chevalier Jean Du Teil of France wrote in the 1770s that tactics similar to siege warfare could be employed on the battlefield. Drawing upon Frederick the Great's success with massing artillery, Du Teil recommended maneuvering field pieces around the battlefield to group them at critical times and places. Equally important, the Frenchman argued that field artillery should be used against enemy troop formations rather than artillery because artillery duels were unprofitable.[36]

Although Du Teil's ideas were controversial, they soon gained adherents. At the beginning of the Napoleonic Wars, the French army still divided its mobile artillery into battalion guns and artillery of position. Rather than massing their artillery of position, the French distributed two to six guns to each corps. Influenced by Du Teil, many French artillerists, including Napoleon, advocated concentrating field artillery to mass fire and persuaded the French army to discard battalion guns by 1800.The French centralized their lighter field guns at the division and heavier field pieces at the corps to mass fire, employed their field artillery to attack troop formations rather than artillery, and established an artillery reserve to help mass fire. Because of the limited effective range of field pieces, commanders had to move their guns around the battlefield to mass fire.They could not simply shift the direction of fire to concentrate it on a particular point in the enemy line. As a result, commanders held back one-fourth to one-third of their guns and howitzers in the form of an artillery reserve. These batteries were strategically positioned and moved forward to tear apart an infantry attack or to support the infantry advance as needed. On the

34. Ltr, McHenry to Sewell, 28 Jun 1798, p. 129; Birkhimer, *Historical Sketch*, pp. 113, 353; Ltr, McHenry to Adams, 24 May 1800, Miscellaneous Ltrs Sent by Secretary of War, microfilm, RG 107; Ltr, Secretary of War to Tousard, 12 Nov 1800.

35. Gunther E. Rothenberg, *The Art of Warfare in the Age of Napoleon* (Bloomington, In: Indiana University Press, 1978), p. 107; Philip Haythornthwaite, *Weapons and Equipment of the Napoleonic Wars* (Poole, Eng: Blandford Press, 1979), pp. 75-81; H.C.B. Rogers, *A History of Artillery* (Secaucus, NJ: The Citadel Press, 1975), pp. 58, 75-76.

36. Robert S. Quimby, *The Background of Napoleonic Warfare* (New York: Columbia University Press, 1977), pp. 88-89; Michael Howard, *War in European History* (New York: Oxford University Press, 1976), p. 78; Hew Strachan, *European Armies and the Conduct of War* (Boston: George Allen and Unwin, 1983), pp. 33-34; John A. Lynn, *The Bayonets of the Republic: Motivation and Tactics of the Army of Revolutionary France, 1791-1794* (Urbana, Il: University of Illinois Press, 1974), pp. 209-15; Rothenberg, *The Art of Warfare in the Age of Napoleon*, p. 23.

defense French field artillery's main mission involved repelling infantry and cavalry charges, while on the offense it softened up enemy infantry formations. As the offense unfolded, gun crews advanced their artillery to enfilade the enemy or to find suitable targets.

Although Du Teil and other Europeans supported creating huge batteries to blast the enemy's line, massing such batteries was not the norm until after 1800 when Napoleon and other European generals started grouping field guns in large batteries to crush the enemy. Besides creating huge batteries, Napoleon employed his field artillery aggressively by pushing it out in front of his infantry line to within four hundred yards of the enemy line to blast the opponent with canister and by advancing the guns even closer on occasions. Like the French, the British found that keeping the artillery under central control rather than dispersing them to battalion commanders furnished greater flexibility and efficiency but still allowed placing batteries in support of infantry and cavalry formations.[37]

As organization and tactics slowly changed during the last years of the eighteenth century, European technology concurrently made progress. Armies still had smoothbore, direct-fire bronze pieces that used black powder and fired canister, shell, shot, and occasionally grapeshot and had effective ranges between five hundred to one thousand yards. Yet, fixed ammunition, which contained the projectile and powder charge in a single unit, was becoming more popular since this form of ammunition increased the rate of fire. Nevertheless, European artillerymen only used fixed ammunition when rapid firing was required and relied on semi-fixed ammunition, in which the projectile and bag of powder were loaded separately. Looking for an anti-personnel projectile with a greater range than canister, which was approximately five hundred yards, Lieutenant Henry Shrapnel of Great Britain developed spherical case in 1784. Unlike shell that burst into several fragments, spherical case was filled with iron pellets. Shrapnel's projectile case had only enough powder charge to open the sphere so that its contents would continue traveling forward and could be shot farther than canister. In fact, Shrapnel boasted that spherical case was effective at all distances within the range of the cannon. This meant that artillerists could rain deadly anti-personnel projectiles at any range. Nevertheless, spherical case had one important drawback. It had a tendency to explode prematurely because of friction heat developed by the intermingling of balls and powder in flight, and this problem discouraged its use. Despite this drawback, the British army adopted spherical case in 1804 and subsequently renamed it shrapnel at the request of Lieutenant Shrapnel's descendents.[38]

As important as Shrapnel's development was, Captain William Congreve's block trail carriage, limber, and caisson loomed just as significant. Seeking a more mobile carriage than John

37. Rothenberg, *The Art of Warfare in the Age of Napoleon*, pp. 74, 75, 107; Lynn, *The Bayonets of the Republic*, p. 209-11; Strachen, *War in European History*, pp. 42-43; Quimby, *The Background of Napoleonic Warfare*, pp. 296-97; B.P. Hughes, *Firepower: Weapons Effectiveness on the Battlefield, 1630-1850* (London: Arms and Armour Press, 1974), p. 103.

38. Rothenberg, *The Art of Warfare in the Age of Napoleon*, p. 77; Albert Manucy, *Artillery Through The Ages: A Short Illustrated History of Cannon, Emphasizing Types Used in America* (Washington: Government Printing Office, 1949), p. 69; Harold L. Peterson, *Round Shot and Rammers* (Harrisburg, Pa: Stackpole Books, 1969), p. 80; Oliver F.G. Hogg, *Artillery: Its Origin, Heyday, and Decline* (Hamden, Ct: Archon Books, 1970), pp. 179-83; Haythornthwaite, *Weapons and Equipment of the Napoleonic Wars*, p. 60.

Muller's bracket trail carriage with its two wood beam trails and basing his work upon that of other Englishmen, Congreve introduced a block trail carriage in 1792. He replaced the two brackets with a solid beam of wood to give his carriage a shorter turning radius than the bracket trail or Gribeauval carriage allowed and shifted the center of gravity forward to permit one person to traverse the trail with the aid of a handspike more easily than the bracket trail allowed. At the same time Congreve designed a limber with an ammunition chest with a seat for part of the gun crew and a caisson with seats for the rest of the crew. Congreve's mounted artillery system, as it was called, formed a third branch of field artillery, surpassed the mobility of any foot artillery system in Europe in the 1790s, and made foot artillery obsolete because the entire gun crew rode into battle and arrived fresh and ready to serve their weapon. Although the British army adopted Congreve's system during the last decade of the eighteenth century, years passed before other European and American armies equipped their artillery with it. National prejudices and conservatism prevented them from recognizing the superiority of Congreve's system.[39]

About the same time the British introduced rocket artillery. Even though rockets had existed for centuries, Europeans had abandoned them in favor of cannon artillery at the end of the fourteenth century because cannons were more accurate and reliable. Impressed with fiery rocket barrages employed by the Indians against British soldiers in 1792 and 1799, the British decided that they required rockets. Because the British lacked any experts on rockets, Sir William Congreve, son of Captain William Congreve, devoted his attention to rocketry. By 1806 he had developed a rocket with a range of three thousand yards that carried a solid shot or canister warhead. After adopting Congreve's rockets during the first decade of the nineteenth century, the British employed them to shatter enemy morale or batter down fortifications since they were still inaccurate. The British success with Congreve's rockets led the way for other European countries to equip their armies with the weapon.[40]

In view of the war hysteria generated by the XYZ Affair of 1798, Secretary of War James McHenry (1796-1800) feared the consequence of falling behind the Europeans in field artillery technology. Writing Samuel Sewell, the Chairman of the Committee of Defense, McHenry complained in June 1798 about the lack of respect that American artillery commanded. Many pieces were defective, while those of the same class differed in length, weight, and caliber. Furthermore, the appropriate stores frequently did not fit the piece for which they were intended. McHenry warned Congress and President Adams to do something to reverse the deplorable condition of the Army's artillery. Based upon the state of American artillery, Secretary McHenry encouraged the United States to develop a system of field and coast artillery and directed the construction of cast-iron field guns for testing so that the Army would be equipped with the latest field artillery.[41]

In 1800 prior to leaving office, McHenry discussed another way to modernize the field

39. Birkhimer, *Historical Sketch*, pp. 237-39.

40. Rogers, *A History of Artillery*, pp. 194-95; William H. McNeill, *The Pursuit of Power: Technology, Armed Force, and Society since A.D. 1000*, (Chicago: The University of Chicago Press, 1982), p. 220.

41. Ltr, McHenry to Adams, 24 May 1800; Birkhimer, *Historical Sketch*, pp. 163, 260. Light artillery is horse artillery by definition. However, the US Army frequently used the term "light artillery" to include both horse and mounted artillery. It also called light artillery horse artillery.

artillery. He urged Congress to adopt light artillery, frequently called horse artillery by the Americans, for the Army. Describing the European experience, McHenry explained that Frederick the Great of Prussia had employed horse artillery when he faced superior armies during the Seven Years War. Frederick's horse artillery stayed abreast of infantry and cavalry marches and multiplied his firepower on the battlefield by permitting him to maneuver his guns more quickly and easily. Nevertheless, as far as McHenry was concerned, Napoleon perfected horse artillery. His horse artillery protected inexperienced infantry, supported bayonet charges, countered enemy field batteries, and increased the field artillery's ability to concentrate on the battlefield.[42]

Knowing that the lack of mobility had restricted the field artillery's impact and ability to mass fire, McHenry envisioned that horse artillery would blend firepower and mobility. It could keep pace with fast-moving cavalry, deliver massed fire on "an unexpected point of attack," and was "free from the inconvenience ascribed to foot artillery of retarding and restraining the maneouvres and marches of troops."[43] While advocating light artillery as a defensive weapon to protect the country from invaders, McHenry actually urged using it in aggressive operations to support attacks and not remain behind defensive works. Exhibiting his faith in light artillery, McHenry purchased drawings of German horse artillery and equipment. A parsimonious Congress, however, did not share McHenry's enthusiasm because adopting light artillery meant spending the country's limited resources. Consequently, Congress failed to appropriate sufficient funds to equip the Army with light artillery during McHenry's tenure as Secretary of War. McHenry's desire to organize light artillery and introduce uniformity in calibers and weights brought him to the foreground in the drive to modernize the field artillery and demonstrated his vision. He fully comprehended that efficiency demanded a system of foot and horse artillery rather than a motley collection of guns, which the Army had been using since the American Revolution.[44]

Demonstrating even greater vision than just focusing in materiel, McHenry insisted that the artillery required trained gunners. From McHenry's perspective victory in the American Revolution had come because the troops had been trained and been experienced. Pickup crews to serve field artillery when fighting Indians was adequate, but it was foolish to depend upon them or inadequately trained artillerists when the French or British were potential enemies. The Army required academies to train engineers to construct fortifications and gunners to man them. Although Secretary McHenry saw the need for artillerists to serve in coastal defenses, he along with Alexander Hamilton recognized the necessity of furnishing formal training to artillerists on field pieces as a means to bolster national defense.[45]

Although congressional frugality and fears of a trained officer corps prevented implementing McHenry's proposals, Secretary of War Henry Dearborn (1801-1809) resisted tendencies to

42. Rpt, McHenry, 4 Jan 1800, *ASPMA*, I, pp. 135-37.

43. *Ibid.*, p. 137.

44. Ltr, McHenry to Adams, 24 May 1800; Huston, *The Sinews of War*, pp. 98-99; Birkhimer, *Historical Sketch*, pp. 192-93.

45. Rpt, McHenry, 31 Jan 1800, *ASPMA*, I, pp. 142-44; *Annals of Congress*, 6th Congress, col. 830; Ambrose, *Duty, Honor, Country*, pp. 22-23; Birkhimer, *Historical Sketch*, pp. 192-93.

maintain obsolete field artillery. Rather than developing light artillery, however, Dearborn supervised reforming existing field artillery with the goal of making it more mobile. In 1801 he made Louis de Tousard Inspector of Artillery to inventory all ordnance, inspect all artillery materiel being manufactured to ensure that it met specifications, and devise models for artillery materiel. The action, in effect, made Tousard Chief of Artillery and gave the Frenchman powers similar to those that Henry Knox had exercised during the American Revolution. Moreover, Dearborn imitated the French system as explained in De-Scheel's *Treatise on the Gribeauval System*. Undoubtedly influenced by Tousard's report of April 1800 on the soundness of McHenry's light cast-iron guns, Dearborn also ruled that one standard field piece, an iron 6-pounder, would be used by the field artillery rather than the bronze fours, sixes, and eights of the French system. In doing so, Dearborn sought to simplify American field artillery by using only one caliber. Although iron was more brittle and burst more easily than bronze, it was abundant in the United States, was cheaper than bronze, and would free the country from foreign sources of copper. Equally important, Dearborn decided that the guns would be fourteen calibers in length and be of the same weight as a bronze 6-pounder to make them mobile.[46]

Nevertheless, President Thomas Jefferson's and Congress' activities threatened to undermine Dearborn's efforts. An opponent of a strong military, Jefferson believed that national security was safeguarded by the Atlantic Ocean. In view of this, the country did not require a large military establishment. In 1802 when it was apparent that the country would not be at war with France, Jefferson and a Republican Congress decreased the number of infantry regiments from four to two and artillery regiments from two to one. As a part of this reorganization, the President and Congress separated the artillerists from engineers by creating the Corps of Engineers and by forming the Regiment of Artillery of five battalions of twenty companies. Each company had one captain, one first lieutenant, one second lieutenant, two cadets, four sergeants, four corporals, four musicians, eight artificers, and fifty-six privates. Jefferson and Congress also eliminated the cavalry completely and discharged many artillery experts, such as Stephen Rochefontaine and Louis de Tousard. With one swift blow the Military Peace Establishment Act of 1802 decreased the size of the Army and Navy.[47]

Undeterred by the President and Congress, Dearborn continued pushing iron cannons. In an attempt to assure a more reliable source of cannons, Dearborn tried to persuade Henry Foxall of the Columbia Foundry to build a new foundry at his own expense on government land near Washington. Knowing that relying solely on government contracts, as Dearborn proposed, would

46. Henry C. Larter, Jr., "Materiel of the First American Light Artillery, 1808-09," *Military Collector and Historian*, Sep 1952, p. 55; Birkhimer, *Historical Sketch*, pp. 226-29; Edward C. Ezell, "The Development of Artillery for the United States Land Service Before 1861 with Emphasis on the Rodman Gun," unpublished doctoral dissertation, University of Delaware, 1963, p. 98; Ltr, Dearborn to Tousard, 14 Apr 1801, Ltrs Sent by Secretary of War; Huston, *The Sinews of War*, pp. 94, 98; Theodore J. Crackel, *Mr. Jefferson's Army: Political and Social Reform of the Military Establishment, 1801-1809* (New York: New York University Press, 1987), p. 79.

47. Allan R. Millett and Peter Maslowski, *For the Common Defense: A Military History of the United States of America* (New York: Free Press, 1984), p. 99; *Annals of Congress*, 7th Congress, col. 1306-12. Ironically, the Act of 1802 also established the US Military Academy at West Point to produce engineers and revealed Jefferson's and the Republicans' commitment to the Regular Army by having the militia and volunteers augment the Army during war.

be risky, Foxall suggested that the government construct its own foundry, which, like the national foundries for small arms, would encourage uniformity of design and caliber and constitute an extra source of production in case of an emergency. Yet, the government failed to adopt Foxall's recommendation because private foundries were furnishing sufficient numbers of cannon. As a result, casting of cannons continued to be done in private foundries. In fact, a congressional report in 1811 indicated that the 530 foundries operating in the United States could adequately meet the country's need for artillery in an emergency. In the meantime, government arsenals at Washington, Pittsburgh, and Watervliet, New York, constructed carriages, limbers, caissons, and other artillery equipment and mounted the cannons, while private industry and government arsenals shared the responsibility of manufacturing artillery ammunition.[48]

Changing from bronze to iron created opposition since many thought that the switch was nothing more than a doubtful experiment. As soon as Dearborn left office, the War Department tried to go back to bronze guns. In fact, in March 1812 Dearborn's successor, William Eustis (1809-1813), ordered twenty-four bronze 6-pounders and twelve bronze 12-pounders to be cast. Despite this action, the use of bronze artillery ceased in 1801 and did not resume until 1836. Private foundries produced bronze cannons during this period of thirty-five years, but the government kept iron cannons as the standard.[49]

In the meantime, Dearborn fielded new carriages. Since mobility was crucial, he reduced the weight of the carriage by about thirty percent, replaced wooden axles with iron ones to withstand higher speeds, introduced firing and traveling trunnions for heavier field pieces, and discontinued driving teams tandem by using the single pole limber to permit hitching the horses in pairs. Realizing that the United States did not have the technology to make production of interchangeable parts a reality, Dearborn did not adopt interchangeable parts for carriages and limbers and, therefore, missed the opportunity to revolutionize the field artillery completely.[50]

Dearborn's modernization efforts, however, produced mixed results. Upon beginning the conversion, he stopped casting bronze cannons and directed that no more would be manufactured until the practicality of iron guns had been definitively proven or disproven. His policy and the peacetime tendency to reduce the casting of cannons created a shortage of field pieces. Reporting to the House of Representatives in December 1811, Eustis, who completed Dearborn's work by introducing the modified Gribeauval carriage in 1809, said that manufacturing of cannons of all calibers and weights and shot was progressing and increasing the supply. He also noted that the cannons were "generally good, sufficiently proved, and may be relied on." The supply of field artillery certainly grew, but the shortages lasted into the War of 1812. On the whole, the introduction of new and improved field artillery certainly outweighed the temporary decreased production

48. Jacob, *The Beginning of the U.S. Army, 1783-1812*, p. 277; Huston, *The Sinews of War*, p. 98.

49. Birkhimer, *Historical Sketch*, pp. 260-61; Huston, *The Sinews of War*, p. 98.

50. Birkhimer, *Historical Sketch*, pp. 230-31; Ltr, Dearborn to Tousard, 14 Apr 1801; Ltr, McHenry to Adams, 24 May 1800; Ltrs, Dearborn to Burbeck, 12 Aug 1807, 3 Jul 1807, 28 Apr 1808, 1 Jun 1808, 17 May 1808, Ltrs Sent by Secretary of War; Report, Cannon, Small Arms and Munitions, 9 Dec 1811, Reports to Congress from Secretary of War, Reel 1, 1803-1809, RG 107; Louis de Tousard, *American Artillerist's Companion* (Philadelphia: C. and C. Conrad, 1809), p. xx; Huston, *The Sinews of War*, pp. 98-99.

of cannons by providing a foundation to be built upon.[51]

As Dearborn introduced new carriages and cannons, he developed light artillery. Aware of horse artillery's mobility, President Jefferson and Dearborn pushed Congress to raise a regiment of light artillery for the Army. In response to British and French interference with American shipping and the possibility of war with either power, Congress tripled the size of the Army in April 1808. It expanded the Army to seven regiments of infantry, a corps of engineers, a dragoon regiment, a rifleman regiment, a regiment of artillery, and a regiment of light artillery of four staff officers and ten companies (batteries) each of one captain, one first lieutenant, one second lieutenant, two cadets, four sergeants, four corporals, two musicians, eight artificers, and fifty-eight privates. Authorized by Congress to organize light artillery companies, Dearborn then appointed Captain George Peter commander of the first and only company in the Light Artillery Regiment in May 1808. Shortly after demonstrating his company's mobility and firepower in the summer of 1808 with iron 6-pounders that fired solid shot and canister, were mounted on modified Gribeauval carriages, and had Gribeauval limbers, Peter transferred his company with its government-owned horses from Baltimore to New Orleans to bolster the latter's defense. He left Baltimore on 24 December 1808 and reached New Orleans late in March 1809. Peter remarked at the conclusion of his journey that light artillery had exceeded his most sanguine expectations because of its mobility and speed.[52]

Despite this auspicious beginning, Secretary Eustis questioned the economic feasibility of light artillery. In a letter on 2 June 1809, he complained to General James Wilkinson, who commanded the Army in New Orleans, about the exorbitant costs of forage and fodder for the horses there. Eustis said that artillery horses could not be maintained at such expense and directed Wilkinson to send the light artillery to some other part of the country where expenses would be lower or dismount the cannoneers. Replying to Eustis' letter but not necessarily expressing his endorsement of light artillery, Wilkinson said that it was impossible to feed the horses on such meager funds as Eustis proposed. Unable to provide the proper maintenance, Wilkinson dismounted the company in 1809, stored the guns, sold the horses, and armed the men as infantry. This put Peter's battery in the same situation as the rest of the soldiers in the Light Artillery Regiment. Discouraged by Eustis' and Wilkinson's actions, Peter resigned his commission and left the Army. Light artillery disappeared after 1809 although the Army was acquiring some light artillery materiel based upon Gribeauval patterns.[53]

Nevertheless, the authorization of the Light Artillery Regiment signified an important development in American artillery. By taking this step Congress, Jefferson, and Dearborn implicitly recognized that light artillery was a distinct branch of artillery and that light artillerists should not

51. Birkhimer, *Historical Sketch*, p. 231; Ernest Cruikshank, ed., *The Documentary History of the Campaign upon the Niagara in the Year 1812* (New York: Welland, 1902, reprinted by the New York *Times* and Arno Press, 1971), pp. 117, 191, 224; *ASPMA*, I, pp. 303-04; Ltr, Henry Foxall to Secretary of War, undated, ASPMA, I, p. 216.

52. Jacob, *The Beginnings of the U.S. Army, 1783-1812*, p. 275; Birkhimer, *Historical Sketch*, pp. 33-36; Ltr, Dearborn to Peter, 6 May 1808, Ltrs Sent by Secretary of War; Rpt, Dearborn, 2 Dec 1807, *ASPMA*, I, pp. 222-23; Crackel, *Mr. Jefferson's Army*, pp. 79-80.

53. Birkhimer, *Historical Sketch*, pp. 36-37; Theo F. Rodenbaugh and William L. Haskins, *The Army of the United States* (New York: Maynard, Merrill, and Company, 1896), p. 301.

be rotated between light and coast artillery units.

As Dearborn and Eustis developed field artillery materiel, treatises on the tactics and discipline of field artillery began appearing in the United States. For unknown reasons Captain William Stevens published only one volume of his three-volume book, *System of Discipline for the Artillery*, in 1797. Volume one covered horse artillery. Volume two discussed heavy artillery, and volume three examined the manufacture of ordnance. Because the only published volume of Stevens' work examined light artillery, which meant other artillery topics were not discussed, the War Department did not adopt it even though many light artillery enthusiasts in the United States read it. Under Dearborn's direction a board of officers prepared a system of movements and maneuvers for infantry, field artillery, and cavalry from European manuals in 1808 for publication. Yet, Dearborn never published the board's study for some unexplainable reason.[54]

In 1809 Tousard's *American Artillerist's Companion* and Thaddeus Kosciusko's *Maneuver of Horse Artillery* appeared. Although Tousard discussed sponging, loading, ramming, and firing the piece, the Frenchman concentrated on materiel and technology to provide a basis for manufacturing cannons in the United States. Because Kosciusko's book focused on tactics and stressed massing fire on infantry formations and not counterbattery work, the War Department officially recognized it and distributed two hundred copies throughout the Army and fifty to West Point.[55]

Using Kosciusko's manual as a basis, Major Amos Stoddard compiled a small work on field artillery that differed with the former's on crew size. Like other Europeans, Kosciusko advocated using horses to maneuver the field piece during battle rather than men. With the limber and carriage joined together by a prolonge, the horses could pull the cannon and provide more mobility than a fourteen-man crew could. This permitted Europeans to reduce crew size to eight men. Even though Stoddard recommended employing the same method, his manual retained the fourteen-man crew for use when horses could not be utilized. Because Stoddard's work represented the latest thinking, the War Department adopted it in August 1812.[56]

Even so, gun drill had not changed perceptively from the American Revolution. Number one still stood at the right of the muzzle and sponged and rammed the round home, while number two positioned himself on the left side of the muzzle to load the powder charge and projectile. As the cannon tube was being sponged, number four served the vent. After the piece was loaded and pointed in the desired direction by number five, number three fired the piece. The other three members of the crew helped bring ammunition from the ammunition chest to the gun.[57]

Notwithstanding the appearance of drill manuals, the Army lacked qualified artillerists. Serving on the frontier, artillerists in the Light Artillery Regiment were armed as infantry and lacked opportunities to train with cannons. In the meantime, artillerists in the 1802 regiment were scattered in small detachments on the frontier where they manned cannons mounted on

54. Birkhimer, *Historical Sketch*, pp. 299-300.

55. *Ibid.*, pp. 300-02.

56. Thaddeus Kosciusko, *Maneuver of Horse Artillery* (New York: Campbell and Mitchell, 1808, trans. by Jonathan Williams), p. 5; Birkhimer, *Historical Sketch*, pp. 299-302, 314; Tousard, *American Artillerist's Companion*, p. 36.

57. Peterson, *Round Shot and Rammers*, p. 66; Kosciusko, *Maneuver of Horse Artillery*, p. 5.

fortification walls and performed as infantry when required.[58]

On the eve of the War of 1812, the War Department had not yet reached its goal of having dependable field artillery. Although new materiel and cannons were being introduced and a number of authors had prepared manuals on the latest tactics and organization, the practice of employing artillerists as infantry or having them serve cannons in garrisons meant that American light artillery was not fit for battle.

The War of 1812

Because of long-standing grievances against the British, the United States declared war on Great Britain in June 1812. When Congress voted for war, the Regular Army had an authorized strength of seventeen regiments of infantry, four regiments of artillery, two regiments of dragoons, one regiment of riflemen, and a small Corps of Engineers. These units were scattered along the coasts and on the frontier in small groups. With the exception of seven infantry regiments, two artillery regiments (the 1802 artillery regiment and the Light Artillery Regiment), one regiment of dragoons, and part of the Corps of Engineers, the Army did not have much substance since the remaining units were still being formed and had little training or experience.[59] Among these were the Second and Third Artillery Regiments. Authorized by the congressional act of 11 January 1812, each regiment had two battalions of ten companies with each company consisting of three officers, two cadets, eighty-two enlisted men, and eight artificers.[60]

As part of the mobilization, the War Department issued an order in February 1812 to mount the Light Artillery Regiment. Lieutenant Colonel John R. Fenwick, commander of the regiment, equipped two light artillery batteries with four guns each and supporting equipment during June 1812 and sent them to the Niagara front that same month. Interestingly, one of his batteries was formerly Peter's battery that had been dismounted in 1809 at the direction of General Wilkinson. Later in the fall of 1812, Major Abraham Eustis mounted three more light artillery batteries in the regiment and shipped them to Plattsburgh, New York.[61]

Ironically, Congress did not provide a chief of artillery. Early in 1812, Colonel George Izard, commander of the 2nd Artillery Regiment, not only complained about the lack of qualified artillerists but also urged Secretary of War Eustis to create a chief to direct the affairs of the artillery as Henry Knox had done during the American Revolution. Although Eustis favored creating a chief of artillery, he failed to take action. War was at hand, and the Secretary of War focused his attention on fielding an army.[62]

The war caught the War Department in the middle of reforming its field artillery. Although modified Gribeauval carriages, limbers, and equipment for the iron 6-pounder were being

58. Birkhimer, *Historical Sketch*, pp. 167-68, 193-94, 231; Crackel, *Mr. Jefferson's Army*, pp. 82-85; Ltr, Foxall to Secretary of War, undated, ASPMA, I, p. 216; Ganoe, *The History of the United States Army*, p. 112.

59. Weigley, *History of the United States Army*, p. 118.

60. BG J.P. Farley, "Types and Traditions of the Old Army," *Journal of the Military Service Institution*, Mar-Apr 1905, p. 316; Birkhimer, *Historical Sketch*, pp. 195-96.

61. Heitman, *Historical Register*, p. 52; Birkhimer, *Historical Sketch*, pp. 356-57.

62. Birkhimer, *Historical Sketch*, pp. 38-41.

introduced, the War Department still had a motley collection of bronze and iron cannons, carriages, limbers, and other artillery materiel that had seen service during the American Revolution or had been produced during the twenty-eight years of peace. The War Department had the John Muller system of field artillery that it had used since 1775 and the modified Gribeauval system. Of the two, the Muller system was dominant because the Gribeauval system included only carriages, limbers, and materiel for the iron 6-pounder and excluded the other calibers in the inventory.[63]

Great Britain had a veteran army to fight the Americans even though most of the army was fighting Napoleon. British forces in Canada consisted of elements of six regiments, some garrison detachments, and eight companies of artillery. Except for troop concentrations at Quebec and Montreal, most British soldiers were assigned by company or detachment to the numerous posts along the shores of the Great Lakes and suffered from the lack of training.[64] The British had modernized their field artillery by adopting the Congreve system of carriages, limbers, and caissons.[65] Moreover, the British knew how to mass fire and had Congreve rockets that were available to be shipped to North America if necessary.[66]

Despite the lack of a trained, experienced army, President James Madison and his principle advisors chose to assume the offensive in 1812. They planned to conquer Canada before the British government could reinforce its weak garrison and thus eliminate the British threat on their northern border. To accomplish this Secretary Eustis ordered a three-pronged invasion of Canada. Major General William Hull with a force of militia and regulars would seize the British garrison at Fort Malden, Canada. Simultaneously, Brigadier Generals Stephen Van Rensselaer of the New York militia and Alexander Smyth of the Regular Army would lead an expedition across the Niagara River against British forts, while Major General Henry Dearborn with an army of regulars with two companies of foot artillery from the 2nd Artillery Regiment for support would advance along Lake Champlain towards Montreal as the main thrust. Dearborn's action would cut the line of communications upon which the British defense of Upper Canada depended.

After Hull's disastrous defeat in August 1812, in which he surrendered without a fight, the British and Americans shifted their attention eastwards along the Niagara frontier.[67] As General Van Rensselaer, commander in chief of the New York militia, indicated, the Americans required time before they could invade Canada. In a lengthy letter to the governor of New York on 19 August 1812, Van Rensselaer highlighted the lack of preparedness. He wrote, "From Buffalo to Niagara my force of military is less than one thousand. Without any ordnance heavier than six-pounders, and a few of them; without artillerists to use the few pieces I have, and the troops in every

63. Birkhimer, *Historical Sketch*, p. 232; T. Harry Williams, *The History of American Wars* (New York: Alfred Knopf, 1981), p. 97; Theodore J. Crackel, "The Battle of Queenston Heights, 13 Oct 1812," in Charles E. Heller and William A. Stofft, eds., *America's First Battles: 1776-1965* (Lawrence, Ks: University Press of Kansas, 1986), pp. 41-42.

64. Crackel, "The Battle of Queenston Heights, 13 October 1812," p. 41.

65. Birkhimer, *Historical Sketch*, pp. 233, 237-38.

66. Haythornthwaite, *Weapons and Equipment of the Napoleonic Wars*, pp. 89-90.

67. Ltr, Hull to Eustis, 26 Aug 1812, in James, *Military Occurences* (London: 1818), p. 374; *Sketches of the War Between the United States and the British Isles* (Rutland, Vt: Fay and Davison, 1815), p. 47.

indifferent state of discipline."[68] Although his command expanded to six thousand troops by September, they were scattered among various posts along the Niagara frontier and plagued by inadequate supplies and poor discipline and training. To support his army Van Rensselaer had Captain Gibson's light artillery battery that was personally commanded by Colonel Fenwick, two field pieces under Lieutenant Colonel Winfield Scott, and two 18-pounders under Captain John Lovett.[69]

Moving to dislodge the British from heights of Queenston and possess the village before the arrival of winter, Van Rensselaer launched his invasion with militia and regulars. He made his first attempt on 11 October, but confusion and a storm prevented it from being carried out. Van Rensselaer's second effort began on the morning of 13 October. Colonel Solomon Van Rensselaer with his militia and Lieutenant Colonel John Chrystie with his regulars would cross simultaneously. Once the regulars and militia were over the river, General Van Rensselaer planned to ferry Fenwick's light artillery and Scott's foot artillery across the river. As Colonel Van Rensselaer's command paddled its boats over the river, the British opened with canister and solid shot from their artillery and musket fire and forced Scott to respond with his cannons. Using solid shot and occasionally canister, Scott's pieces finally silenced the enemy's artillery except for one 18-pounder that was mounted in a stone house on the heights. Unable to defend themselves, the British withdrew to the stone house and allowed the Americans to gain a foothold. American artillery fire from the American side of the river and musketry from the Canadian side finally routed the British from the stone house and permitted the infantry and artillerists serving as infantry to seize the house and the 18-pounder.[70]

Anxious to turn back the invasion, Major General Sir Isaac Brock, who had recently been transferred from Detroit, organized a counterattack. Employing the British 18-pounder and effective small arms fire, the American militia and some regulars drove the first British assault back and killed Brock. Unable to obtain reinforcements because most of the militia refused to cross the

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68. Ltr, BG Van Rensselaer to Tompkins, 19 Aug 1812, in Cruikshank, *The Documentary History of the Campaign on the Niagara Frontier in the 1812*, I, p. 191.

69. Ltr, BG Van Rensselaer to Dearborn, 14 Oct 1812, in John Brannan, ed., *Official Letters of the Military and Naval Officers in the United States During the War with Great Britain in the Years of 1812, 13, 14, 15* (Washington: Way and Gideon, 1823, reprinted by the New York Times, and Arno Press, 1971), pp. 75-76, hereafter cited as *Official Letters*; Farley, "Types and Traditions of the Old Army," p. 316; Ltr, Col Stephen Van Rensselaer to Abraham Van Vechten, 5 Sep 1812, in Cruikshank, *The Documentary History of the Campaign on the Niagara Frontier in the Year 1812*, I, pp. 237-38.

70. Ltr, Van Rensselaer to Secretary of War, 14 Oct 1812, in Cruikshank, *The Documentary History of the Campaign on the Niagara Frontier in the Year 1812*, I, p. 80; Ltr, Wool to S. Van Rensselaer, 23 Oct 1812, in James, *Military Occurances*, p. 385; Alexander C. Casselman, *John Richardson's War of 1812* (Toronto: Historical Publishing Company, 1902, reprinted by Coles Publishing Company, Toronto, 1974), p. 107; *Niles Register*, 14 Nov 1812, p. 169; Ltr, Van Rensselaer to Secretary of War, 12 Oct 1812, in Cruikshank, *The Documentary History of the Campaign on the Niagara Frontier in the Year 1812*, II, pp. 80-82; Ltr, Chrystie, 13th US Infantry, to General Thomas H. Cushing, 22 Feb 1813, in Cruikshank, *The Documentary History of the Campaign on the Niagara Frontier in the Year 1812*, II, pp. 98-99; Crackel, "The Battle of Queenston Heights, 13 October 1812," p. 45; Ltr, John Lovett to Joseph Alexander, 14 Oct 1812, in Cruikshank, *The Documentary History of the Campaign on the Niagara Frontier in the Year 1812*, I, pp. 85-86; Report, MG Van Rensselaer, 14 Oct 1812; Ltr, Maj J.R. Mullen, 23rd Infantry, to MG Stephen Van Rensselaer, 5 Jan 1813, in Brannan, *Official Letters*, pp. 119-21.

river, the Americans had to withdraw before Fenwick's and Scott's artillery could be ferried over the river. To cover the retreat Scott's, Fenwick's and Lovett's artillery fired solid shot and canister from the American side of the river. This allowed most of the American troops to reach safety but only after they had been defeated.[71]

Although American field artillery performed well at Queenston, Fenwick and Scott did not employ their 6-pounders as Europeans were doing during the Napoleonic Wars. Van Rensselaer hoped to maneuver his field pieces with the infantry on the Canadian side of the river, but he lacked the boats to ferry the guns across the river. Because of this, Fenwick and Scott could not move their 6-pounders around to mass fire at decisive spots and had to employ their pieces in static positions like siege artillery.[72]

Subsequent to the battles in the fall of 1812, Colonel Decius Wadsworth, Chief of the Ordnance Department (1812-1821) that had been organized in 1812 to supervise the acquisition of equipment, carriages, munitions, and cannons started absorbing the lessons of 1812. Observing the confusion caused by the motley collection of artillery, he prepared a plan to reduce the number of calibers. In November 1812 he proposed to the Secretary of War that a field artillery train should consist of a division of light artillery of four 6-pounders and two 5.5-inch howitzers, a division of foot artillery of four 6-pounders and two5.5-inch howitzers, a division of six 3-pounders, a division of park artillery of six heavy pieces, and light pieces for reserve artillery.[73]

Inspired by the Europeans, who were concentrating their field artillery into four- and six-piece divisions, also called batteries or companies, and influenced by his drive for uniformity and simplicity, Wadsworth suggested grouping field pieces into divisions of a specific number of pieces of the same size to facilitate massing fire and flexibility.[74] As Wadsworth's plan indicated, he sought to make field artillery support more effective through better organization. By ensuring that light and foot artillery accompanied an army into the field, Wadsworth hoped to furnish a balanced blend of firepower and mobility and tried to introduce the latest technological and organizational developments into the Army. Equally important, Wadsworth's proposals, if they were implemented, promised to reverse the direction that Dearborn's reforms had moved the field artillery.

In 1813 the War Department adopted some of Wadsworth's proposals. In May it published regulations to form the field artillery into divisions or half divisions. Each division consisted of four guns of the same caliber and two howitzers of not more than two different calibers or six cannons of not more than two calibers. This meant that a field artillery company would be composed of a certain number of field pieces if commanders followed the department's guidance. Although the War Department established the number of field pieces per company, it did not identify which cannons would be used. In essence, the War Department opposed reducing the number of calibers.

71. Winfield Scott, *Memoirs* (New York: Sheldon and Company, 1864), p. 60; Ltr, Chrystie to Cushing, 22 Feb 1813.

72. Report, MG Van Rensselaer, 14 Oct 1812, p. 76; Ltr, Chrystie to Cushing, 22 Feb 1813, p. 101; John K. Mahon, *The War of 1812* (Gainesville, Fl: University of Florida Press, 1972), pp. 85-86; Scott, *Memoirs*, pp. 60-61; Ltr, MG Van Rensselaer to Dearborn, 14 Oct 1812, in Brannan, *Official Letters*, p. 77.

73. Ltr, Wadsworth to Morton, 15 Nov 1812, Ltrs Sent by Chief of Ordnance, RG 156, National Archives.

74. *Ibid.*

Such a measure would mean eliminating existing field pieces, and the War Department could not afford to discard any of its field artillery in the midst of a war with Great Britain.[75]

Within weeks after the War Department had outlined its division of field artillery, Wadsworth expounded further on the necessity of reducing the number of calibers. Late in May 1813, Wadsworth wrote William Duane, a prominent American military theorist who was revamping infantry tactics in light of the experiences of 1812, that the Americans did not have a system of field artillery that provided simplicity and symmetry. "The American artillery, including that belonging to the individual states, comprises, I believe, every calibre made use of either in the English or French service, by sea or land, with endless variations in the proportions of each calibre," Wadsworth explained. He then added, "Unless the number of our calibres and their variations be reasonably reduced, and the whole be settled by some permanent regulation, no possible exertion can give our artillery that perfection its importance merits and which the public service requires."[76] Pressing to reduce the variations of guns and howitzers, Wadsworth suggested that 3-, 6-, and 12-pounders and 5.8-inch howitzers should form field artillery, that 18- and 24-pounders, 8- and 5.8-inch howitzers, and 8-, 10-, and 13-inch mortars should comprise siege artillery, that 18- and 24-pounders and 10-inch mortars should compose fixed seacoast artillery, and that 12-pounders and 8-inch howitzers should make up movable seacoast artillery. Although Wadsworth recommended three different calibers of guns for the field artillery, he believed that the 6-pounder was the ideal piece because the 3-pounder was too light and because the 12-pounder was too heavy. By following Wadsworth's proposals the War Department would eliminate five calibers of guns, two calibers of howitzers, and three calibers of mortars.[77]

As his letter to Duane indicated, Wadsworth was not satisfied with the extent of the reform. In Wadsworth's view the War Department had to do more than just specify the number of pieces in a division. It had to establish a manageable number of calibers and patterns to simplify supplying ammunition and had to identify each cannon's function.

Even before Army commanders could implement the new field artillery organization, President Madison placed Major General William H. Harrison in charge of regaining the Old Northwest Territory after Hull had lost it.[78] Rather than pursuing an offensive against Fort Malden in the middle of winter, Harrison waited at Fort Meigs for spring to come. Even without a central command structure, American artillery at Fort Meigs played an important part in defending the fort. In May 1813 Harrison reported to the Secretary of War that his army "raked" the British with artillery fire. Placing their 18-, 12-, and 6-pounders along the fort's walls, the Americans blasted British infantry and artillery with solid shot and canister and did not attempt to

75. Birkhimer, *Historical Sketch*, p. 380; Weigley, *History of the United States Army*, p. 124; Ltr, Wadsworth to Maj George Bomford, 18 Nov 1812, Ltrs Sent by Chief of Ordnance, RG 156, National Archives; Ltr, Secretary of War to Wadsworth, 12 Sep 1814, Ltrs Sent by Secretary of War, RG 107.

76. Ltr, Wadsworth to Duane, 27 May 1813, Ltrs Sent by Chief of Ordnance.

77. Ibid.

78. Ltr, Wadsworth to Dearborn, 15 Dec 1812, Ltrs Sent by Chief of Ordnance; Ltr, Wadsworth to Bomford, 18 Nov 1812, Ltrs Sent by Chief of Ordnance; Reginal Horsman, *The War of 1812* (New York: Alfred Knopf, 1969), pp. 81-82.

confront the enemy on the open battlefield.[79]

Once Harrison had gathered sufficient supplies and nine 18-pounders to complement his few 6-pounders, the American general resumed his offensive. With his lines secured by Major George Croghan's victory at Fort Stephenson early in the fall of 1813 and Commodore Hazzard Perry's victory at the Battle of Lake Erie in September 1813, Harrison chased the British up the Thames River. Unable to employ his 6-pounders because of the dense forest, Harrison depended on mounted infantry to defeat the British at the Battle of the Thames River. In doing so, he regained the Old Northwest Territory for the United States.[80]

Although Harrison's campaign recovered the Old Northwest Territory, John Armstrong, who had replaced Eustis as Secretary of War in 1813, planned that the main attack for the year would be against Montreal. Nevertheless, General Dearborn focused on Kingston, York, and Forts George and Erie. On 27 April an American brigade under Brigadier General Zebulon Pike assaulted York on Lake Ontario with Major Abraham Eustis' division of foot artillery of two 5.5-inch howitzers and four 6-pounders for support. Besides the light pieces, Dearborn, who was aboard an American ship in the bay, employed naval guns to pound British batteries. Although terrain forced the Americans to employ their foot artillery as siege weapons, they reaffirmed that 6-pounders and 5.5-inch howitzers could be transported through dense woods for a short distance and simultaneously showed the utility of the division of foot artillery. Yet, the Battle of York, which was basically a series of assaults against British batteries, did not indicate that the Americans could maneuver their 6-pounders and 5.5-inch howitzers with the infantry on the open battlefield as they were intended to be employed.[81]

Later in May 1813, three American brigades under Colonel Winfield Scott attacked Fort George on Lake Ontario. Under an intense bombardment from naval guns, Scott crossed the river with eight field guns from Colonel Moses Porter's light artillery. As Pike had done at York, Scott employed his light artillery in fixed positions to cover the infantry and furnish counterbattery fire.[82]

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79. Ltr, Harrison to Secretary of War, 13 May 1813, in Casselman, *John Richardson's War of 1812*, p. 172; Ltr, Secretary of War to Harrison, 8 May 1813, *ASPMA*, I, p. 454; Secretary of War to Harrison, 21 May 1813, *ASPMA*, I, p. 454; General Order, Fort Meigs, 9 May 1813, in Brannan, *Official Letters*, pp. 154-56; Ltr, Harrison to Armstrong, 13 May 1813, in Brannan, *Official Letters*, pp. 156-58.

80. Harry L. Coles, *The War of 1812* (Chicago: The University of Chicago Press, 1965), pp. 121-34; Ltr, George Croghan to Harrison, 5 Aug 1813, in Casselman, *John Richardson's War of 1812*, pp. 184-85; Ltr, Harrison to Secretary of War, 9 Oct 1813, in Casselman, *John Richardson's War of 1812*, pp. 234-36.

81. Coles, *The War of 1812*, pp. 136-38; Col William Allan's Account, Cruikshank, *The Documentary History of the Campaign upon the Niagara Frontier in the Year in the Year 1813*, I, p. 194; Ltr, Dearborn to Armstrong, 28 Apr 1813, *ASPMA*, I, p. 443; Ltr, US Army Officer to Editor, *United States Gazetter*, 9 May 1813, in Cruikshank, *The Documentary History of the Campaign upon the Niagara Frontier in the Year in the Year 1813*, I, p. 214; Ltr, Dearborn to Armstrong, 28 Apr 1813; Ltr, Dearborn to Armstrong, 3 May 1813, *ASPMA*, I, p. 444; *Sketches of the War Between the United States and the British Isles*, p. 200; Scott, *Memoirs*, pp. 87-91; Brigade Order, Sackett's Harbor, 25 Apr 1813, in Brannan, *Official Letters*, pp. 144-46; Ltr, Dearborn to Armstrong, 28 Apr 1813, in Brannan, *Official Letters*, pp. 148-49.

82. *Sketches of the War Between the United States and the British Isles*, p. 200; Horsman, *The War of 1812*, pp. 95-96; Ltr, Chandler to Dearborn, 18 Jun 1813, *ASPMA*, I, p. 448; Ltr, Dearborn to Armstrong, 27 May 1813, in Brannan, *Official Letters*, pp. 161-62; Brigade Order, 26 May 1813, in Brannan, *Official Letters*, pp. 160-61; Mahon, *The War of 1812*, pp. 144-45.

Although tactics for employing field artillery existed in 1813, the Americans could not maneuver their guns around the battlefield to mass fire. The terrain precluded using the appropriate tactics. After almost two years of war, the field artillery had not shown its potential for combining firepower and mobility. More important, the inability to convert theory into practice because of the terrain reflected the difficulties of transferring European field artillery tactics to North America where broad plains, at least where the war between the Americans and British was being fought, did not exist. Unable to employ their field guns properly, American commanders utilized them to satisfy their own particular circumstances as their European counterparts frequently did.

Once the war against Napoleon had ended in 1814, Great Britain turned its attention to the irritating conflict in North America. British strategists decided that the Royal Navy would tighten the blockade and liquidate privateering, that the army would invade New York along the Lake Champlain route and blackmail the northern states into pressing for peace, and that the navy in concert with the army would strike hard at the coastal cities. Through this plan the British hoped to force the Americans to sue for peace on favorable terms.

Anticipating the British move, the Americans geared for the campaigns of 1814. In March Congress passed a law that consolidated the three artillery regiments into a corps of twelve battalions of four companies each and left the Light Artillery Regiment unchanged. The act authorized each company to have one captain, one first lieutenant, two second lieutenants, one third lieutenant, five sergeants, one quartermaster sergeant, eight corporals, four musicians, and one hundred privates and abolished the position of artificer because of the creation of the Ordnance Department in 1812 to maintain equipment. Although Congress thought that establishing the corps would promote unity in the artillery, the act did just the opposite. The act failed to provide for a chief of artillery and broke the artillery into twelve units with six battalions to be commanded by lieutenant colonels and the other six commanded by majors.[83]

In the meantime, Colonel Scott established a camp of instruction at Buffalo, New York. Between March and June 1814 Scott drilled several different infantry regiments and two companies of artillery. Drawing upon English and French drill manuals, he taught infantry, cavalry, and field artillery tactics. Gun crews learned to maneuver their piece with other cannons and to sponge, load, ram, aim, prime, and fire their field piece so that each action was done at the right time. Although crew operations were the same as they had been during the American Revolution, field artillery in 1814 was more mobile than it had been in 1775-83 because of the introduction of the modified Gribeauval system and because of the practice of using the limber horses to drag the guns around the battlefield rather than unskilled matrosses. By the time that Scott was ready for action in early summer, he recorded, "Confidence, the dawn of victory, inspired the whole line." Because of this training, the United States had a disciplined army along the Niagara that was prepared for the rigors of battle in 1814.[84]

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83. Birkhimer, *Historical Sketch*, pp. 42-44.

84. Scott, *Memoirs*, p. 120; Arthur D.H. Smith, *Old Fuss and Feathers: The Life and Exploits of Lieutenant General Winfield Scott* (New York: The Greystone Press, 1937), pp. 104-05; Tousard, *American Artillerist's Companion*, pp. 110-42; Peterson, *Round Shot and Rammers*, pp. 80-82; Birkhimer, *Historical Sketch*, pp. 314-15.

In the campaign along the Niagara in 1814, Major General Jacob Brown organized his field artillery along the lines prescribed by the War Department. The general had Major Jacob Hindman's battalion of artillery from the Corps of Artillery that was composed of Captain Thomas Biddle's, Captain Nathan Towson's, and Captain John Ritchie's companies of foot artillery and Captain Alexander Williams' siege artillery company of two 18-pounders to support his entire force. Since War Department regulations did not outline what field pieces should compose a company of field artillery, Brown continued the practice of employing whatever field cannons were available.[85]

Early in July, the British and American armies collided at Chippewa. For the first time since Monmouth in 1778, the British and Americans faced each other on the open battlefield. On the fifth of the month, the British attacked Scott's brigade that was one of two brigades under the command of Brown. Immediately, Captain Nathan Towson's 12-pounders started raking the British with canister. Even though one of his guns was put out of action by hostile artillery fire, Towson continued pouring canister onto the advancing British infantry and eventually silenced the enemy's most effective battery by blowing up its ammunition wagon. In the meantime, Ritchie's 12-pounders and one 12-pounder from Biddle's company joined the action. Canister fire from the American guns finally stopped the attack and along with an aggressive infantry charge defeated the British. As much as Chippewa was a victory for American infantry, the battle also proved the utility of field artillery.[86]

During the weeks after Chippewa, the Americans maneuvered alongside the Niagara River. Late in July 1814, Scott found the British army occupying a hill at Lundy's Lane with two 24-pounders and five other pieces. Positioned alongside Scott's infantry, Towson's 12-pounders bombarded the British with canister and solid shot, supported the infantry, and were soon joined by the rest of the battalion of field artillery. Since the lines had become intertwined and so close, the field guns could not be used effectively and did not influence the outcome of the battle as they had done earlier at Chippewa. After receiving heavy casualties the Americans withdrew to Chippewa with their will to fight broken. The British, who effectively employed Congreve rockets against the Americans during the battle, also retired from the field. The fight, tactically a draw, ended Brown's offensive thrust into Canada. For the field artillery, however, Lundy's Lane reinforced the utility of field pieces. Served by trained crews, twelve-pounders mounted on modified Gribeauval carriages stayed abreast of infantry marches

85. General Orders, 6 Jul 1814, in T.H. Palmer, *The Historical Register of the United States*, Pt. II (Philadelphia: G. Palmer, 1816), pp. 37-38; Ltr, Brown to Secretary of War, 7 Jul 1814, in Palmer, *The Historical Register of the United States*, pp. 38-42; Scott, *Memoirs*, pp. 126-35; Ltr, Hindman to Adjutant General, undated, Cruikshank, *The Documentary History of the Campaign upon the Niagara Frontier in the Year 1814*, I, p. 44; Ltr, Scott to Adjutant General, 15 Jul 1814, *Sketches of the War Between the United States and the British Isles*, pp. 344-46; Ltr, Brown to Secretary of War, 6 Jul 1814, in Palmer, *The Historical Register of the United States*, p. 36; William L. Haskins, "The Organization and Materiel of Field Artillery in the United States Army Before the Civil War," *Journal of the Military Service Institution*, 1882, p. 409.

86. Ltr, BG Scott to Adjutant General, 15 Jul 1814, in Cruikshank, *The Documentary History of the Campaign upon the Niagara Frontier in the Year 1814*, IV, p. 46; Ltr, Hindman to Adjutant General, undated, in Cruikshank, *The Documentary History of the Campaign upon the Niagara Frontier in the Year 1814*, IV, p. 44; Ltr, MG Jacob Brown to Secretary of War, 7 Jul 1814, in Cruikshank, *The Documentary History of the Campaign upon the Niagara Frontier in the Year 1814*, IV, pp. 38-42; Birkhimer, *Historical Sketch*, p. 194.

and provided close support to the infantry.[87]

Besides reaffirming the necessity of well-trained foot artillery, the field batteries that accompanied Brown marked an important milestone. Although the War Department had formed the foot artillery batteries from the three original regiments, which meant artillerists faced the possibility of rotating between coast, garrison, and foot batteries, Towson's, Biddle's, and Ritchie's batteries served solely as field batteries throughout the war. As such, the War Department recognized foot artillery, at least during the war, as a special branch of artillery that deserved to be treated as such.[88]

Although a stout American defense at Plattsburgh, New York, forced the British to retreat back into Canada, the British enjoyed more success in the Chesapeake Bay. In August 1814 British commander, Major General Robert Ross, disembarked a force that was supported by three small cannons and rocket artillery. At Bladensburg Major General William H. Winder positioned twenty 12- and 18-pounders of the Maryland and Washington militia on the west side of the eastern branch of the Potomac River to stop the British advance. When the British approached, Winder's gun crews opened fire with solid shot. Although American infantry left the field because of the heavy enemy cannon and rocket barrages, American cannoneers silenced enemy artillery and slowed down the enemy advance. However, American artillery could not stop the British onslaught and retreated to Washington.[89]

Although the Americans lost the Battle of Bladensburg, an interesting tactical concept emerged. Writing Secretary of War Armstrong, Secretary of State (later President) James Monroe, acting as a cavalry scout, mentioned that Winder had used infantry to support the artillery. Winder also reported that he had ordered the Fifth Maryland Regiment to move forward to "sustain the artillery" that was being left unprotected as the advance infantry retreated back into the first line. Fighting, particularly on a conventional battlefield, as Winder realized, demanded teamwork between the infantry and field artillery.[90] In his report to the Secretary of War, he reinforced the need for infantry and field artillery to protect each other and fight a coordinated battle. As the battles of the war had demonstrated through 1814, guns and howitzers could influence the outcome of a battle. In Scott's case field guns at Chippewa helped defeat the British.

The British never took advantage of their superior position in the Chesapeake Bay. Although they burned Washington, they could not defeat Fort McHenry that defended Baltimore harbor. The American fortress stubbornly resisted the bombardment of rockets, exploding shells, and spherical case and influenced the British to revise their strategy and attack New Orleans. In response, Major General Andrew Jackson strengthened the various forts that guarded the approaches to the city, rendered many bayous impassable, positioned his troops so that they could

87. Ltr, Brown to Secretary of War, 7 Jul 1814, in Brannan, *Official Letters*, p. 368; General Orders, 6 Jul 1814, in Brannan, *Official Letters*, pp. 374-75; Ltr, Hindman to Adjutant General, undated; *Niles Register*, undated, in Cruikshank, *The Documentary History of the Campaign upon the Niagara Frontier in the Year 1814*, I, p. 48.

88. Birkhimer, *Historical Sketch*, p. 194.

89. Ltr, Macomb to Secretary of War, 15 Sep 1814, in Palmer, *The Historical Register of the United States*, pp. 220-24; Coles, *The War of 1812*, pp. 170-71; Horsman, *The War of 1812*, pp. 190-93; George E. Gleig, *A Subaltern in America* (Philadelphia: E.L. Carey and A. Hart, 1833), p. 67; Winder, Narrative, *ASPMA*, I, pp. 557-58.

90. Winder, Narrative, *ASPMA*, I, pp. 557-58; Ltr, Monroe to Secretary of War, 13 Nov 1813, *ASPMA*, I, p. 537.

concentrate quickly, and gathered intelligence on British movements and the topography of the area surrounding the city.[91]

After an indecisive clash with the British on 23 December 1814, Jackson built a defensive line armed with 32-, 24-, 18-, 12-, and 6-pounders and a 6-inch howitzer on the east side of the Mississippi River. Across the river he constructed a battery of one 24-pounder and two 12-pounders served by militia to prevent the British from turning his position. While the Americans shored up their defenses, the British brought forward more artillery. On 1 January 1815 the British assaulted the American works. American guns blasted British batteries with solid shot, tore apart the infantry with canister, and compelled the British to retreat.[92]

Several days later, the British attacked again. Hit by solid shot and canister from American 12- and 18-pounders and musketry, the British right wavered and then broke. Solid shot and canister and musket fire also forced the left to retreat. On the west side of the river, the British utilized six 18-pounders to support an aggressive infantry charge on the American battery. Intimidated by the superior British force and unable to defend themselves because their artillery was positioned to fire obliquely onto the plain on the east side of the river, the Americans spiked their guns and fled. Heavy casualties on both sides of the river and the inability to sustain their offensive around New Orleans, however, influenced the British to withdraw in defeat.[93]

Field artillery played an important role at New Orleans. Writing the Secretary of War on 9 January 1815, Jackson credited his artillery with playing a decisive part in defeating the British. Yet, the composition of Jackson's and the British armies discouraged the Americans from deploying field artillery on the conventional battlefield and forced Jackson to employ his field pieces in fixed positions behind fortifications.[94]

The War of 1812 left the field artillery with a mixed legacy. With the technological improvements—lighter guns and modified Gribeauval carriages and equipment—that had been introduced before the war and organizational and tactical developments borrowed from Europe during the war, American field artillery stood on the brink of a significant breakthrough. With the exception of the Battle of Chippewa and the Battle of Lundy's Lane where gun crews maneuvered their field pieces to support the infantry, combat in broken, wooded country and armies composed of untrained militia, volunteers, and regulars kept the Americans from employing their field artillery as it was intended and demonstrated that using field artillery effectively was dependent upon open country with little cover and trained cannoneers. By mounting the Light Artillery Regiment and forming foot artillery batteries in 1812 that served exclusively as field batteries, the War Department revealed that it envisioned field artillery as a special branch of artillery and was making an effort to separate it from coast and siege artillery. Only time would tell if the field artillery would continue in the direction initiated by the war.

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91. Coles, *The War of 1812*, pp. 201-12.

92. William Surtees, *Twenty Years in the Rifle Brigade* (London: Frederick Muller LTD, 1973, reprinted from 1883 edition), p. 37; Gleig, *A Subaltern in America*, p. 325.

93. Ltr, Jackson to Secretary of War, 9 Jan 1815, in Brannan, *Official Letters*, p. 457; Coles, *The War of 1812*, p. 232; Ltr, Jackson to Secretary of War, 9 Jan 1815, in Palmer, *The Historical Register of the United States*, pp. 291-94.

94. Ltr, Jackson to Secretary of War, 9 Jan 1815, in Palmer, The *Historical Register of the United States*, pp. 291-94.

Chapter III

DEVELOPING A FIELD ARTILLERY SYSTEM: 1815-1861

Between 1815 and 1861 the field artillery underwent a profound change. After years of debate over the proper patterns for carriages, caissons, limbers and gun metal, the War Department introduced a new field artillery system in the 1840s that was employed in the Mexican War of 1846-48. Even though this system represented the latest smoothbore technology, the development of powerful and accurate rifled field artillery in Europe during the 1840s and 1850s threatened to make it obsolete.

Fighting Complacency: 1815-1845

Following the war with Great Britain, the United States quickly demobilized. Even before the United States and Great Britain had exchanged their ratifications of the Treaty of Ghent, Congress passed an act in March 1815 to reduce the Army's size. The act limited the Army to a maximum of ten thousand regulars exclusive of the Corps of Engineers. After the reorganization had been completed in mid-1815, the Army had eight infantry regiments of ten companies each, a rifle regiment of ten companies, the Corps of Artillery of eight battalions of four companies each to man the coastal defenses, and the Light Artillery Regiment of 1808 of ten companies. Each light artillery company had one captain, one first lieutenant, one second lieutenant, two cadets, four sergeants, four corporals, two musicians, eight artificers, and fifty-eight privates. The act cut the Army from its wartime strength of four artillery regiments, seventeen infantry regiments, two dragoon regiments, one rifle regiment, and a Corps of Engineers. In the meantime, the Secretary of War William Crawford (1815-1817) separated the Army into the Division of the North and the Division of the South in May 1815. With this organization the Army was assigned to protect the coasts and interior of the North American continent.[1]

The act also reflected Congress' views on field artillery. While Congress recognized light artillery as a special branch of artillery by retaining the Light Artillery Regiment, its view of foot artillery differed significantly. Even though foot artillery had performed well at the Battles of

1. Russell F. Weigley, *History of the United States Army* (New York: Macmillan Publishing Company, Inc., 1967), pp. 138-39; William E. Birkhimer, *Historical Sketch of the Organization, Administration, Materiel and Tactics of the Artillery, United States Army* (James J. Chapman, 1884, reprinted by Greenwood Press, 1968), pp. 44-45, 336, hereafter cited as *Historical Sketch*.

Chippewa and Lundy's Lane in 1814, Congress permitted it to disappear in its haste to reduce the wartime Army and conserve money. As planned, artillerists would serve in a light or coast artillery company during peacetime.[2]

Although the Army's return to peacetime responsibilities minimized the need for artillery, Colonel Decius Wadsworth, Chief of Ordnance (1815-1821), ambitiously envisioned building an artillery system along European lines. In January 1817 Wadsworth told Secretary of War John C. Calhoun (1817-1825) that American artillery had too many different patterns for the same size of gun or howitzer. This created confusion and required carriages and equipment to be built to fit each gun. To streamline the artillery Wadsworth wanted cannons and howitzers of the same caliber and size to be alike, which would in turn reduce the variation of carriages and equipment.[3] Even though the War Department had made some progress by grouping the guns by caliber, size, and function in 1813 and by limiting the number of calibers to nine in 1816, Wadsworth pointed out in 1818 that it had failed to make sufficient reductions in cannon patterns.[4]

As part of his drive to improve the artillery, Wadsworth pushed adopting new carriage patterns, especially for field artillery. During the War of 1812, the British had used a stocktrail carriage for its field artillery, but the carriage had escaped the attention of the Americans because the war was generally not one of movement on the battlefield. Wadsworth, however, had noticed the carriage. Convinced that it was more maneuverable and stronger than the Gribeauval carriage, Wadsworth proposed developing a carriage based upon the British carriage and even designed his own. He brought the flasks closer together at the trail ends to permit the carriage to turn more sharply than the Gribeauval carriage could. In addition, Wadsworth mounted an ammunition chest on the limber. After testing Wadsworth's carriage in 1818 at the direction of the War Department, Captain William Wade of the Ordnance Department reported that it was satisfactory and would make the Gribeauval carriage obsolete.[5]

With the abatement of the Indian wars in 1818, Secretary Calhoun turned his attention to the current state of the Army and artillery. Calhoun sympathized with Wadsworth's complaints about the multiplicity of patterns and listened to the Chief of Ordnance's suggestions to discard the

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2. Birkhimer, *Historical Sketch*, pp. 199-20; Weigley, *History of the United States Army*, p. 139.

3. Ltr, Wadsworth to Secretary of War, 23 Jan 1817, in Stephen V. Benet, ed., *A Collection of Annual Reports and Other Important Papers, Relating to the Ordnance Department*, Vol. I (Washington: Government Printing Office, 1878), p. 29, hereafter cited as *A Collection of Annual Reports.*

4. Stanley Falk, "Artillery for the Land Service: The Development of a System," *Military Affairs*, Fall 1964, p. 99; Birkhimer, *Historical Sketch*, pp. 278-79; Ltr, Wadsworth to Secretary of War, 22 Jun 1818, in Benet, *A Collection of Annual Report*, I, pp. 34-36.

5. Bvt Maj William L. Haskin, "The Organization and Materiel of Field Artillery in the United States Army Before the Civil War," *Journal of the Military Service Institution*, 1882, p. 410; Ltr, Wadsworth to Secretary of War, 21 Sep 1819, in Benet, *A Collection of Annual Reports*, I, p. 53; Ltr, Wadsworth to Secretary of War, 22 Jul 1818; Ltr, Chief of Ordnance to Cpt George Talcott, 15 Apr 1818, Ltrs Sent by Chief of Ordnance, RG 156, National Archives; Ltr, Wadsworth to Cpt William Wade, 4 Aug 1818, Ltrs Sent By Chief of Ordnance; Ltr, Wadsworth to Maj A.R. Wooley, 18 Jun 1818, Ltrs Sent by Chief of Ordnance; Ltr, Wadsworth to Cpt E. Tyler, 31 Jul 1818, Ltrs Sent by Chief of Ordnance; Birkhimer, *Historical Sketch*, pp. 233, 279; Ltr, George Bomford to Secretary of War, 23 Dec 1823, in Benet, *A Collection of Annual Reports*, I, p. 114; Ltr, Wadsworth to Secretary of War, 21 Sep 1819, in Benet, *A Collection of Annual Reports*, I, p. 55.

Gribeauval system. Wadsworth's ideas, which seemed to be so extreme to the Secretary of War, and the American infatuation with the Gribeauval system prompted Calhoun to convene an ad hoc board of artillery and ordnance officers to study Wadsworth's ideas.[6]

Beginning in September 1818 and continuing into 1819, the board assessed various carriages and made recommendations for an artillery system. Although the Chief of Ordnance handpicked members of the board, they succumbed to the prestige of the Gribeauval carriage, found Wadsworth's model to be inferior to the Gribeauval, and determined to employ cast-iron guns. Addressing patterns for 6-pounders, the board then said that the gun's weight would be reduced to give the piece more mobility. This along with the 6-pounder's length gave the gun the popular name of the "walking stick." The board, moreover, urged abolishing the medium 18-pounder and scrapped 8- and 13-inch mortars as field artillery weapons to reduce the field artillery to 6- and 12-pounders and 24-pounder howitzers. In addition, the board outlined using 12-, 18-, and 24-pounders, 8-inch howitzers, and 15-inch mortars as siege artillery and 24-pounders and 10-inch mortars as coast artillery. By the time that the board had completed its work in 1819, it had selected four calibers for guns, two for howitzers, and two for mortars. Although the board refused to utilize Wadsworth's carriage pattern for field artillery, it embraced the essence of his system by calling for the same calibers and sizes of pieces that the Chief of Ordnance desired. More important, the board encouraged development of a system based upon simplicity and uniformity.[7]

The Wadsworth years left a mixed legacy. Even though the War Department adopted Wadsworth's eight-caliber system of field, siege, and coast artillery and took steps to increase the 6-pounder's mobility, it scorned the British stock-trail carriage by keeping the Gribeauval carriage. This decision proved to be a bad choice since the Gribeauval was already obsolete when the Americans made it their official carriage.

While the Ordnance Department and Wadsworth struggled to organize a system of artillery, congressional attitudes towards the Army shifted dramatically. As the years passed and as the failures of the improvised regiments raised during the War of 1812 were slowly forgotten, the need for a large Regular Army diminished. In 1820 Congress decided to revamp the Army to save money. Despite Calhoun's pleas to create a peacetime army, in which all wartime formations would exist in a skeleton form to allow wartime recruits to be absorbed quickly during an emergency, Congress reduced the size of the Army from ten thousand to six thousand men in the Reorganization Act of 1821 and made no provisions for Calhoun's expansible Army. Congress consolidated the 6th Infantry Regiment and Rifle Regiment, eliminated the 8th Infantry Regiment, merged the Corps of Artillery, the Light Artillery Regiment, and Ordnance Department into four regiments of artillery each with a staff of one colonel, one lieutenant colonel, one major, one captain, one supernumerary for ordnance duty, one adjutant, one sergeant major, one quartermaster sergeant, and nine companies. Each company would be composed of one captain, two first lieutenants, two second lieutenants, four sergeants, four corporals, three

6. Falk, "*Artillery for the Land Service*," p. 98.

7. Birkhimer, *Historical Sketch*, p. 279; Falk, "Artillery for the Land Service," p. 99. An artillery system is an orderly arrangement of weapons, ammunition, and equipment.

artificers, two musicians, and forty-two privates. One of the nine companies in each regiment would be light artillery with the rest being foot or coast artillery. As prescribed by H. Lellemand's *A Treatise on Artillery*, which the War Department adopted as the official artillery manual in 1821, a captain commanded a battery of three two-gun sections. Each section was commanded by a lieutenant and had two gun crews with each under the direction of a noncommissioned officer.[8]

Combining the Ordnance Department with the Corps of Artillery and the Light Artillery Regiment had serious consequences. Since the War Department no longer had an agency dedicated to developing weapons and equipment, it started detailing artillery officers with little or no expertise in munitions or weapon technology as ordnance officers. When artillery officers acquired some ordnance skills, the War Department returned them to the artillery. This practice and the closure of the Ordnance Department left the artillery without any leadership to supervise the acquisition of equipment, carriages, munitions, and cannons. Equally important, the act ended light artillery's independent status by making light artillery companies part of a composite regiment of light, foot, and coast artillery. By doing this Congress legislated the first and only light artillery regiment out of existence, ended light artillery's independent status, and threatened artillerists with duty in any kind of artillery unit.[9]

Following the Reorganization of 1821 and lacking any formal institution to direct rearmament, the War Department grappled to put the artillery system approved in 1819 into effect. After eight years of developing the walking stick gun, artillerymen tested several newly constructed guns at Fort Monroe, Virginia, in 1827. When fired, the cast-iron guns exploded and caused gunners to begin reexamining the possibility of employing bronze artillery.[10] One year later in 1828, artillerymen started questioning the quality of the Gribeauval carriage because of Lieutenant Daniel Tyler's work. Sent by the War Department to France in 1828 to study the Gribeauval carriage, Tyler reported upon returning that the French were adopting the British system of stock-trail carriage, limber, and caisson with a few of their own modifications because it was superior to the Gribeauval system.[11] Based upon complete drawings of the new French system that Tyler had secured while overseas, the Americans constructed several experimental French stock-trail carriages, limbers, and caissons for testing.[12]

Because of the raging debates over carriage, limber, caisson, and gun patterns and problems

8. Birkhimer, *Historical Sketch*, pp. 302, 358; H. Lellemand, *A Treatise on Artillery*, trans. by James Renwick, Vol I (New York: C.S. Van Winkle, 1820), pp. 114-30, 142.

9. Weigley, *History of the United States Army*, pp. 141-42; Birkhimer, *Historical Sketch*, p. 54; Francis B. Heitman, ed., *Historical Register and Dictionary of the United States Army* (Washington: Government Printing Office, 1903), p. 54, hereafter cited as *Historical Register*.

10. Harold L. Peterson, *Round Shot and Rammer* (Harrisburg, Pa: Stackpole Books, 1969), p. 91.

11. Birkhimer, *Historical Sketch*, pp. 237-39, 242-43; Falk, "Artillery for the Land Service," p. 99; Memo, Bvt Col George Bomford, Ordnance Office, War Department, 6 Jul 1830, in Benet, *A Collection of Annual Reports*, I, p. 214; Report on Brass and Cast Iron six-pounders at Ft. Monroe, 23 Nov 1827, Lt, W.H. Bell, Reports of Experiments, Vol. I, RG 156.

12. Birkhimer, *Historical Sketch*, pp. 116, 239-40, 319; Memo, Bomford, Ordnance Office, War Department, 6 Jul 1830; Falk, "Artillery for the Land Service," p. 99.

with the cast-iron guns, the War Department did not have a reliable field artillery system as the 1830s opened.[13] In 1831 Secretary of War Lewis Cass (1831-1836) vented his frustrations about the state of the field artillery. Writing President Andrew Jackson in November, he reported that the Army had 623 cannons of various calibers for field service with an additional 1,165 pieces at the arsenals and fortifications. With the exception of 344 6-pounders and a few heavy artillery pieces, the Army did not have any serviceable field pieces and could not adequately defend the country. Cass protested further that even the Army's 6-pounders were undependable because they were old.[14]

Prompted by fears about the quality of American artillery, Cass appointed a board of officers to find a permanent artillery system. Consisting of General Alexander Macomb, Commanding General of the Army (1828-1841); Brigadier General Charles Gratiot, Chief Engineer; Inspector-General John E. Wool; Colonel Abraham Eustis, Commandant of the Artillery School of Practice, Fort Monroe, Virginia; and Colonel George Bomford, Chief of Ordnance (1832-1848), the board met in March 1832.[15] Ignoring all other questions, the board centered its attention on the proper weapons for field artillery and the stock-trail carriage. It directed Eustis and Bomford to make recommendations on the calibers and types of weapons, carriage patterns, and metal and sent Wool to Europe in mid-1832 to obtain British bronze 6-pounders and stock-trail carriages, French 6-pounders and carriages, 5.5-inch howitzers and carriages, 12-pounders and carriages, and other equipment to serve as models. Late in 1832, Wool returned with nothing except eight sword belts, which left Bomford and Eustis without any guns or carriages to test.[16]

Outside of a few French-style stock-trail carriages, limbers, and caissons under construction by the Ordnance Department, the search for a field artillery system reached a standstill.[17] In November 1833 Bomford and Eustis pointed out their failure to make any progress. In a letter to the Secretary of War early in 1834, they reported that they could "not form any decided opinion on the subject" of the proper system because of the circumstances that had arisen during the past year.[18] Seeking to generate action, they asked the War Department to furnish them with two iron 6-pounders, two bronze 6-pounders, two iron 12-pounders, two bronze 12-pounders, two iron 24-pounder howitzers, two bronze 24-pounder howitzers, eight stock-trail carriages, and eight Gribeauval carriages.[19]

After the proposal to examine the carriages and guns had been endorsed by Cass, a new ordnance board composed of Wool, Gratiot, and Eustis from the ordnance board of 1832 and Lieutenant Colonel George Talcott, Captain Benjamin Huger, and Captain Alfred Mordecai of the

13. Ltr, MG Alexander Macomb to John Eaton, Secretary of War, Nov 1829, *American State Papers, Military Affairs (ASPMA)*, I, p. 156.

14. War Department, Annual Report for 1831, in Benet, *A Collection of Annual Reports*, I, p. 231; Ltr, Secretary of War to President, 21 Nov 1831, Ltrs Sent to President by Secretary of War, microfilm, RG 107.

15. Birkhimer, *Historical Sketch*, p. 243.

16. Falk, "Artillery for the Land Service," p. 100; Ltr, Bomford to Wool, 10 Apr 1832, Ltrs Sent by Chief of Ordnance; Ltr, Bomford to Wool, 16 Apr 1832, in Benet, *A Collection of Annual Reports*, I, pp. 233-34.

17. Ltr, Bomford to Lt John Symington, 6 Jul 1830, in Benet, *A Collection of Annual Reports*, I, p. 214.

18. Ltr, Eustis and Bomford to Secretary of War, undated, in Benet, *A Collection of Annual Reports*, I, p. 271.

19. *Ibid.*

Ordnance Department met late in 1835.[20] Three weeks after they had begun their work, the six officers concluded that the stock-trail carriage should be used because it was superior to the Gribeauval and that bronze pieces should be employed because they were stronger, lighter, and more malleable than cast-iron and were less likely to explode when fired. Based upon the board's findings, in 1836 Cass authorized using bronze as gun metal and the French system of stock-trail carriages, limbers, and caissons with modifications. This decision meant introducing mounted artillery to complement light and foot artillery as branches of American field artillery. Although bronze was accepted as the proper gun metal and although private foundries started producing bronze 6- and 12-pounders in 1836, Cass' decision failed to end the raging controversy over bronze versus cast-iron field artillery.[21]

Despite Cass' efforts, the quality of the Army's artillery failed to improve. The poor state of the artillery at the close of the 1830s prompted Secretary of War Joel Poinsett (1837-1841) to act.[22] In 1838 he complained about the lack of a complete artillery train for any of the Army's four artillery regiments, the dearth of pieces for service in the field, and the Army's inability to utilize rockets, which the Europeans had been using since the first decade of the nineteenth century. He also expressed concern about the nonexistence of trained gunners.[23]

The deficiency of qualified artillerists stemmed from peacetime practices. When the war with Great Britain ended in 1815, the Army returned to policing the frontier and defending the sea coasts. This forced the War Department to scatter troops throughout the country in small garrisons and prevented artillery regiments from training as a unit. Whether stationed in a coastal or frontier fort, artillerymen served mainly as foot soldiers because of the Indian threat.[24] To develop trained artillerists, the War Department formed the Artillery School of Practice at Fort Monroe in 1824 and sent entire artillery units through the school. However, the school failed to develop a body of qualified artillerists.[25] Poorly funded by Congress, the school did not have the proper

20. Birkhimer, *Historical Sketch*, p. 245.

21. Falk, "Artillery for the Land Service," p. 100; Birkhimer, *Historical Sketch*, pp. 248-49, 262-63; Peterson, *Round Shot and Rammers*, pp. 88-91; Ltr, Bomford to Col A.J. Pleasanton, Philadelphia, 18 Jul 1836, Ltrs Sent by Chief of Ordnance; Warren Ripley, *Artillery and Ammunition of the Civil War* (New York: Van Nostrand Reinhold, 1970), pp. 19-20.

22. Report, Ordnance Department, 8 Apr 1839, in Benet, *A Collection of Annual Reports*, I, pp. 363-64; James E. Huston, *The Sinews of War: Army Logistics, 1775-1953* (Washington: Office of the Chief of Military History, 1966), pp. 128, 130-31; Peterson, *Round Shot and Rammers*, p. 80. At the end of the 1830s, the War Department possessed 29 bronze 12-pounders, 31 bronze 6-pounders, 53 bronze 24-pounder howitzers, 10 bronze 12-pounder howitzers, 288 iron 12-pounders, 292 iron 6-pounders, 310 iron 24-pounder howitzers, and 5 iron 12-pounder howitzers at the end of the 1830s. Although the iron field pieces were serviceable, they were old and undependable.

23. Annual Report, Secretary of War, 1838, in Benet, *A Collection of Annual Reports*, I, p. 359.

24. Birkhimer, *Historical Sketch*, pp. 54, 200; Weigley, *History of the United States Army*, pp. 171-72.

25. Ltr, Secretary of War to President, 4 Dec 1854, Ltrs Sent to President by Secretary of War; Ltr, Secretary of War to President, 27 Nov 1821, Ltrs Sent to President by Secretary of War; Ltr, Macomb to Secretary of War, Nov 1828, *ASPMA*, IV, p. 6; William L. Haskin, *The History of the First Regiment of Artillery* (Portland, Me: B. Thurston and Company, 1879), p. 71; War Department, Condition of the Military Establishment and Fortifications, Dec 1824, *ASPMA*, II, p. 699; Richard P. Weinert, Jr., and Colonel Robert Arthur, *Defender of the Chesepeake: The Story of Fort Monroe* (Annapolis, Md: Leeward Publications, Inc., 1978), pp. 32, 40, 52-55; Weigley, *History of the United States Army*, p. 153.

ordnance, machine implements, stores, books, or other vital equipment for successful training.[26]

Moreover, the Black Hawk War and Seminole War of the 1830s hurt training because the War Department had to dispatch artillerists from the school to help quell the uprisings.[27] During those wars, the Army confronted the American Indian, whose warfare of raids, surprise, and mobility minimized the opportunity to utilize field pieces. Combat for the most part produced single-gun battles and small unit actions that often did not involve field pieces and that discouraged even employing field cannons. Taking into consideration the enemy that the Army had been fighting since the early 1820s, Secretary Cass wrote President Andrew Jackson in 1835 that the War Department had a sufficient quantity of field artillery to satisfy its needs. An Indian-fighting army did not require a large amount of field artillery designed to fight an European army. Despite Cass' support for casting bronze guns and introducing new artillery equipment, he did not endorse building a large inventory of new weapons for field or coast artillery and failed to take resolute action to equip the Army with modern field artillery.[28] Limited funds, congressional opposition, and a succession of Indian wars reduced the Artillery School's impact and hampered creating a body of professional artillerists in the 1820s and 1830s.[29]

As circumstances began changing late in the 1830s, the War Department started reassessing the condition of its field artillery. Moving onto the plains, the Americans encountered mounted Indians. This inspired the formation of dragoon units and highlighted the need for light artillery. Also, disputes with Great Britain over the Oregon Territory and Mexico over Texas raised the possibility of an armed confrontation of some kind if the United States and these countries could not resolve their differences peacefully.

Desiring weapons for employment against the Plains Indians and a well-equipped Army, Secretary Poinsett and Colonel Bomford pushed rearming the field artillery. Secretary Poinsett urged Congress to appropriate money for new weapons and even advocated establishing a rocket brigade.[30] Meanwhile, Bomford argued that equipping light artillery for field service was imperative. Concurring with Bomford that light artillery was the "most effective means of defense," Poinsett authorized properly arming light artillery companies and simultaneously supported Bomford's desire to develop a field artillery system.[31]

Guided by Poinsett's directions, the ordnance board of 1838 spent most of its time on field artillery and soon found itself embroiled over the proper metal. Brigadier General John Fenwick, recalling

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26. Morris Swett, "The Forerunners of Sill," *Field Artillery Journal*, Nov 1938, p. 458; Ltr, Macomb to Porter, Nov 1828, ASPMA, IV, p. 6.

27. Swett, "The Forerunners of Sill," pp. 458-59; Annual Report, Secretary of War, 1838, in Benet, *A Collection of Annual Reports*, I, p. 359; Maurice Matloff, ed., *American Military History* (Washington: Office of the Chief of Military History, United States Army, 1969), pp. 155-56.

28. Ltr, Secretary of War to President, 29 Nov 1835, Ltrs Sent to President by Secretary of War.

29. Ltr, Secretary of War to President, 30 Nov 1835, Ltrs Sent to President by Secretary of War; Birkhimer, *Historical Sketch*, pp. 54, 200; Weigley, *History of the United States Army*, pp. 171-72.

30. Annual Report, Secretary of War, 1838, p. 359.

31. Annual Report, Secretary of War, 1838, p. 359; Annual Report, Secretary of War, 1839, in Benet, *A Collection of Annual Reports*, II, p. 372; Falk, "Artillery for the Land Service," pp. 102-03.

his War of 1812 days when cast-iron field guns reigned supreme, opposed bronze, while Lieutenant Colonel George Talcott and others wanted cast iron because technological developments in recent years had reduced the carbon content to make it less brittle, more malleable, and cheaper to produce than in the past. Moreover, this new cast iron reputedly had the advantages of cast iron and bronze and the disadvantages of neither.[32] Although he was the junior member of the board, Captain Mordecai advocated bronze because the Europeans used it for their field artillery. Divided over the merits of the two metals, pressured by iron manufacturers, and influenced by the abundance of inexpensive iron ore, the board tested iron and bronze guns. As the board of 1835 had done, the board of 1838 concluded that bronze was preferable for field pieces because the malleable cast-iron guns undergoing testing were bursting upon firing. Because of this, the board rejected cast-iron cannons and recommended developing a bronze field artillery system of 6- and 12-pounders, 12- and 24-pounder howitzers, and 12-pounder mountain howitzers. At the same time the board urged adopting a French-style stock-trail carriage that would fit any of the ordnance chosen, supported introducing rockets into the Army, and provided a detailed nomenclature of artillery and equipment. Early in 1839, the War Department adopted the board's recommendations. Later in April 1839 after Congress had appropriated funds to prepare drawings of the new system, Poinsett created the ordnance board of 1839, which was composed of Talcott, Major Rufus Baker, Mordecai, and Huger, to begin work on the drawings.[33]

Although the system of 1839 represented the most advanced field artillery that the War Department had seen, Poinsett disagreed with the 1838 ordnance board's finding concerning the type of metal to be used. In the spring of 1839, he gave the board of 1839 the additional mission of testing different types of bronze and iron artillery, ammunition, fuses, and equipment. After ten months of study, board members unanimously advised employing bronze for field artillery. Dissatisfied with the board's conclusion, Poinsett sent Mordecai, Baker, and Huger to Europe early in 1840 to obtain practical and theoretical knowledge about artillery.[34] In November 1840 they returned with overwhelming evidence about the superiority of bronze over iron. This time Poinsett agreed, and in January 1841 he authorized the production of bronze field artillery and the French-style carriages, limbers, and caissons approved in 1839. Beginning in 1841, the board of 1839 resumed the task of designing the system of 1839. In 1847 the board gave Mordecai sole responsibility. Mordecai finished the details of the system, made some changes in the equipment and pieces that had already been produced between 1841 and 1844, and introduced new items. The artillery system consisted of 6- and 12-pounders, 12-, 24-, and 32-pounder howitzers, 12-pounder

32. Falk, "Artillery for the Land Service," p. 103; William H. McNeill, *The Pursuit of Power: Technology, Armed Force, and Society Since A.D. 1000* (Chicago: The University of Chicago Press, 1982), p. 173.

33. Ltr, Bomford to Talcott, 16 Nov 1838, Ltrs Sent by Chief of Ordnance; Ltr, Bomford to Talcott, 25 Jan 1839, Ltrs Sent by Chief of Ordnance; Ltr, Bomford to Cyrus Alger, 25 Jan 1839, Ltrs Sent by Chief of Ordnance; Falk, "Artillery for the Land Service," pp. 103-04; Birkhimer, *Historical Sketch*, pp, 281, 382-83; Ltr, Bomford to Cpt Samuel Ringgold, 28 Mar 1839, Ltrs Sent by Chief of Ordnance; Ltr, Bomford to Cdr, Watervliet Arsenal, 8 Sep 1838, Ltrs Sent by Chief of Ordnance; Ltr, Bomford to R.S. Baker, Watervliet Arsenal, 16 Nov 1838, Ltrs Sent by Chief of Ordnance; Ltr, Bomford to Huger, 2 Mar 1839, Ltrs Sent by Chief of Ordnance.

34. Ltr, Talcott to Secretary of War, 13 Apr 1842, in Benet, *A Collection of Annual Reports*, I, p. 438; Ltr, Secretary of War to Talcott, 16 Mar 1840, Ltrs Sent by Secretary of War, RG 107.

mountain howitzers designed to be mounted on a pack carriage, stock-trail carriages, limbers, and caissons with seats for the gun crew. Finally, Secretary of War George W. Crawford (1849-1850) approved Mordecai's work in August 1849 and ordered the system to be adopted.[35]

In the meantime, the War Department introduced new ammunition and fuses. During the early nineteenth century, fixed ammunition was slowly replacing separate-loading ammunition. By the 1840s artillerymen preferred fixed ammunition for shot, shell, canister, and spherical case. Even though grapeshot was still in the inventory, it had not been used for many years for field artillery because it damaged the bore of the cannon. As new ammunition was being introduced, Captain Charles Bormann of Belgium developed a fuse that was adopted by European and American armies. It was a disc-shaped plug of white metal that could be screwed into the shell. The fuse contained a train of powder in the form of an arc that led to the powder charge within the shell. The arc was marked off on the exterior in quarter-second intervals and had a total burning time of five seconds. By properly setting the fuse, known as the Bormann fuse, gun crews could explode the shell over the heads of enemy troop formations. American field artillery also continued utilizing a wooden fuse. This fuse was a tapered wooden plug with a hole with portfire composition in it. The outside of the plug was marked with lines to indicate the burning time. To set the fuse a member of the gun crew cut it at the desired line for the time duration that was needed.[36]

The field artillery also adopted new artillery implements. Even though portfires and linstocks continued to be standard equipment in the 1840s, gun crews used them only when friction primers, which had been recently developed, were not available. The friction primer consisted of a copper tube with a serrated wire running through it at right angles, friction compound, and musket powder. A loop at the end of the serrated wire served for attaching a lanyard, a long piece of rope. A quick pull on the lanyard dragged the serrated wire across the friction compound to ignite the compound to set off the musket powder that flashed down the copper tube to the charge. By 1848 these primers were standard for field pieces.[37]

Concurrently, the War Department activated light and mounted artillery companies using existing stocks of guns and equipment. In 1838 Poinsett ordered Major Samuel Ringgold to organize a company of light artillery at Carlisle Barracks, Pennsylvania, from men from the 1st and 2nd Artillery Regiments.[38] The following year Poinsett directed equipping three more companies as light artillery as more horses were becoming available to the Army. However, the War Department established the three companies as mounted artillery since the cannoneers rode on the

35. Falk, "Artillery for the Land Service," pp. 108-09; Ltr, Secretary of War to War Department, 16 Aug 1849, in Benet, *A Collection of Annual Reports*, II, p. 282; Ltr, Bomford to Secretary of War, 16 Aug 1849, in Benet, *A Collection of Annual Reports*, II, p. 281; Memo, Secretary of War, 16 Aug 1849, in Benet, *A Collection of Annual Reports*, II, p. 282; Peterson, *Round Shot and Rammers*, pp. 88-89, 95.

36. Peterson, *Round Shot and Rammers*, p. 107; Frank E. Comparato, *Age of Great Guns: Cannon Kings and Cannoneers Who Forged the Firepower of Artillery* (Harrisburg, Pa: The Stackpole Company, 1965), p. 325; Board of Artillery Officers, *Instruction for Field Artillery* (Philadelphia: J.B. Lippincott, 1860), pp. 13-14; Ripley, *Artillery and Ammunition of the Civil War*, p. 265; John Gibbon, *The Artillerist's Manual* (New York: 1860), pp 160, 345.

37. Peterson, *Round Shot and Rammers*, pp. 115-16; Ripley, *Artillery and Ammunition of the Civil War*, p. 233; Board of Artillery Officers, *Instruction for Field Artillery*, 1860, p. 14.

38. Ltr, Bomford to Ringgold, 28 Mar 1838, Ltrs Sent by Chief of Ordnance; Birkhimer, *Historical Sketch*, pp. 54, 57, 58.

limbers and caissons and designated Captain Francis Taylor, Captain John M. Washington, and Lieutenant James Duncan as commanders. Using Robert Anderson's translation of the French *Instruction for Field Artillery: Horse and Foot*, which was published in 1839 and adopted in 1841 as the official manual on field artillery, the War Department created mounted and light batteries of six guns under a captain, divided the battery into three two-gun sections with each under a lieutenant, and formed eight-man gun crews. Seventeen years after the Reorganization Act of 1821, the War Department finally organized field batteries and equipped them, but conservatism prevented taking the next step of making them independent of the existing artillery regiments. Even so, establishing field artillery batteries represented a significant step because it came during peacetime.[39]

Forming light and mounted artillery companies simultaneously compelled the War Department to train soldiers because almost all artillerists had served as infantry or had manned coast artillery weapons since 1815. In General Order No. 28, dated 20 May 1839, Poinsett decreed that portions of the dragoons, artillery, and infantry would be withdrawn from their regiments and sent to Camp Washington, Trenton, New Jersey, for instruction in the duties of their arm. The general order explained, "The occasional concentration of companies of the same regiment, and the bringing together of troops of different arms of the army" was needed to train them in their respective branches and to teach them how to work as a team on the battlefield.[40] Influenced by the deleterious effects of the Indian wars, the dispersion of the Army into small units on the frontier and coasts, and the lack of funding since 1821, Poinsett conceived a training program in 1839 to allow as many companies from a regiment as possible to train together.[41] Poinsett's camp of instruction, even though it lasted only one year, signalled a revival in training and demonstrated that the Secretary of War understood that the revolution in American field artillery weapons and equipment would be less significant if officers, noncommissioned officers, and enlisted personnel could not properly operate the equipment.[42]

With full support of Poinsett, the War Department pressed to make the field artillery more efficient. In General Order No. 21 of 1842, the Adjutant General's Office initiated target practice and ordered commanders to report their efforts to regimental headquarters. In the meantime, the War Department implemented a plan first developed by Calhoun in 1821, in which field artillery companies would serve as schools for subalterns. Using Anderson's manual, the four field batteries trained lieutenants, who had been temporarily detailed to them, and enlisted personnel in the school of the piece to fire their piece, in the school of the driver to drive the carriage, limber, and caisson, and in the school of the battery to maneuver a battery as a unit. The War Department soon learned that detailing lieutenants to the field artillery took them away from their own units and did not strengthen the field artillery. To minimize disruption and provide continuity in 1844 the Adjutant

39. Birkhimer, *Historical Sketch*, pp. 54, 57, 58, 305; Ltr, Bomford to Talcott, 16 Nov 1838, Ltrs Sent by Chief of Ordnance; Anderson, *Instruction for Field Artillery, Horse and Foot* (Philadelphia: Robert P. Desilver, 1839), pp. ii, 117, 118.

40. General Order No. 28, 20 May 1839, in Birkhimer, *Historical Sketch*, pp. 58-59.

41. Birkhimer, *Historical Sketch*, pp. 54, 58-59.

42. Birkhimer, *Historical Sketch*, p. 124; Haskin, "The Organization and Materiel of Field Artillery in the United States Army before the Civil War," p. 71.

General began permanently assigning first lieutenants to a field battery and rotating second and brevet lieutenants annually for training to give the Army a pool of trained officers to draw upon.[43]

Anderson's drill manual also modified gun crew operations. Because of the practice of using the prolonge to join the carriage and limber and using the limber horses to pull the cannon on the field, Anderson reduced the gun crew from fourteen men to eight in 1839. Eight-man crews consisted of a gunner, who was frequently a noncommissioned officer, and seven cannoneers. The gunner aimed the piece and gave the command to fire. Number one cannoneer handled the sponge and rammer, while number two loaded. Number three still thumbed the vent and used the priming wire or vent prick to break open the cartridge. Number four inserted the primer and pulled the lanyard to fire the piece. Number five carried the ammunition from number six to number seven at the limber chest to number two. If a crew was well-trained, it could function smoothly and fire two aimed shots a minute by using fixed ammunition.[44]

The emergence of training programs in the 1840s that produced skilled artillery officers, noncommissioned officers, and enlisted personnel for service in light, mounted, and foot batteries illustrated the growing professionalism of the Army and, in particular, the field artillery. Since the early 1820s, various officers, such as Major Dennis Hart Mahan and Lieutenant (later Major General) Henry W. Halleck, had pushed theoretical and practical training. Encouraged by these men and the need for competent soldiers, the War Department formed the Artillery School of Practice in 1824 and established the Infantry School of Practice at Jefferson Barracks, Missouri, in 1827. At the same time, professional journals, *Military and Naval Magazine* (1833-1836), *Army and Navy Chronicle* (1835-1844), and *Military Magazine* (1839-1842), appeared and reinforced the quest for professionalism.[45]

Poinsett and his successors dramatically transformed the field artillery after 1838. After almost thirty years of debate, a bronze field artillery system began replacing the motley collection of obsolete cast-iron field cannons, while artillerymen were being drilled to serve field pieces and maneuver properly equipped batteries on the battlefield. Yet, field artillerymen remained untested against an army with similar weapons.

The Mexican War

During the Mexican War of 1846-48, American field artillery proved itself. This war marked the first time that the Army fought a weaker army. On paper, the Mexican army appeared to be strong. It numbered about 35,000 men, which was nearly five times the size of the US Army, had twelve infantry regiments, three light infantry regiments, ten cavalry regiments, and was supported by militia and irregular light cavalry units. However, the Mexican army did not represent the formidable foe that its size suggested. It was top heavy with too many generals in relation to the

43. Birkhimer, *Historical Sketch*, pp. 116, 132-33, 316-17; Haskin, "The Organization and Materiel of Field Artillery in the United States Army before the Civil War," p. 72; War Department, *A System of Exercise and Instruction: Field Artillery Including Maneuvers for Light and Horse Artillery*, 1829, p. 26.

44. Birkhimer, *Historical Sketch*, pp. 316-20; Peterson, *Round Shot and Rammers*, p. 80; Anderson, *Instruction for Field Artillery, Horse and Foot*, pp. 1-36.

45. Weigley, *History of the United States Army*, pp. 150-53.

enlisted ranks and had many incompetent senior officers, who had risen through the ranks by bribery or intrigue. In comparison, early in 1846 before the war began the US Army had eight infantry regiments, two dragoon regiments, four artillery regiments, four mounted artillery batteries, and one light artillery battery.[46]

Field artillery gave the US Army a decided advantage over the Mexican army. Although Anderson's drill regulations stipulated that a battery should have six pieces, the reduction in the number of men limited the number of cannons in a battery. Usually, a battery consisted of two or more 6-pounders and one to two 12-pounder howitzers that were pulled by four to six horses and fired canister, shot, shell, or case, which was called shrapnel by the 1840s, as their standard ammunition. Even though 6-pounders and 12-pounder howitzers were the preferred armament for a battery, gun crews had 12-pounders, 12-, 24-, and 32-pounder howitzers, and 12-pounder mountain howitzers available for field duty if required. Endless drills, exercises, and target practice since 1838 had produced skilled gun crews. In comparison, Mexican field artillery had fourteen batteries of varying strength, lacked trained officers and men, and had old guns mounted on huge, immobile stock-trail carriages.[47]

Despite the appearance of new field pieces and equipment and training, the full integration of the field artillery with the other combat arms had not yet occurred. During the pre-war years, field artillery training had focused on maneuvering and firing since they were the keys to success and the field artillery's reason for being.[48] Centering training on maneuvering and firing also revealed the state of the art in the 1840s. Field artillerymen had to master the ability to maneuver their pieces before they could move onto the theory of employing their weapons with the other combat arms. For example, Anderson's artillery manual supplied the rationale for concentrating on drilling and exercising. As Anderson explained in his introduction, through the 1830s field artillery drills and exercises in the Army had varied from commander to commander. To standardize training the War Department directed field artillery officers to develop a common system of drill and exercise so that everyone would be doing the same thing to reduce confusion and enhance efficiency at the same time.[49]

As a result, officers spent their time on systematizing exercises and apparently gave little thought to developing tactics to coordinate the field artillery with the other combat arms. For the most part, writings on field artillery did not advise gunners when or where they should use their pieces or how their arm could best cooperate with the infantry or cavalry. Such writings outlined

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46. Birkhimer, *Historical Sketch*, pp. 59-62; Lester P. Dillon, Jr., *American Artillery in the Mexican War, 1846-1848* (Austin, Tx: Presidial Press, 1975), pp. 19-20; K. Jack Bauer, "The Battles on the Rio Grande: Palo Alto and Resaca de la Palma, 8-9 May 1846," in Charles E. Heller and William A. Stofft, eds., *America's First Battles: 1776-1965* (Lawrence, Ks: University Press of Kansas, 1987), p. 53; Weigley, *History of the United States Army*, p. 182; G.W. Van Deusen, "Our Artillery in the Mexican War," *Journal of the Military Service Institution*, Jul-Aug 1895, p. 90.

47. Dillon, *American Artillery in the Mexican War*, p. ii; Bauer, "The Battles on the Rio Grande: Palo Alto and Resaca de la Palama, 8-9 May 1846," p. 63; Weigley, *History of the United States Army*, p. 182; Van Deusen, "Our Artillery in the Mexican War," p. 90; Birkhimer, *Historical Sketch*, pp. 363-65.

48. Perry D. Jamieson, "The Development of Civil War Tactics," unpublished doctoral dissertation, Wayne State University, 1979, p. 18; Board of Artillery Officers, *Instruction for Field Artillery* (Baltimore: Joseph Robinson, 1845), Forward.

49. Anderson, *Instruction for Field Artillery, Horse and Foot*, Introduction.

that the brigade or division commander directed the actions of the field artillery in combat and not the battery commander since the Army attached a battery to a brigade or division for operational purposes.[50]

Convinced that the Rio Grande River and not the Nueces River was the correct boundary between the United States and Mexico, President James K. Polk dispatched Major General Zachary Taylor with 1,500 troops and three batteries of field artillery into the disputed area between the two rivers. By the summer of 1845, General Taylor had his small army encamped at Corpus Christi on the Nueces River. After being ordered by Polk, Taylor moved to the Rio Grande in March 1846 where he established Fort Brown across the river from Matamoros, Mexico. As tension between the United States and Mexico increased, Mexican troops crossed the river on 25 April 1846 and skirmished with American soldiers.[51]

Even before Congress officially declared war, Taylor fought two battles with the Mexicans. Immediately after informing Polk about the skirmish of 25 April, Taylor learned that Mexican forces were operating north of the Rio Grande and threatening his communication line with Point Isabel, Texas, on the Gulf of Mexico. Fearful about being cut off from the Gulf, Taylor left Fort Brown early in May for Point Isabel with all but five hundred men, who were left behind to garrison Fort Brown.[52] After securing Point Isabel, Taylor started back. On the eighth he found a Mexican army under General Mariano Arista, blocking his path, near Palo Alto, Texas, on a treeless plain. Outnumbering the Americans by almost three to one, the Mexicans confidently deployed to fight. To counter the bold Mexican move Taylor positioned his army with Ringgold's battery of four 6-pounders, Duncan's battery of four 6-pounders, and Lieutenant William Churchill's battery of two 18-pounders on line with the infantry.[53] Duncan's and Ringgold's batteries quickly advanced ahead of Taylor's infantry and opened fire with canister. Accurate fire from these two field batteries along with Churchill's guns forced Arista to abandon his infantry attack and attempt to flank the American right with cavalry. As the Mexican cavalry advanced, Lieutenant Randolph Ridgely's section from Ringgold's battery rained canister fire on the enemy horsemen and stopped the attack.[54] The Mexicans planned a second attack on the American left with cavalry and infantry, but canister fire from Duncan's guns prevented the Mexicans from even starting that advance. In the meantime, a wad from one of Duncan's field pieces set the prairie ablaze. Although smoke from the flames concealed the combatants from each other, it did not stop the battle. As the smoke lifted, an artillery duel opened. Ringgold's battery and Churchill's

50. Grady McWhiney and Perry D. Jamieson, *Attack and Die: Civil War Military Tactics and the Southern Heritage* (University, Al: The University of Alabama Press, 1982), p. 37; Birkhimer, *Historical Sketch*, p. 212.

51. K. Jack Bauer, *The Mexican War: 1846-48* (New York: Macmillan Publishing Company, 1974), pp. ii-15, 1629, 46-48.

52. Ltr, E. Kirby Smith to Wife, 13 May 1846, in Emma Jerome Blackwood, ed., *To Mexico with Scott: Letters of Captain E. Kirby Smith to His Wife* (Cambridge, Ma: Harvard University Press, 1917), p. 47; U.S. Grant, *Memoirs*, Vol. I, (New York: The Century Company, 1909, second edition), p. 68; Cpt. W.S. Henry, *Campaign Sketches of the War with Mexico* (New York: Harper and Brothers, 1847), p. 91; James Duncan, "The Artillery in the Mexican War," *Journal of the United States Artillery*, 1908, p. 314.

53. Henry, *Campaign Sketches of the War with Mexico*, pp. 91-92; Ltr, Duncan to Adjutant General. 19 Jun 1846, in Benet, *A Collection of Annual Reports*, II, pp. 102-03.

54. Duncan, "The Artillery in the Mexican War," p. 314; Henry, *Campaign Sketches of the War with Mexico*, p. 93.

18-pounders on the American right fired fast and effective and compelled the Mexicans to retire. Because of the destruction caused by Ringgold's and Churchill's artillery, the Mexicans concentrated counterbattery fire on them, drove back Ringgold's unit, and mortally wounded Ringgold.[55] Meanwhile, Duncan pushed his cannons out ahead of the infantry on the American left. As one section of Duncan's battery employed canister to force the enemy infantry to retreat, the other section shredded enemy cavalry with canister.[56] The Mexicans attacked again. Even before the charge gained momentum, Duncan's cannons opened fire with canister and dispersed the Mexican right. Together with effective small arms fire, the field artillery decisively defeated the Mexicans.[57]

A day after the Battle of Palo Alto, Taylor bumped into Arista's force once more. This time, the Mexican general blocked the road at Resaca de la Palma, a thick chaparral wood. To break through the Mexican line Taylor deployed his infantry and positioned his artillery.[58] Ordered by Taylor, Ridgely, who had succeeded Ringgold, pushed his 6-pounders forward and poured a rain of canister on the Mexicans. Under the cover of artillery fire, the American infantry pressed ahead. Even though the heavy chaparral broke down unit cohesiveness, American infantry pushed the Mexicans so far into the chaparral that American field artillery could not participate except for the opening salvos fired by Ridgely's unit. Unable to withstand the pressure exerted by American infantry, Arista and his army fled back across the Rio Grande into Mexico.[59]

The Battles of Palo Alto and Resaca de la Palma represented a significant turning point for the Army's field artillery. Since the Battle of Chippewa and Battle of Lundy's Lane in 1814, artillerymen had not had the opportunity to maneuver their pieces on the battlefield because the Army had only fought Indians or manned coastal fortifications. At last, in the opening battles of the Mexican War, cannoneers had the opportunity to use their field pieces to support the infantry in aggressive operations. American field artillerymen rapidly moved their cannons around the battlefield, stopped Mexican attacks, and demonstrated the ability of their guns to multiply an army's firepower. At Palo Alto where the terrain was relatively flat and open, Duncan's and Ringgold's trained gun crews readily countered every enemy move with accurate fire and drove the numerically superior Mexican army from the field. Duncan and Ringgold convinced skeptical infantrymen, such as General Taylor, of their ability to maneuver their 6-pounders with the infantry and prompted the General to explain that "Our artillery, consisting of two 18-pounders and two light batteries, was the arm chiefly engaged, and to the excellent manner in which it was manoeuvered and served is our success mainly due."[60]

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55. Ltr, Smith to Wife, 13 May 1846, p. 49.

56. Henry, *Campaign Sketches of the War with Mexico*, p. 93.

57. Duncan, "The Artillery in the Mexican War," p. 314.

58. Duncan, "The Artillery in the Mexican War," p. 314; Ltr, Philip N. Barbour to Wife, 9 May 1846, in Roda Van Bibber Tanner Doubleday, ed., *The Journals of Major Philip Norbourne Barbour and His Wife, Martha Isabella Hopkins Barbour* (New York: The Macmillan Company, 1919), pp. 57-60, hereafter cited as *The Journals of Major Philip Norbourne Barbour*; Dispatch, Taylor, 9 May 1846, in Edward D. Mansfield, *The Mexican War* (New York: A.S. Barnes and Company, 1848), p. 40.

59. Duncan, "The Artillery in the Mexican War," p. 314.

60. Duncan, "The Artillery in the Mexican War," p. 314; Ltr, Taylor to Secretary of War, 9 May 1846, in Mansfield, *The Mexican War*, p. 39.

Nevertheless, the Battles of Palo Alto and Resaca de la Palma also revealed the field artillery's limitations. As long as the terrain was relatively flat and open, gun crews could move their pieces with the infantry and cavalry and form an elastic and resilient defense or highly mobile offense. When the terrain consisted of heavy woods, such as at Resaca de la Palma, the field artillery could not function as intended. Although the field artillery had made significant strides towards blending firepower and mobility, terrain still influenced its effectiveness.

With the Battles of Palo Alto and Resaca de la Palma behind him and under orders from Polk to occupy Mexico, Taylor set out for Monterrey. After collecting his forces during the summer of 1846, late in August Taylor moved his army of over six thousand, half of them regulars and half volunteers. For artillery support Taylor had Duncan's, Ridgely's, and Captain Braxton Bragg's field batteries, Captain William W. Mackall's battery, Captain Lucien B. Webster's heavy battery of one 10-inch mortar and two 24-pounder howitzers. Equally important, Taylor attached each of his field batteries to an infantry brigade for close support.[61]

After reconnoitering Monterrey, which was heavily fortified with six thousand men and forty-two artillery pieces, Taylor attacked. He directed Brigadier General William J. Worth's division with support from Duncan's and Mackall's batteries to cut the city's communication lines with Saltillo, while the main body of the American army would make a diversionary attack on the east side of the city.[62] Upon reaching the road connecting Saltillo and Monterrey, Worth bumped into Mexican lancers and infantry. Mexican lancers charged Worth's skirmishers but were repelled by canister fire from Duncan's 6-pounders and MacKall's 12-pounder howitzers.[63] After defeating the lancers, Worth severed Monterrey's communications with Saltillo.[64]

In the meantime, Taylor's forces north and east of Monterrey pressed their attack. Under the protective fire of Webster's battery, elements of Brigadier General David E. Twigg's division with support from Bragg's and Ridgely's batteries attacked. Artillery barrages from about thirty cannons of varying size and caliber and musket fire from the Black Fort, a fortification on the northeast side of the city, hit Twigg's men. Although the Americans drove on, they lost all cohesiveness in the maze of streets in Monterrey. Bragg rushed a section of 6-pounders forward, but the Americans still could not make any progress. Mexican infantry perched in and atop houses and Mexican artillery commanding the streets compelled the Americans to withdraw.[65] Taylor then

61. Bauer, "The Battles on the Rio Grande: Palo Alto and Resaca de la Palma, 8-9 May 1846," pp. 89-90; Ltr, Taylor to Adjutant General, 3 Sep 1846, in House Report, Executive Document No. 60, 29 Apr 1848, p. 417; Vardell E. Smith, Jr., "The Quiet Paradigm Changes: The Evolution of the Field Artillery Doctrine of the United States Army, 1861-1905," unpublished doctoral dissertation, Ohio State University, 1977, pp. 22-23; Dillon, *American Artillery in the Mexican War*, p. 26; Birkhimer, *Historical Sketch*, p. 79.

62. Bauer, "The Battles on the Rio Grande: Palo Alto and Resaca de la Palma, 8-9 May 1846," p. 93; Ltr, Edmund Bradford to Caroline Bradford, 27 Sep 1846, in George W. Smith and Charles Judah, ed., *Chronicles of the Gringos* (Albuquerque, NM: University of New Mexico Press, 1958), p. 86; Ltr, Meade to Wife, 27 Sep 1846, *in US Infantry School, Battle of Monterrey* (Fort Benning, Ge: Infantry School Press, 1921), p. 31; David Lavender, *Climax at Buena Vista* (Philadelphia: J.B. Lippincott Company, 1974), p. 107.

63. Ltr, Meade to Wife, 27 Sep 1846; Henry, *Campaign Sketches of the War with Mexico*, p. 201.

64. Dillon, *American Artillery in the Mexican War*, p. 27; Ltr, Bradford to Bradford, 27 Sep 1846, p. 87.

65. Bauer, *The Mexican War*, p. 95; Ltr, Meade to Wife, 27 Sep 1846, p. 33; Henry, *Campaign Sketches of the War with Mexico*, pp. 194-95.

directed Brigadier General John Quitman's brigade from Major General Orlando Butler's division to renew the attack. Quitman avoided fire from the Black Fort and directly assaulted the batteries on the east side of the city. Aided by Ridgely's 6-pounders, which were too light to do any damage to the heavier Mexican pieces, Quitman captured the Mexican batteries, turned their guns on the fleeing Mexicans, and continued the attack.[66]

Chasing the retreating Mexican army as it fled to the center of Monterrey, Worth's assault from the west and Quitman's from the east literally took them from house to house. Mexican sharpshooters behind barricades and on rooftops slowed down the American push through the streets. Despite intense resistance, the uncoordinated American advances forced the Mexicans to surrender.[67]

Because Taylor lacked enough siege artillery, the Americans futilely hit Mexican defenses with shot from their 6-pounders and 12-pounder howitzers. Although American field batteries were potent on the open battlefield, they were too light to serve well in siege work. Six-pounders and 12-pounder howitzers simply did not have the power to break down stone and masonry fortifications and, therefore, played a minor role in defeating the Mexicans at Monterrey.[68]

Even though Taylor lost some of his army to Major General Winfield Scott, who was preparing to assault Vera Cruz and march on to Mexico City, and had received orders from Scott to stay on the defensive in Monterrey, Taylor continued conquering northeast Mexico. Leaving garrisons at Monterrey and Saltillo, he marched five thousand troops with artillery support from Bragg's battery, which was now commanded by Captain Thomas W. Sherman, Captain John M. Washington's oversized battery of two 12-pounder howitzers, four 6-pounders, and two captured Mexican 4-pounders, Ridgely's battery, which was now commanded by Bragg, and Webster's heavy battery to a hacienda called Augua Nueva about eighteen miles south of Saltillo. Warned about a large enemy army approaching on 21 February 1847, Taylor fell back to Buena Vista, a few miles south of Saltillo. Here, Taylor's army could defend itself better against a numerically superior force as the road connecting Augua Nueva and Saltillo ran through natural defenses composed of a network of ridges, ravines, and gullies that could nullify the Mexican advantage.[69]

Upon seeing the Mexican army, Brigadier General John E. Wool, who had been directed by Taylor to select the field of battle, deployed American troops along the road with Bragg's and Sherman's field batteries held in reserve.[70] Just beyond field artillery range, Santa Anna halted his army, fanned it out on both sides of the road, sited his ponderous 18- and 24-pounders to enfilade the American positions, and feigned an attack on the American right. Observing these movements, Taylor, who had just arrived, ordered some infantry and Bragg's battery to move ahead of

66. Bauer, *The Mexican War*, p. 96; Dillon, *American Artillery in the Mexican War*, p. 29.

67. Bauer, *The Mexican War*, p. 99; Ltr, Meade to Wife, 27 Sep 1846, p. 121.

68. Van Deusen, "Our Artillery in the Mexican War," p. 92; Henry, *Campaign Sketches of the War with Mexico*, pp. 195, 200, 207, 208.

69. T. Harry Williams, *The History of American Wars* (New York: Alfred A. Knopf, 1981), p. 177.

70. Ltr, Wool to Assistant Adjutant General, 4 Mar 1847, in Smith and Judah, *Chronicles of the Gringos*, p. 100; R.S. Ripley, *The War with Mexico* (New York: Harper and Brothers Publishers, 1849), p. 392.

Washington's battery that had been deployed earlier to command the road on the American right. In the meantime, Santa Anna pushed his light infantry to the American left. This forced Taylor to shift some infantry and part of Washington's field artillery, a 12-pounder howitzer, a 6-pounder, and a captured Mexican 4-pounder, that was commanded by Lieutenant John Paul Jones O'Brien to the extreme left.[71] O'Brien fired shot and canister on the Mexican infantry. Together with infantry musket fire, O'Brien's artillery stopped the attack and ended the fighting for the day.[72]

During the night, Santa Anna reinforced his right and early in the morning of 23 February launched another assault. After bombarding the Americans, Santa Anna advanced three columns to hit the American left. O'Brien's three guns blasted the Mexican infantry with shrapnel, while two guns from Sherman's battery poured canister onto the charging Mexicans. Accurate field artillery fire and musketry tore gaps in the Mexican line but could not halt the advance. To stop the Mexicans O'Brien pushed his field pieces ahead of the infantry line and continued blasting the enemy with shrapnel and canister. Unsupported by infantry, O'Brien's guns fought with destructive canister fire at fifty yards, fell back, and left one 4-pounder in the hands of the steadily advancing enemy.[73] To stem the flanking movement that was overpowering American infantry and a section of Sherman's battery, Taylor strengthened his left with Bragg's battery and Sherman's other section and raked the Mexicans with canister fire.[74]

After the American cannoneers had stopped the charges on their left, Santa Anna mounted more assaults. He concentrated his forces and made a bold strike at the American center. As Santa Anna made his move, O'Brien advanced one 12-pounder howitzer and two 6-pounders and fired canister until his infantry support retreated. Once again, the Mexicans routed O'Brien's artillery. This time he lost two 6-pounders. Fortunately, Taylor rushed up Sherman's and Bragg's batteries and contained the Mexicans through well-directed canister fire. Santa Anna made one more charge, but field artillery fire from the American center caused him to leave the field defeated. The Battle of Buena Vista ended, and the numerically smaller American army had soundly beaten a much larger Mexican opponent.[75]

American field pieces had played a decisive role in the battle in February 1847. The mobility of the field artillery had allowed Taylor to counter Mexican thrusts with intense firepower that broke Mexican charges by tearing them apart. Describing the action, one American historian wrote in 1850, "Our batteries, however, finally turned the tide. Their fire was so firm, precise and awful, that the enemy could not resist, and fell back in disorder."[76] In Taylor's campaign the

71. Ltr, Wool to Assistant Adjutant General, 4 Mar 1847, p. 101.

72. Ltr, Wool to Assistant Adjutant General, 4 Mar 1847, p. 101;. Ripley, *The War with Mexico*, pp. 394-95.

73. Ltr, Wool to Assistant Adjutant General, 4 Mar 1847, pp. 101-02.

74. Ltr, Wool to Assistant Adjutant General, 4 Mar 1847, p. 103; A.R. Ginsburgh, "O'Brien's Bulldogs," *Field Artillery Journal*, May 1937, pp. 186-87; Henry, *Campaign Sketches of the War with Mexico*, p. 316.

75. Ltr, Wool to Assistant Adjutant General, 4 Mar 1847, p. 104; Henry, *Campaign Sketches of the War with Mexico*, pp. 320-22; Ltr, Wool to Assistant Adjutant General, 4 Mar 1847, p. 104; Samuel Chamberlain, *My Confession* (New York: Harper and Brothers, 1956), pp. 121-25, 127-28.

76. *A Complete History of the Late Mexican War* (New York: F.J. Dow and Company, 1850, reprinted by Rio Grande Press, Chicago, 1965), p. 61.

aspirations of artillery officers since the early nineteenth century had become a reality. During the battles, trained gun crews raced their pieces around the battlefield, advanced in front of the infantry line in the tradition of Napoleon, and provided solid support for the infantry. During the engagements in Northern Mexico in 1846-47, field artillery vindicated its supporters and helped Taylor to win decisively at Palo Alto and Buena Vista.

The successes of the field artillery in 1846-1847 prompted Congress to authorize the President to create four additional field artillery batteries. Under the direction of the President, in July 1847 the War Department designated Captain John Magruder's, Captain John F. Rowland's, Captain Thomas W. Sherman's, and Captain Simon H. Drum's batteries as field artillery batteries. This gave the artillery eight batteries that could be equipped legally as field artillery and also recognized Sherman's, Magruder's, and Drum's batteries, which were already serving as field batteries, as official field batteries. Yet, Rowland's, which did not exist in July 1847, was not organized in time to serve in the field during the war with Mexico.[77]

In the meantime, General Scott marched from Vera Cruz on the Gulf of Mexico to Mexico City. In March 1847 he landed an army of twelve thousand at Vera Cruz. Once the invading Americans had established their camp out of range of the city's batteries, American engineers built five batteries of 68-, 32-, and 24-pounders, 8-inch howitzers, 10-inch mortars, and rockets designed by William Hale, an American inventor, on the hills surrounding the city. These rockets had stabilizing sticks and curved vanes to rotate them to increase their accuracy. They were manned by ordnance officers because the War Department did not think that artillerymen were qualified to fire rockets and because ordnance officers had the benefit of experimental firings. Finally, after minor skirmishes with Mexican soldiers trying to break through the American lines, Scott started bombarding the city with shot, shell, and rockets.[78]

After Vera Cruz capitulated, Scott launched his invasion with Major General William J. Worth, Brigadier General Daniel E. Twiggs, and Major General Robert Patterson as his division commanders and with his artillery attached to the division. Unlike Taylor's campaign of 1846-47, Scott's expedition did not offer any opportunities to deploy field artillery on the battlefield against a conventional force. Using 6-pounders and 12-pounder howitzers as siege weapons, Scott's army assaulted fortified positions armed with heavy artillery. Although gun crews performed their duties with precision, their field pieces did not have the power to destroy even temporary fortifications and fared poorly against heavier garrison pieces. Yet, the field artillery provided valuable covering fire for infantry columns on the attack.[79]

Scott first encountered the Mexicans at Cerro Gordo. Hoping to keep Scott out of Mexico

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77. Birkhimer, *Historical Sketch*, p. 63; Haskin, "The Organization and Materiel of Field Artillery in the United States Army before the Civil War," p. 416.

78. Ltr, Scott to Secretary of War, 25 Mar 1847, in Nathan C. Brooks, *A Complete History of the Mexican War* (Philadelphia: Grigg, Elliot and Company, 1849, reprinted by Rio Grande Press, Chicago, 1965), p. 305; Dillon, *American Artillery in the Mexican War*, pp. 36-37; Ltr, Maj G.H. Talcott to LTC Talcott, 26 Oct 1847, in Benet, *A Collection of Annual Reports*, II, pp. 212-13; Circular Ltr, undated, in Benet, *A Collection of Annual Reports*, II, p. 419; Ltr, G. Talcott to Gen J.A. Dix, US Senate, 18 Jan 1847, in Benet, *A Collection of Annual Reports*, II, p. 156.

79. Birkhimer, *Historical Sketch*, p. 77.

City, Santa Anna positioned batteries of artillery along the road that the Americans had to travel and constructed a battery of four 4-pounders on the summit of Cerro Gordo. Although Santa Anna occupied a strong defensive position, a reconnaissance by Scott's engineers uncovered a narrow path that branched off the right side of the road that could be used to outflank the Mexicans. After Captain Robert E. Lee of the Engineers had widened the path and after a brief skirmish with some Mexicans, the Americans dragged three 24-pounders and Congreve and Hale rockets up the path and placed them on a summit overlooking the Mexican positions.[80] Early in the morning of 18 April, the Americans bombarded the Mexicans. Following the barrage, the Americans assaulted Cerro Gordo, seized the Mexicans' artillery, and then shifted the captured pieces to fire on the fleeing defenders as elements of Twiggs' division assaulted the Mexicans. Americans turned the victory into an overwhelming rout by pursuing the Mexicans with a column of infantry and Captain Francis Taylor's field battery and a 12-pounder from Captain Edward Steptoe's battery.[81]

Upon seizing Jalapa and Pueblo without a fight, Scott continued his invasion of Mexico. On 18 August Scott probed the road leading to Contreras with the intention of bypassing the entrenched positions at San Antonio. He discovered a fortified work at Contreras armed with twenty-two heavy cannons. After cutting through the lava beds in front of Contreras, Major General Gideon Pillow, who had replaced Patterson, pushed the Mexican advance corps back to the safety of its fortifications. With support from two 12-pounders from Magruder's battery, two mountain howitzers from Lieutenant Franklin D. Callender's battery, and rockets from Lieutenant Jesse L. Reno's howitzer and rocket company, the Americans charged the Mexican works. Artillerymen pushed their field pieces forward and helped drive Mexican pickets back to their defenses. Soon, the Americans occupied ground about four hundred yards from Mexican entrenchments. Even though American field artillery provided covering fire for the infantry as it assaulted, counterbattery fire from heavier Mexican pieces forced gun crews to withdraw with their pieces. Meanwhile, another American column stopped a charge by Mexican cavalry as it sallied out from its camp to the rear of the entrenchments.[82]

Rather than pursuing an assault against the strongly armed fortification after breaking up the Mexican cavalry attack, the Americans decided to charge the following day. Early on 19 August, American infantry and artillerymen, serving as infantry, hit Contreras. As the attack began, the Mexicans threw out skirmishers to disrupt the Americans and fired a barrage of canister from their heavy artillery. Since the Mexican artillery cannonade and musket fire was inaccurate, the Americans stormed the fortifications with few casualties and compelled the defenders to abandon their artillery and retreat back to Mexico City.[83]

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80. Raphael Semmes, *The Campaign of General Scott in the Valley of Mexico* (Cincinnati: Moore and Anderson Publishers, 1852), pp. 68-70; Ltr, Hitchcock to Scott, 23 Apr 1847, in Smith and Judah, *Chronicles of the Gringos*, p. 214.

81. Report, Robert E. Lee to Major J.L. Smith, Chief of Engineers, US Army, 12 Aug 1847, in Smith and Judah, *Chronicles of the Gringos*, pp. 236-37.

82. Brooks, *A Complete History of the Mexican War*, pp. 367-68; Entry, Daniel H. Hill Diary, 18-23 Aug 1847, in Smith and Judah, *Chronicles of the Gringos*, p. 240; Semmes, *The Campaign of General Scott in the Valley of Mexico*, pp. 268-70.

83. Daniel H. Hill Diary, 18-23 Aug 1847, pp. 241-42; Semmes, *The Campaign of General Scott in the Valley of Mexico*, pp. 274-79.

Farther to the east, the rest of Scott's command marched towards Churubusco, a strongly fortified convent. Upon reaching Churubusco, the Americans assaulted. General Worth formed his division on an open field and ordered Duncan's 6-pounders forward. As cannon and musket balls whistled overhead, the Americans pressed forward. Since dikes that cut through the field prevented Duncan from maneuvering his battery, Worth ordered him to fall back and keep his guns in reserve. On the American left Twiggs pushed Taylor's 6-pounders forward and imprudently placed them in exposed positions where they were disabled by fire from Mexican 8-pounders. Without field artillery for support, Worth and Twiggs assaulted the convent.[84] Once the enemy's guns had been captured, Worth rushed Duncan's 6-pounders up to within four hundred yards of the buildings. From here, Duncan rained shot and shell on the defenders. Lieutenant Raphael Semmes of Scott's army recorded that there appeared to be no more than three seconds between the shots coming from Duncan's four pieces. Because of the fine training, Duncan's action was "speedy and decisive."[85]

Following the conquests of Contreras and Churubusco, Scott directed his attention to a complex of large stone buildings called El Molino del Rey to the west of Chapultepec.[86] Early on 8 September, Scott launched his attack as Captain Benjamin Huger's 24-pounders opened fire with shot to batter down the walls of El Molino del Rey.[87] After a severe beating American infantry took the enemy's field battery located in front of El Molino del Rey and trained it on the retreating Mexicans, who tried to regain the battery but failed. Concurrently, after displacing forward, Drum's battery of 6-pounders and one of Huger's 24-pounders drove the Mexicans from El Molino del Rey. Using captured Mexican cannons and his own, Huger then blasted the Mexicans with canister as they fled. While this was occurring on the enemy's left and center, Duncan bombarded the Mexican right, which rested on the Casa Mata, a huge stone building just west El Molino del Rey, with shot, while the infantry assaulted it.[88] The Mexicans countered with a cavalry charge. Reacting swiftly, Duncan checked the cavalry with canister and allowed the infantry to advance. After stopping the cavalry Duncan fired shot on Casa Mata and compelled the defenders to flee back past El Molino del Rey to Chapultepec.[89]

After capturing El Molino del Rey, Scott turned his attention to Chapultepec, a strongly fortified castle that protected the western entrances into Mexico City. Following a reconnaissance, Scott's engineers erected siege batteries to support the American attacks that were scheduled to hit Chapultepec from the west and south. The engineers positioned a battery of two 16-pounders and one 8-inch howitzer to batter the south side of the castle, placed a second battery of one 8-inch howitzer and two 24-pounder howitzers on the ridge south of El Molino del Rey to hit the southeast part of the castle, set the third battery of a Mexican 16-pounder and 8-inch howitzer

84. Semmes, *The Campaign of General Scott in the Valley of Mexico*, p. 290; Scott, *Memoirs*, pp. 486, 490.

85. Semmes, *The Campaign of General Scott in the Valley of Mexico*, p. 289.

86. Williams, *The History of American Wars*, p. 184; Bauer, *The Mexican War*, p. 308.

87. Semmes, *The Campaign of General Scott in the Valley of Mexico*, p. 325.

88. Hazard Stevens, *The Life of Isaac Ingall Stevens* (Houghton, Mifflin, and Company, 1900), pp. 204-07; Beauregard Diary, 8 Sep 1847, in Smith and Judah, *Chronicles of the Gringos*, pp. 254-55.

89. Beauregard Diary, 8 Sep 1847, p. 257.

three hundred yards north and east of the second battery, and constructed the fourth battery of a single 10-inch mortar opposite the southwest side of the castle.[90]

After a barrage of shot and shell that lasted from early morning until dark on 12 September, the following morning American heavy artillery, 6-pounders, and 12-pounder mountain howitzers furnished covering fire of canister and shell for infantry assaults. In the west Magruder's battery blasted the Mexicans until the infantry masked his fire. To continue supporting the advance Reno's mountain howitzers lobbed shells over the infantry's heads. After encountering difficult fighting, the infantry finally reached Chapultepec.[91] In the meantime, on the south side of the castle more American infantry advanced. Supported by 16-pounders and Drum's 6-pounders, the infantry ascended the hill leading to Chapultepec under heavy fire. Along with the advance from the west, the attack from the south sent the Mexicans scurrying for safety to Mexico City.[92]

After capturing Chapultepec the Americans chased the fleeing Mexicans to Mexico City with elements of Scott's army and Magruder's and Reno's batteries. George Ballantine, an Englishman in Scott's army, recorded, "As we went at a fast gallop we had soon left the infantry far behind, and found ourselves entirely unsupported."[93] As his statement indicated, field artillery had the ability to outdistance the infantry and keep up with a fleeing enemy. This meant that the field artillery could be invaluable in breakthroughs and pursuits. Ballantine further explained that the field artillery ran into an advancing cavalry column moving out of the city to counter the American attack. "We immediately unlimbered and began to fire shell and round shot among them with the upmost rapidity, when they made a precipitate retreat," he said.[94] Although the field artillery fired rapidly and accurately, Mexican cavalry could have defeated the artillery by charging. Lacking infantry or even cavalry support, American field artillery displayed its vulnerability and dependence on the other combat arms for protection.

The Mexican War offered the first real opportunity for field artillery and infantry to work together. At Palo Alto and Buena Vista gun crews aggressively maneuvered their pieces to support the infantry and shelled the enemy with impunity because the guns could be positioned safely beyond the range of smoothbore.

Although the War Department had settled on six calibers for its field artillery system in the 1840s, it did not have an organization during the Mexican War that effectively harnessed those calibers into a team. Six-pounders and 12-pounder howitzers, which were the heart and soul of the field artillery, were grouped into batteries, but the 12-pounder and 24- and 32-pounder howitzers were not. The War Department might have had a balanced field artillery system with mobility and firepower, but organization emphasized mobility at the expense of firepower.

Years of Peace : 1848-1861

Following the Mexican War, the War Department incorporated the lessons of the war and

90. Dillon, *American Artillery in the Mexican War*, pp. 49-51.

91. Semmes, *The Campaign of General Scott in the Valley of Mexico*, pp. 341-42.

92. George Ballantine, *Autobiography of an English Soldier in the United States Army* (New York: Stringer and Townsend, 1853), pp. 262-63; Stevens, *The Life of Isaac Ingall Stevens*, pp. 210-12.

93. Ballantine, *Autobiography of an English Soldier in the United States Army*, p. 262.

94. *Ibid.*, p. 262.

modernized its field artillery. During the years between 1848 and 1861, the War Department reorganized its field batteries, adopted the 12-pounder Napoleon gun-howitzer, and experimented with rifled field pieces. Yet, peacetime duty also returned the Army to the frontier and dispersed the field artillery in small forts.

To provide a better balance between firepower and mobility, the War Department restructured its field artillery. It established 12-pounder batteries of four 12-pounders and two 24- or 32-pounder howitzers and 6-pounder batteries of four 6-pounders and two 12-pounder howitzers to support the infantry and cavalry and assigned 6- and 12-pounder batteries to the reserves.[95] The restructuring broadened the field artillery's mission more than it had been previously and made light and heavy field pieces more available.[96] Formally constituted heavy field batteries, which had not existed before, would allow the field artillery to batter down fortifications and counter garrison pieces so that the infantry could advance when attacking an entrenched enemy.[97] Light batteries and heavy batteries as needed would provide massed fire on the open battlefield.[98] The Mexican War had demonstrated to the War Department the error of focusing its attention on the open battlefield to the exclusion of destroying fortifications. Monterrey, Contreras, and Churubusco painfully illustrated the limitations of employing field artillery in multi-purpose roles and the necessity of having heavier pieces available when needed.[99] Equally important, the recent war with Mexico reinforced massing fire because such fire had helped Taylor defeat Santa Anna at Buena Vista.[100]

Yet, the creation of 6- and 12-pounder batteries did not satisfy some. Colonel Henry K. Craig, Chief of Ordnance (1851-1861), urged the War Department to reduce the number of field pieces from six calibers to a more manageable number, but he never specified how many calibers should be used. Craig soon found support from Major Alfred Mordecai. After returning from a fact-finding trip to Europe in 1855-56, Mordecai reported that the French were adopting the 12-pounder Napoleon gun-howitzer as its sole field piece to reduce the diversity of calibers and to combine the mobility of a light piece with the power of a heavier one. Like the Americans, the French had learned that field artillery had inherent liabilities and sought a piece that was mobile but still had sufficient power and range to destroy field fortifications and challenge garrison guns. Reaching the same conclusions, the Russians, Prussians, and Austrians followed the French example by introducing the Napoleon into their armies in the 1850s. Despite the growing popularity of the gun and recommendations that the War Department should adopt it, Mordecai remained skeptical although he supported limiting the field artillery to 6-pounders and 12-pounder howitzers. He thought that the Napoleon's weight would sacrifice strength and durability. As many

95. Board of Artillery Officers, *Instruction for Field Artillery*, 1860, pp. 2-3.

96. Ltr, Craig to Secretary of War, 20 Dec 1853, in Benet, *A Collection of Annual Reports*, II, p. 531; Board of Artillery Officers, *Instruction for Field Artillery*, 1860, p. 2.

97. Board of Artillery Officers, *Instruction for Field Artillery*, 1860, pp. 1-4, 7.

98. *Ibid.*, p. 2.

99. Henry, *Campaign Sketches of the War with Mexico*, pp. 195, 200, 207, 208; Van Deusen, "Our Artillery in the Mexican War," p. 92; Brooks, *A Complete History of the Late Mexican War*, pp. 367-68; Semmes, *The Campaign of General Scott in the Valley of Mexico*, pp. 268-70.

100. *A Complete History of the Late Mexican War*, p. 61.

American artillery officers noted, however, the Napoleon possessed significant advantages. It weighed almost five hundred pounds less than the seventeen-hundred pound 12-pounder being used but had the same range and power. Since the Napoleon was as mobile as the 6-pounder, had a range and power comparable to the 12-pounder, and had a trajectory between the gun's and howitzer's, the Napoleon seemed to be the ideal field piece.[101]

Tests of the Napoleon conducted by the Ordnance Department substantiated many artillery officers' claims and convinced Secretary of War Jefferson Davis (1853-1857) to announce in 1856 that the War Department planned to adopt the gun-howitzer for general field artillery employment to replace 6- and 12-pounders and 12-pounder howitzers. This meant that a battery accompanying the infantry and cavalry would have ease of movement as well as range and power. In 1857 the United States cast its first Napoleon but did not begin production in earnest in government arsenals and private factories until 1861 when the Civil War started. The addition of the Napoleon gave the War Department a bronze, smoothbore field artillery system of 6- and 12-pounders, 12-pounder mountain howitzers, 12-, 24-, and 32-pounder howitzers, and the Napoleon in 1857.[102]

European artillery inventions in the 1840s and 1850s, however, threatened to render the War Department's field artillery obsolete just as it was being introduced. Following the Napoleonic wars, many Europeans reached the conclusion that field artillery had become indispensable and started searching for ways to make cannons more accurate. Based upon Benjamin Robin's studies of the 1740s, gun manufacturers of the early nineteenth century knew that a spinning, elongated projectile fired from a rifled weapon was more accurate than a free falling spherical shot from a smoothbore field piece. However, foundries and machine shops that were just beginning to harness steam power early in the nineteenth century were not accustom to the precision work required to produce rifled cannons.[103]

Improved technology introduced by industrialization and the success of rifled small arms in the 1820s and 1830s encouraged European inventors to adapt rifling to artillery. Smoothbore artillery of the 1840s and 1850s had effective ranges of one thousand yards, while the Minie rifle being manufactured in France in the late-1840s could rival the smoothbore cannon's range. Equally important, the Prussian needle gun issued to the Prussian army in the 1840s was a breech-loading weapon, used cartridge ammunition, and could fire three times faster than muzzle-loading smoothbore field artillery. With the dramatic increase in range and rate of fire in small arms, muzzle-loading smoothbore field artillery suddenly became obsolete. It could no longer attack infantry formations at canister range of four hundred to five hundred yards without being hit by small arms fire and had to be replaced by cannons with greater ranges.[104]

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101. Peterson, *Round Shot and Rammers*, p. 96; Report, Major Alfred Mordecai, 25 May 1857, Reports of Experiments, Vol. II, RG 156, National Archives.

102. Annual Report, Secretary of War, 1856, in Benet, *A Collection of Annual Reports*, II, p. 594; Peterson, *Round Shot and Rammers*, p. 92; Report, Mordecai, Military Commission to Europe in 1855-56, pp. 141-45, in Morris Swett Library; Birkhimer, *Historical Sketch*, p. 286.

103. Comparato, *Age of Great Guns*, pp. 16-18.

104. Comparato, *Age of Great Guns*, pp. 15-17; McNeill, *The Pursuit of Power*, p. 236; Hew Strachan, *European Armies and the Conduct of War* (London: George Allen and Unwin, 1983), p. 117.

To help field artillery stay abreast of improvements in small arms and have a role on the battlefield, Europeans developed rifled field pieces. In the 1840s and 1850s Europeans introduced rifled muzzleloaders, but these weapons were difficult to load because the projectile had to fit the bore tightly to engage the rifling to produce the spin.[105] Realizing that breech loading was the only answer, Europeans experimented with various ways to devise a breech mechanism that would withstand the gas pressures generated by the powder explosion. After years of work, Major Gionvanni Cavalli of Italy produced the first workable rifled breech-loading field piece. Cavalli, an artillerist and mathematician, constructed a wrought-iron gun in 1846 with two spiral grooves in its tube that ran from end to end and invented an elongated projectile with two lugs on each side that fit into the grooves.[106] Late in the 1850s, Joseph Whitworth, an accomplished machinist in England, developed hooped, wrought-iron rifled breechloaders and muzzleloaders with hexagonal bores and hexagonal-shape rounds by forcing iron cylinders over one another by hydraulic pressure. In the meantime, Sir William Armstrong of England also manufactured hooped, rifled wrought-iron breechloaders and muzzleloaders. Unlike Whitworth, Armstrong constructed his hooped guns by shrinking successive layers of metal tubes over the other. The spinning action produced by rifling gave rifled cannons greater range and accuracy than smoothbores and threatened to make smoothbore artillery obsolete.[107]

Rifled field artillery soon demonstrated its superiority to smoothbores. In the Italian War of 1859, Napoleon III's rifled muzzleloaders had longer ranges and better accuracy than the Austrian smoothbores. French field pieces forced Austrian guns to stay behind the infantry where they could not hit the French and where they could not support the infantry. Encouraged by its dominance of Austrian guns and the greatly increased effectiveness of fire, French field artillery blasted the Austrians without any worries about counterbattery fire.[108] Despite this showing, most European armies clung to smoothbores at the beginning of the 1860s. Smoothbores were easier to load than rifled muzzleloaders, and rifled breechloaders were dangerous because they leaked gases at the breech, often exploded when fired, and were more expensive than smoothbore muzzleloaders.[109]

Although rifling and breech loading represented important advances, steel field artillery loomed as equally significant. In the 1850s the Krupps of Prussia manufactured a few rifled steel breechloaders and exhibited them at the Great Exhibition in London in 1851. Impressed with the guns, the King of Prussia eventually ordered three hundred in 1858 to make his army the first to be equipped with rifled, steel breechloaders. Most field artillery officers, however, showed less

105. Ltr, Secretary of War to Pres, 4 Dec 1854, in Ltrs Sent to President by Secretary of War, 1840-1849, microfilm, RG 107, National Archives; Ltr, George D. Ramsay, Fort Monroe Arsenal, to Craig, Chief of Ordnance, 8 Apr 1854, in Reports of Experiments, Ordnance Department, Vol. II, RG 156.

106. Comparato, *Age of Great Guns*, p. 18; James E. Hicks, *Notes on U.S. Ordnance: 1776-1941* (Green Farm, Ct: Modern Books and Crafts, Incorporated, 1971), pp. 139-40.

107. Phillip H. Stevens, *Artillery Through the Ages* (New York: Franklin Watts, 1965), p. 60; H.C.B. Rogers, *A History of Artillery* (Secaucus, NJ: The Citadel Press, 1979), pp. 93-95; Ripley, *Artillery and Ammunition of the Civil War*, pp. 366, 372.

108. William McElwee, *The Art of War: Waterloo to Mons* (Bloomington, In: Indiana University Press, 1974), p. 124.

109. Trevor N. Dupuy, *The Evolution of Weapons and Warfare* (New York: The Bobbs-Merrill Company, Incorporated, 1980), p. 192.

enthusiasm. Although Krupp's guns had four times the tensile strength of cast-iron and twice that of wrought-iron, artillery officers generally regarded steel as too brittle since several Krupp guns had exploded during trials.[110] In the 1850s Henry Bessemer of England discovered a way to process steel to reduce its cost and brittle nature and made steel guns more practical and available. By blowing air through the molten steel, he could regulate the chemical content of the steel more exactly and could produce it more cheaply than ever before.[111]

Despite advancements in steel, some inventors, such as Captain Thomas J. Rodman of the US Army, clung to iron guns. Rodman cast his cannons over a water-cooled core. Since the molten iron metal next to the core cooled faster than the succeeding layers, the process exaggerated shrinkage and made the interior metal denser than the outside. That made his iron gun stronger than those cast as solid blocks of iron or bronze and then bored out or those cast around a sand core to create a hollow tube that was smoothed out by machining. Using his technique, Rodman developed a whole family of Columbiad-type smoothbore guns, also known as Rodman guns, for coastal defense that saw considerable action during the American Civil War and introduced a superior method of casting iron or bronze guns.[112]

Influenced by the Europeans, the War Department experimented with rifled field artillery during the 1850s. After testing various rifled field pieces, the Ordnance Department concluded in 1859 that rifled muzzleloaders were more accurate than smoothbore artillery and should be adopted by the Army. Rather than developing totally new field pieces, which would be expensive, the Ordnance Department decided in 1860 to recall one-half of all the field cannons in the Army to rifle their barrels. Under a plan conceived by Charles T. James of Rhode Island, the Ordnance Department converted existing bronze muzzleloaders into rifled artillery by cutting narrow, deep grooves in their bores. These pieces, known as James rifles, threw elongated projectiles that weighed twice as much as the spherical rounds of their smoothbore counterparts fired. As such, a rifled, bronze 6-pounder became known as a 12-pounder James rifle. Since many artillery and ordnance officers were suspicious that the added strain caused by the heavier projectile would be too much for bronze pieces, the Ordnance Department dropped its project of converting bronze smoothbore muzzleloaders to rifled muzzleloaders in 1861 and started work on a 3-inch wrought-iron rifled muzzleloader that was eventually named the 3-inch Ordnance Rifle. In the meantime, Captain Robert P. Parrott, superintendent of the gun foundry at West Point, produced a cast-iron rifled muzzleloader with a wrought-iron band around the breech for added strength and with a bore of three inches that threw a ten-pound shell 3,200 yards at an elevation of five degrees. Nevertheless, this range was of little value because the gun crew could not see that far, especially in broken terrain.[113]

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110. *Ibid.*, p. 174.

111. McNeill, *The Pursuit of Power*, p. 237.

112 Ripley, *Artillery and Ammunition of the Civil War*, pp. 78-79.

113. Ripley, *Artillery and Ammunition of the Civil War*, pp. 109-10, 370; Peterson, *Round Shot and Rammers*, pp. 92-95; Ltr, Bvt BG George Talcott to Bvt Col B. Huger, 13 Jan 1851, in Benet, *A Collection of Annual Reports*, II, pp. 364-65; Rpt, Ordnance Department, 26 Oct 1859, in Benet, *A Collection of Annual Reports*, II, p. 668; Ltr, Craig to Floyd, 25 Nov 1859, in Benet, *A Collection of Annual Reports*, II, p. 679; Comparato, *Age of Great Guns*, pp. 183-84; Weigley, *History of the United States Army*, p. 19.

Important developments in ammunition for rifled cannons occurred at the same time. The major problem to be surmounted involved designing shot and shell projectiles that would come into contact with the rifling so that the round would spin in flight. Yet, the round could not fit so tightly that it was difficult to load. Some inventors developed ammunition with studs to engage the rifling, while Whitworth produced a hexagonal-shape projectile to fit his rifled field piece. However, studded or hexagonal ammunition was difficult to load in muzzleloaders and was also expensive. Seeking to make cheaper ammunition, Parrott produced a round with a wrought-iron cup cast into its base. When the field piece was fired, the gas produced by the explosion pushed the edge of the cup against the rifling to make the round spin. Later, a round with a brass or copper rotating band cast into the base, which expanded when the gas hit it, was introduced early in the 1860s. Even though other types of ammunition for rifled artillery were used, artillery officers favored the expanding cup and rotating band types and employed percussion and time fuses to detonate their shells.[114]

During the 1850s the War Department championed smoothbore field artillery and avoided adopting rifled pieces, especially breechloaders. In fact, American artillery officers contended that the mechanism for opening and closing the breech of the cannon was so clumsy that a good crew could fire a smoothbore muzzleloader faster than a rifled breechloader.[115] Caught in the middle of a technological revolution, the War Department and artillery officers displayed their conservatism by safely basing their field artillery on bronze, smoothbore cannons that were rapidly becoming obsolete with the introduction of rifled artillery and small arms.[116]

Peacetime conditions, however, hampered exploiting the new technology and organizational reforms being introduced. Thinking that field artillery was useless in Indian warfare, Secretary of War Charles M. Conrad (1850-1853) dismounted six batteries in 1851 although he knew that the country required properly equipped field batteries to fight an European power. Aware of the need for field artillery for conventional warfare, the War Department and Conrad later urged Congress to provide funds to mount eight field batteries. In response, Congress appropriated money in 1853. However, Secretary of War Jefferson Davis furnished horses for only three batteries, which gave the Army seven mounted batteries, and sent them to the Indian frontier where they soon fell into decay. This left only four batteries of field artillery by 1856.[117] Late in 1856, Davis dismounted three field batteries and sent them to Fort Monroe for training in garrison, siege, and coast artillery. Advised by General Scott, Secretary of War John B. Floyd (1857-1860) remounted the three batteries. The constant dismounting and mounting of batteries between 1848 and 1857, however, disrupted training, hurt morale, and created instability. Repeated dismounting and mounting of field batteries along with the War Department's practice of dispersing batteries on the frontier and rotating men between field and foot (siege, garrison, coast, or rocket) artillery units prevented the development of effective field artillery. Consequently, the War Department had field artillery in name only through 1857.[118]

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114. Peterson, *Round Shot and Rammers*, pp. 110-12.

115. Stevens, *Artillery Through the Ages*, p. 60; McNeill, *The Pursuit of Power*, pp. 237-39.

116. Board of Artillery Officers, *Instruction for Field Artillery*, 1860, pp. 13-14.

117. Birkhimer, *Historical Sketch*, pp. 6468, 134-36.

118. *Ibid.* pp. 64-68, 138-39.

Nor did frontier duty help the field artillery. Although each frontier fort had howitzers and field guns, usually 6-pounders and 12-pounder howitzers, commanders favored the 12-pounder mountain howitzer for field use. Originally designed for pack use and later provided with several variants of field carriages, the 12-pounder mountain howitzer was easily transported and used extensively on the frontier between 1848 and 1861.[119] Although the Army used field pieces against the Indians on occasions, the field artillery languished.[120] When a commander needed artillery, he relied upon pick-up crews of infantry or cavalry and occasionally used artillerymen. As a result, artillerymen had few opportunities to man field pieces in combat. Moreover, the Army frequently employed artillerymen as infantry because of the need for soldiers on the frontier.[121]

Because of the loss of many artillerymen to infantry duties and the the repeated mounting and dismounting of field batteries, the War Department took measures to improve the skills of its artillerymen. In 1858 Brevet Lieutenant Colonel Harvey Brown organized The Artillery School at Fort Monroe for theoretical and practical instruction. Realizing that the school was oriented towards producing officers and noncommissioned officers for foot artillery, Secretary Floyd devised a plan in 1859 to develop field artillerymen. General Order No. 10, May 1859, directed that each field battery would pass through a post school to receive practical and theoretical instruction. That measure met with only moderate success. Batteries were still scattered on the frontier with few opportunities to drill properly. Many artillerymen were serving as infantry, and the War Department continued rotating artillerymen among the various kinds of artillery units after 1859.[122]

Although the War Department reforms produced new field artillery organizations, new weapons, and training in the 1850s, conservatism, frontier duty, and rotating artillerymen among the various types of artillery units hindered any real improvements. In the middle of a technological revolution, the War Department safely developed a field artillery system of bronze smoothbore weapons and moved slowly to adopt rifled field pieces. Frontier service dispersed field batteries throughout North America, encouraged the employment of artillerymen as infantry, and prevented the development of effective field artillery gun crews, while rotating personnel among siege, garrison, and field units produced a generic artilleryman. The War Department might have had the latest smoothbore field artillery weapons, but it lacked trained people to serve them.

119. Robert M. Utley, *Frontiersmen in Blue: The United States Army and the Indian: 1848-1865* (New York: The Macmillan Company, 1967), pp. 28, 114, 188, 189, 202-03, 207, 250, 265, 267, 269, 272-75, 277-78, 294-95, 298-99, 320, 323, 335.

120. *Ibid.*, pp. 113-14.

121. Birkhimer, *Historical Sketch*, pp. 134, 206; Circular Ltr to Secretary of War, undated, in Benet, *A Collection of Annual Reports*, II, pp. 628-29; Circular Ltr to Bvt Lieutenant General Scott, 15 Nov 1857, in Benet, *A Collection of Annual Reports*, II, p. 629; Circular Ltr to Secretary of War, 15 Nov 1857, in Benet, *A Collection of Annual Reports*, II, p. 633; Utley, *Frontiersmen in Blue*, p. 28.

122. Birkhimer, *Historical Sketch*, pp. 2-7; 69, 125, 134-35, 206; Weinert and Arthur, *Defender of the Chesepeake*, pp. 75, 76.

Chapter IV

FIELD ARTILLERY IN THE CIVIL WAR: 1861-1865

After realizing from their shared experience of the futility of employing Mexican War field artillery tactics and organization in an era of rifled muskets and large armies, Union and Confederate armies adopted new tactics and organizations. They moved their field pieces behind the infantry line, established chiefs of artillery, created artillery reserves, and centralized command of their artillery to facilitate massing fire.

Failure of the Old Ways

Unable to resolve their differences over slavery, states' rights, and other controversial issues that had divided them for years, the North and South resorted to a clash of arms in 1861. On the eve of the Civil War, the Army had a strength of 16,000 officers and men and was divided into ten infantry regiments, four artillery regiments with eight field batteries, two dragoon regiments, two cavalry regiments, and one mounted rifleman regiment. When organized for war, each field battery had one captain, three lieutenants, two staff sergeants, six sergeants, twelve corporals, six artificers, two buglers, fifty-two drivers, and seventy cannoneers, was attached to a brigade, and had six field pieces. Although the Army was experimenting with rifled, muzzle- and breech-loading field artillery, smoothbore 6- and 12-pounders, 12-, 24-, and 32-pounder howitzers, and 12-pounder Napoleons that were drawn by four to six horses and threw solid shot, canister, explosive shell, and spherical case were the standard pieces.[1]

At the outbreak of hostilities in the spring of 1861, the Union and Confederacy started assembling their forces. Unable to deploy the Regular Army immediately, President Abraham Lincoln initially opted to rely upon the militia. In April 1861 he requested the loyal states to provide 75,000 men for three-months duty. One month later, Lincoln increased the Regular Army by nine infantry regiments, one artillery regiment, and one cavalry regiment and issued a call for 42,000 volunteers for three years of service. By the early summer of 1861, the Union had over

1. Board of Artillery Officers, *Instruction for Field Artillery* (Philadelphia: J.B. Lippincott and Company, 1860), pp. 1-19; William E. Birkhimer, *Historical Sketch of the Organization, Administration, Materiel and Tactics of The Artillery, United States Army* (James J. Chapman, 1884, reprinted by Greenwood Press, 1968), p. 79, hereafter cited as *Historical Sketch*; W. Glenn Robertson, "First Bull Run, 19 July 1861," in Charles E. Heller and William A. Stofft, eds., *America's First Battles: 1776-1965* (Lawrence. Ks: University of Kansas Press, 1986), p. 81.

300,000 regulars and volunteers in uniform. Meanwhile, the Confederate Congress authorized President Jefferson Davis to activate state militias for six months and to accept 100,000 one year volunteers. At the same time the Confederacy created its own regular army that remained essentially a paper force throughout the war. It did include, however, a Corps of Artillery of forty companies. Each company would have one captain, two first lieutenants, one second lieutenant, four sergeants, four corporals, two musicians, and seventy privates.[2]

Although field artillery organization differed slightly in the two armies and although rifled artillery was being introduced, battery and gun drill remained essentially the same in both armies. A captain commanded the battery, and a lieutenant directed two guns. A sergeant served as chief of the piece, while corporals were gunners who aimed the cannon, gave the firing command, and were chiefs of ordnance. Number one cannoneer sponged and rammed home the round. Number two loaded. Number three still thumbed the vent, while number four inserted the primer and pulled the lanyard. Number five carried ammunition from number six or seven at the limber chest to number two at the muzzle.[3]

As the North and South recruited men for military duty, they started forming armies. A short distance south of Washington, the North gathered an army of over thirty thousand under the command of Major General Irwin McDowell. To the west of Washington at the northern end of the Shenandoah Valley, the North positioned an army of fifteen thousand led by Major General Robert Patterson. In the meantime, the South stationed an army of twenty-two thousand under Major General P.G.T. Beauregard around the small town of Manassas Junction, Virginia, and a force of eleven thousand under Major General Joseph E. Johnston in the Shenandoah Valley to watch Patterson. Although the generals did not contemplate any major action in 1861, public pressure, particularly in the North, prodded them to move.

Assured that Johnston would be contained by Patterson, McDowell marched on Richmond via Manassas Junction with five divisions of infantry, seven companies of cavalry, and forty-nine rifled and smoothbore cannons. On 21 July 1861 McDowell launched his attack against Beauregard's army of seven infantry brigades of varying size, 1,600 cavalry, and 25 rifled and smoothbore field pieces. Using a motley collection of field artillery, which included two James rifles, six 6-pounders, two 12-pounder howitzers, and four 10-pounder Parrott rifles, Brigadier General Daniel Tyler's division bombarded the Confederates at the stone bridge over which the Warrenton-Alexandria road crossed Bull Run Creek.[4] Meanwhile, Colonel David Hunter's division crossed Bull Run at Sudley Spring with Colonel Ambrose E. Burnside's brigade in the lead. After fording the river, Burnside marched his men about one mile south through the woods until

2. Robertson, "First Bull Run, 19 July 1861," p. 84; Jenning C. Wise, *The Long Arm of Lee: The History of the Artillery of the Army of Northern Virginia* (1915, reprint, New York: Oxford University Press, 1959), p. 108.

3. Board of Artillery Officers, *Instruction for Field Artillery*, 1860, pp. 107-26; Harold L. Peterson, *Round Shot and Rammers* (Harrisburg, Pa: Stackpole Books, 1969), p. 119.

4. Robertson, "First Bull Run, 19 July 1861," p. 85; William Reid, *Arms Through the Ages* (New York: Harper and Row Publishers, 1976), p. 216; Wise, *The Long Arm of Lee*, pp. 136-37; Rpt, Beauregard, 26 Aug 1861, in US War Department, *War of the Rebellion: Official Records of the Union and Confederate Armies* (Washington: 1880-91), Series I, Vol. 2, p. 488; Hereafter cited as *Official Records*. Unless otherwise indicated all citations come from Series I.

he came upon a clearing. Here, Colonel Nathan G. Evans of the Confederate army had already positioned his command.[5] Seeing the Confederate army, Burnside threw skirmishers out, deployed the Rhode Island battery of six James rifles in front of the Union line, and attacked. Upon hearing artillery and musket fire, Hunter dispatched reinforcements.[6] Confronted by an overwhelming Union force on his left, Johnston, who had assumed command of the Confederate army after arriving from the Valley, sent additional forces to bolster Evans and abandoned any attempt to attack the Union left.[7]

Drawing upon their Mexican War experience, Union and Confederate commanders committed their field artillery a battery at a time because of the practice of attaching the battery to the brigade. On the Union side the Rhode Island battery fought alone for nearly half an hour before the howitzers of the 71st New York militia joined the fight. A few minutes afterwards, Captain Charles Griffin brought up his battery of six 10-pounder Parrott rifles to the left of the Rhode Island and New York batteries.[8] Finally, McDowell deployed Captain James Rickett's battery of six 10-pounder Parrott rifles. The batteries advanced to within four hundred yards and poured round after round onto Confederate lines, but rifled musket fire tore apart gun crews at such close ranges.[9] In the meantime, the Confederacy moved its artillery into action in piecemeal fashion until four batteries were firing canister and shell into Union forces. The surging mass of Federal infantry and artillery finally caused the Confederacy to retire and encouraged McDowell to move Rickett's and Griffin's batteries even farther in front of the Union line to Henry's Hill. The inability to mass artillery fire and the tendency of shells from the Union's rifled artillery to bore into the ground before exploding because of defective fuses prevented McDowell from shattering the Confederate army.[10]

Inspired by the stand of Brigadier General Thomas (Stonewall) J. Jackson's brigade, the Confederate army rallied. Led by Brigadier General Barnard Bee and supported by thirteen well-sited smoothbore field pieces that blasted Rickett's and Griffin's batteries with canister and spherical case, the Confederate infantry captured the Union's exposed batteries after a difficult fight. Nevertheless, the Union compelled the Confederates to fall back. After obtaining reinforcements, the Confederates pushed the Union off the cannons. As more Union infantry poured onto the field, the Confederates retreated from Henry's Hill again and left the prized guns in the hands of the Union.[11]

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5. Rpt, Evans, 24 Jul 1861, *Official Records*, Vol. 2, pp. 558-59; L. Van Loan Naisawald, *Grape and Canister: The Story of the Field Artillery of the Army of the Potomac, 1861-1865* (New York: Oxford University Press, 1960), pp. 5-6; Wise, *The Long Arm of Lee*, pp. 128, 136.

6. Rpt, Beauregard, 27 Jul 1961, p. 489; Rpt, McDowell, 4 Aug 1861, *Official Records*, Vol. 2, p. 319.

7. Douglas S. Freeman, *Lee's Lieutenants*, Vol. 1 (New York: Charles Scribner's Sons, 1942), p. 59; Rpt, Evans, 24 Jul 1861, pp. 558-59.

8. Rpt, Barry, 23 Jul 1861, *Official Records*, Vol. 2, p. 346.

9. Rpt, Early, 23 Jul 1861, *Official Records*, Vol. 2, p. 557; Robertson, "First Bull Run, 19 July 1861," p. 86; Naisawald, *Grape and Canister*, p. 14; Wise, *The Long Arm of Lee*, pp. 133, 135.

10. Rpt, Beauregard, 14 Oct 1861, in Frank Moore, ed., *The Rebellion Records*, Vol. 2 (New York: D. Van Nostrand Publishers, 1866), p. 491.

11. Rpt, Barry, 23 Jul 1861, p. 347.

Early in the afternoon, the Confederate army seized the initiative. Hoping to rout McDowell, Johnston ordered a flanking movement on the Federal right. Colonel Jeb Stuart's cavalry, Colonel Jubal Early's 6th Brigade, and fresh reinforcements coming from the Valley hit the Union hard. A shower of musket, canister, and spherical case and a cavalry charge caused the Federal right to break and permitted the Confederate army to recapture Rickett's and Griffin's field pieces. Although Union commanders made every effort to stem the Confederate attack, the North finally retreated.[12]

At Bull Run commanders utilized field artillery tactics and organization from the Mexican War. They did not fully comprehend that the size of the armies, technology, and terrain were different in Virginia. Influenced by the lack of experience and the field artillery's successful performance in 1846-48, they employed obsolete tactics and ineffective organization and failed to adapt to the advent of larger armies and improved technology.

A Time of Transition: 1861-1862

Aware of the futility of Mexican War tactics and organization at Bull Run, Union and Confederate armies in the East reformed their field artillery to facilitate massing fire and to overcome the impact of rifled small arms. Upon assuming command of the Army of the Potomac in July 1861 after President Abraham Lincoln had relieved McDowell, Major General George B. McClellan recruited Major William F. Barry as chief of artillery to equip and supply the artillery properly and Major Henry J. Hunt as chief of the artillery reserve to oversee replenishing and reinforcing batteries on the front lines. Under McClellan's watchful eye, Barry and Hunt built Camp Barry, a few miles from Bladensburg, Maryland, where they refitted the batteries. Using *Instructions for Field Artillery* (1860), Barry and Hunt turned seacoast artillerists and recruits into trained field artillerymen.[13]

While training proceeded, Barry reorganized McClellan's field artillery. He changed the ratio of guns to men from two and one-half per one thousand to three to one thousand if needed, advocated restricting the field artillery to 3-inch Ordnance rifles, also called guns, Parrott guns, and the Napoleon, and wanted a field battery to be composed of six pieces of uniform caliber. Barry also wanted four batteries to be assigned to a division rather than one battery to a brigade with one of the four batteries to be a regular one to provide leadership with the other three consisting of volunteers. Additionally, Barry desired an artillery chief (the senior battery commander) for each division to train the gun crews, one hundred field pieces for the artillery reserve, four hundred rounds per gun, and fifty pieces for the siege train.[14] By the time that Barry had reorganized the

12. Naisawald, *Grape and Canister*, pp. 16-17; Rpt, McDowell, 4 Aug 1861, p. 320; Rpt, Beauregard, 26 Aug 1861, p. 494; William C. Davis, *Battle at Bull Run: A History of the First Major Campaign of the Civil War* (Baton Rouge, La: Louisiana State University Press, 1977), p. 217; Rpt, Stuart, 26 Jul 1861, *Official Records*, Vol. 2, p. 483; Rpt, Early, 1 Aug 1861, *Official Records*, Vol. 2, p. 557.

13. Edward Longacre, *The Man Behind the Guns: A Biography of General Henry Jackson Hunt, Chief of the Artillery, Army of the Potomac* (New York: A.S. Barnes and Company, 1977), p. 95; George B. McClellan, *Report on the Organization and Campaigns of the Army of the Potomac* (New York: Sheldon and Company, Publishers, 1864), p. 55.

14. McClellan, *Report on the Organization and Campaigns of the Army of the Potomac*, pp. 55-56; Report on the Artillery of the Army of the Potomac, Barry, 1 Sep 1862, in Brigadier General J.G. Barnard, *Report of the Engineer and Artillery Operations of the Army of the Potomac* (New York: D. Van Nostrand, 1863), pp. 105-07.

field artillery in March 1862, the Army of the Potomac had 92 fully equipped batteries of 520 guns and 12,500 men. Reflecting upon the formation of such a large field artillery organization, McClellan stated in his Report on the Army of the Potomac in 1864, "The creation of an adequate artillery establishment . . was a formidable undertaking, and had it not been that the country possessed, in the regular service, a body of accomplished and energetic artillery officers, the task would have been almost hopeless."[15]

Although McClellan's comment implied the existence of a trained body of field artillery officers and men, that was not the case. Artillerymen were available, but their experience was limited to coast artillery duty, service in isolated frontier posts, and theoretical instruction in field artillery tactics. When McClellan assumed command in July 1861, moreover, the Army of the Potomac had only nine inadequately equipped field batteries. From the bare rudiments and with assistance from a few artillerymen with some appropriate experience, Barry and Hunt fashioned a field artillery organization fit for combat within a few short months.[16]

The arsenal system also allowed Barry and Hunt to expand the field artillery rapidly. Because of the uncertainty of cannon supplies during the War of 1812, Congress in 1816 authorized the President to purchase land for arsenals and armories for storing cannons and equipment. Although arsenals at Washington, Pittsburgh, and Watervliet, New York, constructed carriages, limbers, and caissons and mounted the cannons, the government relied on private foundries for guns. As a result of the arsenal system and private manufacturers, the Army of the Potomac had little difficulty obtaining rifled and smoothbore field pieces and equipment for its batteries.[17]

The size of the field artillery organization, the creation of a division artillery chief, and the assignment of the battery to the division did not overshadow Barry's proposal to simplify the field artillery and exploit the Napoleon gun. Since supplying the existing system of seven calibers of smoothbore muzzleloaders would be difficult, Barry proposed limiting the field artillery to rifled Parrott and 3-inch Ordnance guns and the 12-pounder Napoleon to expedite logistical support. Although Barry endorsed adopting rifled muzzleloaders, he knew that their usefulness would be restricted in North America. Because of the densely wooded areas where the Army of the Potomac would be operating and the higher dud rate of the rifled projectiles because of defective fuses, the Army could not take advantage of long-range rifled pieces. The woods and undergrowth would limit the fields of fire to short distances and nullify the rifled gun's superior range. Given this logic, Barry and McClellan wanted the Napoleon to form the backbone of the Army of the Potomac's artillery since it had a shorter range and was ideal for close in fighting. Barry wanted two-thirds of the batteries to be equipped with Napoleons with the remaining one third having Parrott or 3-inch Ordnance guns. Yet, in 1862 less than one third of the batteries had Napoleons because of limited production facilities. As a result, McClellan armed his field batteries with Parrott rifles, James rifles, 6- and 12-pounders, Napoleons, and a few 12-pounder mountain

15. McClellan, *Report on the Organization and Campaigns of the Army of the Potomac*, pp. 55-56.

16. Birkhimer, *Historical Sketch*, p. 117; Longacre, *The Man Behind the Guns*, pp. 94-97; McClellan, *Report on the Organization and Campaigns of the Army of the Potomac*, p. 55.

17. James Huston, *The Sinews of War: Army Logistics, 1775-1953* (Washington: Office of the Chief of Military History, 1966), pp. 114, 118, 128, 130.

howitzers. This gave McClellan a mixture of field artillery and a potential ammunition resupply problem.[18]

Like the Union army, the Confederate army reformed its artillery following Bull Run, but it did not make such extensive changes. Johnston continued to attach the battery to the brigade even though Captain Edward P. Alexander had successfully experimented with grouping artillery into battalions of three batteries each in April 1861 and even though Napoleon had demonstrated the necessity of massing artillery at the division and higher. Yet, Johnston established an artillery reserve of fourteen batteries under a chief of artillery.[19]

The Peninsula Campaign of 1862 provided the first opportunity to test the new field artillery organizations. Completely outmatched by the Union army, Johnston retreated up the peninsula towards Richmond with his army as McClellan pursued. Moving to hit the Union army before it could threaten Richmond, Johnston struck the Union at Seven Pines as General Stonewall Jackson engaged the Union in the Shenandoah Valley to create the illusion of attacking Washington. Although massed Union smoothbore and rifled artillery blasted the South with shell, case shot, and canister, Johnston's army overran the Union's first line and advanced to engulf the second line. Seeing the danger, Union gun crews on the second line of defense bombarded Johnston's army with case shot and canister and with help from small arms fire stopped the Confederate attack.[20] The following day, McClellan employed massed artillery fire and musketry to push back the Confederate army.[21]

The Union's success at repelling the Confederate offensive at Seven Pines revealed the importance of attaching field artillery to the division and having chiefs of artillery who, despite commanding their own battery and being administrators for the most part, could maneuver the division's artillery when necessary. McClellan's commanders and field artillerymen concentrated their cannons rather than employing them piecemeal. That allowed the Union army to fight Johnston's force to a standstill and helped to prevent the South from pushing McClellan's left into the Chickahominy.

Captain Alexander of Johnston's army comprehended the implication of attaching field artillery to the division. Reflecting some years after Seven Pines, he wrote in his

18. Birkhimer, *Historical Sketch*, p. 81; Naisawald, *Grape and Canister*, pp. 35, 36, 38; Ltr, Brigadier General James T. Ripley to Secretary of War, 14 Jul 1862, in Stephen V. Benet, ed. *A Collection of Annual Reports and Other Important Papers Relating to the Ordnance Department*, Vol. III (Washington: Government Printing Office, 1890), p. 237, hereafter cited as *A Collection of Annual Reports*; Ltr, McClellan to Secretary of War, 10 Jul 1862, in Benet, *A Collection of Annual Reports*, III, p. 239.

19. Wise, *The Long Arm of Lee*, pp. 141-43.

20. John C. Tidball, "Artillery Service in the War of the Rebellion," *Journal of the Military Service Institution*, Jul 1891, pp. 717-19; Rpt, Maj Robert West, Chief of Artillery, 1st Division, 4 Jul 1862, *Official Records*, Vol. II, part I, p. 883; Rpt, BG Darius Couch, Commanding General, 1st Division, 7 Jun 1862, *Official Records*, Vol. II, part I, pp. 879-80; McClellan, pp. 214-22. Tidball had a series of articles entitled, "Artillery Service in the War of the Rebellion," that ran in *Journal of the Military Service Institution*. Rather than citing the journal's name hereafter, only the article title and date will be used.

21. Tidball, "Artillery Service in the War of the Rebellion," Jul 1891, pp. 717-19; Rpt, West, 4 Jun 1862, p. 883; Rpt, Couch, 7 Jun 1862, pp. 879-80; McClellan, *Report on the Organization and Campaigns of the Army of the Potomac*, pp. 214-22.

memoirs,". . .each [Confederate] infantry brigade had a battery attached to it. There were no field officers of artillery, charged with combining batteries and massing them to concentrate heavy fire upon important points."[22] He noted that the Confederate army had sufficient cannons at Seven Pines but lacked an organization to make them effective. Unable to mass fire, the Confederate artillery provided ineffective counterbattery fire and permitted Union guns to devote their whole attention to the attacking Confederate infantry. In Alexander's view the Confederates' inability to maneuver their guns as coordinated teams contributed to their failure to drive McClellan's left into the Chickahominy.[23]

Prompted by weak artillery support at Seven Pines, General Robert E. Lee, who took over command from Johnston early in June, reformed the artillery. Lee not only requested Brigadier General William Pendleton to remain as chief of the artillery but also gave him authority to reorganize the field artillery as needed. Pendleton created the army artillery reserve of five battalions of three to five batteries each and formed a division reserve under a chief of artillery. Later in the month, Lee gave the division's chief of artillery administrative charge of all the division's batteries whether they were assigned to a brigade or the division reserve with the division commander retaining tactical control. Although Lee limited the battalion organization to the army reserve and preserved the practice of attaching the battery to the brigade, he still made a significant contribution by forming the reserve into battalions.[24]

After restructuring his field artillery, Lee attacked the Union's right on the north side of the Chickahominy. Through skillful deployment of his force, Lee hit McClellan at Mechanicsville on 26 June and Gaine's Mill the following day with eighty-four rifled and smoothbore field pieces. Taking advantage of the Union's division artillery, Major General Fitz-John Porter, the Union V Corps commander, moved ninety-six guns around at Mechanicsville and Gaine's Mill to fill in gaps and defend weak spots.[25] Yet, Porter still experienced difficulties maneuvering his field pieces because his division artillery chiefs still served as battery commanders and had little time to supervise the division's artillery and because division commanders had tactical control of the artillery. As a result, positioning Union batteries was frequently haphazard since division commanders had to concentrate on their battle and not just on what the field artillery was doing.[26]

Like McClellan, Lee had problems deploying his artillery at Mechanicsville and Gaine's Mill. Lee's commanders lacked enough experience and frequently started a battle before the artillery reserve was in position to help. Also, Lee's batteries seldom massed fire and often acted independently. This was in part because of aligning the battery under the brigade and in part

22. E.P. Alexander, *Military Memoirs of a Confederate* (New York: Charles Scribner's Sons, 1912), p. 90.

23. Alexander, *Military Memoirs of a Confederate*, p. 90; Wise, *The Long Arm of Lee*, p. 190.

24. Wise, *The Long Arm of Lee*, pp. 196-200.

25. Tidball, "Artillery Service in the War of the Rebellion," Jul 1981, pp. 723-24; Rpt, Charles Richardson, Cdr, 2nd Battalion, 12 Jul 1862, *Official Records*, Vol. II, part I, p. 538.

26. Naisawald, *Grape and Canister*, pp. 84-102; Major General Fitz John Porter, "Hanover Court House and Gaines's Mill," *Battles and Leaders of the Civil War*, Vol. I (New York: The Century Company, 1884), pp. 336-40; Rpt, Cpt William B. Weeden, C Battery, 2 Jul 1862, *Official Records*, Vol. II, part I, pp. 28182; Rpt, Lt Henry W. Kingsburgy, D Battery, 5 Jul 1862, *Official Records*, Vol. II, part I, pp. 286-87; Rpt, Col S. Crutchfield, Chief of Artillery, 23 Jan 1863, *Official Records*, Vol. II, part 2, p. 560.

because of the difficult terrain. Colonel Stapleton Crutchfield, General Stonewall Jackson's artillery chief, recorded that he could not mass his guns on the Confederate left where they were needed on 21 June because of the ground and poor roads. Despite adverse conditions, the Confederate army occasionally massed its pieces. On 27 June Crutchfield assembled thirty cannons at Gaine's Mill and helped push the Union army toward Malvern Hill.[27]

After fleeing from positions farther up the peninsula, McClellan made a final stand on Malvern Hill. Realizing that the Confederate army would have to hit the Union left, Colonel Hunt gathered his artillery reserve of eighteen batteries of 12-pounder howitzers, 3-inch Ordnance guns, 10- and 20-pounder Parrotts, and 32-pounder howitzers and positioned them to support division artillery if needed. By 1 July the Union had over one hundred division guns and howitzers along the mile-wide summit of Malvern Hill with the artillery reserve ready for action.[28] Despite this vast array of Union artillery, the Confederate army opened with musket and artillery fire and began pushing infantry forward to carry the hill. Union artillery blasted the attacking infantry with canister, shell, and spherical case and overpowered Confederate batteries that operated independently, while the infantry poured musket fire on the foot soldiers. Together, Union field artillery and musketry shattered Lee's army.[29]

The Union's artillery reserve played a major role in destroying the Confederate offensive. In his report Hunt recorded, "It [the artillery reserve] re-enforced strongly the whole line, and sent forward its full quota to repel the attack on our front and left, and finally brought to the decisive point at the close of the day the howitzers and three horse batteries, thus bringing every gun of this larger artillery force into the most active and decisive use. Not a gun remained unemployed and not one could have been safely spared."[30] Through efficient employment of his reserve, Hunt helped blast the Confederate army off the field at Malvern Hill and established the artillery reserve as a vital artillery organization.[31]

The Confederate army encountered a different situation with its artillery reserve on the peninsula. Writing in July 1862, Pendleton complained that his reserve was scattered throughout Lee's Army of Northern Virginia. "With a command thus necessarily diffused," he explained, "I could give only general direction to the whole and occasional personal supervision to each portion."[32] Rather than keeping it in one area, Confederate generals chose to have the "Reserve Artillery posted on different fronts, where it could be conveniently and rapidly brought into action when necessary." Although this thinking was sound, it prevented massing fire. Division artillery chiefs faced a similar problem. With the exception of massing their guns at Gaine's Mill and

27. Rpt, Crutchfield, 23 Jan 1863, p. 560; Naisawald, *Grape and Canister*, pp. 90-102.

28. Longacre, *The Man Behind the Guns*, p. 114; Rpt, Hunt, 7 Jul 1862, *Official Records*, Vol. II, part 2, pp. 236-41; Tidball, "Artillery Service in the War of the Rebellion," Jul 1891, p. 730; McClellan, *Report on the Organization and Campaigns of the Army of the Potomac*, p. 270.

29. McClellan, *Report on the Organization and Campaigns of the Army of the Potomac*, p. 271; Wise, *The Long Arm of Lee*, pp. 227-28, 230, 233.

30. Rpt, Hunt, 7 Jul 1862, p. 239.

31. Rpt, MG F.J. Porter, Commanding General, V Corps, 26 Sep 1862, *Official Records*, Vol. II, part 2, p. 241.

32. Rpt, Pendleton, 21 Jul 1862, *Official Records*, Vol. II, part 2, p. 536; Rpt, Jackson, 20 Feb 1863, *Official Records*, Vol. II, part 2, p. 558.

White Oak Creek, they deployed their batteries individually because their guns were attached to the brigade. Unable to mass their artillery because of its organization, the weather, and the heavily wooded terrain, Confederate commanders used it ineffectively and even observed its destruction at Malvern Hill.[33]

Seeing the inadequacies of his field artillery on the peninsula, Lee reorganized it in August 1862. He attached batteries to the division, placed an artillery chief over them, and formed his artillery reserve into battalions of three batteries each. Like McClellan, Barry, and Hunt, Lee had learned that attaching the battery to the brigade hampered massing fire.[34]

Second Bull Run of August 1862 gave Lee the first opportunity to use his restructured artillery. In August 1862 Lee divided his army by dispatching Stonewall Jackson's corps with its twenty-one field batteries to hit the Union's logistics at Manassas Junction to force the Union general, Major General John Pope, to follow or lose his supply base, while Lieutenant General James Longstreet's corps with twenty-two batteries held Pope's front. After attacking Manassas, Jackson assumed a defensive stance along the Warrenton-Centerville Pike near Bull Run and waited for Pope's Army of Virginia with its 175 field pieces. Jackson posted most of his infantry in an old railroad cut with his field batteries positioned on the crest of a wooded ridge behind the infantry so that they could pour crossfire upon the Union.[35] Early on the morning of 29 August, Pope struck Jackson after an artillery duel. Although difficult terrain prevented Colonel Crutchfield from committing all of his artillery at the beginning of the battle, by mid-morning he had pooled his field pieces and rained canister, shell, and spherical case on the Union lines assaulting Jackson's center. After stopping this attack, Crutchfield then crushed an attempt to turn Jackson's left and forced the Union to retreat.[36] On 30 August Pope attacked again. This time he faced Jackson and Longstreet, who had combined during the late hours of 29 August. Pope struck the entire Confederate front and exposed his left to withering fire from forty field guns collected by Crutchfield and Lieutenant Colonel Stephen D. Lee, Longstreet's artillery chief. After this charge collapsed, Pope's army could hold no longer. Since he was too far from assistance and could not continue the fight, Pope withdrew from the battlefield in defeat.[37]

Although Pope undoubtedly made tactical and strategic blunders because of confusion, his inability to mass his field artillery contributed to his defeat. During both days of the battle, Union gun crews fought on the tactical offensive and maneuvered their pieces in two-gun sections or single batteries and frequently could not move them into effective canister range because of rifled

33. Rpt, Hill, 3 Jul 1863, *Official Records*, Vol. II, part 2, p. 558; Alexander, *Military Memoirs of a Confederate*, pp. 158-60.

34. Wise, *The Long Arm of Lee*, pp. 242-45; Birkhimer, *Historical Sketch*, p. 84; Naisawald, *Grape and Canister*, pp. 145-48.

35. Bruce Catton, *The Civil War* (New York: American Heritage Press, 1971), pp. 88-89; John Pope, "The Second Bull Run," *Battles and Leaders of the Civil War*, Vol. II, p. 464.

36. Rpt, Crutchfield, 14 May 1863, *Official Records*, Vol. 12, part 2, p. 652.

37. Rpt, Crutchfield, 14 May 1863, p. 653; Rpt, Col Stephen C. Lee, CSA, Commanding Light Artillery Battalion, 2 Oct 1862, *Official Records*, Vol. 12, part 2, p. 577; William M. Owen, *In Camp and Battle with the Washington Artillery of New Orleans* (Boston: Ticknor and Company, 1885, reprinted by Pelican Publishing Company, New Orleans, 1964), p. 119; Pope, "The Second Bull Run," p. 489; Wise, *The Long Arm of Lee*, pp. 270, 275, 276.

musket fire. Consequently, in the face of massed artillery fire, the North did not have the firepower to silence Confederate batteries fighting on the tactical defensive and could not provide adequate support to the infantry. Pope had not learned the lesson of the Peninsula Campaign. At Second Bull Run Pope attached his batteries to the brigades and also ignored the tactic that prescribed concentrating his artillery on the offense on the enemy's cannons, while artillery on the defensive should mass against charging infantry. As a result, Confederate artillery was free to rake Union infantry without worrying about counterbattery work. Fighting on the offense, which made massing fire difficult, failing to use his cannons to knock out enemy artillery, and using an anachronistic field artillery organization, Pope suffered defeat at the hands of a well-positioned enemy with the ability to mass its artillery.[38]

Following Second Bull Run the Union and Confederacy restructured their field artillery once again. On 5 September McClellan made Colonel Hunt the Chief of the Artillery for the Army of the Potomac when General Barry assumed the post of Inspector of the Artillery for all Union artillery. Tactical control of the guns was left to the commanders. Although McClellan continued to attach the battery to the brigade in Major General Joseph Hooker's corps, he gave each division in the rest of his corps two to three batteries while keeping the senior battery commander, a captain, as chief of artillery. Impressed by his massed artillery at Second Bull Run, Lee formed his artillery into battalions of four to seven batteries, attached them to the division, and created a corps artillery reserve of one battalion of eight batteries and an army artillery reserve of four battalions. Equally important, Lee placed colonels or lieutenant colonels in command of his artillery battalions. Essentially, Lee's and McClellan's field artillery contrasted significantly. The Confederacy had centralized command of its 73 batteries of 288 guns, whereas the Union had centralized only a portion of its 55 batteries of 322 cannons.[39]

Shortly afterwards, the new artillery organizations met their first test at the Battle of Antietam. Early on the morning of 17 September 1862, McClellan launched his offensive by shoving Hooker's corps against Jackson's corps on the Confederate left. To break through Jackson's lines Hooker opened with heavy counterbattery fire from 20-pounder Parrott rifles and then pushed out his infantry. Hindered by wooded terrain, Union division artillery had problems keeping up with the infantry and provided ineffective support. While this was happening, Hunt's reserve artillery of long-range rifled pieces bombarded Confederate field artillery with impunity. Despite being almost completely torn apart by counterbattery fire from Union guns, Jackson's corps massed its artillery, poured deadly canister and shell onto Hooker's infantry, and checked the attack.[40] Once Jackson stopped Hooker, the Confederate general tried to turn the Union

38. Rpt, Cpt Stephen Weed, Chief of Artillery, 5th US Artillery, 8 Sep 1862, *Official Records*, Vol. 12, part 2, p. 485; Rpt, Lt Alanson M. Randol, E and G. Batteries, 1st US Artillery, 8 Sep 1862, *Official Records*, Vol. 12, part 2, p. 486; Naisawald, *Grape and Canister*, p. 163.

39. Longacre, *The Man Behind the Guns*, p. 119; Tidball, "Artillery Service in the War of the Rebellion," Sep 1891, pp. 954-55.

40. Allen J. Greer, "The Roaring Guns from the Seven Days to Cold Harbor," *Field Artillery Journal*, Feb 1936, p. 12; Rpt, Hooker, 8 Nov 1862, *Official Records*, Vol. 19, part 1, p. 212; Rpt, McClellan, 15 Oct 1862, *Official Records*, Vol. 19, part 1, p. 30; Rpt, Crutchfield, 11 Oct 1862, *Official Records*, Vol. 19, part 1, p. 845; Naisawald, *Grape and Canister*, pp. 199-203; Tidball, "Artillery Service in the War of the Rebellion," Sep 1891, pp. 962-63; Longacre, *The Man Behind the Guns*, pp. 120-21; Wise, *The Long Arm of Lee*, pp. 295, 298-301.

general's left. Massed Union artillery fire crushed the counterattack. Although the Union halted Jackson's drive, Hooker's corps had expended its energy. As a result, McClellan launched more attacks with his other corps, but Jackson's field artillery helped repulse each one with canister, shell, and spherical case shot.[41]

As the fighting diminished on the Confederate left, McClellan hit Lee's right. Although Longstreet's batteries enfiladed the Rohrbach Bridge over Antietam Creek where the Union forces had to cross, Major General Ambrose Burnside pushed his men over the bridge under cover of counterbattery fire from Hunt's artillery reserve and division artillery.[42] Supported by two batteries that had advanced over the bridge and Hunt's guns, the Union pressed forward against the sagging Confederate line. As the Confederacy fell back, Major General Ambrose P. Hill rushed up two brigades and artillery from Harper's Ferry to bolster the sagging Confederate right. Three Confederate batteries massed fire and shattered Burnside's charge. Despite fierce Union attacks, the Confederate right held.[43]

Field artillery played an important role in the fighting on 17 September. Jackson's ability to group his guns on the tactical defense stopped numerous Union charges. In his official report of 23 April 1863, Jackson recounted that Major General Jeb Stuart, his cavalry commander, employed his field artillery so well that he helped repel Hooker's attack. Moreover, Colonel Lee, Jackson's chief of artillery reserve, moved his pieces around, countered Union charges, and also shifted his guns to bolster Longstreet's front. Describing his field artillery's action under Longstreet, Lee mentioned that massed field pieces repelled some six or eight Union attempts to take the Confederate right.[44] As numerous reports indicated, Lee's ability to pool his artillery at critical times on the defense helped prevent his army from being routed by McClellan's numerically superior force.[45]

Despite the outstanding record against Union infantry, Confederate artillery had less success in counterbattery fire. Confederate Major General Daniel H. Hill insisted that bad "handling of our artillery," contributed to the failure to win at Sharpsburg. According to him, Confederate field artillery simply could not cope with the "superior weight, caliber, range, and number of Yankee guns." In fact, Union field artillery smashed Confederate artillery in counterbattery fire or forced it to withdraw.[46]

While Confederate artillery displayed an inability to withstand Union counterbattery work, the Union also experienced problems. From the heights overlooking the South's position, Hunt's

41. Rpt, Jackson, 23 Apr 1863, *Official Records*, Vol. 19, part I, p. 957; Stephen W. Sears, *Landscape Turned Red* (New York: Ticknor and Fields, 1983), pp. 181-254.

42. Rpt, Major Frobel, CSA, Chief of Artillery, 1 Oct 1862, *Official Records*, Vol. 19, part I, p. 926.

43. Rpt, BG Alfred Pleasanton, Commanding General, Cavalry Division, 19 Sep 1862, *Official Records*, Vol. 19, part I, pp. 211-13; Rpt, MG D.H. Hill, CSA, 1862, *Official Records*, Vol. 19, part I, pp. 1024-25.

44. Rpt, Lee, 11 Oct 1862, *Official Records*, Vol. 19, part I, p. 946.

45. Wise, *The Long Arm of Lee*, pp. 324-25; Rpt, Longstreet, 10 Oct 1862, *Official Records*, Vol. 19, part I, p. 840; Rpt, McClellan, 15 Oct 1862, *Official Records*, Vol. 19, part I, p. 29; Owens, *In Camp and Battle with the Washington Artillery of New Orleans*, pp. 142-67.

46. Rpt, D.H. Hill, 1862, p. 1026.

reserve and McClellan's division artillery concentrated counterbattery fire on Jackson in the early hours of 17 September and did the same for Burnside's attack in the afternoon. When the battle became more fluid on both wings, artillery chiefs could not mass their batteries even though they bombarded the Confederacy with devastating results.[47] Fighting on the offense, Union commanders generally employed their division artillery in piecemeal fashion if at all.[48] Some years after Antietam, John C. Tidball, who commanded a horse artillery battery in the Army of the Potomac, recalled that most of McClellan's guns were unemployed at critical periods of the battle on the Union right. Although Union field artillery shattered Lee's army, it failed to demonstrate its potential because it was randomly employed. Only at the beginning of the attacks against the Confederate right and left did the Union mass fire. As at Second Bull Run, Antietam once again illustrated the difficulties of massing artillery on the tactical offensive, especially in wooded, broken terrain, and the relative ease of concentrating artillery on the tactical defense.[49]

Antietam represented a major turning point in the employment of field artillery because it was the first battle where both sides in the eastern theater pooled their guns at one time or another. Until then, only one side had been able to mass artillery fire because of the terrain, decentralized command of the artillery, or the lack of a chief of artillery. By the late summer of 1862, the Army of the Potomac and Army of Northern Virginia had grasped the importance of massing fire to rake infantry or knockout hostile cannons and had developed appropriate artillery organizations to facilitate grouping batteries. Consequently, commanders and gun crews rained massive quantities of fire at Antietam in a more systematic manner. Combined with rifled small arms, the practice of attaching the battery to the division, the formation of artillery reserves, and the creation of chiefs of artillery unleashed an unprecedented destructive power in the in the annals of American military history.

Moreover, the field artillery had a fairly well-defined role by Antietam. On the offense field artillery engaged in counterbattery fire to prevent enemy guns from blasting the advancing infantry with impunity. Fighting on the defense, gun crews opened with solid shot and shell from their rifled pieces to break up the infantry advance. If this did not stop the attack, artillerymen continued firing with their rifled guns and started firing shell from their smoothbore field pieces. If the enemy got within four hundred yards, gun crews then employed canister. Coupled with rifled musket fire, these field artillery tactics wreaked havoc at Antietam.

Although Union and Confederate field artillerymen were growing more dependent upon rifled artillery by 1862, they did not abandon smoothbore field pieces. At First Bull Run and Antietam rifled artillery performed well in a counterbattery role but had problems stopping infantry attacks. Defective fuses in rifled ammunition frequently failed to detonate the shells, which allowed the infantry to continue pushing up against the defense. Because of this, gun crews had to employ smoothbore artillery to halt the infantry charge with canister. Rifled artillery might have been more accurate and might have had greater ranges, but the state of rifled artillery technology encouraged Union and Confederate artillerymen to keep smoothbore muzzleloaders

47. Longacre, *The Man Behind the Guns*, pp. 120-21.

48. Tidball, "Artillery Service in the War of the Rebellion," Sep 1891, p. 958.

49. *Ibid.*

because they were particularly effective in close-in fighting in wooded terrain.[50]

Realizing that the motley collection of field pieces in his army hampered operations at Antietam, Lee took steps to reduce the number of calibers of artillery in Confederate service to simplify ammunition supply. Like Hunt, Lee endorsed the Napoleon, the 10-pounder Parrott, and 3-inch Ordnance rifle. Influenced by Lee, Colonel Josiah Gorgas, Chief of Ordnance for the Confederacy, distributed a circular in November 1862 that restricted field artillery production to Napoleons and 10-pounder Parrotts. Nevertheless, Confederate armies used whatever field pieces were available because of limited production facilities in the South.[51]

In the meantime, the inability of Union division commanders to mass their batteries on the tactical offensive at Antietam convinced Colonel Hunt to push for greater control of the Army of the Potomac's artillery. In the fall of 1862, he proposed consolidating the field artillery into a single corps to give the commander greater firepower and flexibility.[52] Neither McClellan nor his successors, Burnside and Hooker, accepted Hunt's recommendations. Satisfied with the existing organization, they kept their chiefs of artillery powerless, generally as inspectors, administrators, and senior battery commanders, and left the batteries attached to the division. As a result, the Army of the Potomac lacked a field artillery organization to ensure that its batteries would act as a team. This placed the Army of the Potomac in an undesirable position since the Army of Northern Virginia had a battalion of four to six batteries under a lieutenant colonel or major in each division, grouped two battalions together to serve as the corps reserve, and even had an army reserve of four battalions under the command of a brigadier general.[53]

The Battle of Fredericksburg in December 1862 illustrated the inherent weaknesses of the Union's field artillery organization. Attempting to capture Richmond, Burnside attacked a strongly entrenched Confederate army. From Stafford Heights overlooking the town, Hunt's reserve of 149 rifled and smoothbore artillery rained shot and shell on Lee's army to allow Burnside to push Major General Edwin V. Sumner's and Major General William F. Franklin's grand divisions of two corps each and a total of 124 guns over the Rappahannock River. Once across, Sumner deployed his infantry and 104 field pieces in front of the city and Maryes' Hill, while Franklin positioned his infantry and 114 guns south of the city. During Union artillery preparations, Lee posted 260 pieces on the ridge overlooking the city. He employed two hundred for immediate action with the remainder close by.[54]

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50. Russell F. Weigley, *History of the United States Army* (New York: Macmillan Publishing Company, Inc., 1967), p. 237; Vardell Nesmith, Jr., "The Quiet Paradigm Change: The Evolution of the Field Artillery Doctrine of the United States Army, 1861-1905," unpublished doctoral dissertation, Duke University, 1977, pp. 16-21; Grady McWhiney and Perry D. Jamieson, *Attack and Die: Civil War Military Tactics and the Southern Heritage* (University, Al: The University of Alabama Press, 1982), p. 123.

51. Tidball, "Artillery Service in the War of the Rebellion," Sep 1891, pp. 457-58; Naisawald, *Grape and Canister*, p. 184; Wise, *The Long Arm of Lee*, pp. 278-83, 340-41.

52. Allan Nevins, ed., *Diary of Battle: The Personal Journals of Colonel Charles S. Wainwright, 1861-1865* (New York: Harcourt Brace and World, Inc., 1962), pp. 107, 114, 129; Tidball, "Artillery Service in the War of the Rebellion," Nov 1891, p. 1214.

53. Nevins, *Diary of Battle*, pp. 114, 129; Tidball, "Artillery Service in the War of the Rebellion," Nov 1891, p. 1214.

54. Longacre, *The Man Behind the Guns*, p. 134.

On 13 December Sumner and Franklin launched independent assaults. Lacking chiefs of artillery with authority to command the guns, Sumner's field artillery soon became congested in front of the city. Only seven of the nineteen batteries that accompanied Sumner were used at all. Even those seven were only partially engaged in the battle. Poor artillery organization and positioning of Hunt's reserve on Stafford Heights permitted Lee's field artillery to halt repeated Union advances against Maryes Hill.[55] In comparison, Colonel Charles S. Wainwright and Captain Romeyn B. Ayres, serving as Franklin's chiefs of artillery, controlled the movements of the field artillery in their respective corps to ensure the availability of their cannons. Reflecting on Wainwright's and Ayres's artillery, Jackson mentioned that judicious posting of Union artillery made the advance of Confederate troops across the plain hazardous.[56]

Nevertheless, Franklin's artillery still had difficulty supporting the infantry. Following heavy counterbattery fire, Franklin attacked, but broken, wooded terrain hampered Union artillery from following the infantry. As a result, the infantry quickly masked Franklin's guns and allowed Jackson's batteries that had remained silent during the Union's counterbattery work to open fire with canister and shell. In fact, Major John Pelham, one of Stuart's horse artillery commanders, moved forward with two Napoleons and blasted the exposed flank of Major General George G. Meade's division with canister. Despite receiving heavy counterbattery fire from four Federal batteries, Pelham's bombardment slowed down Meade's attack before being forced to retire, which allowed Meade to continue his advance.[57]

Hunt's and Wainwright's reflections on Burnside's artillery at Fredericksburg offered alternatives to the Army of the Potomac's existing field artillery organization. Hunt pointed out that he could have shifted the idle guns and howitzers from Sumner to Franklin if he had held the proper authority. Along with the assistance from two more divisions from Hooker's command held in reserve, Hunt insisted that the additional field artillery would have given Franklin sufficient firepower to dislodge Jackson from the ridge and silence the South's artillery. Although Wainwright praised Union batteries for their individual efforts, he severely criticized the Union's organization. He insisted that chiefs of artillery should be more than captains and should be experts that commanders could rely on. Without sufficient rank and authority, division artillery chiefs did nothing more than maneuver their own batteries. Sensing that artillery chiefs were nothing more than figureheads, Hunt and Wainwright urged creating chiefs of artillery with command authority and even suggested establishing a chief of artillery for the Army of the Potomac, who could direct all the army's artillery with little interference from commanders.[58]

As the Army of the Potomac and the Army of Northern Virginia struggled to centralize their artillery, the western armies of the Union and Confederacy also labored to improve field artillery organization. The Battle of Fort Donelson in February 1862 prefigured problems that western field artillerymen would have. After seizing Fort Henry, Major General Ulysses S. Grant attacked Fort Donelson with field and siege artillery. Handicapped by heavily wooded terrain cut by

55. *Ibid.*

56. Tidball, "Artillery Service in the War of the Rebellion," Nov 1891, p. 1217.

57. Wise, *The Long Arm of Lee*, pp. 382-83; Naisawald, *Grape and Canister*, pp. 247-50, 252-58; Tidball, "Artillery Service in the War of the Rebellion," Nov 1891, pp. 1218-20.

58. Naisawald, *Grape and Canister*, p. 261; Nevins, *Diary of Battle*, p. 148.

ravines, Union and Confederate field artillerymen could not maneuver their guns around the battlefield or mass them on the offense. Rather, gun crews frequently left the infantry to fight without any artillery support because of the difficulty of moving field pieces over the rugged ground or engaged in long-range artillery duels. Despite the impact of terrain upon field artillery on the offense, Union and Confederate field artillery still managed to mass fire on the defense.[59]

Grant's victories at Forts Henry and Donelson compelled General Albert Sidney Johnston, who commanded all of the Confederacy's forces from the Appalachians to Indian Territory, to retreat. Hoping to prevent the Union from making any more thrusts into the Confederacy and from cutting the railroad lines that ran east and west, Johnston concentrated over forty thousand men and about 120 guns near Corinth, Mississippi, a strategic railroad junction. He divided his command into four corps, attached artillery to each brigade, and appointed a chief of artillery for each division.[60] Nevertheless, his chiefs of artillery exercised little tactical control over their cannons since Johnston had given infantry officers, who had little understanding of artillery, authority to employ their field pieces as they saw fit.[61]

While Johnston busily prepared, Grant assembled a 44,000-man Army of the Tennessee to invade the Confederate heartland. Grant had six divisions, twenty-two batteries of 128 smoothbore and rifled cannons, artillery chiefs for each division, and an artillery chief, Colonel J.D. Webster, for his entire army. In theory Grant had centralized his artillery, but in reality it was still decentralized. Although he had chiefs of artillery for his divisions to direct the artillery, they commanded their batteries and nothing more since Grant had attached the battery to the brigade and had eight independent, unassigned batteries.[62] Isolated from developments in the East, Grant and Johnston had obsolete field artillery organizations. Lacking any expertise and drawing on their Mexican War experiences, they created a battery-brigade arrangement that was being abandoned by eastern armies by May 1862.

Early in April 1862, Grant's and Johnston's armies collided at Shiloh, Mississippi. Despite meeting stiff opposition from twelve rifled and smoothbore guns that spewed solid shot and canister, Johnston allowed his field batteries to operate independently and fire on the Union's reserves and second line and boldly thrust some of his cannons as close as four hundred yards from Grant's army. At such ranges Union riflemen cut down Confederate gun crews and compelled them to withdraw to safer positions behind their infantry. Yet, Johnston's army forced the Union to retreat.[63] Brigadier General Benjamin M. Prentiss' division on the extreme Union left stalled

59. Rpt, BG John McClernand, Division Commander, Union Army, 28 Feb 1862, *Official Records*, Vol. VII, p. 176; Rpt, Cpt Jasper M. Dressor, Battery A, Illinois Light Artillery, 19 Feb 1862, *Official Records*, Vol. VII, p. 191; Rpt, Cpt Ezra Taylor, Battery B, 1st Illinois Light Artillery, 18 Feb 1862, *Official Records*, Vol. VII, p. 209; Larry Daniels, *Cannoneers in Gray: The Field Artillery of the Army of Tennessee*, 1861-1865 (University, Al: The University of Alabama Press, 1984), pp. 24-25.

60. Rpt, Beauregard, 7 Apr 1862, *Official Records*, Vol. 10, part I, p. 385.

61. Allan Nevins, *The War for the Union*, Vol. II (New York: Charles Scribner's Sons, 1960), pp. 74-75; Tidball, "Artillery Service in the War of the Rebellion," *Journal of the Military Service Institution*, Mar 1893, p. 310; *Official Records*, Vol. 7, pp. 382-83.

62. Tidball, "Artillery Service in the War of the Rebellion," Mar 1893, p. 313; *Official Records*, Vol. 8, pp. 100-07.

63. Tidball, "Artillery Service in the War of the Rebellion," Mar 1893, p. 318; Rpt, MG John A. McClernand, Commanding General, 1st Division, 24 Apr 1862, *Official Records*, Vol. 10. pp. 115-16.

Johnston's aggressive offensive as the rest of Grant's army retired to Pittsburgh Landing. After fierce fighting, Prentiss organized the "most obstinate resistance of the day" by posting infantry and massing artillery immediately behind a dense thicket, called the Hornet's Nest. A Confederate brigade vigorously assailed the Hornet's Nest but recoiled under murderous artillery and musket fire.[64] Another Confederate brigade attacked, but Union cannons and musket fire threw it back in disorder. Finally, successive Confederate charges supported by massed canister fire from 6-pounders and 12-pounder howitzers forced Prentiss to surrender. Although the Union collapsed late in the afternoon of 6 April, Prentiss, perhaps, saved Grant from a disastrous defeat. Prentiss held sufficiently long to allow Colonel Webster to assemble about sixty cannons near Pittsburg Landing where he provided shelter for the retreating, shattered Union army.[65]

Even though Johnston had driven the Union back on the sixth, he could not exploit his field pieces. In his official report Brigadier General Jones M. Withers, a Confederate division commander, complained about the difficult ground that prevented his batteries from staying abreast of infantry advances.[66] Terrain cut by ravines and softened by recent rain hampered moving Confederate cannons and often left commanders without any field pieces for support. Outside of massing artillery to bombard Union positions near Shiloh Church and at the Hornet's Nest, southern commanders generally committed their batteries piecemeal because of the practice of attaching the battery to the brigade and because of the terrain.[67]

The Union army did not did have much better success with its artillery. Lacking a battle line when the Confederates attacked, the Union's field pieces were scattered and remained so through the rest of the day except at Pittsburg Landing, the Hornet's Nest, and Shiloh Church. Like their Confederate counterparts, Union commanders attached the battery to the brigade, deployed their guns in piecemeal fashion, and often split their batteries into two-gun sections to dilute firepower further.[68]

With support from Major General Don Carlos Buell's army that arrived late on 6 April, Grant, understanding the advantage of the initiative, launched a strong offensive. Early in the morning of the seventh, one of Buell's divisions hit the Confederacy. Using field artillery tactics from the Mexican War, Union and Confederate commanders often boldly moved their guns ahead of the infantry line when possible to blast the infantry with canister.[69] Coming into action against the Confederate's extreme right, for example, Captain William R. Terrill's battery assumed an

64. Rpt, Prentiss, 17 Nov 1862, *Official Records*, Vol. 10, part I, pp. 278-79; Rpt, Bragg, 30 Apr 1862, *Official Records*, Vol. 10, part I, pp. 465-66.

65. Rpt, Bragg, 30 Apr 1862, p. 466; Rpt, Prentiss, 17 Nov 1862, pp. 278-79; Grady McWhiney, *Braxton Bragg and Confederate Defeat: Field Command*, Vol. I (New York: Columbia University Press, 1969), p. 242.

66. Rpt, BG Jones M. Withers, CSA, Division Commander, 20 Jun 1862, *Official Records*, Vol. 10, part I, pp. 532-33.

67. Daniels, *Cannoneers in Gray*, pp. 31-34, 38; Rpt, BG Daniel Ruggles, Union division commander, 25 Apr 1862, *Official Records*, Vol. 10, part I, pp. 471-72; Beauregard, "The Campaign of Shiloh," *Battles and Leaders of the Civil War*, Vol. I, p. 586.

68. Rpt, Sherman, 10 Apr 1862, pp. 249-50; Rpt, McClernand, 24 Apr 1862, pp. 115-18; Tidball, "Artillery Service in the War of the Rebellion," Mar 1893, pp. 313-14, 317-19.

69. Rpt, MG Don Carlos Buell, CG, Army of the Ohio, 15 Apr 1862, *Official Records*, Vol. 10, part I, pp. 294-95; Rpt, McClernand, 24 Apr 1862, p. 119; Tidball, "Artillery Service in the War of Rebellion," Mar 1893, p. 323.

advanced position with infantry skirmishers and helped silence enemy small arms and artillery. The Confederate army, nevertheless, forced the skirmishers to retreat. On the verge of being overwhelmed by the Confederacy, Terrill's battery finally retired a section at a time as it fired canister.[70] With his line being hard pressed by a strong Union offensive, Major General Braxton Bragg, one of Johnston's commanders, ordered Captain William W. Ketchum's battery forward. "Advancing the battery in a gallop on a road bringing us on the enemy's left," Ketchum reported, "We came into battery, discharging canister from our six pieces at a distance of 40 to 50 yards, checking his [the Union's] advance and driving him back. . . ."[71] Although pushing the artillery ahead of the infantry worked successfully occasionally, Confederate and Union gunners learned the hazards of this action. At such close range they exposed themselves to heavy rifled musket fire.[72]

During the second day of the battle, Beauregard, who replaced Johnston as commander of the Confederate forces, introduced new artillery tactics to offset the impact of the rifled musket. He started positioning some of his field pieces to the rear of the infantry. Since Beauregard generally employed his cannons on line or to the front, placing them behind the infantry was an isolated practice. Nevertheless, Beauregard and others were at least beginning to realize that they could not thrust their field pieces aggressively ahead of the infantry without suffering damaging consequences. Civil War armies might have advanced their guns in front of the foot soldiers at Shiloh, but the rifled musket caused field artillerymen to place their cannons on elevations behind the infantry as the battle wore on. Like their counterparts and commanders in the East, those in the West learned the futility of Napoleonic field artillery tactics in the face of rifled muskets. Equally important, the heavily wooded terrain on the battlefield limited visibility, which was essential for employing direct fire muzzleloaders effectively, and forced commanders to depend upon smoothbore cannons rather than rifled pieces.[73]

Despite the lessons of Shiloh, commanders and field artillery officers in the West persisted attaching the battery to the brigade and allowing each brigade commander to control the battery. For example, on 30 December 1862 after several days of skirmishing near Murfreesboro, Tennessee, Major General William S. Rosecrans' Army of the Cumberland of 47,000 men and 32 batteries of 185 guns attacked Bragg's Army of Tennessee of 38,000 men and 24 batteries of approximately 124 pieces.[74] In the confusion of battle, some Union batteries shook loose from their brigades and massed fire. For nearly four hours thirty Union field guns grouped together between Brigadier General Phillip H. Sheridan's division and Brigadier General James S. Negley's

70. Rpt, Cpt William R. Terrill, 5th Field Artillery, 8 Apr 1862, *Official Records*, Vol. 10, part I, pp. 321-22; Rpt, Buell, 15 Apr 1862, p. 294.

71. Rpt, Cpt William H. Ketchum, Alabama Battery, 15 Apr 1862, *Official Records*, Vol. 10, part I, p. 528.

72. Rpt, Ketchum, 15 Apr 1862, p. 527; Rpt, Terrill, 8 Apr 1862, pp. 321-22; Rpt, Cpt Henry Richardson, D Battery, Missouri Light Artillery, 9 Apr 1862, *Official Records*, Vol. 10, part I, p. 167; Cpt W. Irving Hodgson, 5th Company, Washington Artillery, 9 Apr 1862, *Official Records*, Vol. 10, part I, p. 513; Rpt, T.J. Stanford, Mississippi Battery, 10 Apr 1862, *Official Records*, Vol. 10, part I, pp. 436-47; Rpt, Cpt W.L. Harper, Jefferson (Washington) Battery, 10 Apr 1862, *Official Records*, Vol. 10, part I, p. 610.

73. Rpt, Cpt John Mendenhall, 4th US Artillery, Chief of Artillery, 5th Division, 9 Apr 1862, *Official Records*, Vol. 10, part I, p. 373; Tidball, "Artillery Service in the War of the Rebellion," Mar 1893, p. 332.

74. Rpt, Rosecrans, 12 Feb 1862, *Official Records*, Vol. 20, part I, p. 192; Rpt, Bragg, 7 Jan 1863, *Official Records*, Vol. 20, part I, p. 664.

division in a clump of cedar trees, known as Round Forest, and raked attacking Confederate infantry with canister.[75] After four unsuccessful charges, the Confederacy stopped its offensive.[76]

By concentrating his batteries as they retreated and massing their fire on the Confederacy, which attacked without any artillery support because of the rugged terrain, Rosecrans repulsed Confederate charges on 31 December and preserved his army. Bragg succeeded in driving Rosecrans from his original position on the right as intended, but massed Union batteries at Round Forest fired at will because they did not face any counterbattery fire and saved Rosecrans from a resounding defeat.[77]

On 2 January 1863 Bragg renewed his offensive. Rather than attacking the strong Union right, he probed the enemy's left across Stones River on a hill overlooking the Confederate right. In the afternoon the Confederacy pressed forward against heavy Union musket and artillery fire. Although the North bombarded the attacking enemy infantry with canister, the South shoved the Union left off the hill. The Federal army formed a new line and counterattacked, but canister fire from Confederate cannons that had just been brought forward broke up the charge. Major General John C. Breckinridge, who commanded the Confederate left, soon realized, however, that fifty-eight Union field pieces on the other side of the river commanded the hill and retreated before being destroyed by hostile field artillery fire.[78]

The Battle of Murfreesboro reinforced the organizational weaknesses of Union and Confederate field artillery in the West and the difficulties of using artillery on the offense, especially on broken terrain. During the course of the battle, Confederate commanders never questioned the valor and dedication of their cannoneers. Yet, they noted that their batteries frequently became lost or separated from their brigades because of the rugged ground.[79] Bragg recorded that his army had to cross "ground of the roughest character, covered with huge stones and studded with the densest growth of cedar. . . ."[80] Because of the "almost impassable terrain," Confederate artillery was rarely employed on 31 December 1862. Therefore, Bragg had to rely on foot soldiers to push the Federal army from Round Forest.[81] Fighting on rugged terrain where the artillery had problems staying abreast of the attacking infantry and committing the guns as single batteries prevented Bragg from exploiting his cannons. This left the Confederate infantry virtually alone to assault Union positions supported by massed artillery.[82]

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75. Tidball, "Artillery Service in the War of the Rebellion," Sep 1892, p. 888; Rpt, MG Lovell H. Rousseau, CG, lst Division, US Army, ll Jan 1863, *Official Records*, Vol. 20, part l, p. 378; Rpt, LTG Leonidas Polk, Army of Tennessee, 28 Feb 1863, *Official Records*, Vol. 20, part l, pp. 687-90; Thomas L. Connelly, *Autumn of Glory: The Army of Tennessee, 1862-1865* (Baton Rouge, La: Louisiana State University Press, 1971), p. 56.

76. Rpt, LTG William J. Hardee, CSA, *Official Records*, Vol. 20, part l, 28 Feb 1863, p. 777.

77. Tidball, "Artillery Service in the War of the Rebellion," Sep 1892, p. 894; Daniels, *Cannoneers in Gray*, p. 59.

78. Rpt, MG John C. Breckinridge, Commanding General, lst Division, CSA, Jan 1863, *Official Records*, Vol. 20, part l, p. 786; Tidball, "Artillery Service in the War of the Rebellion," Sep 1892, pp. 890-97.

79. Rpt, MG Jones M. Withers, Commanding General, 2nd Division, CSA, 20 May 1863, *Official Records*, Vol. 20, part l, p. 758.

80. Rpt. Bragg, 23 Feb 1863, p. 665.

81. Rpt, Breckinridge, Jan 1863, p. 784; Daniels, *Cannoneers in Gray*, pp. 61-63; Rpt, Bragg, 23 Feb 1863, p. 665.

82. Rpt, Hardee, 28 Feb 1863, p. 778; Rpt, Breckinridge, Jan 1863, p. 785.

The Union had greater success exploiting their field pieces during the battle. Although the ground prevented the Federal army from maneuvering its artillery freely, fighting on the defense and retreating allowed the batteries to concentrate. The Union's ability to mass its guns at Murfreesboro despite the difficult terrain and obsolete artillery organization preserved it from a disastrous defeat.

As 1862 drew to a close, the Union and Confederate armies had an interesting mixture of old and new field artillery practices. On the one hand, progressive commanders and field artillery officers were introducing reforms that were more suitable to large armies and rifled weapons. On the other hand, more conservative commanders still attached the battery to the brigade even though such an arrangement hindered massing fire. This was particularly true in the West where commanders and field artillery officers ignored the lessons of Shiloh by maintaining a decentralized command of their artillery.

Equally important, the battles through 1862 indicated the changing role of field artillery in combat. Rifled muskets and wooded terrain prevented using field artillery aggressively on the offensive. Because of the rifled musket, gun crews could not boldly push their cannons within canister range and rake infantry lines with impunity as Major General Zachary Taylor had done in Mexico and as Napoleon had done at the beginning of the nineteenth century. To protect gun crews commanders had to position their batteries behind the infantry line out of range of small arms fire. Also, wooded terrain hampered moving batteries forward to support the advancing infantry. Field artillery was becoming a better defensive than offensive weapon.

The Last Years: 1863-1865

During 1863 Union and Confederate commanders and field artillery officers continued reforming their artillery. Prompted by the battles of 1862 and early 1863, they created strong chiefs of artillery at the division- and corps-level and grouped batteries into battalions in the Confederate army and brigades in the Union army. In doing so, the Union and Confederacy centralized their field artillery even more and enhanced their ability to mass fire.

The Battle of Chancellorsville of May 1863 reemphasized the need for better command of the field artillery. As his predecessors had done, Major General Joseph Hooker, commander of the Army of the Potomac, had weak artillery chiefs for his divisions, attached the battery to the division, retained the artillery reserve, but dismissed Hunt as chief of artillery. This left Hooker without anyone to provide overall guidance for his seventy-four batteries of over four hundred field pieces.[83] To oppose this impressive array of field artillery, Lee's army had only 228 guns. Realizing the necessity of exploiting his existing artillery resources, Lee organized his field artillery into battalions of four to six batteries each and attached four battalions to each corps under a chief of artillery, formed an artillery reserve for each corps, and established an artillery reserve for his entire army during the early months of 1863. By taking these steps Lee centralized his artillery. He clearly understood that concentrating fire was critical to the success of an army whereas Hooker did not fully comprehend the value of massing artillery at an echelon higher than division.[84]

83. Naisawald, *Grape and Canister*, pp. 273-74.

84. Wise, *The Long Arm of Lee*, pp. 413-43; Naisawald, *Grape and Canister*, p. 274.

Early in May 1863, Hooker halted his army near Chancellorsville with the intention of forcing Lee out of his lines at Fredericksburg. Once Lee realized what Hooker hoped to do, he attacked. To protect Fredericksburg Lee left part of his force there and then marched the rest towards Chancellorsville. As he approached Hooker, Lee dispatched Jackson on a sweep around the Union's right flank. After brushing a few pickets aside, Jackson hit the Union XI Corps. In response to the onslaught, Captain Hubert Dilger's battery of six Napoleons and two other batteries opened fire with shot and then canister before falling back because of heavy small arms fire and effective counterbattery work by Confederate artillery. Although Dilger lost one gun when three of the four horses pulling it were shot during the withdrawal, he unlimbered and started hitting the advancing enemy lines once again with canister from his remaining Napoleons to help cover the retreating Union XI Corps. Nevertheless, Dilger had to retire once more to avoid being captured. As soon as the torrent of fugitives from the XI Corps, which included Dilger's battery, had passed, Union cannoneers from three batteries at Hazel Grove poured canister on Jackson's troops. This barrage sent the Confederate army reeling and caused it to flee to the cover of the woods from which it had just emerged. The unexpected shock staggered Jackson so badly that he could not gain the rear of the Union XII Corps as he had done with the XI Corps.[85] After being driven back Jackson tried to outflank the battery at Hazel Grove. Thirty-six Union field pieces at Hazel Grove and thirty-four cannons at Fairview massed canister, case shot, and shell on the Confederacy and prevented the Union right from crumpling on 2 May. The following day, Major General Jeb Stuart, who had assumed command of the flanking movement after Jackson had been seriously wounded the day before, led an offensive that compelled the Union to withdraw its artillery from Hazel Grove. With help from Colonel Edward P. Alexander, who ran battery after battery of Confederate artillery up to Hazel Grove, Stuart later overpowered the Union field pieces at Fairview.[86] The Union fought fiercely, but the lack of ammunition and imminent defeat forced it to retreat. When the Union XII Corps was pushed back, Hooker's entire right flank collapsed. In the meantime, Lee assailed the Union position around Chancellorsville House that had been fortified by grouping fifty-six artillery pieces. When Stuart captured Fairview and closed in towards Lee, Hooker perceived his position at Chancellorsville House to be untenable and retreated.

Although Union artillery performed well at Chancellorsville, it did not achieve its potential. Attaching batteries to the division with no supervision, using the senior captain as the division's artillery chief, and lacking an artillery chief for the entire army created problems. No one directed the North's artillery let alone the division's. Despite being massed on three different occasions and battering Confederate charges, most of Hooker's pieces stood idle because he lacked an artillery chief after relegating Hunt to administrative duties prior to the battle.[87]

Much to Hooker's credit, however, he saw the error of dismissing his chief of artillery. With Lee and Stuart pushing him hard, he assigned Colonel Charles S. Wainwright on the third of May

85. Tidball, "Artillery Service in the War of the Rebellion," Mar 1892, pp. 289-98; Darious Couch, "The Chancellorsville Campaign," *Battles and Leaders of the Civil War*, Vol. III, pp. 179-82; Naisawald, *Grape and Canister*, pp. 290-98.

86. Tidball, "Artillery Service in the War of the Rebellion," Mar 1892, pp. 295-300; Naisawald, *Grape and Canister*, pp. 302-07.

87 Tidball, "Artillery Service in the War of the Rebellion," Mar 1892, pp. 284, 301.

to supervise Federal artillery. For the Union, concentrating its field artillery in the midst of battle was too late. The battle was effectively over with the Confederate army winning a convincing victory.[88]

In his official report on the Battle of Chancellorsville, Hunt complained about the improper use of field artillery. Hunt explained that the command and management of the field artillery, which consisted of 412 guns, 980 carriages, and large ammunition trains, had been left to five field officers and that no artillery commander existed until late in the battle. In a pointed remark Hunt added, "I doubt if the history of modern armies can exhibit a parallel instance of such palpable crippling of a great arm of the service in the very presence of a powerful enemy, to overcome whom would require every energy of all arms under the most favorable circumstances."[89] In his report Hunt leveled a serious charge against Hooker. As far as Hunt was concerned, the general had crippled the field artillery. Many division batteries remained out of action, while the artillery reserve merely guarded the fords over the Rappahanock River and did not see action. For Hunt, the Battle of Chancellorsville reaffirmed the necessity of organizing the field artillery into brigades, attaching them to the corps, and designating a chief of artillery to direct the artillery during battle.[90]

Yet, the terrain certainly did not help massing artillery. With the exception of a few clearings, the dense forest prevented field artillerymen from finding suitable firing positions and hampered maneuvering batteries. As a result, the terrain and artillery organization precluded effective artillery support at Chancellorsville.

Prompted by the poor management of Union artillery at Chancellorsville and earlier battles, Hooker finally decided to make changes. Accepting Hunt's advice, he formed his field artillery into brigades (the equivalent of a Confederate battalion) of four to six batteries each, assigned a brigade to each corps, two to the cavalry, and four to the artillery reserve, established artillery chiefs with command authority, and promoted Hunt to artillery chief of the Army of the Potomac. These actions centralized command of Hooker's artillery of 366 rifled and smoothbore cannons and promised to improve massing fire.[91]

As Hooker revamped his artillery, Lee continued reforming his. Because of the death of Stonewall Jackson at Chancellorsville, Lee restructured his two-corps army into three. As a part of this reorganization, Lee broke up the general artillery reserve by distributing it along with the rest of his field artillery among his three corps that were commanded by Lieutenant Generals James Longstreet, A.P. Hill, and Richard Ewell. This arrangement would ensure that Lee's 272 rifled and smoothbore muzzleloaders would not be held back in battle. Once the reorganization had been completed, Lee had five battalions of four batteries each in the corps under a corps artillery chief. Subject to the corps commander, the corps chief of artillery had total responsibility for directing about eighty guns. As with Hooker, Lee saw that centralizing command was the best

88. Tidball, "Artillery Service in the War of the Rebellion," Mar 1892, p. 302, 309, 310, 316.

89. Rpt, Hunt, 1 Aug 1863, *Official Records*, Vol. 25, p. 252.

90. *Ibid.*

91. Edward B. Coddington, *The Gettysburg Campaign: A Study in Command* (New York: Charles Scribner's Sons, 1968), p. 40; Tidball, "Artillery Service in the War of the Rebellion," May 1892, p. 466; Naisawald, *Grape and Canister*, p. 332.

way to increase firepower without adding more guns. Even though both armies' field artillery organizations differed in terminology, they were both guided by the desire to increase firepower through centralization and the creation of strong artillery chiefs.[92]

The Battle of Gettysburg in July 1863 illustrated the impact of a centralized artillery command. Early in the morning of 1 July, Hill's leading division engaged Brigadier General John Buford's cavalry. Upon meeting, the two forces deployed along McPherson Ridge just west of the town. Soon, the Union I Corps under Major General Joseph I. Reynolds joined the fighting. Colonel Wainwright of I Corps massed three batteries of 3-inch Ordnance rifles and Napoleons on Seminary Ridge and sent one battery forward to assist on McPherson Ridge.[93] I Corps, nevertheless, could not hold because Confederate columns were outflanking it and fell back to Seminary Ridge. As Reynolds was falling back, Major General Oliver O. Howard's XI Corps started deploying on Seminary Ridge. Howard's cannoneers massed their field pieces and fired shell and canister onto the advancing Confederate infantry. Although the Federal army fought tenaciously on Seminary Ridge, Lee's infantry drove it towards Cemetery Ridge.[94] Here, the Union positioned its cannons to command the approaches to the ridge and town. Even though the North had fallen back from its initial positions, resolute fighting allowed Major General George G. Meade, commander of the Army of the Potomac, to bring up his other corps to strengthen his hold along Cemetery Ridge. Equally important, centralized command of the Union artillery ensured that all batteries were engaged and were not idle.[95]

On the second of July, Lee renewed his offense. Under the cover of counterbattery fire from approximately eighty field pieces, Lieutenant General James Longstreet's corps on Lee's right stormed the ground between Roundtop and Little Roundtop.[96] Massed Union artillery poured canister fire to check the advance and prevent the Federal line from collapsing.[97] Although the Union's brigade system for its field artillery was new, it worked. Division and brigade commanders did not have to worry about their artillery since chiefs of artillery maneuvered the batteries around the battlefield to mass fire on critical positions.[98]

In the meantime, Lee assaulted the Union right on Cemetery Hill and Culp Hill as part of a diversionary attack. Confederate forces drove the Union from its entrenchments and captured several field pieces in the process. When Hunt moved his artillery reserve into position and began firing, the Confederate attack stalled. Later, Hunt wrote that all the guns that could be brought to bear on the South opened fire with shrapnel (spherical case) and then with canister with excellent effect.[99]

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92. Naisawald, *Grape and Canister*, p. 333.

93. Rpt, Hunt, 27 Sep 1863, *Official Records*, Vol. 27, part I, pp. 229-30; Alexander, p. 383; Nevins, pp. 232-33; Rpt, Wainwright, 17 Jul 1863, *Official Records*, Vol. 27, part I, p. 355.

94. Nevins, *Diary of Battle*, pp. 235-36; Rpt, Hunt, 27 Sep 1863, pp. 229-31.

95. Rpt, Hunt, 27 Sep 1863, p. 231; Rpt, Wainwright, 17 Jul 1863, pp. 375-85; Tidball, "Artillery Service in the War of the Rebellion," May 1892, p. 484.

96. Tidball, "Artillery Service in the War of the Rebellion," May 1892, pp. 485-86.

97. Hunt, "The Second Day at Gettysburg," *Battles and Leaders of the Civil War*, Vol. III, p. 310.

98. Hunt, "The Second Day at Gettysburg," p. 311; Tidball, "Artillery Service in the War of the Rebellion," Jul 1892, p. 687.

99. Rpt, Hunt, 27 Sep 1863, p. 234.

Although the Confederate attack on the Union right was stopped, Lee's success on the Union left emboldened him to try another assault. To support this thrust Pendleton, Lee's chief of artillery, posted Longstreet's and Hill's artillery battalions (160 cannons) at the edge of the woods along Seminary Ridge to blast the Union on Cemetery Ridge. Ironically, Pendleton failed to exploit all of Lee's artillery by leaving fifty-six cannons in positions that would prevent them from participating in the action.[100] In the meantime, Hunt sited 166 field pieces along Cemetery Ridge and held 54 in reserve. Early in the afternoon, Lee's cannons bombarded Union artillery with shot and shell and forced Meade's field pieces to reply vigorously. Hunt, fearing that his ammunition would be exhausted by such an intense duel, gradually reduced the rate of fire and prepared to bring up batteries from the reserve to replace those that had been damaged during cannonade. As Union artillery fire cut back, Longstreet, who commanded Lee's right, pushed Major General George E. Pickett's division forward to lead the attack. As Pickett's men advanced, Confederate artillery opened fire again. Rather than fighting a counterbattery duel, Federal artillery chose to rake the attacking infantry with shot, shell, and case shot. This shelling by Union batteries tore gaps in the Confederate line but failed to stop it. Union gun crews finally fired canister as battle-tested II Corps soldiers opened a blaze of small arms fire when the Confederates came within range of musket fire.[101] To help the infantry Confederate artillerymen pushed forward approximately eighteen pieces. Nevertheless, their guns were overwhelmed by heavier Federal cannons and provided little assistance. Despite intense artillery and small arms fire, part of Pickett's division finally broke through the Union line, but it was thrown back by Meade's reserves. In the meantime, effective field artillery work tore apart the other divisions supporting Pickett's division and forced them to retreat. As a result, the entire Confederate attack was repulsed.[102]

On 2-3 July the field artillery vindicated Hunt's reforms of 1863. Hunt moved batteries around, directed corps artillery chiefs in their duties, and replaced batteries with fresh ones from the reserve. "The batteries, as fast as withdrawn from any point, were sent to the Artillery Reserve, replenished with ammunition, reorganized, returned to the rear of the lines, and there awaited assignment," boasted Hunt.[103] Because of the artillery reserve, the brigade system, and the special ammunition train created by Hunt, Union gun crews shredded Confederate advances.[104]

Although Lee concentrated his guns and used his corps artillery reserve, he suffered from ammunition shortages and faulty artillery employment. When it appeared that Pickett's charge had failed, Confederate artillery ceased firing because it had nearly exhausted its ammunition during the three-day battle.[105] This allowed Union artillery to focus upon the advancing infantry without facing serious counterbattery fire. Pendleton's misjudgement also played a part in the

100. Rpt, Lee, 20 Jan 1864, *Official Records*, Vol. 27, part 2, p. 320; Wise, *The Long Arm of Lee*, p. 665; Tidball, "Artillery Service in the War of the Rebellion," Jul 1892, pp. 691-92.

101. Coddington, *The Gettysburg Campaign*, p. 513.

102. Tidball, "Artillery Service in the War of the Rebellion," Jul 1892, pp. 695, 698.

103. Rpt, Hunt, 27 Sep 1863, pp. 239-40.

104. Longacre, *The Long Arm of Lee*, pp. 156, 159.

105. Alexander, "The Great Charge and Artillery Fighting at Gettysburg," *Battles and Leaders of the Civil War*, Vol. III, pp. 356-66; Rpt, Lee, 20 Jan 1864, p. 32.

defeat. By allowing fifty-six cannons to sit idle on 3 July, Pendleton gave the Union a significant advantage in the number of field pieces and reduced Confederate firepower.[106]

Nevertheless, the battalion and brigade system worked well for both armies at Gettysburg. Chiefs of artillery, who actually commanded their batteries, maneuvered their pieces around to mass fire. The ability to mass fire was especially critical for the Union. Supported by an artillery organization that permitted fire to be massed easily, Meade's commanders prevented Confederate attacks from overwhelming their lines and with accurate rifled musketry decimated the offense.[107]

Lieutenant General Grant, the terrain where the battles were fought in 1864-65, and the extensive trench networks brought an end to the war of maneuver and further reduced the impact of field artillery on the offense in the East. At the Battle of the Wilderness (5-7 May 1864) in Virginia, dense woods prevented Union and Confederate field artillerymen from using their pieces effectively. Both sides fired at unseen targets and tried to push their way through the tangled undergrowth. The vegetation was so thick that the fighting degenerated into small unit action and limited the field artillery's role. Artillerymen sat idle in rear areas or committed their batteries piecemeal as the infantry grappled with each other. At Spotsylvania (10-12 May 1864) in Virginia, field artillerymen contributed more than they had done during the Wilderness, but by this time both armies had grasped the necessity of entrenching to protect themselves from rifled muskets. Fighting on the defense behind strong breastworks and armed with Napoleons and 3-inch Ordnance rifles, the Confederate small arms and field artillery fire mowed down Union charges despite effective Union counterbattery work. Union cannoneers simply endeavored to sweep the field clear of the enemy and supplement small arms fire without trying to follow the infantry, relied upon increasing the tempo of their firing to defeat the enemy, and often found themselves unemployed when the infantry became involved in skirmishes.[108] Because of the wooded terrain, the construction of entrenchments during the Battles of the Wilderness and Spotsylvania, and poor technique, the field artillery did not serve effectively on the offense, except occasionally when the Union attacked the Confederacy. Protected by breastworks, batteries performed well on the defense as the action during both battles indicated.[109]

Since the Wilderness and Spotsylvania confirmed his belief that he did not need a large number of guns, Grant reorganized his field artillery in mid-May 1864. Thinking that the artillery reserve of forty-nine batteries would not be utilized in the wooded countryside where he planned to fight, Grant proposed sending it back to Washington. That news stunned Hunt, who fought to retain the batteries, men, and material. In order to save the reserve, Hunt recommended reducing each battery from six to four guns and dispersing the remaining reserve units after the 20-pounder Parrott batteries had been dispatched to Washington throughout the rest of the army. By doing this, each corps artillery brigade would be increased to at least twelve batteries, but with less equipment and fewer cannons to hinder mobility.[110]

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106. Wise, *The Long Arm of Lee*, pp. 666-67.

107. Tidball, "Artillery Service in the War of the Rebellion," Jul 1892, p. 692.

108. Longacre, *The Man Behind the Guns*, pp. 193, 194; Alexander, *Memoirs*, p. 498; Naisawald, *Grape and Canister*, pp. 472, 498; Wise, *The Long Arm of Lee*, pp. 179-80; Rpt, Pendleton, 28 Feb 1865, *Official Records*, Vol. 36, pp. 1043-44.

109. McWhiney and Jamieson, *Attack and Die*, pp. 121-22.

110. Longacre, *The Man Behind the Guns*, p. 196; Rpt, Hunt, 31 Oct 1864, *Official Records*, Vol. 36, p. 287.

In his report of 31 October 1864, Hunt explained the potential consequences of dissolving the artillery reserve. He wrote that the many campaigns of 1862-63 had revealed the value of the reserve. "Its record proved that on the field it has done its full share of the fighting and borne its due proportion of the losses of the artillery," Hunt explained. He then added, "At many of our principal battles, notable at Malvern Hill and Antietam, its ammunition trains supplied the batteries of the divisions, many of which would otherwise have been rendered useless."[111] The artillery reserve had kept the field artillery of the Army of the Potomac an effective arm by ensuring that replacements and ammunition could be rushed forward. Persuaded by Hunt's arguments against dissolving the artillery reserve, Grant accepted Hunt's plan, dispersed the reserve's guns throughout the army, and shipped some pieces to Belle Plain, Virginia.[112]

Following the decision to disperse the artillery reserve and the Battles of the Wilderness and Spotsylvania, Grant continued maintaining pressure on Lee by fighting constantly. By early June 1864 the Union and Confederate armies were entrenched at Cold Harbor. Three Union corps occupied Lee's right and two confronted Major General Jubal Early at Bethesda Church. Repeatedly, Confederate artillery employed enfilading canister fire to repel Union charges. Fighting on the strategic and tactical offensive, which the Union army had not done extensively during the war, Union commanders spread their pieces across the entire front and abandoned counterbattery fire.[113] Convinced that frontal assaults against fortifications armed with artillery and rifled muskets were futile, Grant chose to turn Lee's left and proceeded to Petersburg. Although Grant caught Lee by surprise, the Confederate general reached Petersburg first and built strong defenses there. Rather than charging fruitlessly against Confederate fortifications, Grant laid siege from June 1864 through April 1865 with 188 heavy siege pieces and 202 field pieces. The siege finally forced Lee to retreat. Grant pursued him to Appomattox Court House, Virginia, where the Confederate general surrendered in April 1865.[114]

Meanwhile, in the West Bragg reorganized his artillery following his retreat after the Battle of Murfreesboro in Tennessee. Only after prodding from Lee in April 1863, Bragg attached his artillery to the division, established artillery chiefs with command authority, and organized artillery battalions, a general artillery reserve, and a horse artillery. Through these reforms he liberated the battery from the brigade and modernized his artillery organization in the process, while Rosecrans still attached his artillery to the brigade and had chiefs of artillery with little command authority. Ironically, Bragg's artillery marched with the brigade, which left it dispersed despite the reforms.[115]

During the Battle of Chickamauga in September 1863, Bragg employed his newly reorganized field artillery for the first time. Knowing that the Union command was dispersed, Bragg moved to turn the Union's left and cut its lines of communication with Chattanooga. The heavily wooded terrain quickly broke the fighting into brigade-size actions and prevented field artillerymen from

111. Rpt, Hunt, 31 Oct 1864, p. 287.

112. Rpt, Hunt, 31 Oct 1864, p. 287; Longacre, *The Man Behind the Guns*, p. 196.

113. Wise, *The Long Arm of Lee*, p. 318; Naisawald, *Grape and Canister*, p. 498.

114. Naisawald, *Grape and Canister*, p. 530; Huston, *The Sinews of War*, pp. 193-94.

115. Daniels, *Cannoneers in Gray*, pp. 86-88; *Official Records*, Vol. 30, part 2, pp. ll-21.

freely maneuvering their batteries and providing supporting fire. In fact, some Union and Confederate batteries got lost and never fired a round. With a minimal amount of firepower, the Confederacy almost cut through the center of the Union line, but Federal batteries that had become separated from their brigades massed canister fire to end the threat for the day.[116]

The next day, Bragg stunned Major General George H. Thomas, who had barricaded his corps behind rails and old logs on the Federal left. This caused Rosecrans to move units from his right to left where he thought that the major attack would come and created a gap in the Union line. Taking advantage of the break, Longstreet poured his corps into the gap to roll up Thomas' right. Disorder in the Union ranks soon followed.[117] Undaunted by the Confederate success but unable to mass his field artillery because of the difficult terrain and practice of attaching the battery to the brigade, Thomas stood firm. He formed a new line. After a day of tough fighting, Thomas stopped a potential rout that had seen the rest of the Union army retreat back to Chattanooga.[118]

The fighting at Chickamauga provided few opportunities for Confederate cannoneers to mass their field pieces. Drawing upon their past experiences in the Mexican War, conservative division commanders attached their batteries to their brigades and thereby cancelled the introduction of the artillery battalion and policy of attaching the artillery to the division. Confederate commanders simply could not resist relying upon the old ways although the battalion promised to expedite massing fire. The wooded terrain also impeded the Confederacy's ability to pool their field artillery on the tactical offense because the thick woods retarded moving the batteries around the battlefield to support the infantry.[119]

Union cannoneers had similar problems. Major General August Willich, a brigade commander, complained about the unfavorable ground that prevented him from maneuvering his field pieces. In complete harmony with Willich's assessment, Colonel James Barnett, Rosecrans' chief of artillery, explained that the high losses of men and equipment "may be attributed to the fact that the heavy masses of the enemy could get within very short range before the batteries could open on them" because the woods concealed enemy formations until they were close.[120]

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116. Tidball, "Artillery Service in the War of the Rebellion," Nov 1892, pp. 1085-86, 1090-97, 1102-09; Daniels, *Cannoneers in Gray*, pp. 95-96; Rpt, BG William B. Hazen, Commanding General, 2nd Brigade, 28 Sep 1863, *Official Records*, Vol. 30, part 1, p. 762; Rpt, MG Joseph J. Reynolds, Commanding General, 4th Division, US Army, 23 Sep 1863, *Official Records*, Vol. 30, part 1, pp. 440-41; Tidball, "Artillery Service in the War of the Rebellion," Jan 1893, pp. 4, 14, 15, 16, 24, 25; Rpt, MG George H. Thomas, Commanding General, XIV Corps, 30 Sep 1863, *Official Records*, Vol. 30, part 1, pp. 251-52; Rpt, BG A. Baird, Commanding General, 1st Division, undated, *Official Records*, Vol. 30, part 1, p. 275; Rpt, Maj Thomas K. Porter, Chief of Artillery, 10 Nov 1863, *Official Records*, Vol. 30, part 1, p. 360; Rpt, Rosecrans, Oct 1863, *Official Records*, Vol. 30, part 1, p. 62.

117. Rpt, MG Thomas L. Crittenden, Commanding General, XXI Corps, 1 Oct 1863, *Official Records*, Vol. 30, part 1, pp. 610-11; Brevet Brigadier General Gates P. Thruston, US Volunteers, "The Crisis at Chickamauga," *Battles and Leaders of the Civil War*, Vol. III, pp. 663-64; Rpt, Hill, undated, *Official Records*, Vol. 30, part 2, pp. 141-44; Rpt, Hazen, *Official Records*, Vol. 30, part 1, pp. 763-64.

118. Rpt, Brigadier General William Preston, CSA, Division Cdr, 31 Oct 1863, *Official Records*, Vol. 30, part 2, pp. 417-18.

119. Rpt, Porter, 10 Nov 1863, *Official Records*, Vol. 30, part 2, pp. 359-60; Tidball, "Artillery Service in the War of Rebellion," Nov 1892, p. 1093.

120. Tidball, "Artillery Service in the War of the Rebellion," Nov 1892, p 1093; Rpt, Col James Barnett, Chief of Artillery, 1st Ohio Light Artillery, 10 Oct 1863, *Official Records*, Vol. 30, part 1, pp. 233-35; Rpt, Lt Norman A. Baldwin, B Battery, 1st Ohio Light Artillery, 27 Sep 1863, *Official Records*, Vol. 30, part 1, p. 759.

As a result of Chickamauga, Union and Confederate armies in the West reformed their artillery once more. Realizing the need for improving the effectiveness of his cannons, Rosecrans gave two batteries to each division, organized seven batteries into a battalion, and attached the battalion to the corps. Equally important, he established a corps chief of artillery, made Brigadier General John Brannan his chief of artillery, and gave Brannan command authority. For Rosecrans, the reorganization represented a dramatic step. He finally established a field artillery suitable for the huge armies that the Union was fielding in 1863. In the meantime, in November 1863 Bragg formed artillery battalions of three batteries each, attached them to the division, invigorated the artillery reserve by enlarging it from three batteries to seven, and called it the general reserve. Under intense pressure to win, both generals finally grasped that massing fire by centralizing command of the field artillery could mean the difference between defeat and victory.[121]

As Rosecrans and Bragg restructured their artillery, they also positioned their armies around Chattanooga. Perched atop Missionary Ridge, Bragg poured artillery fire on the Union army from batteries scattered along the ridge. Intent on breaking the siege, Secretary of War Edwin M. Stanton (1862-1868) sent two corps from the Army of the Potomac to Chattanooga, while the War Department dispatched four divisions from Major General William T. Sherman's command. By the time that the Union had completed the reshuffling, Grant commanded all Union troops between the Appalachian Mountains and Mississippi River except for Major General Nathaniel Banks' army in Louisiana.

During late November 1863, Grant and Bragg fought for control of Chattanooga, the gateway to the Confederate heartland. Although the battle for the city did not represent a classic battle of maneuver, the field artillery played a decisive role in the Union victory. Grant assembled forty field pieces and two heavy guns on the Confederate left to support Hooker's attack that drove the Confederates off Lookout Mountain. The following day, Grant massed more guns to assist Sherman's attempt to turn the South's right and Thomas' successful assault on the Confederate center. By gathering field artillery to cover infantry advances, Grant prevented Confederate cannons from sweeping Union foot soldiers from the field and demonstrated that he had learned the lessons from previous battles.[122]

Even though Bragg's artillery was well-handled, the terrain and dispersion of his guns in single batteries, two-gun sections, or even one-gun batteries along the ridge adversely influenced his artillery. Because of the steep incline of Missionary Ridge and Lookout Mountain, Bragg's gun crews could not depress the muzzles of their field pieces sufficiently to hit attacking Union soldiers accurately. Scattering his cannons around the battlefield further diluted firepower and indicated Bragg's failure to comprehend fully the significance of massing fire.[123]

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121. Tidball, "Artillery Service in the War of the Rebellion," Jan 1893, p. 28; Birkhimer, *Historical Sketch*, p. 95.

122. Rpt, Thomas, 1 Dec 1863, *Official Records*, Vol. 31, part 2, pp. 92-93; Rpt, BG John M. Brannan, Chief of Artillery, Army of the Cumberland, 5 Dec 1863, *Official Records*, Vol. 31, part 2, p. 551-53; Rpt, Hooker, 13 Mar 1864, *Official Records*, Vol. 31, part 2, p. 317; Grant, "Chattanooga," *Battles and Leaders of the Civil War*, Vol. III, pp. 700-04; Rpt, Sherman, 19 Dec 1863, *Official Records*, Vol. 31, part 2, pp. 573-75; Daniels, *Cannoneers in Gray*, pp. 110, 113.

123. Rpt, Brannan, 5 Dec 1863, pp. 551-53.

The Battle of Chattanooga spawned more changes in Union and Confederate field artillery in the West. During the winter of 1863-1864, General Sherman, who had taken command of the Army of the Cumberland, the Army of the Tennessee, and the Army of the Ohio, obtained the services of Brigadier General William F. Barry as his chief of artillery. Upon assuming his new position, Barry reduced the number of calibers of field artillery from twelve to four (10- and 20-pounder Parrotts, 3-inch Ordnance rifles, and Napoleons), decreased the proportion of cannons from three to two per one thousand men, formed an artillery reserve, and shipped the surplus guns to the rear. By the time that Barry and Sherman had completed reducing their field artillery, they had fifty batteries of 254 guns. Equally important, Barry grouped his artillery into brigades of six to seven batteries each and placed them under a corps chief of artillery in the Army of the Cumberland and under a division chief of artillery in the Armies of the Tennessee and the Ohio. Barry's actions further streamlined field artillery command and gave Sherman greater potential to mass his guns in each of his armies. Meanwhile, General Joseph E. Johnston, who had become commander of the Army of Tennessee, solidified the artillery battalion in the spring of 1864. Although Bragg had formed the Army of Tennessee's field artillery into battalions, his informal command structure had allowed the artillery to follow the brigade. To end this Johnston created battalions of three four-gun batteries, assigned one battalion to a division, and grouped three battalions into a general reserve for the entire army. Johnston further centralized his artillery by assembling his battalions into regiments and attaching them to the corps. However, during combat each battalion reported to a division commander. In July 1864 Johnston disbanded the general reserve and established a corps reserve as Lee had done in the Army of Northern Virginia. Understanding the limitations of decentralized artillery upon operations, Johnston, Barry, and Sherman abandoned the practice of attaching field artillery to the brigade and even division in their attempts to modernize field artillery organization.[124]

Although the field artillery in both armies fought effectively in the Battles of Reseca, Cassville, Kennesaw Mountain, and Bush Mountain as Johnston and Sherman maneuvered southeastward from Tennessee into Georgia, the first opportunity to test their artillery reforms of 1864 really did not come until Major General John Hood, who had replaced Johnston as the commander of the Army of Tennessee in July 1864, decided to take to the offense around Atlanta, Georgia.[125] Late in July, Hood attacked Sherman's army. At Peachtree Creek, north of Atlanta, waves of Confederate infantry supported by artillery hit the Union's extreme left. Entrenched behind temporary breastworks and supported by massed field pieces, Union infantry threw the South back. Unlike Sherman, who took advantage of the recent artillery reforms, Hood could not. The wooded terrain prevented

124. Ltr, Barry, 10 Sep 1863, *Official Records*, Vol. 38, part I, p. 120; Tidball, "Artillery Service in the War of the Rebellion," Jan 1893, pp. 28-29; Daniels, *Cannoneers in Gray*, pp. 313-32; *Official Records*, Vol 38, part I, pp. 89-115. After the Battle of Chattanooga in November 1863, production of field artillery became even more critical than before. As a result of the battle, the Confederacy lost possession of copper mines in the region and had to stop production of bronze field artillery. See William Le Roy Brown's article, "Confederate Ordnance During the War," *Journal of the United States Artillery*, Jan-Feb 1898, pp. 1-13, for more information on the topic of Confederate ordnance production. Brown held various positions in the Confederate Ordnance Department during the Civil War.

125. Allan R. Millet and Peter Maslowski, *For the Common Defense: A Military History of the United States of America* (New York: The Free Press, 1984), pp. 220-21.

the Confederate general from massing his guns on the offense. Unable to withstand intense Union musket and artillery fire, the Confederate army fell back to its defensive works.[126]

As Sherman continued his push to the east of Atlanta to cut the city's lines of communication, Hood assaulted the Union again. Attempting to smash the Union's left, Hood charged on 22 July. Concentrating three batteries, Brigadier General Thomas W. Sweeny of the Army of the Tennessee opened a barrage of canister fire. The Confederate offense overwhelmed a portion of the Army of the Tennessee. Responding to the attack, massed Union artillery and infantry swept the Confederates away. While the Federal army was able to concentrate its field artillery on the defense, Hood's artillery failed to suppress Union cannons. Broken, wooded terrain precluded Confederate artillery from following the infantry and left foot soldiers to assault enemy defenses alone.[127]

Hoping to stop Sherman's movement around the west of Atlanta, which meant a major change of direction for the Union, Hood planned on beating Sherman to Ezra Church crossroads to the west of the city. Nevertheless, Sherman arrived there earlier and quickly entrenched his army. This forced Hood to attack. The Confederates advanced steadily, but the Federal army repulsed it easily. After reforming, the Confederate army charged the Union line across open ground. Major General Oliver O. Howard of the Army of the Tennessee massed twenty-six guns to clear his flank of Confederate infantry. In contrast, Hood's artillery contributed little. Once again, wooded, rugged terrain prevented effective artillery action on the offense. Thus, at crucial times when Hood required massed field artillery fire, he did not have any. He had artillery battalions and chiefs of artillery, but the rough, wooded ground reduced his cannons' effectiveness and negated recent organizational reforms.[128]

In his after action report, General Barry captured the dilemma for Union and Confederate artillery in the rugged terrain around Atlanta. He wrote, "The nature of military operations in a country like ours is peculiar, and often without precedent else where. It is generally unfavorable to the developed and legitimate use of artillery. This is eminently the case. . .where large tracts of uncleared land and dense forest materially circumscribe its usefulness and often force it into positions of hazard and risk."[129] As the battles for Atlanta had demonstrated, difficult terrain was a critical factor in Hood's inability to exploit field artillery on the offense. Cannoneers could mass their field pieces on the defense, which required less movement, but they could not concentrate them on the offense.

Unlike other Civil War battles, those around Atlanta failed to generate significant changes in field artillery organization and tactics. Union and Confederate armies continued grouping

126. Daniels, p. *Cannoneers in Gray*, 157; Jacob D. Cox, Atlanta (New York: Charles Scribner's Sons, 1882), pp. 154-55; Oliver O. Howard, "The Struggle for Atlanta," *Battles and Leaders of the Civil War*, Vol. IV, p. 314; Rpt, Cpt Lyman Bridges, Illinois Light Artillery, 9 Sep 1864, *Official Records*, Vol. 38, part I, p. 488; Rpt, O.O. Howard, 18 Sep 1864, *Official Records*, Vol. 38, part I, pp. 202-03; Rpt, Lt Lyman A. White, Bridge's Battery, 9 Sep 1864, *Official Records*, Vol. 38, part I, p. 496; Rpt, Cpt Wilber F. Goodspeed, Battery A, 1st Ohio Light Artillery, 7 Sep 1864, *Official Records*, Vol. 38, part I, p. 500.

127. Daniels, *Cannoneers in Gray*, p. 158, 169.

128. Cox, *Atlanta*, pp. 184-85; Howard, "Struggle for Atlanta," p. 319; Daniels, *Cannoneers in Gray*, p. 160.

129. Rpt, Barry, 10 Sep 1863, p. 122.

batteries into battalions and attaching the battalion to the corps, while massing fire was still sought to destroy temporary fortifications, support the infantry advance, prevent the enemy from forming, dismount batteries, and crush massed troop formations. By 1864 field artillery battalions and chiefs of artillery with command authority were accepted because they centralized command and promoted the effective massing of fire.[130]

While field artillery organization and tactics underwent radical changes during the war, the transition from smoothbore muzzleloaders to rifled muzzleloaders and breechloaders, as many had hoped, did not transpire. During the war, rifled muzzleloaders, such as the 10-pounder Parrott and 3-inch Ordnance rifle proved to be accurate and effective weapons for counterbattery work. In the meantime, the Union Ordnance Department investigated the possibility of introducing breech-loading field artillery. In March 1864 Chief of Ordnance, Brigadier General George D. Ramsay (1863-1864), found smoothbore muzzleloaders to be superior to rifled breechloaders. In a letter to Secretary of War Stanton, he explained that the rapidity and safety with which smoothbores could be fired were too great to justify adopting rifled breechloaders.[131] If breech-loading artillery could be handled as safely as muzzleloaders, they would be adopted. Given the state of breech-loading technology in the mid-1860s, Ramsay and Union leaders had solid reasons for rejecting rifled breechloaders. Through 1863 the British were experiencing gas leaks with their Whitworth and Armstrong breechloaders. Because of this problem and because of the breechloader's tendency to jam at the breech, the British virtually abandoned its breech-loading system by early 1864 and returned to muzzleloaders. Although an undetermined number of Whitworth and Armstrong breechloaders saw action during the Civil War, neither the North nor South converted to rifled breechloaders. Technological problems with breechloaders simply outweighed the advantages. Yet, the Union and the Confederacy did not necessarily oppose breech-loading artillery in principle. They only wanted to ensure that breechloaders were reliable and would function as they were intended before abandoning rifled or smoothbore muzzleloaders.[132]

Prompted by the problems associated with muzzle- and breechloading field artillery and the nature of the war, Union and Confederate field artillerymen still employed the Napoleon and other smoothbore field pieces. Rifled artillery was more difficult to clean than smoothbore artillery, and their exploding shells were unreliable because of defective fuses. In fact, the Napoleon proved to be the most effective field piece during the war since most battles were fought in difficult terrain at close ranges that allowed the 12-pounder Napoleon to pour shell, case shot, and canister into enemy infantry and prevented gun crews from taking advantage of

130. Birkhimer, *Historical Sketch*, p. 95; Board of Artillery Officers, *Instruction for Field Artillery* (Philadelphia: J.B. Lippincott and Company, 1864), p. 2.

131. Ltr, Ramsay to War Department, 15 Mar 1864, in Benet, *A Collection of Annual Reports*, III, p. 270.

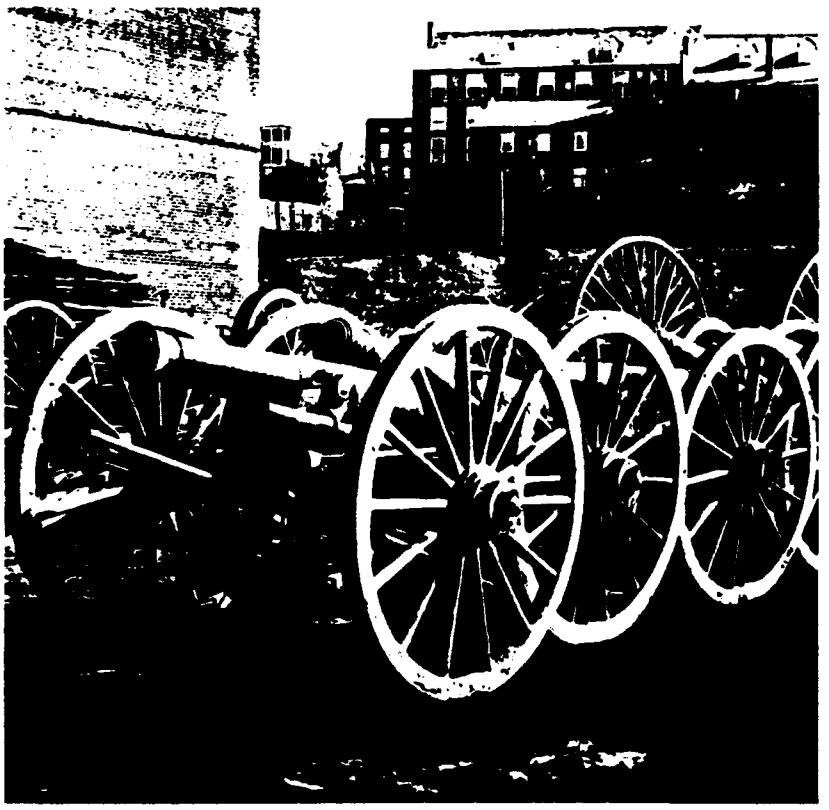
132. Ltr, Ramsay to War Department, 15 Mar 1864, p. 271; "English Field Artillery, The Armstrong System," *Army and Navy Journal*, 12 Dec 1863, pp. 250-51; Nesmith, "The Quiet Paradigm Change," p. 133; William H. McNeill, *The Pursuit of Power: Technology, Armed Force, and Society since A.D. 1000* (Chicago: The University of Chicago Press, 1982), p. 239.

long-range rifled guns.[133]

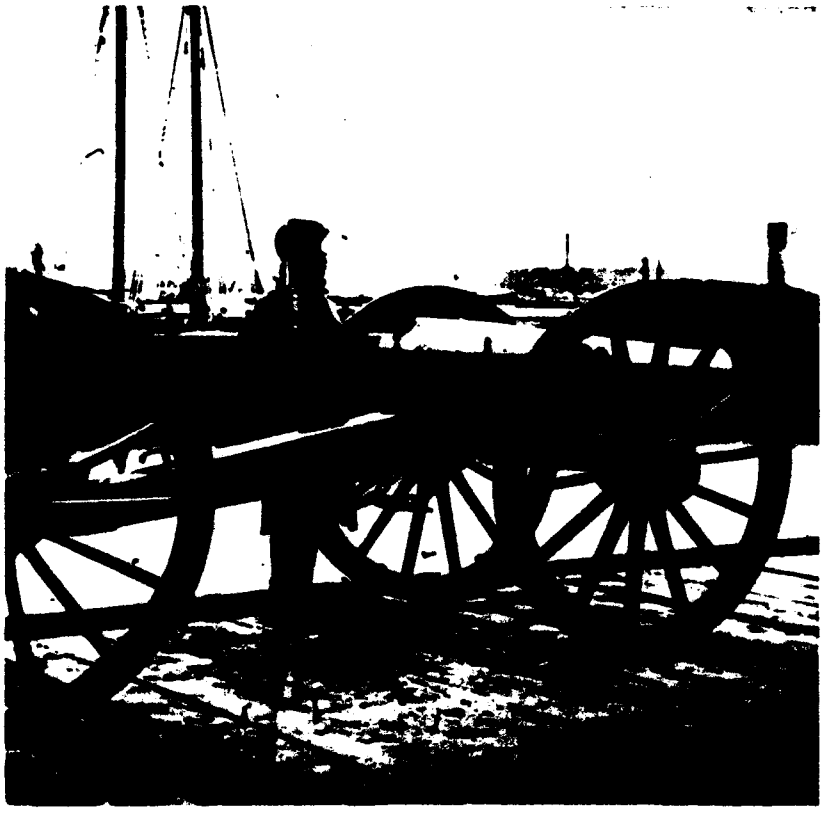
Although field artillerymen did not enthusiastically embrace rifled breechloaders, the reforms of 1861-65 in the Union and Confederate armies dramatically altered the field artillery. Because of the growth in the size of the armies during the Civil War, massing artillery fire assumed a great importance. Deploying batteries piecemeal simply did not provide sufficient firepower to stop large infantry formations from advancing or silence enemy guns. Civil War armies required their guns to be grouped in large numbers to be effective. Concurrently, the huge armies and large battlefields created the need for an artillery reserve to augment the division's or corps' artillery. It permitted chiefs of artillery to replace guns disabled by counterbattery fire or pool artillery at critical spots in the line. In their efforts to establish a field artillery system suitable for large armies, Civil War commanders and artillery officers, in effect, imitated Napoleonic field artillery organization of the early 1800s. After all, it was the model upon which all European armies built their artillery.

Ironically, the technological revolution of the 1840s and 1850s had made Napoleonic field artillery tactics, which Civil War armies used at the outset of the war, obsolete. Rifled muskets made cannoneers vulnerable. Rather than pushing their guns in front of the infantry to blast the opposing line with canister, commanders had to position their artillery behind the infantry on elevations from which they could bombard the enemy but be out of range of small arms fire. Because of the rifled musket and terrain, the field artillery no longer served as a bold offensive weapon as it had done during the Napoleonic and Mexican Wars. Its greatest value during the Civil War involved massing on the defense to rake enemy infantry. Technological changes had knocked the field artillery from its position of being the supreme offensive weapon.

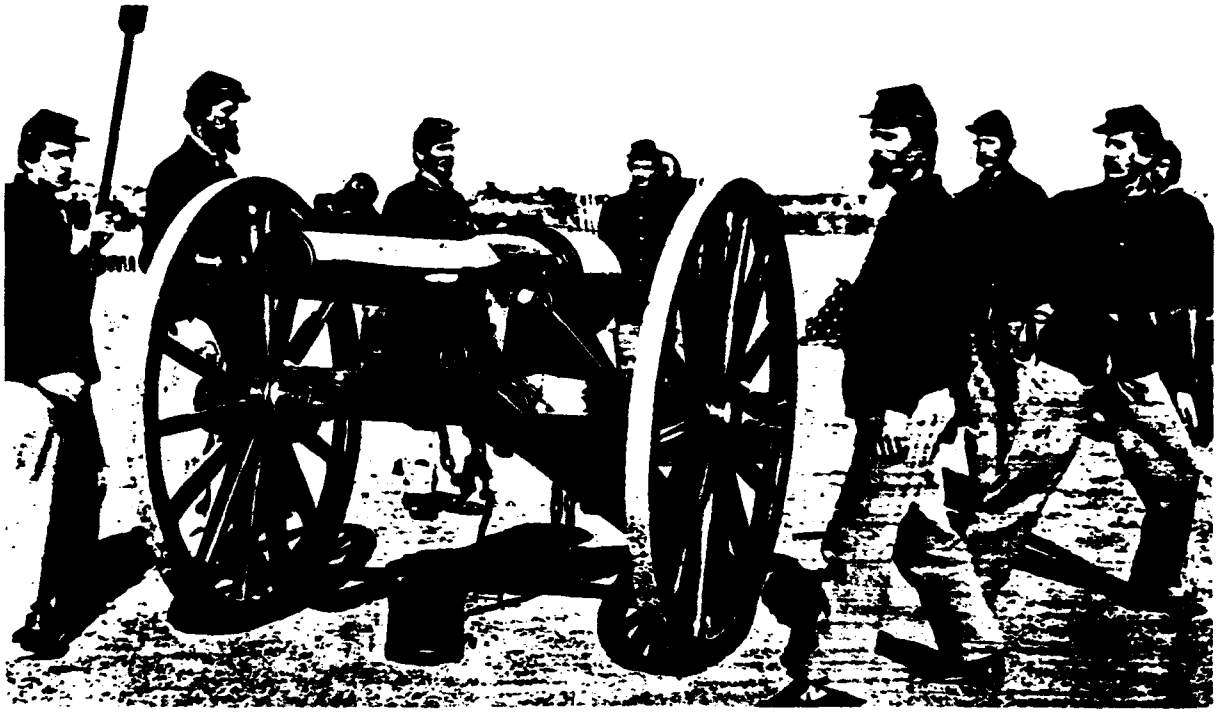
133. Endorsement, Ltr, H.F. Mann of Pittsburgh, 4 Jul 1864, in Benet, *A Collection of Annual Reports*, III, p. 278; Warren Ripley, *Artillery and Ammunition of the Civil War* (New York: Van Nostrand Reinhold Company, 1970), pp. 15, 372-73; Birkhimer, *Historical Sketch*, pp. 285, 294; Barry, "A Few Facts About Artillery," *United States Service Magazine*, Jan 1864, pp. 12-14; Weigley, *History of the United States Army*, p. 273; McWhiney and Jamieson, *Attack and Die*, p. 123.



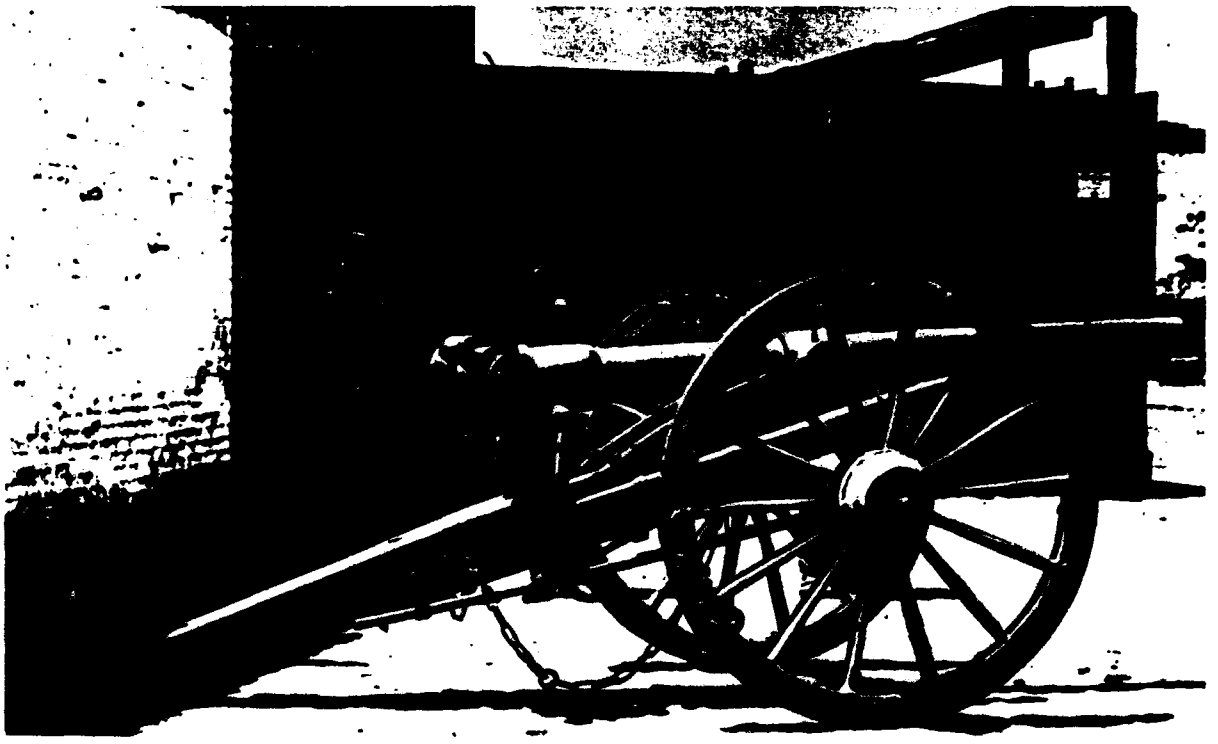
6-pounder field gun, Model M1841.



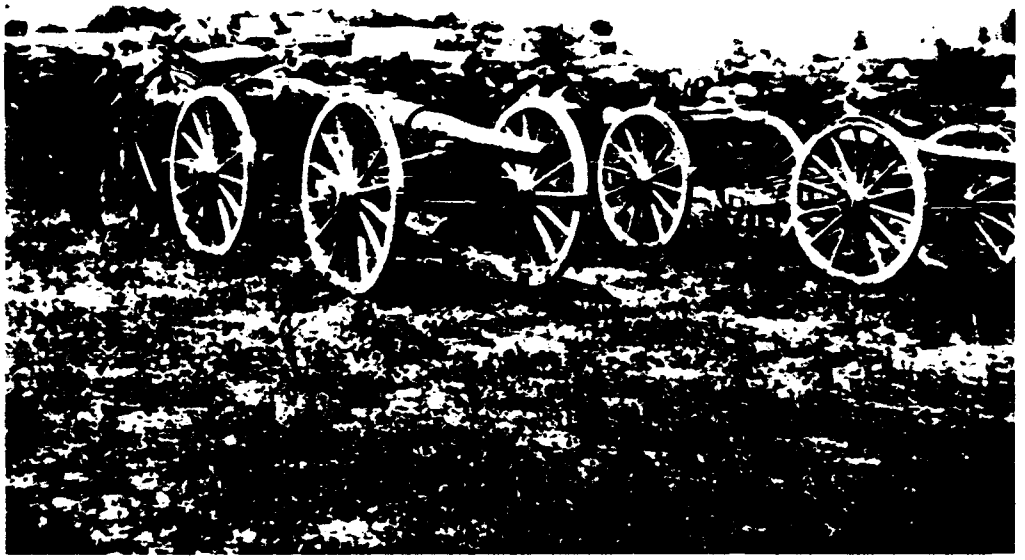
12-pounder Napoleon, Model 1857, Civil War.



Model M1861 3.67-inch Parrott Rifle with crew, ca. 1861.



Whitworth 12-pounder breech-loading rifle, ca. 1861.



20-pounder Parrott rifled guns of the 1st New York Battery, June 1862.

Chapter V

TOWARDS A NEW FIELD ARTILLERY: 1865-1898

Following the Civil War, the War Department slowly modernized its field artillery. Indian warfare, a surplus of Civil War cannons, and problems with the new technology discouraged introducing rifled, steel breechloaders. Nevertheless, the War Department replaced its smoothbore and rifled muzzleloaders with steel breechloaders by 1898.

Years of Frustration: 1865-1898

After the Civil War the War Department returned to peacetime duties. Although the Commanding General of the Army, General Ulysses S. Grant (1864-1869), wanted a Regular Army of eighty thousand men, Congress and Secretary of War Edwin Stanton (1862-1868) disagreed. In July 1866 Congress voted to create a Regular Army of fifty-four thousand men to serve in forty-five infantry regiments, ten cavalry regiments, and five artillery regiments of field and coast artillery. When the southern states were authorized to restore their militias, Congress cut the authorized strength of the Army to forty-five thousand men in 1869. This action gave the Army twenty-five infantry regiments, ten cavalry regiments, and five artillery regiments with field and coast artillery batteries. Each of the five artillery regiments had one battery of 12-pounder Napoleons and one battery of 3-inch Ordnance rifles, while each field battery was composed of one captain, three lieutenants, two staff sergeants, four sergeants, eight corporals, two artificers, two buglers, twenty-four drivers, and thirty-four cannoneers. As with the rest of the Army, the ten field batteries were scattered throughout the United States to help enforce Reconstruction policies, to patrol the Mexican border, and to serve on the frontier.[1]

Before the peacetime Army was completely organized, the federal government had to take measures to stop the Indian wars in the West. Toward that end the government signed a series of peace treaties in 1865 and devised a policy of moving the Indians onto reservations in areas that the whites did not desire. Unhappy with reservation life in Indian Territory (Oklahoma), many

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1. War Department, *Instruction for Field Artillery*, 1867, p. 4; William E. Birkhimer, *Historical Sketch of the Organization, Administration, Materiel and Tactics of the Artillery, United States Army* (James J. Chapman, 1884, reprinted by Greenwood Press, 1968), pp. 72-73, hereafter cited as *Historical Sketch*; Russell F. Weigley, *History of the United States Army* (New York: Macmillan Publishing Company, Incorporated, 1967), p. 266; Vardell E. Nesmith, Jr., "The Quiet Paradigm Change:The Evolution of the Field Artillery Doctrine of the United States Army, 1861-1905," unpublished doctoral dissertation, Duke University, 1977, pp. 71-72.

Cheyenne Indians rebelled by raiding nearby white settlements. To stop the Indian depredations, General William T. Sherman and Major General Philip H. Sheridan outlined an ambitious winter offensive in 1868 to drive the Cheyenne back onto the reservation. Three columns were to converge on the Indians located in the far western part of Indian Territory. Major Andrew W. Evans would lead one column from Fort Bascom, New Mexico. Lieutenant Colonel (brevet brigadier general) Alfred Sully would command a column from Fort Dodge, Kansas, and Major (brevet major general) Eugene A. Carr would head another column from Fort Lyon, Colorado.[2]

Even though Lieutenant Colonel George A. Custer, who succeeded Sully as commander of the column from Fort Dodge, and Evans demonstrated the value of winter campaigning by successfully defeating the Cheyenne, their actions reflected a reluctance to employ field pieces against Indians. Despite the availability of field artillery, Custer did not tow any cannons along with him because he thought that he would not need any.[3] Characteristic of many cavalry officers of the era, Custer saw limited use for field artillery in Indian warfare.[4] In contrast, Evans took four mountain howitzers with him, but he left them behind when he was chasing the Indians and only employed his howitzers to fight off Indian attacks.[5] Both, Custer and Evans feared that pulling field pieces along with them would restrict their mobility and ability to catch the Indians in rugged terrain.[6]

Part of Custer's and Evans' aversion to field artillery undoubtedly stemmed from artillery practices of the day. In view of the Army's Civil War experience and European practices, War Department manuals emphasized massing field artillery to attack troop formations, fortifications, or hostile batteries. Field artillery tactics fit harmoniously with the conventional battlefield and were not designed for Indian warfare where mobility was more important than firepower and where hit-and-run tactics predominated. As a result, many Army officers failed to see the need for employing field pieces on the frontier to defeat lightly armed, mobile Indians and were reluctant to tow field pieces with them in difficult terrain.[7]

Besides this, many artillery officers questioned whether rifled breechloaders were better than rifled muzzleloaders. Based upon the performance of breechloaders during the Civil War, many American artillery officers did not see any reason to abandon muzzle-loading artillery. Whitworth and Armstrong breechloaders used in the war had been difficult to maneuver and did

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2. E.S. Godfrey, "Some Reminiscences, Including the Washita Battle," *The Cavalry Journal*, Oct 1928, p. 483; D.B. Randolph Keim, *Sheridan's Troopers on the Borders: A Winter Campaign on the Plains*, 1885, reprinted by Books for Libraries Press, Freeport, NY, 1970, p. 253; Carl G. Rister, "Colonel A.W. Evans' Christmas Day Indian Fight (1868)," *The Chronicles of Oklahoma*, Sep 1938, pp. 285, 289, 290, 292-95; W.S. Nye, *Carbine and Lances: The Story of Old Fort Sill* (Norman, Ok: University of Oklahoma Press, 1937), pp. 78-83.

3. Robert M. Utley, *Life in Custer's Cavalry: Diary and Letters of Albert and Jennifer Barwitz, 1867-1868* (New Haven, Ct: Yale University Press, 1977), pp. 188, 201.

4. Larry D. Roberts, "The Artillery with the Regular Army in the West," unpublished doctoral dissertation, Oklahoma State University, 1981, p. 60.

5. Rister, "Colonel A.W. Evans' Christmas Day Indian Fight," p. 293.

6. Roberts, "The Artillery with the Regular Army in the West," pp. 56-59.

7. Board of Officers, *Instructions for Field Artillery*, (Philadelphia: J.B. Lippincott, 1864), p. 2; MG J.P. Sanger, "The Artillery Council of 1887," *Journal of the United States Artillery*, Sep-Dec 1918, p. 244.

not have a rate of fire that was noticeably faster than muzzleloaders.[8]

Not even the Austro-Prussian War of 1866 encouraged the War Department to adopt rifled breechloaders. Like Whitworth and Armstrong breechloaders, the Prussians' steel breechloaders manufactured by Alfred Krupp, the Prussian industrialist, leaked gas at the breech and often exploded when fired. Moreover, Austrian gun crews performed better than their Prussian counterparts, and aggressive Austrian field artillery tactics prevented Prussian field artillery from playing a decisive part in the Prussian victory. Influenced by the ineffective work of Prussian field artillery but more so by defective steel breechloaders, most European armies resisted arming their field artillery with breechloaders.[9]

Despite the rifled breechloader's ambiguous record during the American Civil War and the Austro-Prussian War, the ordnance board of 1868 recognized the breechloader's potential. The board urged Secretary of War John M. Schofield (1868-1869) to authorize tests conducted by the War Department to determine if breechloaders were superior to muzzleloaders. After approving the board's proposal, Schofield made plans in March 1868 to experiment with breechloaders and muzzleloaders. The existence of a surplus of smoothbore muzzleloaders from the Civil War (4,346 cannons) and the problems with breechloaders prevented the Secretary from taking any action. In view of this, American artillery officers, who pushed equipping the field artillery with breechloaders, faced an unreceptive audience; and nothing was done to introduce the latest field pieces as the 1860s drew to a close.[10]

International affairs also influenced modernizing the field artillery following the Civil War. Disputes over Confederate debts, a border dispute in the West, and conflicts over fishing rights in the waters off North America kept tension high between the United States and Great Britain. This caused the Chief of Ordnance, Brigadier General Alexander B. Dyer (1864-1874), to neglect the field artillery. Since Congress, the Commanding General of the Army, General William T.

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8. Ltr, BG Ramsay to War Department, 15 Mar 1864, in Stephen V. Benet, ed., *A Collection of Ordnance Reports and Other Important Papers Relating to the Ordnance Department*, Vol. III (Washington: Government Printing Office, 1890), p. 271, hereafter cited as *A Collection of Ordnance Reports*; Ltr, Ramsay to War Department, 4 Jul 1864, in Benet, *A Collection of Ordnance Reports*, III, p. 278; "English Field Artillery—The Armstrong System," *Army and Navy Journal*, 12 Dec 1863, p. 250.

9. "Austrian and Prussian Armaments," *Army and Navy Journal*, 16 Jun 1866, pp. 683-84; William Manchester, *The Arms of Krupp, 1587-1968* (Boston: Little, Brown and Company, 1968), pp. 100-01; "Breech-loading Ordnance," *Army and Navy Journal*, 26 Jun 1875, p. 738; Prince Kraft zu Hohenlohe Inglefingen, *Letters on Artillery*, trans by Colonel N.L. Walford (London: Edward Stanford, 1898), pp. 59-74; *Army and Navy Journal*, 29 Oct 1870, p. 165; Frank E. Comparato, *Age of Great Guns: Cannon Kings and Cannoneers Who Forged the Firepower of Artillery* (Harrisburg, Pa: The Stackpole Company, 1965), p. 25; Michael Howard, *The FrancoPrussian War: The German Invasion of France, 1870-1871* (London: Methuen, 1981), p. 5; William H. McNeill, *The Pursuit of Power: Technology, Armed Force and Society since A.D. 1000* (Chicago: The University of Chicago Press, 1982), p. 251; Bernard and Fawn M. Brodie, *From Crossbow to H-Bomb: The Evolution of the Weapons and Tactics of Warfare* (Bloomington, In: Indiana University Press, 1973), p. 141; "Austrian and Prussian Armament," *Army and Navy Journal*, 16 Jun 1866, p. 638; Manchester, *The Arms of Krupp*, pp. 100-01, 119-21; *Army and Navy Journal*, 21 Oct 1871, p. 154; Arthur T. Coumbe, "Combined Arms Operations in the Franco-German War of 1870-1871," *Field Artillery*, Aug 1988, p. 11.

10. Report, Secretary of War, 1866, pp. 13, 181-82; "Light Artillery Board," Annual Report, Chief of Ordnance, 1882, p. 10; "Rifled Field Guns and Rifled Mortars," *Army and Navy Journal*, 21 Oct 1871, p. 155; *Army and Navy Journal*, 25 Nov 1870, p. 165.

Sherman (1869-1883), and artillery officers failed to show any discernible interest in improving the field artillery to fight Indians, Dyer devoted his energies to introducing modern coast artillery.[11]

Meanwhile, the Franco-Prussian War of 1870-71 convinced European and American artillery officers to reassess their position on breechloaders. After having technological difficulties with its steel field guns during the Austro-Prussian War, the Prussian army discarded all of its smoothbore field artillery between 1866 and 1870 for improved Krupp steel breechloaders that did not leak gas at the breech and concurrently revised its field artillery tactics. With the introduction of rifled breechloaders with effective ranges beyond four thousand yards, the general reserve, which had been created to mass fire from smoothbores with effective ranges of three hundred yards to four hundred yards with canister and one thousand yards with shell, had become obsolete. Consequently, the Prussians abolished the general reserve and stressed employing all of the available guns at the beginning of the battle. To mass fire the Prussians stressed placing field artillery in the center of the corps' line and shifting the direction of fire rather than physically moving batteries around the battlefield as was necessary with smoothbore artillery. Armed with superior field guns and tactics, the Prussians smashed the French army in 1870-71.[12] In an article in the *Army and Navy Journal* in 1870, an anonymous writer commented, "It [the Prussian artillery] was bad in the Danish War, not good in the Austrian, and is now good, though the accounts of observers say it is not excellent. However that may be, it is better in every way than the French, and it has been seen in more than one battle holding the enemy far beyond his own striking distance and soundly punishing him there."[13] Persuaded by the success of Prussian steel breechloaders, European countries began equipping their armies with steel breech-loading field artillery in the 1870s.[14]

Technological developments paved the way for manufacturing steel breechloaders. Although the Bessemer process, first introduced in the mid-1850s, improved the quality of steel and reduced production costs, the perfection of the Siemens-Martin openhearth method in the 1870s made possible even greater control over the quality of steel and at the same time cut costs. By using hot waste gases or gases generated from low-grade coal to preheat the fuel and air, the Siemens-Martin method yielded strong, elastic, tough, erosion- and heat-resistant steel, making it even more desirable for gun tubes.[15]

Besides adopting steel breechloaders, Europeans developed recoil systems, smokeless powder, and new ammunition during the last three decades of the nineteenth century. For years gunners had searched for practical ways to eliminate the fatiguing task of pushing the cannon back

11. Nesmith, "The Quiet Paradigm Change," pp. 85, 90, 101, 103, 104; Report, Secretary of War, 1866, pp. 13, 181-82; "Light Artillery Board," Annual Report, Chief of Ordnance, 1882, p. 10; "Rifled Field Guns and Rifled Mortars," *Army and Navy Journal*, 21 Oct 1871, p. 155.

12. Manchester, *The Arms of Krupp*, pp. 119-20; Coumbe, "Combined Arms Operations in the Franco-German War of 1870-1871," pp. 12-13; Hohenlohe, Letters on Artillery, pp. 129-32; Comparato, *Age of Great Guns*, pp. 26, 31, 209; Phillips H. Stevens, *Artillery Through the Ages* (New York: Franklin Watts, Inc., 1965), p. 87; *Army and Navy Journal*, 29 Oct 1870, p. 165.

13. *Army and Navy Journal*, 29 Oct 1870, p. 165.

14. *Army and Navy Journal*, 25 Nov 1871, p. 237.

15. Comparato, *Age of Great Guns*, pp. 26, 31, 209; Stevens, *Artillery Through the Ages*, p. 87.

into battery after the recoil had moved the gun out of position to be fired. To solve this problem Europeans searched for an effective recoil system. Rather than mounting the cannon directly on the carriage, Krupp used a cradle that allowed the tube to move back and forward. The tube was coupled to a hydraulic cylinder with a recoil rod. The recoil rod was attached to a piston with orifices so arranged that when the cannon recoiled, the piston was pulled through the cylinder, forcing the oil through the orifices and absorbing the recoil. This action also compressed a spring inside the hydraulic cylinder that returned the tube back into battery when the recoil stopped. Although the Krupp system, which was introduced in 1873, allowed the cannon to recoil on the ground, it still reduced the time to relay and reload the gun. Soon, other Europeans were designing recoil systems similar to Krupp's. By the mid-1890s most European field artillery manufacturers were using wheel brakes, trail spades, hydraulic cylinders, and springs to absorb the recoil. Coupled with fixed ammunition in which the projectile and powder charge were one unit, efficient breech mechanisms, and sights, recoil systems permitted Europeans to produce quick-fire (rapid-fire) field guns with capabilities of firing up to ten rounds a minute, three times faster than muzzleloaders.[16]

With the fielding of the M1897 75-mm. breechloader, the French created the model rapid-fire gun. The M1897 recoil system consisted of two parallel cylinders that were connected at the breech by a series of valves and a diaphragm. In the upper cylinder a piston was attached to a rod. In the lower cylinder was a floating piston that separated the fluid from pressurized air. During recoil, the rod pulled the piston through the upper cylinder and forced the fluid in that cylinder through the valves and diaphragm into the lower cylinder to brake the rearward movement of the cannon. The fluid movement into the lower cylinder compressed the air. At the end of the recoil, the compressed air forced the fluid back into the upper cylinder and moved the gun tube back into battery. The system was so sound that the cannon recoiled and returned to its firing position, while the carriage remained stationary to permit the tube to stay aligned on its target. The gun's recoil system, sights, and breech mechanism allowed the crew to fire up to thirty rounds a minute with fixed ammunition.[17]

The introduction of smokeless powder complemented recoil systems and breech mechanisms. Desiring a propellant that did not obscure the battlefield with smoke as black powder did upon firing, Henri Braconnot of Nancy, France, produced a highly inflammable substance in 1832 by treating sawdust or cotton with nitric acid. Although Braconnot's invention was highly volatile and unmanageable, it proved to be comparatively smokeless and more powerful than black powder. That encouraged other European inventors to experiment with nitrogen-based compounds.[18] In 1884 a French chemist, Paul Vieille, developed the first dependable

16. Comparato, *Age of Great Guns*, pp. 32-36.

17. Comparato, *Age of Great Guns*, pp. 38-39; Brodie, *From Crossbow to H-Bomb*, p. 143; Shelford Bidwell and Dominick Graham, *Fire-Power: British Army Weapons and Theories of War, 1904-1945* (London: George Allen and Unwin, 1982), pp. 8-9.

18. Joseph Jobe, ed., *Guns: An Illustrated History of Artillery* (Greenwich, Ct: New York Graphic Society, 1971), pp. 138-39; W.J. Savoy, "The Evolution of the American Modern Light Field Gun," unpublished masters thesis, US Army Command and General Staff College, 1978, p. 9; Brodie, *From Crossbow to H-Bomb*, p. 143; Comparato, *Age of Great Guns*, pp. 84-85; Oliver F.G. Hogg, *Artillery: Its Origin, Heyday, and Decline* (Hamden, Ct: Archon Books, 1970), pp. 135-41.

nitrocellulose (a combination of nitric acid and wood pulp or cotton) propellant for military use. Building upon Vieille's invention, Alfred Nobel of Sweden combined nitrocellulose and nitroglycerine and patented his propellant as ballistite in 1888, which the British subsequently named cordite.[19]

Slower and more controllable burning of smokeless powder provided other benefits. Black powder generated a high breech pressure and had a burning rate that was so fast that the gases could only accelerate the projectile a short distance in the tube. In comparison, smokeless powder burned longer and generated an explosive force that created less pressure but propelled the round longer in the tube, producing greater muzzle velocity and range. In addition, smokeless powder was almost four times more powerful than black powder.[20] Taking advantage of smokeless powder's burning rate, power, and low breech pressure, gun manufacturers were able to reduce the size and weight of the breech and introduced longer tubes. Because of these developments, the new gun tubes appearing in the 1890s weighed between nine hundred and one thousand pounds and allowed European field artillerymen to throw fifteen- to sixteen-pound projectiles over five thousand yards with the French 75-mm. reaching almost eight thousand yards. Only two decades earlier, a breechloader with a tube of comparable weight, a 12-pounder Armstrong field piece, shot a 12-pound projectile about four thousand yards.[21]

In the meantime, Europeans introduced high explosives as bursting charges for their ammunition. In the 1870s the Germans experimented with dynamite, but it was too stable to be detonated by the simple fuses of the day. Through the work of Vieille and his associate, Emile Sarrau, the French learned to control picric acid, a highly explosive substance, in 1886. Vieille's and Sarrau's combination of picric acid and nitrocellulose was patented as melinite and later accepted for French service as a shell filler. Soon, other European countries were using melinite to explode field artillery rounds. Unlike shells that were filled with black powder and fragmented into five to six pieces, shells filled with high explosives shattered into about one thousand splinters and were deadly when employed against troops.[22]

Although some form of primitive indirect fire for the field artillery had existed for years, increased ranges and firepower as demonstrated by the Franco-Prussian War encouraged artillery officers to develop an effective method of indirect fire to protect their guns in defilade positions and take advantage of the long ranges to hit targets beyond the limits of human eyesight. Initial methods of indirect fire depended upon a line of markers from the gun to the point where the target became visible. This was unsatisfactory for a mobile battlefield and caused Europeans to search for a better method. In 1882 a Russian officer, Karl G. Guk, described the basics of the

19. Brodie, *From Crossbow to H-bomb*, p. 143.

20. Comparato, *Age of Great Guns*, p. 85.

21. A.B. Dyer, *Handbook for Light Artillery* (New York: John Wiley and Sons, 1898), pp. 120-33; Comparato, *Age of Great Guns*, p. 39; Brodie, *From Crossbow to H-Bomb*, p. 143; Savoy, "The Evolution of the American Modern Light Field Gun," p. 10; Hogg, *Artillery*, p. 141; Sisson C. Pratt, *Field Artillery: Its Equipment, Organization, and Tactics* (London: Kegan Paul, Trench, Truebner and Company, 1902), pp. 6-7; Field Artillery School, *History of the Development of Field Artillery Materiel*, 1940, pp. 48-49; Warren Ripley, *Artillery and Ammunition of the Civil War* (New York: Van Nostrand Reinhold Company, 1970), p. 372; Hew Strachan, *European Armies and the Conduct of War* (London: George Allen and Unwin, 1983), p. 119.

22. Comparato, *Age of Great Guns*, pp. 82-95.

modern indirect fire system when he outlined the role of the compass, the aiming point, and the forward observer. Essentially, the system involved laying the sight of one gun of a battery on an aiming point, such as a stake or steeple. Then the angle between that point, the gun (the apex), and the target was measured by the forward observer and was set off on the sight dial. The base piece and other guns, allowing for intervals, were then traversed the requisite degrees to bring them to bear on the target. Range was estimated and adjusted by the forward observer. If shells landed to the right or left of the target, the forward observer corrected the deflection. By the 1890s the Germans, Russians, and French were introducing the aiming point method because it was the most effective form of indirect fire. Even though the British were aware of this technique for indirect fire, they lagged behind the others and did not adopt it until the twentieth century because of conservatism. Even so, European artillery officers preferred direct fire because it was less complicated and permitted attacking a target more quickly.[23]

The appearance of rapid-fire field pieces late in the 1890s reinforced the necessity of hiding batteries to protect them and employing indirect fire. In 1897 the French pointed out that a plainly visible battery positioned on high terrain, the traditional location for guns, could be easily destroyed by counterbattery fire. In agreement German Major General Moriz Edler von Reichold noted in 1897 that the increased ranges, improved efficiency, the precision of modern fire, and the introduction of smokeless powder made utilizing natural and artificial cover imperative. The field artillery had to keep itself out of sight as long as possible to be effective and to prevent it from being destroyed through counterbattery fire and had to employ indirect fire.[24]

By the end of the 1890s, steel breechloaders with recoil systems and high rates of fire (ten to thirty rounds a minute) that threw high explosive, metallic-cased cartridge ammunition up to eight thousand yards began to appear. Such field pieces dramatically multiplied firepower, caused new tactics to be introduced, and encouraged the development of indirect fire. Interestingly, indirect fire, even though it represented a major breakthrough because gun crews could hit unseen targets and take advantage of their guns' long ranges, had the potential of destroying the field artillery's support for the infantry and cavalry. Hidden from view, the field artillery would not be able to see the other combat arms as they maneuvered and could not identify the gravest threats to the infantry and cavalry. Because of indirect fire, the field artillery had to depend upon a forward observer, who was tenuously linked to the guns with a field telephone or other means of communication, to locate targets. As a result, fire support was becoming dependent upon the ability to communicate via mechanical means, which were susceptible to destruction during combat.[25]

In the meantime, the US Army slowly improved its field artillery. Hampered by the lack of

23. Major General Moriz von Reichold, "Indirect Fire," *Journal of the United States Artillery*, Sep-Oct 1897, pp. 171-75; Cpt Ernest Hinds, trans., "Employment of Artillery Fire," *Journal of the United States Artillery*, Jul-Aug 1904, pp. 55-57; Hinds, trans. "Employment of Artillery Fire," *Journal of the United States Artillery*, Sep-Oct 1904, p. 156; J.B.A. Bailey, *Field Artillery and Firepower* (Oxford: The Military Press, 1989), pp. 118-19; Chris Bellamy, *Red God of War: Soviet Artillery and Rocket Forces* (London: Brassey's Defense Publishers, 1986), pp. 28-30.

24. von Reichold, "Indirect Fire," p. 170; Maj M. Wallut, trans., "Employment of Rapid Fire Artillery in the Field," *Journal of the United States Artillery*, 1905, p. 204; Comparato, *Age of Great Guns*, p. 97.

25. Strachan, *European Armies and the Conduct of War*, p. 119. Armies were using visual or electrical means to communicate. For example, they employed heliographs, signal flags, and telephones. The last was preferred because it was the most rapid and secure means of communication.

funds and a surplus of Civil War field artillery, the War Department took several years to develop its first breechloader.[26] Encouraged by the Chief of Ordnance, Colonel Stephen V. Benet (1874-1891), the Ordnance Department finally remodeled a 3-inch Ordnance rifle in 1878 to make it a breechloader. The department cut the gun at the breech, added a Krupp sliding steel breech block, rebored the gun to a 3.18-inch diameter to use the latest rifled ammunition, and mounted the piece on a steel carriage to withstand the increased strain caused by the larger charges and greater tube elevations. Named the 3.18-inch Breech Loading Chambered Rifle, the converted gun proved to be a satisfactory weapon. Subsequently, five more 3-inch Ordnance rifles were converted. The War Department designated all six guns the 3.2-inch Breech Loading Rifle (Converted) and instructed the Ordnance Department to test them.[27] Following the trials, Benet indicated in his annual report for 1879 that he was pleased because the breech mechanism did not stick.[28]

Emboldened by the initial success of the converted 3.2-inch piece, the Light Artillery Board of 1881, convened by the War Department to consider changes in harnesses, guns, and equipment for the field artillery, suggested a competition between the converted 3.2-inch breechloaders and muzzleloaders.[29] Subsequently, Colonel Benet placed six 3.2-inch guns onto active service and pitted them against the muzzleloaders.[30] The trials demonstrated that the breechloaders were sound and dependable and were preferable to muzzleloaders. Even though converting the 3-inch Ordnance rifle to a breechloader was an efficient way to dispose of the gun and also an inexpensive way to procure breechloaders, the War Department never standardized the converted 3.2-inch field gun. Steel breechloaders, which were beginning to dominate European field artillery, were making wrought-iron field pieces obsolete. Based upon this, Benet and the board urged the War Department to introduce steel breechloaders to stay current with field artillery developments in Europe.[31]

That recommendation by Benet and the board represented an important milestone in the evolution of the field artillery following the Civil War. Differing with the existing push to convert wrought-iron muzzleloaders to breechloaders to save money, Benet and the board announced their desire to adopt the latest technology by arming the field artillery with steel breechloaders.[32] Converting muzzleloaders to breechloaders was nothing more than an expediency as far as Benet and the board were concerned because steel breechloaders were the wave of the future.[33]

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26. Konrad F. Schreier, Jr., "The U.S. Army 3.2-inch Field Gun," *Military Collector and Historian*, Fall 1972, p. 77; Rogers Birnie, *Gun Making in the United States* (Washington: Government Printing Office, 1905), pp. 27, 33; Nesmith, "The Quiet Paradigm Change," pp. 134-39, 147; Birkhimer, *Historical Sketch*, p. 32.

27. Nesmith, "The Quiet Paradigm Change," p. 191; Birnie, *Gun Making in the United States*, p. 32; Savoy, "The Evolution of the American Modern Light Field Gun," pp. 27-29; Annual Report, Chief of Ordnance, 1882, p. 10.

28. Annual Report, Chief of Ordnance, 1879, p. 179.

29. Annual Report, Chief of Ordnance, 1879, p. 179; Ltr, Benet to Ordnance Board, 21 Sep 1882, Benet, *A Collection of Ordnance Reports*, III, p. 334.

30. Ltr, Benet to Ordnance Board, 21 Sep 1882, pp. 333-34; Nesmith, p. 192; Annual Report, Chief of Ordnance, 1879, p. 9, 179.

31. Schreier, "The U.S. Army 3.2-inch Field Gun," p. 78; Ltr, Benet to Ordnance Board, 21 Sep 1882, p. 334; Annual Report, Chief of Ordnance, 1882, p. 10; Birkhimer, *Historical Sketch*, pp. 294-96.

32. Annual Report, Chief of Ordnance, 1882, p. 10; Ltr, Benet to Ordnance Board, 21 Sep 1882, p. 334.

33. Schreier, "The U.S. Army 3.2-inch Field Gun," p. 78.

Moving to make steel field pieces a reality, Benet directed the Light Artillery Board to design a steel breechloader. Because of the abundance of 3.2-inch ammunition, the board kept the caliber of the new weapon at 3.2 inches and examined two different 3.2-inch breechloaders in 1884. One had the DeBange breech, and the other had the Freyre breech.[34] Trials in 1884 indicated that both cannons, which were mounted on steel carriages, had ranges of 6,479 yards at twenty degrees elevation, and used black powder, were comparable to similar field pieces in Europe. Consequently, the board recommended putting the 3.2-inch steel breechloader into service. With permission from the War Department, the Ordnance Department issued an order in 1885 to the Watertown Arsenal, Watertown, Massachusetts, to manufacture five newly designated M1885 3.2-inch guns with the DeBange breech and another order to the West Point Foundry, West Point, New York, for twenty cannons with the Freyre breech.[35] These twenty-five guns with steel carriages, limbers, and caissons were delivered to the War Department and tested in 1887. After a few minor modifications, the guns were then issued to the field artillery. After the 3.2-inch gun had seen service for a short time, the War Department ordered seventy-five more of them with the DeBange breech because the Freyre breech was easily damaged during operation. Once these guns reached the field in the 1890s, the War Department had one hundred in service.[36]

Introducing the M1885 field gun, steel carriages, and telescopic sights moved the field artillery into the age of breechloaders. Through the 1880s Civil War era pieces dominated the Army's field artillery inventory. Expressing his concern, Secretary of War William C. Endicott (1885-1889) complained to Congress and the President in 1887 that we "have nothing but smoothbores and rifled muzzle-loading guns used during the late war. New guns are required in order to maintain the efficiency and discipline of our artillery regiments. . .Indeed, to use them [the existing stocks of artillery] in war against the improved field batteries of other nations would put our troops at terrible disadvantage."[37] That same year, Benet reported that the Army had "absolutely no suitably equipped field batteries" should an emergency arise, that the Ordnance Department possessed only two dozen modern steel field guns, and that the Army's field artillery was twenty-five years old.[38] In 1888 Benet reemphasized the inferiority of the War Department's field artillery in relation to its European counterpart. Endicott quickly came to Benet's aid by noting that "some of the light artillery is still plodding along with the same guns they had at the close of the war of rebellion although the Prussians learned. . .that such guns would not meet modern requirements."[39] As far as Endicott and Benet were concerned, the War Department had to replace its obsolete field artillery to stay abreast of European developments.[40]

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34. Nesmith, "The Quiet Paradigm Change," pp. 218-22; Savoy, "The Evolution of the American Modern Light Field Gun," pp. 29-30; Ltr, Benet to Ordnance Board, 21 Sep 1882, pp. 333-34.

35. Annual Report, Chief of Ordnance, 1884, pp. 19-20; Annual Report, Chief of Ordnance, 1882, p. 10; Annual Report, Chief of Ordnance, 1886, p. 23; Savoy, "The Evolution of the American Modern Light Field Gun," pp. 30-31; Annual Report, Chief of Ordnance, 1885, pp. xxiii, 499.

36. Savoy, "The Evolution of the American Modern Light Field Gun," p. 30; Nesmith, "The Quiet Paradigm Change," p. 232.

37. Annual Report, Secretary of War, 1887, I: 32.

38. *Ibid.*, I: 13-15.

39. Annual Report, Secretary of War, 1888, I: 104.

40. Annual Report, Secretary of War, 1887, I: 13-15.

An inventory of antiquated Civil War pieces and twenty-five M1885 3.2-inch field guns caused others to voice their concern. In an address to the Military Service Institution, a professional association for Army officers and interested civilians to promote writing and discussing military science and history, Captain Rogers Birnie of the Ordnance Department complained in 1887 about the War Department's coast and field artillery. Because of the limited number of modern guns, it was third rate.[41] The Artillery Council of 1887, an unofficial body composed of ten artillery officers from the five artillery regiments, agreed.[42] "The ideas engendered by the late civil war, that the nation had unbounded military strength. . .and that a body of infantry and cavalry is all that the country requires to terminate the Indian hostilities," the council wrote in 1887, "have served to divert public attention from the actual condition and needs of the artillery during the past twenty years."[43]

In many respects the council was right since the Indian wars of the 1870s and 1880s certainly did not encourage vast rearmament but did prompt finding a suitable piece for frontier duty. Although the 3-inch Ordnance rifle, the 12-pounder Napoleon, and the 12-pounder mountain howitzer were deployed against the Indians, frontier commanders of the 1870s did not find these field pieces suitable. The mountain howitzer, which weighed 220 pounds, had an effective range of nine hundred yards with spherical case, the most useful round in Indian warfare, whereas breech-loading rifles employed by the Plains Indians in the 1870s had effective ranges of twelve hundred yards and made serving on a gun crew suicidal. Moreover, the 3-inch Ordnance rifle with a tube weight of 830 pounds and Napoleon with a tube weight of 1,230 pounds were heavy and cumbersome to move over rugged terrain. During his campaign against Chief Joseph of the Nez Perce, Brigadier General Oliver O. Howard complained frequently about the Herculean efforts required to pull field artillery along when the Indians were on the move.[44]

Colonel Nelson A. Miles expressed similar concerns. Based on his experiences against the Sioux and Cheyenne, in 1877 he insisted that the mountain howitzer and 3-inch Ordnance rifle were too heavy for service on the Indian frontier. The Army required a light field gun with a range that was superior to the small arms used by the Indians. Pressured by Miles and the need for a light, mobile field piece on the frontier, the War Department bought a Hotchkiss 1.65-inch breech-loading rifled gun that used metallic fixed ammunition and weighed 117 pounds. The cannon's carriage could be broken down and loaded on horses to facilitate movement, while the cannon had an effective range of four thousand yards. Even though the piece's projectile was lighter than the 3-inch Ordnance rifle's, the Napoleon's, and mountain howitzer's and did less damage when it exploded, Miles expressed satisfaction with it. In fact, the gun rendered valuable service in 1877 against Chief Joseph.[45] Because the 1.65-inch piece was much lighter than the mountain howitzer

41. Birnie, *Gun Making in the United States*, p. 9.

42. Sanger, "The Artillery Council of 1887," p.244.

43. *Ibid.*

44. Robert M. Utley, *Frontier Regulars: The United States Army and the Indian, 1866-1890*, (Bloomington, In: University of Indiana Press, 1976), pp. 199-200, 303-05; Annual Report, Secretary of War, 1877, p. 605; Oliver O. Howard, *Nez Perces' Joseph* (Boston: Lee and Shepard Publishers, 1881), pp. 159-62.

45. Annual Report, Chief of Ordnance, 1878, p. xiii; Annual Report, Chief of Ordnance, 1879, p. 23; Paul I. Wellman, *The Indian Wars of the West* (Garden City, NY: Doubleday, 1947), p. 179.

and 3-inch Ordnance rifle, it soon became the dominant field piece on the frontier.[46]

As the Indian campaigns of the 1870s and 1880s indicated, the challenge of moving cumbersome field artillery over rugged country restricted its use. When the Indians were running, field artillery was generally worthless because it could not stay up with fast-moving cavalry or infantry columns.[47] However, when the Indians fought on the Army's terms or when the Army defended against Indian charges, field artillery demonstrated its value. Although commanders employed field guns whenever the opportunity presented itself, the difficulties of pulling cannons along when chasing the Indians reinforced the popularly held opinion that only cavalry or infantry could be effectively utilized in Indian warfare. This led General Sherman to conclude as early as 1875 that field artillery was limited to "war on a large scale."As far as Sherman was concerned, field artillery's only real value was engaging massed troop formations on the conventional battlefield.[48]

Moreover, the Indian wars also caused field artillerymen's skills to deteriorate. If commanders used guns or howitzers, they generally employed them individually or in twos.This stemmed from the lack of cannons on the frontier and the necessity of dispersing them around the Trans-Mississippi West. Moreover, untrained cavalry or infantry usually served the pieces, while artillerymen, serving on the frontier, were detailed as infantry or cavalry.[49] The War Department recognized that gunners were losing their skills. After dismounting five field batteries in 1869, the War Department sent four of the remaining five field batteries to Fort Riley, Kansas, to form a school for practical instruction. Even before the school could have any impact, the War Department closed it in 1871 and diverted artillerymen to cavalry duty to satisfy the urgent need for soldiers on the frontier.[50] Some years later in 1884, First Lieutenant William E. Birkhimer of the 3rd Artillery Regiment bitterly wrote, "In a word, the field artillery school was strangled in its infancy. That which, if properly nurtured, gave promise of fair proportions, bringing strength, symmetry, and high order of excellence to the field artillery. . ."[51] As such, frontier duty, dismounting half of the ten field batteries, and the lack of a school of instruction designed especially for field artillery prevented cannoneers from practicing or learning more about their trade during the 1870s and 1880s.[52]

The existing regimental organization also impaired the development of effective field batteries. Because of the heterogeneous regiments created after the Civil War, the War Department

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46. 1LT Alexander D. Schenk, "The Pack Mule and Mountain Howitzer," *Journal of the United States Artillery*, Oct 1894, p. 584; Utley, *Frontier Regulars*, pp. 72-73; Annual Report, Chief of Ordnance, 1878, p. xiii; Robert G. Murray, "Artillery Against the Northern Plains Indians, 1823-1890," *Gun Report*, Oct 1967, p. 27; Dyer, *Handbook for Light Artillery*, pp. 23, 57; Birkhimer, *Historical Sketch*, pp. 296.

47. Annual Report, Secretary of War, 1877, pp. 604, 606.

48. Annual Report, Secretary of War, 1875, I: 18.

49. Utley, *Frontier Regulars*, p. 73.

50. Birkhimer, *Historical Sketch*, pp. 137-38.

51. *Ibid.*, pp. 138-39.

52. Utley, *Frontier Regulars*, p. 73; Annual Report, Secretary of War, 1880, I: 7; Annual Report, Secretary of War, 1883, I: 153, 155; Annual Report, Secretary of War, 1885, I: 128; Richard P. Weinert, Jr., and Colonel Robert Arthur, *Defender of the Chesapeake: The Story of Fort Monroe* (Annapolis, Md:Leeward Publications, Inc, 1978), pp. 141-46.

continued the pre-war practice of rotating officers between coast and field artillery units. The field artillery was not recognized as an independent branch of artillery and existed in name only.[53] Even though the War Department was arming its field batteries with the M1885 3.2-inch gun, modernizing the field artillery required more than adopting one new gun. Trained gun crews did not exist, while obsolete guns and howitzers outnumbered modern field pieces. Equally important, tactics were still based upon smoothbore artillery.

The state of the field artillery generated serious cries for reform early in the 1890s. Seeking to improve the artillery, the War Department tested steel field carriages, smokeless powder, pneumatic and hydraulic recoil brakes, a metal cartridge case, high explosives to burst projectiles, and elevating, traversing, and sighting mechanisms for the M1885. The War Department even developed a longer tube (M1890) for the 3.2-inch gun. However, it produced only one because the one hundred M1885 guns met the field artillery's requirements. Like the M1885, the M1890 employed black powder and separate-loading ammunition because smokeless powder used in cartridge ammunition deteriorated rapidly in storage and because the M1890's breech mechanism like the M1885's could not be easily adapted to cartridge ammunition without extensive redesign and modification. As a result, serious work with smokeless powder and cartridge ammunition was dropped.[54] In addition, the War Department introduced a 3.6-inch field gun and 3.6-inch mortar, divided the field artillery into light (3.2-inch gun) and heavy (3.6-inch) batteries, and made provisions for forming field artillery battalions of two, three, and four batteries.[55] Seeing the virtue of rapid-firing artillery, the Ordnance Department also tested a rapid-fire 6-pounder gun similar to those being introduced in Europe.[56]

In the meantime, influenced by the introduction of the M1885 and M1890 3.2-inch field pieces, both of which threw explosive shell, canister, and shrapnel, the War Department reformed battery organization, operations, and tactics and opened a school for practical instruction. War Department drill regulations of the 1890s for the field artillery specified a wartime battery of six pieces with one captain, four lieutenants, three staff sergeants, fifteen corporals, five artificers, two trumpeters, one guidon bearer, one wagoneer, forty-eight drivers, eighty-four cannoneers, eight supernumerary drivers, and two range finders to determine the distance to the target and other points that might be fired upon. However, the continued practice of rotating officers between field and coast artillery units hampered forming effective field batteries.[57]

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53. Lt E.M. Weaver, "History of Second Artillery," *Journal of the Military Service Institution*, Nov 1893, p. 1259; Theo Rodenbaugh and William L. Haskin, *The Army of the United States* (New York: Maynard, Merrill, and Company, 1896), p. 372; Lt Charles Parkhurst, "Field Artillery: Its Organization and Its Role," *Journal of the United States Artillery*, Jul 1892, p. 266; Bvt Lt George M. Wright, "Shall the United States Have Light Artillery," *Journal of the United States Artillery*, Jan 1895, p. 65.

54. Weigley, *History of the United States Army*, p. 291; Annual Report, Chief of Ordnance, 1890, p. 5; Annual Report, Chief of Ordnance, 1893, p. 29; Annual Report, Chief of Ordnance, 1894, p. 44; Schreier, "The U.S. Army 3.2-inch Field Gun," pp. 78-79; Savoy, "The Evolution of the American Modern Light Field Gun," p. 31; Annual Report, Chief of Ordnance, 1891, p. 16; Dyer, *Handbook for Light Artillery*, p. 261.

55. Annual Report, Chief of Ordnance, 1891, p. 16; Dyer, *Handbook for Light Artillery*, p. 261.

56. Annual Report, Chief of Ordnance, 1894, p. 43.

57. War Department, *Light Artillery Drill Regulations*, 1891, pp. 231-32; Schreier, "The U.S. Army's 3-inch Field Gun Model 1902," *Military Collector and Historian*, Winter 1973, p. 185; Schreier, "The U.S. Army 3.2-inch Field Gun," pp. 78-84; War Department, *Drill Regulations for Light Artillery*, 1896, pp. 222-23.

Also, a gun crew for the M1885 normally had two corporals and five privates. The senior corporal served as the gunner, aimed the cannon, and loaded the projectile and powder charge, while the junior corporal was the caisson corporal. Number one private rammed the round. Number two handed the projectile and powder charge to the gunner, inserted the primer into the vent in the breechblock, fired the weapon, and alternated with number four, who carried the ammunition from the caisson. Number three assisted the gunner as needed to point the piece in the desired direction. Number five inserted the fuse into the round and gave the projectile and powder charge to either number two or number four. Occasionally, number five was assisted by two privates, which then gave the crew seven members. The biggest difference between operating muzzleloaders and breechloaders was the positioning of the cannoneers. Rather than being stationed at the end of the muzzle, numbers one and two were placed behind the carriage wheels at the breech to load the cannon at the breech rather than at the muzzle.[58]

With the introduction of long-range breechloaders, US Army artillery officers also debated the value of the general artillery reserve. After arguing that field artillery should be attached to the corps and not the brigade or division, First Lieutenant Charles D. Parkhurst of the 4th Artillery Regiment wrote in 1892 that a general reserve was essential for massing fire to support the infantry and cavalry.[59] Five years later, First Lieutenant William E. Birkhimer of the 3rd Artillery Regiment noted that civilians had commanded divisions and in some cases corps in past wars and did not understand the necessity of massing artillery. As a result, they objected when their field artillery was taken away from them and often refused to permit the corps commander to take their artillery. This was particularly true at Fredericksburg where Burnside's division commanders complained loudly when he took their artillery to mass it for a river crossing.[60] "Let us, therefore, leave our volunteer or inexperienced subordinate generals in full possession of their divisions or other commands, and not organize our army in such manner that these subordinates will be deliberately disconcerted at the very time when their only thoughts should. . . be directed solely to getting the most fighting out of their troops," Birkhimer maintained.[61] In other words, a general reserve was essential so that commanders could mass their guns without alienating their subordinates. Dispensing with the reserve in a professional army like Germany's might be possible and even desirable, but it would be impossible in the US Army since many officers were volunteers. Like Parkhurst, Birkhimer feared that disbanding the general artillery reserve would reduce the commander's ability to mass fire.[62] Ironically, Parkhurst and Birkhimer failed to see that the 6,600-yard range of the 3.2-inch field gun permitted shifting the direction of fire to mass fire and meant that commanders would not have to move batteries around as frequently to mass fire as long as the guns were strategically positioned along the front.

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58. War Department, *Light Artillery Drill Regulations*, 1891, pp. 34-35, 44-47, 49-50, 394-95, 421; War Department, *Drill Regulations for Light Artillery*, 1896, pp. 52-53, 382-83, 408.

59. 1LT Charles D. Parkhurst, "Field Artillery, Its Organization and Its Role," *Journal of the U.S. Artillery*, Jul 1892, p. 269.

60. 1LT Birkhimer, "Question of an Artillery Reserve," *Journal of the Military Service Institution*, May 1897, p. 533.

61. *Ibid.*, p. 534.

62. *Ibid.*, pp. 534, 536-39.

In an article entitled, "An Antiquated Artillery Organization," in the *Journal of the Military Service Institution* in 1895, Captain Arthur L. Wagner, a rising military intellectual, assaulted the general artillery reserve.[63] Seeking support for his position, he turned to the Prussian army because it had eliminated the general artillery reserve when it introduced effective steel breechloaders in the 1870s. Noting that the US Army was equipping its ten field batteries with the 3.2-inch field piece with a range of 6,600 yards, Wagner insisted upon abolishing the general reserve in favor of corps artillery reserve. Like the Prussians, Wagner advocated employing the corps reserve from one corps to help another if necessary.[64] Wagner concluded, "It would seem that the segregation of one-fourth to one-third of the field batteries to form an artillery reserve for the army is plainly a sacrifice of power of throwing a preponderating force of artillery into action promptly."[65] Wagner pushed a radical reform of field artillery organization and tactics. He wanted to abandon obsolete practices based upon smoothbore cannons for tactics and organization grounded on rifled breechloaders.

The debate over the general artillery reserve represented more than just a fight over the preferred method of massing fire. It also reflected the resistance to change. Birkhimer, Parkhurst, and other officers feared innovation and saw no reason to abandon the general artillery reserve because it had proven itself during the Civil War.[66] In contrast, Wagner understood that breechloaders permitted massing fire by shifting the direction of fire, pushed to abolish the general reserve, and visualized that steel breechloaders would revolutionize field artillery tactics. As a result, he pressed to take advantage of the emerging technology.[67]

The War Department responded to the move to dissolve the general artillery reserve. Through 1892 it authorized a general reserve. For example, in *Troops in Campaign, Regulations for the Army of the United States* (1892) the War Department recommended assigning not more than three-fourths of the field artillery to the corps or division. The rest would be organized into brigades and constitute the reserve of the army.[68] Four years later, in *Drill Regulations for Light Artillery* (1896) the War Department placed all of the field artillery in the corps or division.[69] Given the increased ranges of the field artillery of the 1890s and the German success in 1870-71 without a general reserve, the War Department finally concluded that massing fire could be accomplished by redirecting fire rather than holding back part of the guns to be rushed forward at a critical time and spot and that all field pieces would be committed at the start of a battle. Holding back a portion was no longer acceptable by 1896 because the commander needed to

63. Cpt A.L. Wagner, "An Antiquated Artillery Organization," *Journal of the Military Service Institution*, Jul-Dec 1895, pp. 40-57.

64. Nesmith, "The Quiet Paradigm Change," p. 124; Arthur L. Wagner, *Organization and Tactics* (Kansas City, Mo: Kimberly Publishing Company, 1894), p. 325; Wagner, "An Antiquated Artillery Organization," p. 56; Hohenlohe, *Letters on Artillery*, pp. 47, 129-31.

65. Wagner, "An Antiquated Artillery Organization," p. 56.

66. Cpt James Chester, "The Army Artillery Reserve," *Journal of the Military Service Institution*, Jan-May 1895, pp. 491-98.

67. Wagner, *Organization and Tactics*, pp. 325-26.

68. Birkhimer, "Question of an Artillery Reserve," pp. 529-30.

69. War Department, *Drill Regulations for Light Artillery*, 1896, pp. 381-82.

increase the amount of firepower available to the offense at the beginning of the battle to overcome the defense that had been strengthened at the expense of the offense with the advent of rifled small arms and field artillery.[70]

Steel breechloaders also prompted Army artillery officers to explore the possibility of adopting indirect fire to protect their cannons from counterbattery work. In articles in the *Journal of the United States Artillery* in the 1890s, they wrote that ranges in excess of six thousand yards and precision fire of modern field guns made direct fire impractical because the gun crew could not see a target at such distances and because a battery in the open could be easily destroyed. Consequently, gun crews had to hide their field pieces and develop indirect fire methods. Yet, American artillery officers of the 1890s were reluctant to adopt indirect fire for the same reasons that their European contemporaries opposed indirect fire. Technique and technology needed to be refined more before the Americans were willing to employ indirect fire. As a result, the field artillery lacked indirect fire capabilities and still stressed direct fire to engage targets.[71]

As artillery officers struggled to adjust to the new technology of the 1890s, they also recognized the need for trained gunners to serve the M1885. In 1887 Congress authorized the War Department to establish a school of instruction for drill and practice for the cavalry and field artillery that would consist of one regiment of cavalry and no more than five field batteries to teach officers and enlisted men in the combined operations of cavalry and field artillery as well as the special duties of each arm.[72] Five years later in 1892, the War Department established The School of Application for Cavalry and Light Artillery at Fort Riley, Kansas. During the academic year, the school commandant devoted one half of the training to each branch and the other half to combined operations.[73] Although artillery officers and enlisted personnel received valuable theoretical and practical training at the school, Major William F. Randolph, who directed the field artillery portion of the training, wrote in 1894 that combined operations was "the most important and instructive portion of our work. . . ."[74]

The creation of the US Cavalry and Light Artillery School, the introduction of the M1885 3.2-inch field piece, new gun crew operations and tactics consolidated the revolution in American field artillery. Armed with steel breechloaders with ranges of 6,600 yards, trained gun crews of the late 1890s had more firepower than their predecessors had. Yet, the War Department persisted rotating officers between field and coast artillery batteries and had obsolete field artillery at the

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70. *Ibid.*, p. 385.

71. Cpt William Lassiter, "Range and Position Finding," *Journal of the United States Artillery*, Apr 1895, pp. 239-40; "The Theoretical and Practical Training of the Light Artillery," *Journal of the United States Artillery*, Sep-Oct 1897, p. 164; von Reichold, "Indirect Fire," pp. 170, 171, 174-75; "Field Artillery on the Smokeless Battlefield," *Journal of the United States Artillery*, Jan 1894, p. 134; ILT Joseph E. Kuhn, "A New Method of Indirect Laying for Field Artillery," *Journal of the United States Artillery*, Jul 1894, pp. 445-47; Graham A. Cosmas, "San Juan Hill and El Caney, 1-2 July 1898," in Charles E. Heller and William A. Stofft, eds., *America's First Battles: 1776-1965* (Lawrence, Ks: University Press of Kansas, 1986), pp. 114-15.

72. Annual Report, US Cavalry and Light Artillery School, 1892, pp. 1-3; Morris Swett, "The Forerunners of Sill," *Field Artillery Journal*, Nov 1938, p. 460.

73. Swett, "The Forerunners of Sill," p. 460.

74. Annual Report, US Cavalry and Light Artillery School, 1894, p.20.

end of the nineteenth century. Although the War Department had several different guns, the M1885 3.2-inch field piece, which formed the heart of the field artillery, failed to keep pace with European advancements because it used separate-loading ammunition, lacked a recoil system, and utilized black powder as a propellant and a bursting charge. In comparison, European rapid-fire field guns had recoil systems, used fixed ammunition, and fired smokeless propellants.

The Spanish American War

The Spanish-American War of 1898 furnished the War Department with the first opportunity to test its new field artillery. When President William McKinley chose to use military force to expel the Spanish from Cuba, the Army consisted of approximately 25,000 officers and men in twenty-five regiments of infantry, ten regiments of cavalry, five regiments of artillery, and ten field batteries, all of which were scattered across the country. Mobilization, however, enlarged the Regular Army to about 58,000 officers and men, expanded the artillery to seven regiments, and provided eight volunteer batteries of heavy artillery and sixteen volunteer batteries of field artillery.[75]

After Admiral William T. Sampson's ships bottled up Spanish warships in Santiago harbor, the Army's V Corps invaded Cuba. Despite logistical nightmares, Major General William R. Shafter, Commanding General, V Corps, had two divisions of infantry and one division of dismounted cavalry, a provisional battery of four Gatling guns under First Lieutenant John H. Parker, a provisional field artillery battalion of four batteries of 3.2-inch field pieces under Major John H. Dillenback, two batteries of siege artillery, two engineer companies, and a Signal Corps detachment with an observation balloon. After a poorly conducted reconnaissance of Spanish positions around Santiago manned by thirteen thousand troops armed with modern clip-fed, bolt-action Mauser rifles, two rapid-fire 3-inch Krupp field pieces, and sixteen obsolete muzzleloaders that had been converted to breechloaders, Shafter formulated his plans. He decided to assault the village of El Caney that sat atop a small hill and blocked the left approach to Santiago with Brigadier General Henry Lawton's infantry division.[76] As soon as Lawton's division had captured El Caney, Major General Joseph Wheeler's dismounted cavalry division and Brigadier General Jacob F. Kent's infantry division would make a frontal assault on San Juan Heights that was composed of San Juan Hill and Kettle Hill and was located to the front of El Poso where the main body of Shafter's force was positioned. Since Shafter did not adequately reconnoiter El Caney, he expected to defeat the little village quickly to permit Lawton to reinforce Wheeler and Kent as they stormed the heights.[77]

On 1 July Lawton launched his attack. At the southeast corner of the village stood a strong stone fort with a deep rifle trench on its southern and eastern sides. At intervals around the rest of the village, the Spanish had built six small blockhouses that were connected by trenches and wire

75. David F. Trask, *The War with Spain in 1898* (New York: The Macmillan Publishing Company, 1981), pp. 145, 155, 156; Graham Cosmas, *An Army for Empire: The United States Army in the Spanish-American War* (Columbia, Mo: University of Missouri Press, 1971), p. 8.

76. Cosmas, "San Juan Hill and El Caney, 1-2 July 1898," p. 113.

77. Arthur L. Wagner, *Report of the Santiago Campaign* (Kansas City, Mo: Franklin Hudson Publishing Company, 1908), pp. 64, 69; Rpt, Shafter, 13 Sep 1898, I: 62.

entanglements.[78] Brigadier General Adna R. Chaffee's brigade attacked the north and east sides of the village, and Brigadier General William Ludlow's brigade hit from the south and west. In the meantime, Colonel Evan Miles' brigade was held in reserve on the south side.[79] Throughout the morning Captain Allyn Capron's battery of four 3.2-inch field pieces randomly fired shrapnel. In fact, Capron failed to concentrate his fire on any one target. He opened fire on enemy soldiers moving from Santiago to El Caney, then fired a few shots at the blockhouses, and finally fired some shots into the village. This ineffective display of firepower forced Chaffee's and Ludlow's brigades to fight their way up the side of the hill without any substantial field artillery support. Even though the Spanish lacked any artillery at El Caney, they inflicted heavy casualties with their Mauser rifles and disrupted Shafter's plans.[80]

Although Shafter ordered the offensive against El Caney to be broken off to release Lawton to join the other divisions, Lawton reasoned that withdrawing would destroy his division's morale and pressed his attack more vigorously.[81] Lawton directed Chaffee to charge and moved Capron's battery within one thousand yards of the stone fort. As shell after shell from American field pieces struck the fort, the infantry stormed it. Nevertheless, Lawton soon discovered that the Spanish controlled the village from which they were pouring heavy rifle fire on the Americans. Lawton's division then doggedly dislodged the Spanish from every position and eventually forced them to retreat to Santiago.[82]

As Lawton was fighting, Shafter's main body with Kent's infantry division deployed on the left and Wheeler's dismounted cavalry division on the right launched its attack. Shafter initially planned that Kent's and Wheeler's divisions would take up a position between the San Juan River and the heights once they had ascertained that Lawton was routing the Spanish at El Caney and would wait for him to reinforce their right and that Captain George S. Grimes' four-gun battery would provide artillery support from El Poso with Captains Charles D. Parkhurst's and Clermont L. Best's four-gun batteries forming the reserve. Thinking that Lawton was driving the enemy from its defensive lines, Kent and Brigadier General Samuel S. Sumner, who had temporarily replaced Wheeler when the latter became ill, pushed their divisions towards the heights as Grimes opened fire with shrapnel. White smoke from Grimes' field pieces revealed his position, and soon two Spanish 3-inch rapid-fire pieces found the range and forced the American battery to stop firing. Two hours later, Grimes resumed shelling the Spanish to cover the infantry advance that was beginning to unfold.[83]

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78. Arthur H. Lee, British military attache with the US Army, "The Regulars at El Caney," *Schribner's Magazine*, Oct 1898, p. 403.

79. Herbert H. Sergeant, *The Campaign of Santiago de Cuba* (Chicago: A.C. McGlure and Company, 1907), p. 103; Rpt, Shafter, 13 Sep 1898, Annual Report, Secretary of War, 1898, I: 62.

80. Stephen Bonsal, "The Fight for Santiago," *McClure's Magazine*, Oct 1898, p. 505; Cosmas, "San Juan and El Caney, 1-2 July 1898," pp. 127-28.

81. Wagner, *Report of the Santiago Campaign*, p. 76; Bonsal, "The Fight for Santiago," pp. 505-06.

82. Lee, "The Regulars at El Caney," p. 411; Bonsal, "The Fight for Santiago," pp. 513-14.

83. John Biglow, *Reminiscences of the Santiago Campaign* (New York: Harper and Brothers Publishers, 1899), pp. 117-18; Rpt, Shafter, 13 Sep 1898, I: 63; Rpt, Kent, 7 Jul 1898, Annual Report, Secretary of War, 1898, I: 76; Cosmas, "San Juan Hill and El Caney, 1-2 July 1898," p. 132.

Even though Spanish small arms and artillery fire made Kent's and Sumner's positions untenable, they continued their advance. Crawling along the ground, cavalry units from Sumner's division, which included the First Voluntary Cavalry Regiment (Rough Riders) under Colonel Leonard Wood with Theodore Roosevelt as lieutenant colonel, seized Kettle Hill to the right and front of San Juan Hill and caused the Spanish to flee to San Juan Hill.[84] Scarcely had Kent's infantry reached San Juan Hill when the First Voluntary Cavalry and Sumner's dismounted cavalry joined the attack on the hill. Together, American infantry and dismounted cavalry stormed Spanish defenses with support from Grimes' field artillery and Parker's Gatling guns.[85] As the Spanish retreated to their main line of defense, Major Dillenback moved Best's and Parkhurst's batteries forward to Kettle Hill to assist Grimes, who was still located at El Poso. By the time that Best and Parkhurst had unlimbered they could fire only one shot since American infantry and dismounted cavalry had already taken possession of the crest of San Juan Hill.[86] From their positions on El Poso and Kettle Hill, American artillerymen could not engage an enemy counterattack from the reverse side of the hill if it came because they employed direct fire techniques, had flat trajectory weapons, and could not see the enemy. As a result, Best moved his battery to the top of San Juan Hill to shell the enemy when it counterattacked. Spanish musketry and artillery fire, nevertheless, drove Best's battery off the hill. Finally, after tough fighting the Americans held the hill and were able to place three field batteries in gun pits on line with the infantry.[87]

As the Spanish-American War indicated, technology had changed the size of the battlefield, but tactics had not kept pace. In his report Parkhurst noted that his first shot on 1 July was at a range of 2,450 yards, that his second was 2,475, and that his third was 2,500 yards.[88] Captain Best wrote that his battery fired at 2,600 yards on 1 July.[89] Although the ranges of field artillery had increased significantly since the American Civil War, artillerymen had not appreciably adjusted their tactics to fit the new technology. Caught in the middle of a technological revolution, cannoneers of the 1890s still stressed closing with the enemy by firing at distances of eight hundred yards, which was well within the range of rifles of the time. *Drill Regulations* of 1896 taught that the field artillery generally should not be advanced to within one thousand yards of enemy infantry unless friendly infantry fire was closer. "Ordinarily, artillery will hold itself beyond the zone of effective infantry fire; but for the close support of its own infantry at decisive moments, or before an enemy that is disorganized, it should not hesitate to enter this zone and meet the fire of the enemy's infantry at short ranges (eight hundred yards)," the regulation emphasized.[90] Only

84. Richard H. Davis, "The Battle of San Juan," *Scribner's Magazine*, Oct 1898, p. 401; Rpt, Shafter, 13 Sep 1898, I: 63; Rpt, Kent, 7 Jul 1898, I: 76-77.

85. Rpt, Kent, 7 Jul 1898, I: 76-78.

86. Cosmas, "San Juan and El Caney, 1-2 July 1898," pp. 137-38.

87. Trask, *The War with Spain in 1898*, pp. 244-45; Rpt, Grimes, 17 Jul 1898, in Cpt Charles Parkhurst, "The Artillery at Santiago," *Journal of the United States Artillery*, Mar-Apr 1899, pp. 177-79; Rpt, Dillenback, 15 Jul 1898, in Parkhurst, "The Artillery at Santiago," pp. 179-81; Rpt, 2LT Dwight Aultman, 16 Jul 1898, in Parkhurst, "The Artillery at Santiago," pp. 185-86; Rpt, Parkhurst, 12 Sep 1898, in Parkhurst, "The Artillery at Santiago," pp. 189-91.

88. Rpt, Parkhurst, 12 Sep 1898, Annual Report, Secretary of War, 1898, 2: 419.

89. Rpt, Best, undated, Annual Report, Secretary of War, 1898, 2: 416.

able to employ direct fire, American artillerymen preached moving their field pieces as close as possible to enemy infantry even if such action brought them within the range of small arms fire.

Employing direct fire and moving their guns within one thousand yards of the enemy created problems for the field artillery in the Spanish-American War. At San Juan Hill Dillenback positioned his batteries on line with the infantry during the night of 1-2 July to bombard the Spanish. "When the batteries commenced the enemy opened upon us with artillery and infantry from entrenched lines and sharpshooters but a few hundred yards away," Dillenback wrote. Because of this, the enemy covered American artillery with heavy fire, prevented the cannoneers from serving their guns properly, and forced Dillenback to withdraw his field artillery from the infantry line for the rest of the battle around Santiago.[91] Brigadier General Dwight E. Aultman, a second lieutenant in Parkhurst's battery in the Spanish-American War, remembered years later, "The crash of rifle fire from his immediate front commenced almost instantly, with the continuous whine of bullets through our position and the sharp cracking sound when they struck wood or metal on the guns and carriages. The Artillery fire of the enemy was not long delayed and very soon shrapnel and shells were adding their share to our discomfiture.[92] After fighting only Indians for the past thirty years, the Army had forgotten the lessons of the Civil War in which rifled muskets had cut many batteries to pieces during the course of a battle when they moved within small arms range and did not fully understand that improved technology, which had appeared since 1865, was even more lethal. Artillerymen simply could not position their guns in the open for direct fire. Such tactics made the field artillery batteries vulnerable to enemy action and prevented the proper employment of the guns to support the infantry.

At the same time, longer field artillery ranges made hitting the target even more difficult. At 2,500 yards gun crews could not easily observe the effect of their fire and equally important often could not see their target, especially in broken terrain. This was the case as the Spanish retreated from San Juan Hill to their second line of defense. From their positions on Kettle Hill and El Poso, American field pieces certainly had the range to hit the Spanish, but gun crews could not see the enemy and lacked indirect fire techniques to hit an unseen target. Consequently, the Americans could not engage the Spanish with field artillery and had to move their guns to the crest of San Juan Hill to see the enemy.[93]

The inability of the field artillery to deploy on line with the infantry at San Juan Hill caused some infantry officers to complain. In *Report of the Santiago Campaign* (1907) Lieutenant Colonel Arthur L. Wagner wrote, "There was much dissatisfaction felt by the infantry because of the position of Dillenback's artillery in the engagements of 10th and 11th of July.[94] From the field artillery's perspective, Wagner comprehended why the guns were placed six hundred to eight hundred yards behind the infantry. Yet, the average infantry soldier understood little about the science of gunnery and wanted the guns on line with them for moral support.[95]Although Wagner and

90. War Department, *Drill Regulations*, 1896, pp. 403-04.

91. Rpt, Dillenback, 15 Jul 1898, p. 180; Rpt, Shafter, 13 Sep 1898, I: 65.

92. Dwight E. Aultman, "Personal Recollections of the Artillery at Santiago, 1898," *The Santiago Campaign* (Richmond, Va: Williams Printing Company, 1927), p. 191.

93. Aultman, "Personal Recollections of the Artillery at Santiago, 1898," pp. 192-93.

94. Wagner, *Report on the Santiago Campaign*, p. 117.

95. *Ibid.*, p. 118.

many other Army officers recognized the impact of the new technology on the battlefield, they were simply not ready to accept positioning field guns behind the infantry to protect them from counterbattery work and small arms fire.

Even though the Army used antiquated field artillery tactics and direct fire in Cuba, it had modernized command of the batteries. Drawing upon the Civil War, the drill regulations of the 1890s taught that the "full effect of artillery can be produced only when its action is guided by a single chief who received his orders direct from the general commanding."[96] With this as guidance, Shafter appointed Dillenback commander of his provisional field artillery battalion and had him orchestrate its movements. On the first of July, Dillenback maneuvered his batteries with the exception of Capron's at El Caney and coordinated their fire as well as possible. When the fighting stopped, he examined the ground with his battery commanders for future positions. Shafter told him what the artillery's mission was, and Dillenback deployed the artillery accordingly.[97]

Yet, Dillenback and Shafter never took advantage of the centralized command of the field artillery to mass fire. Although field artillery tactics stressed massing fire, the Americans employed their guns piecemeal by committing Grimes' battery first and then Best's and Parkhurst's batteries on 1 July. Even after assuming positions on San Juan Hill on the night of 1-2 July, the Americans could not mass fire during the remaining days of the Battle of Santiago. This time deadly small arms and counterbattery fire from the Spanish prevented the Americans from employing their field guns effectively whereas faulty deployment on the first day stopped the gun crews from massing fire.[98]

The Spanish-American War demonstrated the danger of lagging technologically. By using black powder field pieces, the Americans quickly revealed their battery positions and brought destructive counterbattery fire from rapid-fire Spanish field artillery and infantry. Also, the smoke slowed down the rate of fire since gun crews had to wait until the smoke cleared away before firing again. Because of this, the Army's field artillery was ineffective and extremely vulnerable to fewer but more sophisticated smokeless powder Spanish field pieces.[99] Captain Grimes wrote in 1898, "In all the operations of the campaign now terminated our artillery, while apparently always superior to the enemy's in point of number of guns, has been at a great disadvantage in the matter of powder. The enemy's artillery used for the most part smokeless powder. We still cling to blackpowder (sic). We should be supplied with smokeless powder with the least possible delay."[100]

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96. War Department, *Drill Regulations*, 1896, p. 387.

97. Rpt, Cpt H.L. Anderson, Commander, Battery B, 4th Artillery, 29 Aug 1898, Annual Report, Secretary of War, 1898, 2: 56; Rpt, Cpt H.L. Anderson, Commander, Battery B, 4th Artillery, 19 Aug 1898, Annual Report, Secretary of War, 1898, 2: 235.

98. Trask, *The War with Spain in 1898*, pp. 244-45, 299; Rpt, Grimes, 17 Jul 1898, in Parkhurst, "The Artillery at Santiago," pp. 177-79; Rpt, Dillenback, 15 Jul 1898, in Parkhurst, pp. 179-81; Rpt, Aultman, 16 Jul 1898, in Parkhurst, pp. 185-86; Rpt, Parkhurst, 12 Sep 1898, in Parkhurst, "The Artillery at Santiago," pp. 189-91; Wagner, *Report on the Santiago Campaign*, pp. 101-02; Rpt, 1lt Ernest Hinds, Commander, Light Artillery Battery, 16 Jul 1898, in Annual Report, Secretary of War, 1898, 1: 414.

99. Rpt, Shafter, 31 Sep 1898, 1: 63; Rpt, Aultman, 16 Jul 1898, in Annual Report, Secretary of War, 1898, 2: 415; Rpt, Hinds, 16 Jul 1898, Annual Report, Secretary of War, 1898, 2: 414; Annual Report, Secretary of War, 1898, 2:417.

100. Rpt, Grimes, 17 Jul 1898, in Parkhurst, "The Artillery at Santiago," p. 178.

Aultman's comments shed additional light on the problem created by black powder. Some years after the war, he wrote, "Great clouds of white smoke from our obsolete powder hung over the batteries and, while obscuring everything from use, rendered our position beautifully visible to the Infantry and Artillery of the enemy."[101] Fortunately, the Spanish army presented a less formidable force than the French, German, or British armies of the 1890s were and did not really test the 3.2-inch piece or American army for that matter.

Yet, Grimes' assertion about stubbornly clinging to black powder did not accurately reflect field artillery developments of the 1890s. The Ordnance Department constructed 110 smokeless powder M1897 3.2-inch field guns and were distributing them when the war broke out. However, limited supplies of smokeless powder forced the War Department to convert all but thirty M1897 pieces to black powder to supplement the M1885. Lacking the capacity to produce sufficient quantities of smokeless powder, the War Department had to rely upon black powder field artillery even though it shipped some smokeless powder pieces to Cuba after the fighting had started. The war simply caught the War Department still experimenting with new propellant.[102]

Although the War Department had modernized its field artillery by adopting the 3.2-inch field piece and appropriate equipment, the Spanish-American War reaffirmed the inadequacy of American field artillery materiel and direct fire tactics. The Americans required smokeless powder, rapid-fire guns with indirect fire capabilities to survive on a battlefield that was becoming more lethal because of improved technology.

101. Aultman, "Personal Recollections of the Artillery at Santiago, 1898," pp. 190-91.

102. Annual Report, Secretary of War, 1895, 3: 51-52; Annual Report, Secretary of War, 1898, l: 208, 210 and 3: 14, 21, 22.

Table 3

CAPABILITIES OF SELECT AMERICAN FIELD PIECES IN THE LATE 19th CENTURY

Weapon	Projectile	Elevation in degrees	Range in Yards
M1841 6-pounder	shot	5	1,525
M1857 Napoleon	shot	3.45	1,680
	sph case	3.45	1,135
	shell	3.45	1,300
10-pounder Parrott	shell	10	3,000
	shell	20	5,000
3-inch Ordnance Gun/Rifle	shell	10	2,900
	shell	20	3,900
M1885 3.2-inch Gun	shell	10	4,500
	shell	20	6,600
M1890 3.2-inch Gun	shell	10	4,500
	shell	20	6,600

Source: War Department, *Instruction for Field Artillery*, 1867, pp. 29-32; Ordance Bureau, *Ranges of Guns, Howitzers, and Mortars*, 1863, pp. 5-14; Report, Chief of Ordnance, 1886, p. 23; A.B.Dyer, *Handbook for Light Artillery* (1898), p. 104; War Department, *Handbook of the 3-inch Field Artillery Materiel with Instruction for its Care*, 1912, p. 31.

Chapter VI

MORE MODERNIZATION: 1898-1918

After the Spanish-American War the field artillery experienced a dynamic change. During the years between 1898 and 1918, the War Department introduced new field pieces, adopted indirect fire, organized the School of Fire for Field Artillery, separated the field artillery from the coast artillery, grouped batteries into battalions and regiments, and integrated the field artillery into the division. Even with these reforms, the United States entered World War I in 1917 without sufficient field artillery and had to rely upon the Europeans to arm its batteries.

Time of Rapid Change: 1898-1914

Realizing that the 3.2-inch field gun was obsolete, the War Department launched an aggressive program to develop modern field pieces. Late in 1898, it began equipping field batteries of the 6th and 7th Artillery Regiments with the smokeless powder M1897 3.2-inch field gun.[1] The M1897, nevertheless, represented a token effort to improve the field artillery. Like every American gun before it, the M1897 lacked a recoil system.[2]

Aware of the M1897's inadequacy, the Ordnance Department initiated action to produce a rapid-fire field piece with a recoil system. In 1897-98 Captain Charles B. Wheeler designed a 3 inch piece and carriage with a recoil system with hydraulic cylinders to absorb the recoil, springs in the cylinders to return the tube to a firing position, and a spade at the end of the trail to check carriage recoil. Commenting on Wheeler's field piece, Chief of Ordnance, Brigadier General Adelbert R. Buffington (1899-1901), announced in 1900 that this gun equalled or surpassed any new field artillery recently produced in Europe. Although Wheeler's recoil system allowed the gun to jump enough so that the piece had to be relaid after each shot, Buffington found the 3-inch piece to be an impressive improvement over the 3.2-inch gun. He wrote, "It is believed that this new materiel fully responds to the modern

1. Brig Gen D.W. Flagler, "Report of the Chief of Ordnance," *Army and Navy Journal*, 19 Nov 1898, pp. 272-73.

2. Annual Report, Secretary of War, 1898, 3: 46 and 4: 17; Cpt Charles Parkhurst, "The Artillery at Santiago," Journal of the United States Artillery, Mar-Apr 1899, p. 146; "Present State of the Field Artillery Rearmament," *Journal of the United States Artillery*, Mar-Apr 1904, p. 191; Konrad F. Schreier, Jr., "The U.S. Army 3-inch Field Gun Model 1902," *Military Collector and Historian*, Winter 1973, p. 185; Annual Report, Chief of Ordnance, 1900,p. 401; Annual Report, Secretary of War, 1897, 2: 38; Annual Report, Secretary of War, 1901, I: 14.

requirements for field artillery as respects power, flatness of trajectory, accuracy and rapidity of fire, mobility, simplicity, and endurance."[3] As Buffington implied, the Ordnance Department had made a major breakthrough with the 3-inch piece. Equally important, his comments suggested that the introduction of the 3-inch field gun was more than just a modernization effort. It enhanced the Ordnance Department's image by thrusting it into the foreground of field artillery development.[4]

Opposition quickly arose to challenge the Ordnance Department's effort to adopt Wheeler's gun. Urged by Brigadier General J.I. Rogers, a former artillery officer, Lieutenant General Nelson A. Miles, Commanding General, US Army (1895-1903), criticized the piece in 1900. Miles wrote Secretary of War Elihu Root (1899-1904) that the gun was "practically the same gun as the 3.2-inch." The 3-inch gun did not use self-contained rounds in brass cases to permit rapid firing and had a short recoil system. As a result, the gun crew still had to relay the piece after each shot,which kept the rate of fire below five rounds per minute. In view of these limitations, Miles urged Root to suspend production on the gun to allow the Board of Ordnance and Fortifications to test other field artillery pieces. Convinced by Miles of the requirement for a better piece, Secretary Root directed the Ordnance Department in August 1900 to stop procurement of Wheeler's piece and informed Buffington that the Board of Ordnance and Fortifications would determine the type of field gun and carriage.[5]

Under the supervision of the Board of Ordnance and Fortifications, the Ordnance Department launched a series of trials to find the best field piece. Late in 1901, the Department tested guns and carriages that recoiled as a unit, guns with a short recoil, guns with a long recoil, and a M1897 3.2-inch field gun. After the trials the Department concluded that long-recoil systems were superior. They were steadier under fire, recoiled without requiring frequent relaying, and fired six times faster than the M1897 gun. With this information as support, the Ordnance Department ceased experimenting with the other systems in February 1902 and narrowed its choices to three long-recoil systems—the Bethlehem No. 2, the Ehrhardt (a German gun), and the Ordnance Department's model designed by Wheeler. Although the Department found Wheeler's gun and carriage to be the best, it created the M1902 3-inch field gun by combining the best features of Wheeler's and the Ehrhardt system. The M1902 gun had a hydrospring recoil system and panoramic sights, fired fixed ammunition of shrapnel and high-explosive steel shell, used smokeless powder, and had a range of 6,000 yards. Expressing their opinion about the M1902, the Board of Ordnance and Fortifications and the Ordnance Department said that the system was superior to any in service in the world and insisted

3. Annual Report, Chief of Ordnance, 1900, p. 406.

4. Annual Report, Secretary of War, 1901, I: 50, 374-75; Annual Report, Chief of Ordnance, 1900, p. 403; Ltr, Brig Gen J.I. Rogers to Maj Eli D. Hoyle, President of the Board for the Preparation of Field Artillery Drill Regulations, 4 Jan 1904, Correspondence of the President of the Board for the Preparation of Field Artillery Drill Regulations, 1904, Morris Swett Library, Fort Sill.

5. "Field Guns and Pistols," *Army and Navy Journal*, 4 Aug 1900, p. 1153; Annual Report, Chief of Artillery, 1900, pp. 40102; Vardell E. Nesmith, Jr., "The Quiet Paradigm Change:The Evolution of the Field Artillery Doctrine of the United States Army, 1861-1905," unpublished doctoral dissertation, Duke University, 1977, p. 282; Ltr, Rogers to Hoyle, 4 Jan 1904; Charles B. Wheeler, *A Discussion of the Proposed Methods to Increase the Rapidity of Fire of Field Guns* (Washington: Government Printing Office, 1901), p. 8.

that they had taken major strides towards modernizing the field artillery.[6]

Others shared the Board's and Department's enthusiasm about the M1902. In 1903 Brigadier General Wallace F. Randolph, the Chief of Artillery (1903-1904) that oversaw artillery developments, insisted, "With the adoption of the rapid-fire field gun, the Field Artillery is about to be placed on a footing of equality with that of other armies. The change will be revolutionary."[7] In a short letter to the Chief of Artillery in March 1903, Major William H. Coffin, President, Field Artillery Board, Fort Riley, Kansas, reaffirmed the significance of the gun. "The passage from the 3.2" field piece to the new 3." rapid fire piece marks a new era for our Field Artillery," he wrote. In light of the adoption of the piece, however, the War Department had to prepare an entirely new field artillery drill regulation and adopt indirect fire.[8] As Randolph and Coffin firmly believed, the War Department reached a significant milestone with the introduction of the M1902 3-inch gun. Armed with this piece, field batteries would not have to rely on slow-firing, black powder guns without recoil systems and sights. With the appearance of the M1902, the age of rapid-fire field artillery opened for the Army.

Shortly after, the War Department adopted other field guns with recoil systems that fired shrapnel and high-explosive steel shell ammunition. Between 1902 and 1914 it standardized the M1904 4.7-inch gun, the M1905 3.8-inch howitzer, the M1906 6-inch howitzer, and the M1907 4.7-inch howitzer. While the howitzers used separate-loading ammunition, meaning that the projectile and powder charge were separate, the guns employed fixed ammunition.[9] This combination of mobile guns and howitzers gave the War Department a balanced inventory of modern field artillery.Yet, limited congressional funding prevented producing the quantities of field artillery necessary for fighting a major European power.[10]

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6. "Board of Ordnance and Fortifications," *Army and Navy Journal*, 24 Nov 1900, p. 204; Annual Report, Secretary of War, 1902, I: 27-28 and 7: 9-10; "Board of Ordnance and Fortifications," *Army and Navy Journal*, 13 Sep 1902, p. 30; Wheeler, *A Discussion of the Proposed Methods to Increase the Rapidity of Fire of Field Guns*, p. 8.

7. "Report of the Chief of Artillery," *Army and Navy Journal*, 28 Nov 1903, p. 330.

8. "Present State of Field Artillery Rearmament," pp. 190223; Ltr, Coffin to Chief of Artillery, 24 Mar 1903, Correspondence to the President of the Board for the Preparation of Field Artillery Drill Regulations, 1904; Annual Report, Secretary of War, 1903, 2: 285; Annual Report, Secretary of War, 1904, 2: 318; *Army and Navy Journal*, 25 Mar 1905, p. 796, and 28 Oct 1905, p. 235.

9. Ordnance Department, *Table of US Army Cannon* (Washington:Government Printing Office, 1913), pp. 4-5; Chief of Ordnance, *Handbook of Artillery* (Washington: Government Printing Office, 1920), pp. 23, 118, 161; Ordnance Department, *Handbook of the 3.8-inch Howitzer Materiel, M1915* (Washington: Government Printing Office, 1917), pp. 11, 20; Ordnance Department, *Handbook of the 4.7-inch Gun Materiel, Model 1906* (Washington: Government Printing Office, 1910), pp. 7, 16; Oliver L. Spaulding, Jr., *Notes on Field Artillery for Officers of All Arms* (Leavenworth, Ks: Press of Ketcheson Printing Company, 1917), pp. 46-66; Harry G. Bishop, *Elements of Modern Field Artillery* (Menasha, Wi: George Santa Publishing Company, 1914), pp. 15-18.

10. Field Artillery School, *Field Artillery Materiel* (Fort Sill,Ok: The Field Artillery School, 1932), p. 10. Interestingly, experiments conducted by the Sixth Artillery Regiment early in 1907 revealed that 3-inch projectiles, whether high-explosive or common shell, produced little or no damage to fortifications and reaffirmed that M1902 should be limited to attacking troops in the open. The regiment concluded that the US Army had a glaring deficiency in heavy field artillery because it expected fortifications to appear on every important battlefield of the future and recommended arming field artillery regiments with heavy guns and howitzers, especially designed for attacking entrenchments. See Report, The Field Artillery Board, subj: Test of the Efficiency of Modern Field Works When Attacked by the Latest Types of Field Cannon Designed for the United States Artillery, 4-6 Oct 1909, Morris Swett Library, for more information.

Although state-of-the-art field artillery existed at the turn of the century to make indirect fire a reality in European and American armies, the Russo-Japanese War of 1904-05 convinced artillerymen to convert to this form of fire. At the Battle of Sha-ho on 1 September 1904, the Japanese deployed their batteries on the reverse slopes to protect them from counterbattery fire. From concealed positions Japanese gun crews employed indirect fire to shell unseen targets and effectively silenced Russian fieldpieces placed in the open for direct fire, while the Russian even though they had modern, rapid-fire guns, had difficulty hitting Japanese batteries. The Battle of Sha-ho and subsequent battles of the war finally convinced the Russians to adopt indirect fire.[11] Seeing the impact of indirect fire in the Russo-Japanese War, other European armies abandoned direct fire for indirect fire within a few years and simultaneously introduced new field guns with flat trajectories and high rates of fire (twenty to thirty rounds a minute) that were comparable to the French 75-mm.[12]

Interestingly, many professional European soldiers still wanted to employ direct fire even though the Russo-Japanese War proved that it was deadly for exposed field artillery. British and French armies, for example, insisted upon retaining direct fire as an option because it was less complicated, while the Germans stressed indirect fire even though commanders warned about the necessity of using direct fire to press home the attack. Accepting the new concept of fire involved changing a way of thinking, using unreliable visual and mechanical communication systems, and positioning the guns behind the infantry where they could not be seen. This in turn reduced the field artillery's ability to provide moral support to the infantry. As a result, many European army officers, including some field artillerymen, desired direct fire as the primary means of engaging the enemy and fought to employ field artillery fire at close ranges from exposed positions.[13]

Aware that the Russo-Japanese War also demonstrated the need for howitzers to hit targets on reverse slopes and in trenches, European armies slowly integrated howitzers into the division's field artillery to complement their guns. The British introduced eighteen howitzers into its infantry division. The Germans put twelve in their infantry division, while the Russians placed only three or four in their infantry division. Caught in the middle of a debate over the proper caliber of howitzer, the French did not have any howitzers in their infantry division on the eve of

11. Shelford Bidwell and Dominick Graham, *Firepower: British Army Weapons and Theories of War, 1904-1945* (London: George Allen and Unwin, 1982), pp. 10, 12; Capt John E. McMahon, "Indirect Fire," *Journal of the United States Cavalry Association*, Apr 1906, pp. 664-65; Frank E. Comparato, *Age of Great Guns: Cannon Kings and Cannoneers Who Forged the Firepower of Artillery* (Harrisburg, Pa: The Stackpole Company, 1965), p. 241; Nesmith, "The Quiet Paradigm Change," p. 316; War Department, *Reports of Military Observers Attached to the Armies in Manchuria During the Russo-Japanese War*, Part 1 (Washington: Government Printing Office, 1906), pp. 83-84, 111-12, 115; War Department, *Reports of Military Observers Attached to the Armies in Manchuria During the Russo-Japanese War*, Part 3 (Washington: Government Printing Office, 1906), pp. 31-32.

12. Hew Strachen, *European Armies and the Conduct of War* (London: George Allen and Unwin, 1983), pp. 138-39; H.A. Bethel, *Modern Artillery in the Field* (London: Macmillan and Company Limited, 1911), pp. 2, 151; Spaulding, *Notes on Field Artillery for Officers of All Arms*, pp. 66-74.

13. Bidwell and Graham, *Firepower*, pp. 12-13; Strachan, *European Armies and the Conduct of War*, p. 139; Bethel, *Modern Artillery in the Field*, p. 2; Comparato, *Age of Great Guns*, p. 118; War Department, Document 507, Study on the Development of Large Caliber, Mobile Artillery, and Machine Guns in the Present European War, in War Department, *Statement of A Proper Military Policy for the United States* (Washington: Government Printing Office, 1916), pp. 3-4.

World War I although maneuvers held by the French army in 1913 with an experimental battery of 105-mm. Schneider howitzers proved the howitzer to be effective.[14]

Despite adopting indirect fire and rapid-fire field pieces, European armies differed over the proper field artillery tactics. The French and British emphasized short but violent bursts of artillery fire to neutralize the enemy by forcing it to take cover. In contrast, the Germans insisted upon employing field artillery fire to neutralize as well as destroy the enemy and had a more balanced view of the field artillery's role.[15]

The Russo-Japanese War also encouraged American artillerymen to adopt indirect fire. Knowing that the technology was available, General Rogers vigorously pushed indirect fire. In 1904 he wanted field artillery tactics to be developed to reflect conditions as they existed at the beginning of the twentieth century. "Now that the system [3-inch gun] has been introduced by which a single piece can administer a fire equal to that of a battery of the former guns," Rogers wrote, "the Drill Regulations should embody in it a clear, comprehensive and logical statement of the conditions effecting the employment of field artillery...and rational methods of procedure to meet these conditions."[16] The following year, Chief of Artillery, Brigadier General John P. Story (1904-1905), attributed the Japanese success in the Russo-Japanese War to superior organization and methods of fire even though their field artillery was inferior to Russian guns. Since the extensive use of indirect fire had led to the Japanese victory, Story pushed to adopt indirect laying.[17] Story along with Rogers urged the War Department to devise tactics for indirect fire to allow gun crews to utilize the natural cover of hills and ridges to protect their guns.[18]

Encouraged by Story, Rogers, and the performance of Japanese field artillery in 1904-05, the War Department revamped its field artillery tactics. Although it did not totally abandon direct fire, the War Department standardized the aiming point method of indirect fire in 1905.[19] Two years later, the War Department wrote that hiding field guns was paramount and explained in *Drill Regulation* (1907), "When not incompatible with the effective accomplishment of the duty to be performed, concealment from view is always to be sought."[20] The regulation added, "By rendering the guns inconspicuous, or entirely concealing them, their sustained service may be counted upon, while the difficulties of the enemy in locating his targets and adjusting his firing are increased."[21] By rearming the field artillery with the latest weapons and adopting indirect fire, the

14. Jonathan House, *Toward Combined Arms Warfare: A Survey of Tactics, Doctrine, and Organization in the Twentieth Century* (Fort Leavenworth, Ks: Combat Studies Institute, US Army Command and General Staff College, 1984), pp. 16-17; Strachan, *European Armies and the Conduct of War*, p. 139; Bidwell and Graham, *Firepower*, pp. 10-18; War Department, Document 507, pp. 3-4.

15. House, *Toward Combined Arms Warfare*, pp. 16-17; Bidwell and Graham, *Firepower*, pp. 10-18.

16. Ltr, Rogers to Hoyle, 4 Jan 1904.

17. Nesmith, "The Quiet Paradigm Change," p. 322.

18. Ltr, Rogers to Hoyle, 4 Jan 1904; Nesmith, "The Quiet Paradigm Change," p. 322; Ltr, Maj C. Woodard, Artillery Corps, to Hoyle, 26 Jan 1904, Correspondence to the President of the Board for the Preparation of Field Artillery Drill Regulations, 1904.

19. War Department, *Drill Regulations for Field Artillery*, 1905, pp. 71-73; McMahon, "Indirect Fire," pp. 665-66.

20. War Department, *Drill Regulations*, 1907, p. 163.

21. *Ibid.*

War Department introduced technology and tactics that rivaled their European counterparts and revolutionized its field artillery. Even so, the Americans still made provisions for direct fire as late as 1916 and were reluctant to make a clean break because indirect fire was more complicated.[22]

Indirect fire also changed gun crew operations and the role of the observer. The gunner no longer opened and closed the breech and inserted the charge. Rather, he laid the gun for direction only or direction and range. Number one crewman helped lay the piece when ordered, opened and closed the breech, and fired the weapon. Number two moved the trails as directed for approximated range, loaded the cannon but no longer fired the weapon, while number four set the fuse, served the ammunition, and was assisted by numbers three and five.[23]

Although forward observers had been employed in the past, they had generally only spotted enemy movements. As field pieces with ranges of six thousand yards began appearing in the 1890s and as artillerymen began moving their field pieces behind the infantry line for protection, many artillery officers visualized the need for forward observers to direct fire. In 1896 the War Department pointed out that positioning an officer or noncommissioned officer ahead of the guns could facilitate directing fire since the individual would be in a better position to observe the impact of the fire and see what the infantry was doing. Nevertheless, forward observers in the 1890s did nothing more than their predecessors had done since the War Department had not developed a satisfactory method of indirect fire yet. With the introduction of indirect fire during the early years of the twentieth century, the forward observer's duties changed. From positions where he could see the target, the aiming point, and battery, the forward observer relayed information back to the gun crew about the accuracy of its shots and told it how to adjust fire to hit the target. The forward observer was no longer a passive but an active member of a gun team.[24]

The forward observer's new duties simultaneously changed battery operations. During the age of direct fire, each gunner fired his piece independently.[25] With the advent of indirect fire, the forward observer aimed the guns. As a result, the battery became a firing unit and not just a tactical element. Aiming each field piece independently by the gunner disappeared except on rare occasions when direct fire was employed. Moreover, the battery commander assumed a more instrumental role in controlling fire than he had done in the past when he served as the forward observer. Previously, the commander had only indicated the target, superintended fire

22. War Department, *Provisional Drill and Service Regulations for Field Artillery*, Vol. III (New York: Military Publishing Company, 1916), pp. 50-51; William J. Snow, "The Functions and Training of Field Artillery," unpublished manuscript, Army War College, 1908, p. 182, in Morris Swett Library.

23. War Department, *Drill Regulations for Field Artillery*, 1905, pp. 50-58; War Department, *Drill Regulations for Light Artillery*, 1896, pp. 42-43; Spaulding, *Notes on Field Artillery for Officers of All Arms*, pp. 89-90.

24. War Department, *Field Artillery Drill Regulations*, 1911, pp. 109, 122; 2d Lt William Lassiter, "Range and Position Finding," *Journal of the United States Artillery*, Apr 1895, pp. 239-40; "The Theoretical and Practical Training of the Light Gunner," *Journal of the United States Artillery*, Sep-Oct 1897, p. 164; MG Moriz Edler von Reichold, "Indirect Fire," *Journal of the United States Artillery*, Sep-Oct 1897, pp. 170, 171, 174, 175; "Field Artillery on the Smokeless Battlefield," *Journal of the United States Artillery*, Jan 1894, p. 134; 1st Lt Joseph E. Kuhn, trans., "A New Method of Indirect Laying for Field Artillery," *Journal of the United States Artillery*, Jul 1894, pp. 445-47; War Department, *Drill Regulations for Light Artillery*, 1896, p. 410.

25. "Influence of the New Guns on Field Artillery Fire," *Journal of the United States Artillery*, Jan-Jul 1904, pp. 283-84; Spaulding, *Notes on Field Artillery for Officers of All Arms*, p. 90.

discipline, watched over the security of his battery, and replenished ammunition without generally directing fire even though he could if he had so desired.[26]

Converting from signal flags and runners to the field telephone allowed the full impact of indirect fire and the forward observer to be felt. By 1912 each field battery maintained three telephones, and each regiment and battalion had two, which greatly sped up the transmission of fire commands from the forward observer.[27] Even though the field telephone permitted rapid communication, it had an inherent weakness. Wires linking one telephone with another could be cut or damaged during battle, which would sever communications and reduce the forward observer's ability to direct fire. Because of this, the War Department did not totally abandon signal flags or other forms of communication. In 1912 Colonel E.A. Miller, President, Field Artillery Board that tested new equipment and materiel, wrote that signal flags were an "indispensable adjunct" to the telephone. They allowed instant communication and could be used until telephone lines could be laid. Yet, they also revealed the observer's position and were dangerous when riflemen were present.[28]

Understanding that indirect fire hid the battery from the view of ground observers, who were trying to discover the position of enemy guns for counterbattery work, armies sent aircraft aloft to spot hostile field pieces. With the appearance of aircraft over the battlefield in World War I, European field artillerymen camouflaged their guns. Camouflaging in turn led the French to develop sound ranging in 1914. Three years later, the Americans adopted sound ranging. To find the location of enemy field artillery positions, sound ranging employed an arc of microphone pickup stations. Each recorded the sounds of enemy guns and sent the data back to a central station where analysts plotted it. Using mathematical formulas, they calculated the guns' direction and distance so that field artillerymen could fire on enemy batteries.[29] Meanwhile, the Europeans introduced flash ranging in World War I as another means of pinpointing hostile artillery. In flash ranging observers used high-powered telescopes to find enemy guns by their muzzle flashes, which were sometimes bright enough to be seen even during daylight, and wired their information to an operator, who plotted it on a map.[30] Even though sound-and-flash ranging was in its infancy in 1914-18, European and American field artillerymen found it to be a welcome breakthrough. Weather could ground balloons and aircraft and interrupt the flow of information, but it did not deter sound-and-flash ranging activities. As result, sound-and-flash ranging promised all-weather observation and greatly extended the ability of field artillery to silence enemy batteries.[31]

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26. War Department, *Drill Regulations for Light Artillery*, 1891, pp. 69-70.

27. Capt Oliver Spaulding, "The Use of Field Artillery," *Journal of the United States Artillery*, May-Jun 1912, p. 24; War Department, *Regulations for Field Artillery*, 1911, p. 271.

28. Ltr, Capt Adrian S. Fleming, Adjutant, 4th Field Artillery, to Adjutant General's Office, 27 May 1911, 7th Endorsement by Field Artillery Board, Fort Riley, Kansas, 26 Oct 1912, File No. 413.77, Field Artillery Board, Fort Bragg, North Carolina, RG 177, National Archives; Lt Col John E. McMahon, "The Field Artillery of the United States: Its Organization and Tactical Use," *Field Artillery Journal*, Jan-Mar 1912, pp. 96-97.

29. Comparato, *Age of Great Guns*, p. 99.

30. Comparato, *Age of Great Guns*, p. 99; Daniel J. Kevles, "Flash and Sound in the AEF: The History of a Technical Service," *Military Affairs*, Dec 1969, p. 374; Benedict Crowell, ed. *America's Munitions* (Washington: Government Printing Office, 1919), pp 383-86.

31. Bidwell and Graham, *Firepower*, pp. 109-10.

Indirect fire, therefore, dramatically changed the technical aspects of the field artillery. Paraphernalia of the cannoneer was no longer the powder keg, marking chalk, and wheel chocks. Besides being able to use the gunner's quadrant, a device for measuring the gun's angle of elevation, field artillerymen had sound-and-flash ranging equipment, panoramic telescopes, binoculars, transits, plotting boards, measuring tapes, rulers, scales, compasses, electrical communication systems, and tables of fire. Because of this new technology, the field artillery took on a more scientific atmosphere. Precision instruments had become the rule rather than the exception, but they did not eliminate the trial-and-error method of adjusting fire or make indirect fire more responsive to the infantry's needs.[32]

The increased sophistication of the field artillery with the introduction of modern field guns and equipment encouraged the War Department to revamp training. For the purpose of learning modern methods of massing fire with the M1902 3-inch field gun and other modern field pieces scheduled for introduction, the War Department authorized forming a provisional regiment of three battalions at Fort Riley, Kansas, under General Order No. 152, dated 14 September 1904. As pressure mounted to learn indirect fire and to train on the latest equipment, the War Department issued General Order No. 89, 14 June 1905, at the direction of President Theodore Roosevelt. The order suspended the general order of 1904 and organized two provisional regiments of field artillery for training officers, noncommissioned officers, and enlisted personnel in the new fire control methods. One regiment had three battalions of two batteries each at Fort Riley, Kansas, under Colonel Sidney W. Taylor, while the other regiment had two battalions of three batteries each at Fort Sill, Oklahoma, under Colonel Walter Howe.[33] Reflecting on the impending creation of the provisional regiments, Chief of Artillery, General Story, wrote in his annual report of June 1905, ". . .the modern methods of fire control, including the use of guns of increased range, of increased rapidity. . .as well as the employment of indirect fire. . .make it essential to effective unity of action that during peace most careful training be had in the organization that is adopted for use in war."[34] For the field artillery to be effective in war, it had to be properly trained in peace. This involved forming regiments, the accepted wartime organization, to teach massing fire with indirect fire.

With the disbanding of the two provisional regiments in November 1905, training artillerymen in modern fire control methods with rapid-fire field guns fell to the School of Application for Cavalry and Field Artillery at Fort Riley. As directed by General Order No. 138, dated 17 August 1905, the War Department planned to send each field battery and officer through the school's three-year course in theoretical and practical instruction in tactics, equipment, and techniques. Unfortunately, a shortage of enlisted personnel to man the batteries and inadequate ammunition allowances curtailed firing exercises, while the frequent rotation of units and officers through the school precluded them from completing the three-year course.[35]

32. Comparato, *Age of Great Guns*, p. 104; Bidwell and Graham, *Firepower*, pp. 8-9.

33. War Department, General Orders No. 152, 14 Sep 1904; War Department, General Orders No. 89, 14 Jun 1905; Annual Report, War Department, 1905, 2: 260-61.

34. Annual Report, War Department, 1905, 2: 261.

35. War Department General Order No. 138, 17 Aug 1905.

By 1907 the War Department faced a cruel dilemma. With the introduction of new field guns and modern fire control techniques, the need for qualified field artillerymen was paramount. The Mounted Service School at Fort Riley, the successor to the School of Application for Cavalry and Field Artillery in 1907, with its emphasis upon the theoretical instruction in the combined operations of cavalry and field artillery also failed to develop field artillerymen with the ability to conduct indirect fire. Not even garrison schools at Army posts eliminated deficiencies in the field artillery because they emphasized theoretical instruction and rote memorization at the expense of practical training. The schools' inadequate efforts left the field artillery without qualified personnel to employ the new technology or employ indirect fire effectively. To remedy this the Chief of Coast Artillery in 1908 recommended creating a school of fire for field artillery.[36]

In view of this poor quality of officers and men, President Theodore Roosevelt sent Captain Dan T. Moore to observe training in European field artillery schools in 1908 and 1909. Based upon Moore's report on the German Artillery School at Juterbog, the War Department decided to initiate formal training for its field artillerymen. As a result, it dispatched Moore to Fort Sill, Oklahoma, late in 1910 to organize the School of Fire for Field Artillery to train officers and noncommissioned officers. In September 1911 the school opened to provide practical instruction with some theoretical instruction. Creating the school along with establishing the Field Artillery Association in 1910 to promote the interests of the field artillery and professionalism and the *Field Artillery Journal* in 1911 to disseminate the latest information laid the foundation for a modern field artillery in the US Army.[37]

Two serious problems retarded the school's ability to produce proficient field artillerymen. After pointing out the potential of the School of Fire, Captain Moore, commandant of the school from 1911 to 1914, criticized the War Department in May 1911 for fiscal thriftiness. In Moore's view the War Department had to spend more money to obtain the proper facilities and equipment. Without sufficient money invested in training, the infantry and cavalry would pay "in blood for the mistakes made by our arm [field artillery], through the lack of opportunity [training] given to its officers. A field artillery captain who cannot direct the fire of his battery is useless...to any army."[38] Ultimately, limited funding caused a shortage of men for instruction batteries (batteries used to learn fire control), equipment, and ammunition and severely restricted the school's efforts late in 1911 to train officers and noncommissioned officers.[39]

Simultaneously, field artillerymen with little or no practical experience conducting indirect

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36. Annual Report, School of Application for Cavalry and Field Artillery, 1906, pp. 7, 43; War Department, General Order No. 152, 29 Aug 1906; War Department, General Order No. 191, 13 Sep 1907; War Department General Order No. 115, 27 Jun 1904; War Department Circular 23, 3 Jun 1904; War Department General Order No 124, 28 Jul 1905; War Department Circular 38, 1 Aug 1905; War Department General Order No. 133, 23 Jul 1906; Annual Report, Chief of Artillery, 1906, p. 33; Annual Report, War Department, 1908, 2: 255; Report, School of Fire for Field Artillery, 9 Feb 1912, pp. 2, 5, 8, 15, 24; Rpt, The Field Artillery Board, subj: Test of the Efficiency of Modern Field Works When Attacked by the Latest Types of Field Cannon Designed for the United States Artillery, 4-16 Oct 1909, p. 86.

37. *Theodore Roosevelt: An Autobiography* (New York:The Macmillan Company, 1919), p. 276; Annual Report, Chief of Artillery, 1906, p. 9; Riley Sunderland, *History of the Field Artillery School: 1911-1942*, Vol I (Fort Sill, Ok: Field Artillery School, n.d.), p. 30; General Orders No. 72, War Department, 3 Jun 1911.

38. Ltr, Moore to Greble, 30 May 1911, Moore-Greble File, Morris Swett Library.

39. Ltr, Moore to Greble, 8 Aug 1911, Moore-Greble File.

fire or firing a field piece profoundly challenged the newly organized school. In July 1911 even before the school opened, Captain Moore wrote Colonel Edwin St. John Greble of the Army General Staff about a student, who had had a battery command for over four years and had "absolutely no idea as to how the fire of a battery should be conducted."[40] To Moore this student officer's deficiencies reinforced the necessity of training.[41]

The overall lack of proficiency of the students soon influenced the level of training offered by the school.[42] In a letter in December 1911 to Greble, Moore complained that course material was too advanced for the average student. They arrived at Fort Sill poorly prepared to learn the intricacies of indirect fire and battery operations. In an insightful comment about the qualifications of student officers, he wrote Greble in December 1911, "There is no use attempting battalion practice until our men are better able to handle the firing battery; until that time it is a waste of ammunition."[43] Along these lines Moore lamented in January 1912 that the Americans were so far behind the Europeans in the quality of their artillerymen "that it really makes one shudder." He continued, "I have never have had such a hopeless feeling in my life as I had during the latter part of the last course [fall of 1911], when I found out that the student officers hadn't ever grasped the elements and the firing they did was rotten. As a matter of fact they did not seem to even grasp the rudiments, it was simply pitiful."[44] Late in 1911 and early in 1912, Moore found the Army's field artillerymen to be inferior to their European counterparts because they lacked a solid foundation in the basics. With this in mind, he revamped the school's curriculum early in 1912. He eliminated all advanced subjects and focused on the basics for the rest of his tenure at the School of Fire.[45]

Over the next several years, the quality of the students at the school improved slowly. Graduates of the school went back to their batteries where they trained subordinates, who later often attended the School of Fire. As a result, Captain Moore reported to the Adjutant General in June 1913 that student officers in 1912-13 were better prepared than their predecessors of 1911-12.[46] This situation in turn produced graduates, who were better grounded in field artillery fundamentals than their predecessors, even though insufficient funding by a Congress, which was unreceptive to reforming the Army, prevented equipping the school with the required amounts of materiel.[47]

Although the quality of graduates improved, Lieutenant Colonel Edward McGlachlin, Jr., who

40. Ltr, Moore to Greble, 21 Jul 1911, Moore-Grebel File.

41. Ltr, Moore to Greble, 8 Aug 1911.

42. Report, School of Fire for Field Artillery, 9 Feb 1912, pp. 2, 5, 8.

43. Ltr, Moore to Greble, 16 Dec 1911, Moore-Greble File.

44. Ltr, Moore to Greble, 16 Jan 1912, Moore-Greble File.

45. Rpt, School of Fire, 27 Jun 1916, p. 2; Maj Richard C. Burleson, "Some Observations Concerning the Use of Accompanying Batteries During the World War with Some Personal Experiences," *Field Artillery Journal*, Nov-Dec 1921, p. 525, hereafter cited as "Some Observations."

46. Rpt, School of Fire, 27 Jun 1913, pp. 4, 6, 16.

47. Rpt, Chief of Field Artillery, 1919, p. 76; Rpt, School of Fire, 27 Jun 1916, p. 2; Burleson, "Some Observations Concerning the Use of Accompanying Batteries During the World War with Some Personal Experiences," p. 525.

succeeded Moore as commandant in 1914 and served in that capacity until the school was closed in 1916 to help furnish troops for Pershing's expedition into Mexico, still questioned the competency of graduates. In his annual report of 1916, he insisted that they had not received well-rounded training and instruction to prepare them for the exigencies of modern war as demonstrated by the war in Europe. Some of the most experienced student officers could conduct fire, but most lacked the skills required to employ indirect fire because the school's curriculum concentrated on the basics to the exclusion of advanced subjects. Despite training at the School of Fire, the Army's field artillerymen still were not as skilled as their European counterparts. The emphasis on the basics to cover deficiencies in officers and men left the Army with inadequately trained field artillerymen on the eve of American entry into World War I.[48]

The new field artillery technology and indirect fire also caused many American artillerymen to challenge existing tactics. Borrowing ideas from European field artillery experts, such as Major E. Thionville and General Hippolyte Langlois of the French army, American artillerymen argued that the Napoleonic artillery duel in which each side tried to knock out the other's guns was obsolete because the batteries would be in hidden, fortified positions that would be difficult to destroy. Rather, field artillery on the offensive should temporarily silence the enemy's field pieces by forcing gun crews to seek cover through short, violent bombardments. This would allow the infantry to advance without facing artillery fire. If the offensive artillery could not do this, it had to keep enemy gun crews so busy with counterbattery fire that they would not have time to shell the attacking infantry. Field pieces, therefore, had to fight enemy artillery and support the infantry simultaneously.[49]

For some of the Army's artillerymen, engaging in counterbattery duels and supporting the infantry simultaneously suggested dividing the field artillery into two groups. One would check the enemy's field pieces, while the other would support the infantry. Given this line of thought, Captain Oliver Spaulding, Jr., a rising American field artillery intellectual, and the War Department recommended assigning the field artillery a specific mission before the battle started. The battery should be assigned to support the infantry or shell enemy artillery with counterbattery fire. Nevertheless, Spaulding and the War Department did not propose creating a rigid organization by designating batteries permanently with an infantry support or counterbattery mission. Although a battery's primary mission was counterbattery, it could still support the infantry as required. This permitted flexibility since a battery could serve several different roles during the course of an attack.[50]

Although Lieutenant Colonel John E. McMahon of the Army General Staff agreed that field artillery should either support the infantry or fire upon hostile artillery, he wanted even more

48. Rpt, School of Fire, 27 Jun 1916, p. 2; Burleson, "Some Observation Concerning the Use of Accompanying Batteries During the World War with Some Personal Experiences," p. 525. Ltr, Maj Gen Thomas H. Barry, Eastern Department Commander, to MG Leonard Wood, Army Chief of Staff, 5 Jun 1913, Moore-Greble File.

49. McMahon, "The Field Artillery of the United States," pp. 103-04; Maj E. Thionville, "Artillery in Battle Yesterday and Today," *Journal of the United States Artillery*, Jan-Mar 1904, pp. 272-81; Allan R. Millett, "Cantigny, 28-31 May 1918," in Charles E. Heller and William A. Stofft, eds., *America's First Battles: 1776-1965* (Lawrence, Ks: University Press of Kansas, 1986), p. 153.

50. Spaulding, *Notes on Field Artillery for Officers of All Arms*, p. 332; War Department, *Drill Regulations for Field Artillery*, 1911, p. 301.

flexibility. He opposed giving a battery a specific mission before the attack as commanders could not foresee how many pieces would be required for supporting the infantry or for counterbattery work.[51] According to McMahon's thinking in 1912, the field artillery had to be free to shell the most serious threat to the infantry and, therefore, should not have a strict assignment. The commander required freedom to gather as many guns as necessary to silence enemy pieces or rake hostile trenches to support the infantry. McMahon implied that his philosophy governing field artillery on the offensive differed from Spaulding's and the War Department's, but in reality it did not. All recognized that flexibility was the reigning concept and desired tactical organizations to permit the artillery to mass its firepower on the gravest threat to the infantry.[52]

On the defense the field artillery assumed a different role. It had to force the enemy's infantry to start its attack at a long range and assist in repulsing the infantry by inflicting seyere losses. Colonel McMahon wrote in 1912 that the field artillery directed its attention to the hostile guns once it had forced the infantry to deploy. Friendly artillery assaulted enemy field pieces until the infantry had massed for the attack, which made it vulnerable. At that time gun crews swept enemy infantry with intense fire but not to the exclusion of raking opposing guns.[53]

Influenced by Spaulding, McMahon, and developments in Europe and Japan, the War Department created a flexible doctrine to guide the employment of its field artillery on the eve of the United States' entry into World War I. *Drill and Service Regulations for Field Artillery* of 1916 explained that the field artillery's primary objective on the offense was hostile artillery until friendly infantry came within effective small arms range. When the attacking infantry reached small arms range, the field artillery intensified its fire on the enemy infantry and increased its range to prevent reinforcements from being pushed up. On the defense the field artillery shelled enemy guns until the infantry attacked. It then shifted to engage the infantry but left some guns to bombard enemy field pieces. Although it discussed the importance of assigning the field artillery specific missions, the War Department stressed employing batteries interchangeably to assist the infantry or silence enemy guns as needed. This permitted commanders to focus their field artillery on the most serious threat. The new concept also reflected the difficulty of breaking with past tactics of massing fire from all of the field guns on a target that might be threatening to the infantry for new tactics of accepting a particular mission and employing only a portion of the field artillery to hit a target.[54]

As the War Department struggled to adapt its tactics to the new technology, many artillerymen pushed for reorganization of the artillery. After much prodding Secretary Root convinced Congress to enlarge the Army to meet the needs of the colonial empire that the United States had acquired as a result of the Spanish-American War. In 1901 Congress agreed to increase the size of the Army. A Congressional act of February 1901 expanded the infantry from twenty-five to thirty regiments and dissolved the artillery's regimental organization that had mixed coast and field artillery units together in the same regiment and rotated officers between the two artilleries since

51. McMahon, "The Field Artillery of the United States," pp. 103-04.

52. McMahon, "The Field Artillery of the United States," p. 104; Spaulding, *Notes on Field Artillery for Officers of All Arms*, p. 332; War Department, *Drill Regulations for Field Artillery*, 1911, pp. 300-01.

53. McMahon, "The Field Artillery of the United States," p. 106.

54. War Department, *Drill and Service Regulations for Artillery*, Vol IV, 1916, pp. 100-01.

1821. The act also established an Artillery Corps of coast artillery with 126 companies and field artillery with 30 batteries that included field, mountain, and horse batteries under a chief of artillery to oversee the artillery and serve on the Army General Staff with General Randolph being the first chief. Yet, the act failed to divorce the field artillery from coast artillery totally. It continued the practice of rotating officers between two artilleries, which had no tactical relationship with each other. This hurt the coast artillery, certainly did not improve the efficiency of the field artillery, and produced a generic artillery officer without sufficient training in either artillery branch to function effectively.[55]

Organizationally, the act of 1901 represented antiquated thinking. Despite the War Department's recommendation for the organization of regiments, Congress kept the battery as the highest level of organization because it did not fully understand the importance of massing fire. As a result, Congress preserved an obsolete practice that was incongruous with field artillery developments in Europe and Japan as well as within the Army that accepted field artillery battalions and regiments as the norm.[56]

The act's failure to centralize field artillery command prompted a loud outcry. Army maneuvers at Manassas, Virginia, in September 1904 reaffirmed the necessity of organizing the field artillery into regiments. Afterwards, late in 1904, Captain William G. Haan of the Army General Staff wrote in the *Journal of the United States Artillery* that the field artillery's decentralized organization during the maneuvers prevented effective massing of fire. Temporary battalions were formed at Manassas to serve as division artillery, and chiefs of artillery were created. Yet, nothing was done to place the division's battalions under one commander. This allowed each battalion to operate independently. Consequently, except for one occasion the field artillery never massed fire during the maneuvers.[57] Because of this situation, the War Department had to organize its field artillery to work as a team.[58] If the field artillery would have been organized as the other combat arms had been, the battalions would have been formed into a regiment under a colonel. This would have permitted coordinating the division's artillery for massing fire efficiently. As far as Haan was concerned, the field artillery regiment was the wave of the future and the proper division artillery organization.[59] In the summer of 1905, Lieutenant Colonel Alexander D. Schenck, another advocate of the battalion and regiment, pointed out European, Russian, and Japanese regiments' and even brigades' ability to deliver deadly massed fire from screened positions.[60]

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55. Annual Report, Chief of Artillery, 1904, p. 8; Russell F. Weigley, *History of the United States Army* (New York: Macmillan Publishing Company, 1967), p. 317; James E. Hewes, *From Root to McNamara: Army Organization and Administration, 1900-63* (Washington: Center of Military History, 1975), p. 386. Annual Report, War Department, 1904, 2: 41; Annual Report, Chief of Artillery, 1906, p. 9.

56. Annual Report, War Department, 1905, 1: 261; Annual Report, Chief of Artillery, 1906, p. 11; Cpt W.G. Haan, "Remarks of the Use of Field Artillery in General, and the Need of Reorganizing of Our Field Artillery," *Journal of the United States Artillery*, Sep-Oct 1904, p. 143, hereafter cited as "Remarks on the Use of Field Artillery;" Lt Col A.D. Schenck, "A Regiment of Field Artillery," *Journal of the United States Artillery*, Jan-Feb 1905, pp. 1-4; Annual Report, War Department, 1903, 2: 368; War Department, General Orders No. 152, 14 Sep 1904.

57. Haan, "Remarks on the Use of Field Artillery," pp. 144-45.

58. *Ibid.*, p. 145.

59. *Ibid.*, pp. 142-46.

60. Schenck, "A Regiment of Field Artillery," pp. 1-4.

The Chief of Artillery promptly joined the crusade to reform the field artillery. In November 1904 General Story recorded, "It is a remarkable fact that our field artillery was not organized in our great civil war or in our late war with Spain so as to secure the most effective service."[61] Since Congress had made the battery the highest level of command, it had not yet learned the lesson of the Civil War where battalions and brigades had proven to be indispensable for massing fire. At the same time, the field artillery did not have enough guns to support the infantry and cavalry according to Story. The Army had thirty regiments of cavalry and infantry that were the equivalent of five divisions, and each division should have at least nine batteries organized into three battalions with each battalion commanded by a major or lieutenant colonel. Three battalions should form a regiment under a colonel.[62] In a powerful paragraph in his annual report for 1904, General Story blasted, "There is not a first-class power which has so systematically neglected its field artillery as the United States."[63] As Story saw the situation, the War Department had to form its field artillery into battalions and regiments and increase the number of batteries from thirty to at least thirty-six.[64]

The pursuit of reform convinced Chiefs of Artillery, Brigadier Generals Samuel Mills (1905-1906) and Arthur Murray (1906-1907), that the regimental organization for the field artillery was essential for efficient operations and that the number of batteries had to be increased so that the infantry would have enough support. Following the General Staff's lead, Murray argued for a ratio of 3.35 guns per thousand soldiers and stridently opposed two guns per thousand as was the current practice.[65] In 1906 he added, "It is a lamentable fact that the single battery has been the fighting unit of the United States Artillery up to the present time, notwithstanding the fact that the Confederates during the civil war [sic] and other nations have recognized and enjoyed the advantages of the larger fighting units in action."[66] Together, Mills and Murray pressed Congress to group the field artillery into battalions and regiments. Fearful of an armed conflict with a foreign power as the United States moved to increase its influence in world affairs, Mills and Murray also wanted the total separation of coast and field artillery so that officers would no longer rotate between the two, the creation of regiments, and the expansion of the number of batteries from thirty to thirty-six.[67]

After much prodding Congress finally recognized that coast and field artillery had little in common and that rotating officers between the two was detrimental. In light of this, a congressional act passed on 25 January 1907 separated the coast artillery from the field artillery by making each an independent branch of artillery and permitted establishing field artillery battalions and regiments.[68] Several months later, War Department General Orders No. 118, dated 31 May

61. Annual Report, Chief of Artillery, 1904, p. 12.

62. *Ibid.*

63. *Ibid.*, p. 14.

64. *Ibid.*

65. Annual Report, War Department, 1905, 2: 260; War Department, General Order No. 89, 14 Jun 1905.

66. Annual Report, Chief of Artillery, 1906, p. 12.

67. Annual Report, Chief of Artillery, 1905, p. 15.

68. War Department, General Order No. 24, 2 Feb 1907; War Department, Special Order No. 132, 6 Jun 1907; Annual Report, War Department, 1907, 2: 189, 216, 217; House of Representatives, Resolution No. 17347, File No. 107347, RG 94, National Archives; Memo for Secretary of War, subj: Proposed Order for the Organization of the Field Artillery into Six Regiments, 16 May 1907, File No. 1242815, RG 94.

1907, formed the field artillery into six regiments (three mounted, two mountain, and one horse) of two battalions each under a chief. Equally important, the act allowed the War Department to develop officers, noncommissioned officers, and enlisted personnel with expertise in field artillery by ending the pernicious policy of rotating them from one artillery branch to the other. With the passage of the January 1907 act and the subsequent creation of field artillery battalions and regiments, the field artillery assumed an independent status.[69]

As a part of the process of modernizing the field artillery, the War Department integrated field artillery into the division. To ensure that the infantry, cavalry, and field artillery worked together, the War Department combined them in the division. In 1905 War Department *Field Service Regulations* explained that the division consisted of three brigades of infantry (two or more regiments per brigade), one regiment of cavalry, nine batteries of field artillery organized as a provisional regiment of three battalions (thirty-six guns), one battalion of engineers, one signal company, and four field hospitals. Each field artillery battalion had a staff of 5 officers and 1 sergeant major, while each battery was composed of 1 captain, 2 first lieutenants, 1 second lieutenant, 1 first sergeant, 1 quartermaster sergeant, 1 stable sergeant, 6 sergeants, 12 corporals, 2 cooks, 4 artificers, 2 musicians, and 131 privates.[70] In concert with the Congressional act of 1907 that recognized the regiment as a permanent organization, the War Department replaced the division's provisional field artillery regiment with a field artillery brigade of two regiments (forty-eight guns and four battalions) in 1908. The regimental staff consisted of nine officers and forty-five men, and the battalion staff had three officers and five men. The battery was composed of one captain, four lieutenants, one first sergeant, six sergeants, six corporals, two musicians, one guidon bearer, and a driver for each pair of horses and had four guns, while a gun crew had two corporals and five privates.[71]

Over the next several years further changes in the division altered the field artillery. In 1910 the Army's Chief of Staff, Major General James Franklin Bell (1906-1910), created the First Field Army. Even though it was a paper organization until mobilized, the First Field Army consisted of three divisions. Each division had three infantry brigades of three infantry regiments each, a cavalry regiment, an engineer battalion, one or two signal companies, and one field artillery regiment with a staff of eight officers and twenty-eight enlisted men and two battalions of six batteries (forty-eight guns). The battalion had a staff of three officers and nineteen enlisted men.[72]

Events along the Mexican border soon caused the War Department to abandon the Field Army organization. In 1911 the War Department assembled many units of the First Field Army in Texas as the Maneuver Division. Following *Field Service Regulations* guidance, the Maneuver Division was composed of three infantry brigades, a field artillery brigade of three regiments (six

69. War Department, General Order No. 118, 31 May 1907; War Department, Special Order No. 132, 6 Jun 1907, War Department, File No. 1242815, RG 94; Annual Report, War Department, 1907, 2: 189, 216, 217; Annual Report, War Department, 1908, 2: 217.

70. John B. Wilson, "Army Readiness Planning: 1899-1917," *Military Review*, Jul 1984, p. 62; War Department, *Field Service Regulations*, 1905, pp. 12, 20, 26; War Department, *Drill Regulations for Field Artillery*, 1905, pp. 110-11.

71. Wilson, "Army Readiness Planning," pp. 64-65; War Department, *Drill Regulations for Field Artillery*, 1908, pp. 67, 193, 217, 221.

72. War Department, *Field Artillery Drill Regulations*, 1911, pp. 252, 256; Wilson, "Army Readiness Planning," p. 64.

battalions, eighteen batteries, and seventy-two guns), an engineer battalion, and medical and signal companies. Since the Maneuver Division was an assortment of hastily collected units, the War Department created a permanent division when it established four peacetime divisions in 1914. Each division had three infantry brigades, an engineer battalion, medical and signal units, and a field artillery brigade of two regiments, each with a staff of eight officers and twenty-eight men. One regiment had two battalions of 3-inch guns (twenty-four) and one battalion of 3.8-inch howitzers (eight), while the other regiment had two battalions of 3-inch guns (twenty-four) and one battalion of 4.7-inch howitzers (eight). The battalion had a staff of three officers and nineteen men and three batteries of four guns each, while a battery had one captain, two first lieutenants, two second lieutenants, one first sergeant, two scouts (corporals), three enlisted signal personnel, one quartermaster sergeant, one stable sergeant, eight mechanics, two musicians, six sergeants, four gunners (corporals), thirteen caisson corporals, sixty drivers, and sixty-five cannoneers. Besides creating division artillery, the War Department allotted a regiment of two battalions to a field army. One battalion had two batteries of 4.7-inch guns (eight), and the other had two batteries of 6-inch howitzers (eight).[73]

During the years following the Spanish-American War of 1898, the War Department dramatically modernized its field artillery by separating it from coast artillery and rearming it. The adoption of rapid-fire field pieces gave unprecedented firepower, while the integration of field artillery battalions, regiments, and brigades in the division centralized command to expedite massing fire and offered the potential of improving close support to the other combat arms. Although the School of Fire and other training programs existed, their focus on the basics of indirect fire produced inadequately trained field artillerymen and neutralized the impact of the new technology, tactics, and organizations. As the United States approached the eve of entry into World War I, an interesting dichotomy emerged. Modern field artillery weapons and equipment existed, but the Army lacked qualified personnel to exploit the new technology.

War Years: 1914-1918

Between 1914 and 1918 the Army had its first opportunities to employ its new field artillery system in combat. In response to raids into the United States by Pancho Villa, President Woodrow Wilson ordered Brigadier General John J. Pershing, Commander, 8th Brigade, 3rd Division, to take a punitive expedition into Mexico to assist the Mexican government in capturing Villa. For his mission Pershing organized a provisional division of two cavalry brigades of two cavalry regiments and two batteries of 3-inch field guns and one infantry brigade of two infantry regiments and two engineer companies with medical, signal, wagon, and air units as divisional troops. Although Pershing pursued Villa in vain throughout early 1916, he did fight two battles with Mexican government troops, who were also trying to catch Villa. Because the Mexican government did not want the United States to do its work, it demanded the withdrawal of Pershing from Mexico. With the Mexican president threatening war unless the Pershing got out of Mexico and Wilson unwilling to pull out Pershing, war seemed inevitable. As a result, the War Department

73. Weigley, *History of the United States Army*, pp. 334-36; Wilson, "Army Readiness Planning," p. 65; War Department, *Drill Regulations for Field Artillery*, 1911, pp. 253, 257, Appendix I; Bishop, *Elements of Modern Field Artillery*, pp. 34-36.

called out the National Guard of Texas, New Mexico, and Arizona, but the Guard seemed hardly enough. With the possibility of war with Mexico and with a war already raging in Europe that could involve the United States, House and Senate conferees on Army legislation passed the National Defense Act in May 1916.[74]

Culminating two decades of modernizing the armed forces, the act authorized doubling the Army and quadrupling the Organized Militia or National Guard over a period of five years, furnished a means of training new officers by establishing Reserve Officer's Training Corps in colleges, and endorsed the Plattsburg summer camp program. The act permitted the Army to grow from 108,000 to 175,000 men during peacetime and expand to 285,000 men during war (65 infantry regiments, 25 cavalry regiments, 21 field artillery regiments, 7 engineer regiments, 2 mounted engineer battalions, 263 coast artillery companies, and 8 aero squadrons) and form divisions and brigades. Although the act kept the division's infantry brigades at three, it enlarged the engineers from a battalion to a regiment of two battalions and increased the field artillery brigade from two to three regiments. One field artillery regiment would have 3.8-inch howitzers (twenty-four), while the other two regiments would have 3-inch guns (forty-eight). Together, the three regiments would give the division seventy-two field pieces.[75]

As the United States took action to strengthen its defenses, the Europeans adapted their field artillery to trench warfare. Since movement was not critical, the combatants positioned their field artillery in pits to protect them from counterbattery fire, placed ammunition in racks in the pits, and stretched a canopy of camouflage netting overhead to conceal the position from aerial observers. Extra ammunition was scattered around the vicinity of the battery and was covered with camouflage netting, tarpaulins, or brush. Combatants also moved the limbers, caissons, and horses to the rear about one to two miles and established posts for forward observers in carefully protected, masked positions located near the first line of trenches. The combatants connected the observation posts by telephone to their batteries where the battery commander normally conducted fire. Positioning of the field artillery in trench warfare differed from open warfare. In the latter field artillerymen did not fortify the battery by placing it in a pit or behind sandbags for protection and sited guns, limbers, caissons, and horses close together for rapid movement from one location to another, while extra ammunition was kept in wagons.[76]

To overcome the trenches that were appearing by 1915, Europeans increased the number of heavy artillery pieces and decreased their dependence upon light field guns. For example, the French army had 990 75-mm. gun batteries and 50 heavy batteries (batteries composed of field pieces larger than the 75-mm. gun) in August 1914. Four years later in 1918, the French army had 966 75-mm. batteries and 1,014 heavy batteries. Also, rapid bursts of artillery fire from light field guns to force the defense to take cover to allow the infantry to maneuver had been replaced by long, exhausting bombardments. These cannonades created dust and smoke that hindered observed indirect fire. Because of this problem and the difficulty of communicating with

74. Weigley, *History of the United States Army*, p. 348; William A. Ganoe, *The History of the United States Army* (Ashton, Md: Eric Lundberg, 1964), p. 456.

75. Weigley, *History of the United States Army*, p. 348.

76. Maj M.E. Locke, "Artillery in Europe," *Field Artillery Journal*, Jul 1917, pp. 296-97.

undependable field telephones, signal flags, and messengers, and unreliable methods of aerial observation, the French developed unobserved fire or map firing in 1916. Unobserved fire depended upon maps of enemy positions developed from aerial photographs and information from sound-and-flash ranging rather than forward observers. Once the targets had been placed on the map, field artillerymen used time-consuming mathematics to determine the range and direction to the target from their battery, incorporated weather data into their calculations because temperature, air pressure, wind speed and direction, and air density influenced the projectile's accuracy, and then opened fire. Although observed fire could be effective, dust, smoke, undependable communication systems, and the scarcity of observers made unobserved fire the favorite technique for engaging targets by 1917.[77]

Since unreliable communications also discouraged observed fire for close support for the infantry, the British introduced the rolling barrage in 1916. The rolling barrage, which the other combatants soon adopted, laid a curtain of shrapnel fire about one hundred to two hundred yards in front of the infantry and moved forward at a predetermined rate with little concern for the speed of the infantry advance. Sometimes, the rolling barrage left the infantry behind because craters caused by the shelling, barbed wire entanglements, and other obstacles hindered movement. If the rolling barrage advanced too far ahead of the infantry, the defense had time to recover after the shelling passed and could open with machine gun and small arms fire on the attacking infantry. Nevertheless, field artillerymen preferred the rolling barrage to observed fire because the former was not dependent upon communications.[78]

Besides introducing unobserved fire and the rolling barrage, the Europeans adopted gas-filled artillery shells. Unwilling to accept the indecisiveness of trench warfare, the Germans conducted the first major gas attack even though the French had experimented with various noxious gases on a small scale at the end of 1914. On 22 April 1915 in the Ypres sector, the Germans opened the valves on cylinders of chlorine gas. The escaping gas created a cloud that drifted across the terrain, settled in every depression, and finally spilled into the French trenches. Although the gas caused French divisions to break, the Germans could not exploit their offensive because they lacked the reserves. Shortly afterwards, the French and British started discharging gas from cylinders and allowing the prevailing winds to carry the clouds of gas over the Germans. Unable to depend upon the wind to blow the noxious gas over the enemy, the Germans developed gas-filled artillery shells in 1916 to hit hostile trenches. Soon, the British and French obtained their own gasfilled artillery shells. In 1917 combatants on the Western front expanded their use of gas shells to counterbattery fire. By utilizing gas shells over a broad front, field artillerymen could neutralize hostile artillery in two to four hours. In comparison, between 1914 and 1916 counterbattery work with high-explosive shell required several days to put enemy artillery out of action. Because of this, artillery commanders relied heavily on gas shells for counterbattery fire in 1918, and the number of rounds fired were only restricted by their availability.[79]

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77. Locke, "Artillery in Europe," p. 298; Col Maitre, "Evolution of Ideas in the Employment of Artillery during the War," *Field Artillery Journal*, Jan-Feb 1922, pp. 1, 4, 6-8, 1415; Bidwell and Graham, *Firepower*, p. 99-113; LTC C.N.F. Broad, "The Development of Artillery Tactics: 1914-1918," *Field Artillery Journal*, Sep-Oct 1922, pp. 375, 378, 379, 380; Lt Col Alexander T. Jennette, "Mass Fire in World War I," *Field Artillery Journal*, May-Jun 1975, pp. 40-43.

78. Bidwell and Graham, *Firepower*, pp. 83-85; Jennette, "Mass Fire in World War I," p. 45.

79. Charles E. Heller, *Chemical Warfare in World War I: The American Experience, 1917-1918* (Fort Leavenworth, Ks: Combat Studies Institute, US Army Command and General Staff College, 1984), pp. 7-11, 18-19, 86.

Meanwhile, influenced by economic interests and the desire to help the embattled governments of France and Great Britain, the United States joined the war against Germany in April 1917. Empowered by the National Defense Act, the War Department increased the number of field artillery regiments from six to nine. Of those nine, seven were light. One was mountain artillery, and the other was horse. After the declaration of war, the War Department formed twelve more to complement National Guard and Organized Reserve field artillery regiments. By the time that the armistice had been signed in November 1918, the field artillery had expanded from 9 to 234 regiments (Regular Army, National Guard, and National Army) and from 8,000 to 460,000 officers and men.[80]

Simultaneously, the War Department, as authorized by the National Defense Act of 1916, created a division in 1917 that was large enough to provide striking and staying power. This division of 28,000 men was composed of two infantry brigades (four regiments), a field artillery brigade with one heavy regiment (twenty-four six-inch howitzers) and two light regiments (forty-eight 3-inch guns), a regiment of combat engineers, three machine gun battalions, and signal, medical, and other supporting troops. In comparison, combat power in the German division of 1918 consisted of one infantry brigade (8,500 men) of two regiments and an artillery command of twenty-four 77-mm. field guns and twelve 105-mm. howitzers.[81]

Besides causing chaos, the rapid expansion of the field artillery in 1917-18 created an acute shortage of trained personnel and caused the War Department to take steps to resolve the problem. Of the nine regiments in 1917, only two were trained. Out of 408 regular field artillery officers, 275 had more than one year of experience, but they had only received training in basic field artillery subjects and had little practical experience. This small group, nevertheless, received the awesome task of organizing and training the expanded field artillery.The enlisted ranks shared a similar fate. Approximately 5,000 out of 8,253 enlisted men were trained. Since this cadre of officers and enlisted men could not be spread throughout the field artillery, training was an urgent problem. In July 1917 theWar Department dispatched Colonel (later major general) William J. Snow to reopen the School of Fire for Field Artillery. Upon arrival, Colonel Snow found students with little knowledge of field artillery and encountered equipment shortages to preclude effective training. Depending upon a small cadre of Regular Army field artillerymen, Snow set out to eliminate the deficiencies in the student officers. He enlarged the school to accommodate 1,200 students, developed a course of ten weeks, organized six academic departments (Firing, Liaison, Field Engineering, Field Gunnery, Transportation, and Materiel), and increased the number of school troops to support the training.[82] Although every effort was made to coordinate training received at Fort Sill with that being given in France, Snow concentrated upon teaching observed fire to equip graduates to fight mobile warfare. Field artillerymen trained for open warfare had the ability to adapt to trench warfare. However, field artillerymen trained for trench warfare could not adjust easily to open warfare. Open warfare required quick decisions and the rapid calculation of

80. *Report of the Chief of Field Artillery*, 1919, pp. 20-21.

81. House, *Toward Combined Arms Warfare*, pp. 40-41; Millet, "Cantigny, 28-31 May 1918," p. 155.

82. Sunderland, History of the *Field Artillery School*, pp. 53-56; *Report of the Chief of Field Artillery*, 1919, pp. 7-20, 78, 106.

fire direction data whereas trench warfare fostered making deliberate decisions and permitted careful computation of fire direction data. If an officer could make quick decisions, he could make deliberate ones when conditions allowed.[83]

Not withstanding the efforts of the School of Fire and division schools, which transformed civilians into officers without any real field artillery training, the rapid expansion produced chaos in training personnel. The lack of proper facilities and shortages of trained instructors plagued training duringthe early months of the war and brought training to a standstill. Realizing that building a field artillery was not progressing satisfactorily, the War Department established the Office of the Chief of Field Artillery on 15 February 1918 to train and equip the field artillery. Subsequently, the War Department made Major General Snow the Chief of Field Artillery. Over the next several months, Snow oversaw the creation of replacement depots at Camp Jackson, South Carolina, and Camp Zachary Taylor, Kentucky, and the Field Artillery Central Officers' Training School at Camp Zachary Taylor to train enlisted men and civilians to be officers. He also directed the creation of brigade firing centers at Fort Sill, Camp Jackson, Camp McClellan, Alabama, and Camp Knox, Kentucky, and schools of instruction for specialists and mechanics to complement the School of Fire. Acting under the Army Chief of Staff, Snow centralized all training and equipping the field artillery under the Chief of Field Artillery.[84]

Although General Snow made valiant efforts to produce trained field artillerymen, the two to four months of training failed to satisfy the requirements of modern warfare. The demand for troops in France curtailed training in the United States and forced the War Department to ship personnel overseas with superficial training. This in turn compelled training centers to be established in France where personnel and units were equipped and trained until they were needed at the front. Looking at this system of developing field artillerymen, General Snow commented in his report in 1919, "It is an incontrovertible fact that even with the most intensive training and the greatest of incentives, it is impossible to properly train Field Artillery units in from two to four months."[85]

This rapid mobilization of 1917-18 also taxed the War Department's ability to arm its field artillery regiments.When the country entered the war, the War Department had 574 3-inch guns, 107 2.95-inch mountain guns and howitzers, 40 3.8-inch guns and howitzers, 55 4.7-inch guns, 112 4.7-inch howitzers, and 42 6-inch howitzers. Although these pieces were enough for an army of 250,000, they would not satisfy the requirements of a two million-man force projected for duty in Europe. Guns and howitzers of all calibers were important, but most American field artillery officers insisted that the 3-inch field piece was the most crucial. As a result, the War Department armed two of every three regiments with the weapon because it was ideally suited for war of movement. The War Department wanted a mobile force and not one encumbered with heavy guns and stridently opposed trench warfare.[86] This meant that the Army had to have one 3-inch gun for every gun of any other caliber.[87]

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83. Sunderland, *History of the Field Artillery School*, pp. 63-64; William J. Snow, *Signposts of Experience: World War Memoirs* (Washington: United States Field Artillery Association, 1941), p. 143; MG William J. Snow, "Field Artillery: A Retrospect," *Field Artillery Journal*, Oct-Dec 1919, pp. 482-83.

84. *Report of the Chief of Field Artillery*, 1919, pp. 9-12, 20, 58; Snow, *Signposts of Experience*, p. 14-26, 44-55, 84-100, 153; Sunderland, *History of the Field Artillery School*, pp. 68-71.

85. *Report of the Chief of Field Artillery*, 1919, pp. 9, 29, 70, 188.

86. *Report of the Chief of Field Artillery*, 1919, p. 11; Weigley, *History of the United States Army*, p. 362.

The War Department's action hampered arming the field artillery. Although the simplest and quickest way to supply the American Expeditionary Force (AEF) with field guns was to use French 75-mm. guns and 155-mm. and 240-mm. howitzers and British 8-inch and 9.2-inch howitzers and although General Snow believed that the 3-inch gun was excellent and could serve in Europe, Chief of Ordnance, Major General William Crozier (1901-1917), chose to develop a new field piece. With the idea of simplifying ammunition supply in Europe and making a field gun that was superior to those to be furnished by American allies, Crozier and the Ordnance Department recaliberated the 3-inch gun's tube to make it 75-mm. and adopted a split-trail carriage to achieve greater elevation and traverse than the stock-trail carriage permitted. Because of the desire to equip the field artillery with this experimental gun (M1916), the War Department signed contracts with American manufacturers in 1917. Field tests in December 1917, nevertheless, revealed that the M1916 was inaccurate and that its carriage would break down after hard service.[88]

In the meantime, the Ordnance Department let Bethlehem Steel Corporation of Pennsylvania a contract to produce the British 18-pounder. Initially, the Ordnance Department planned to rechamber the gun to fire 3-inch rounds, but following the decision to use French 75-mm. ammunition as the standard, it remodelled British 18-pounder, which was designated the M1917, to fit French 75-mm. rounds. The slow production of the M1917 and the American M1916 caused by frequent design changes and defects with those pieces compelled the War Department to expand production of the French M1897 75-mm. field gun. Nevertheless, the war ended before the United States could field the M1897 because retooling took time and because the French reluctantly furnished the promised information about their field gun. In fact, American manufacturers completed only 109 French 75s by the end of the war.[89] Viewing the United States' failure to produce its own field guns and reliance upon foreign countries for field artillery, General Snow critically wrote, "It may be said, then, that we could not and did not equip our Army with artillery during the War."[90] The AEF had field pieces only because the government purchased them from the French and British.[91]

Besides equipping their batteries with French and British field artillery, the Americans adopted the French gas shell and borrowed European gas warfare doctrine for artillery. Imitating the French, the Americans divided gas shell fire into a destructive bombardment of two minutes of rapid fire to create a dense cloud to inflict heavy casualties and into a neutralizing

87. Snow, *Signposts of Experience*, pp. 196-97.

88. Memorandum for General Snow, School of Fire for Field Artillery, Fort Sill, Ok, 15 Mar 1918, in Snow, *Signposts of Experience*, pp. 197-98; Snow, *Signposts of Experience*, pp. 209, 291; Memorandum for the Chief of Staff, 25 Oct 1918, in Snow, *Signposts of Experience*, p. 291.

89. James F. Huston, *The Sinews of War: Army Logistics, 1775-1953* (Washington: Office of the Chief of Military History, US Army, 1966), p. 324; Edward S. Farrow, *American Guns in the War with Germany* (New York: E.P. Dutton and Company, 1920), pp. 146-47, 153; H.A. DeWeerd, "American Adoption of French Artillery, 1917-1918," *Journal of the American Military Institute* (now Journal of Military History), Summer 1939, p. 110; Snow, *Signposts of Experience*, p. 198; Ian Hogg, *The Guns: 1914-1918* (New York: Ballantine Books, 1971), pp. 93-99.

90. Snow, *Signposts of Experience*, p. 242.

91. *Ibid.*

bombardment of an unspecified length of time to lower the enemy's physical resistance and morale. Based upon German practices, the Americans also decided to include gas in all barrages that supported the infantry attack.[92]

As General Snow struggled to equip and train the field artillery, General John J. Pershing, Commander, AEF, started sending field artillery units to the front. Normally, he assigned them to a quiet sector for training and experience before moving them to the scene of heavy fighting. This practice essentially meant that American units were being absorbed by the French and British. Nevertheless, Pershing objected strenuously since this prevented him from organizing an independent American army and concluded that he could no longer permit the American forces to be dispersed. With this desire in mind, Pershing began forming all American units into an American army near the Lorraine in the spring and summer of 1918 to operate as an independent force.[93]

While Pershing was moving his army into position, the Germans opened a series of offensives designed to end the war before the Americans could help. The first struck two British armies in the Valley of the Somme on 21 March 1918 and drove a forty-by-sixty-mile salient into the British line after one week of fighting. To draw off any Allied reserves the Germans launched another offensive early in April 1918 in Flanders. As the German push stalled, the Americans, who had just moved into the front lines, counterattacked and captured Cantigny. Before the Americans could make any additional dispositions, the Germans mounted another major drive between Noyon and Reims and advanced as far as Chateau-Thierry. For three weeks two American divisions helped hold the Marne River and launched a local counterattack that recaptured Belleau Wood and Vaux.[94]

As the Americans and French fought to hold the Marne in the summer of 1918 and as the Germans opened their fourth offensive designed to merge the Marne and Amiens salients and later staged their fifth offensive to widen the Marne salient, Marshal Ferdinand Foch, Commanding General, Allied forces, planned a major counteroffensive. Before he began, he had to erase three German salients—the Marne in the French sector, the Amiens in the British sector, and the St. Mihiel salient opposite the Americans. He chose the Marne as his first objective.[95]

Foch struck the Marne salient hard. Concealed in covered positions behind the infantry, hundreds of batteries opened a tremendous barrage in the early hours of 18 July 1918. When the preliminary bombardment was completed, eight American infantry divisions helped a French-dominated force attack entrenched German positions. To silence machine gun nests and destroy other obstacles that might slow down the assault, French and American field artillery provided a rolling barrage of shrapnel to force the enemy to seek cover and cut through light obstacles.[96] When the

92. Heller, *Chemical Warfare in World War I*, pp. 52,86.

93. T. Harry Williams, *The History of American Wars* (New York: Alfred A. Knopf, 1981), p. 405.

94. Allan R. Millett and Peter Maslowski, *For the Common Defense: A Military History of the United States of America* (New York:The Free Press, 1984), p. 350; Williams, *The History of American Wars*, pp. 407-09.

95. Williams, *The History of American Wars*, p. 410.

96. "An Artillery Study Made in the AEF," *Field Artillery Journal*, Jan-Feb 1920, p. 53; Rpt, Cdr, 1st FA Brigade, to Cdr, 1st Division, AEF, subj: Report on Operations South of Soissons, 18-24 Jul 1918, in Morris Swett Library; Bidwell and Graham, *Firepower*, p. 84.

infantry moved out of effective artillery range, gun crews displaced their pieces forward, usually a battalion at a time, and frequently placed them in exposed positions close to the infantry where they could respond quickly and accurately to requests for fire.[97] During the rest of the Aisne-Marne offensive, the Americans repeated their tactics of the eighteenth. They opened each attack with an artillery bombardment to silence all German batteries and disrupt defensive efforts and followed it with an infantry charge supported by a rolling barrage. Finally after several weeks of artillery barrages and infantry attacks, the Americans and French pushed the Germans back twenty miles to the Aisne and Vesle Rivers and erased the Marne salient.[98]

Although the Americans favored mobile warfare that required the ability to shift artillery fire rapidly around the battle field by employing forward observers and effective communication networks, they found themselves trapped in trench warfare that required less responsiveness. Long rows of trenches, barbed wire, and other man-made obstacles limited movement. Like the Europeans, the Americans had to camouflage their guns to conceal them from aerial observation that was becoming increasingly more important, had to place their artillery behind sandbag barriers or in gun pits to prevent hostile counterbattery action from destroying their field pieces, and sometimes had to leave their guns unprotected if they had to move them frequently to support the infantry. Fighting in trenches and not in the open forced the Americans to give division, corps, or army artillery a specific mission. In doing so, the Americans broke with pre-war doctrine that had discouraged making permanent assignments before a battle. Composed of two regiments of 155-mm. howitzers (twelve batteries and forty-eight howitzers) and a battalion of 240-mm. trench mortars and commanded by a brigadier general, corps artillery with occasional assistance from division artillery's 155-mm. howitzers engaged the enemy's artillery to keep it from shelling the advancing infantry. Although corps artillery commanders generally used data obtained from sound-and-flash ranging, whenever possible, they also employed observers in balloons or aircraft to locate enemy gun positions.[99] As corps artillery bombarded the enemy's batteries, division artillery of two regiments of 75-mm. field guns (twelve batteries and forty-eight guns), a regiment of 155-mm. howitzers (six batteries and twenty-four howitzers) for general support, and a battery of 58-mm. trench mortars undera brigadier general supported the infantry with rolling barrages. In the meantime, army artillery formed the reserve. It had four brigades of three regiments each of 155-mm. howitzers, four brigades of three regiments each of 8-inch or 9.2-inch howitzers, five regiments of 75-mm. guns, and two brigades of railway or heavy coast artillery pieces served by coast artillerymen and commanded by a major general. Although railway artillery had been used in the Civil War to destroy strong fortifications and since the war to defend coasts, it assumed even more significance in World War I because of the need for more firepower. Steel and concrete fortifications simply required heavier guns. As a result, the War Department confiscated six 12-inch guns being built by American manufacturers for the Chilean government and shipped

97. Rpt, Cdr, 1st FA Brigade, to Cdr, 1st Div, AEF, 4 Aug 1918.

98. Millett and Maslowski, *For the Common Defense*, pp. 35354; Ltr, I Army Corps, AEF, to French Sixth Army, 29 Jul 1918, Historical Division, Department of the Army, *United States Army in the World War, 1917-1919*, Vol. 9, p. 459.

99. Brig Gen William M. Cruikshank, Chief of Artillery, I Corps, Lecture, 7 Apr 1919, Army Center of Artillery Studies, AEF, in Morris Swett Library; James W. Rainy, "Ambivalent Warfare: The Tactical Doctrine of the AEF in World War I," *Parameters*, Sep 1983, pp. 34-46; Millett, "Cantigny, 28-31 May 1918," p. 161.

them to France in 1917. From August 1918 through the armistice, they served satisfactorily when track, camouflage, supply, and other conditions were favorable. The railway gun and coast artillery allowed army artillery to fill any assignment.[100]

As the composition of the artillery indicated, light field pieces did not dominate AEF's field artillery as many field artillery officers had projected. Fighting in trenches and shelling strong defensive positions caused the Americans to increase the ratio of heavy guns to light because of the need for greater range and power than the flat-trajectory 75-mm. field piece offered. By doing this, the AEF compromised mobility and maneuverability but confirmed a prophecy of the Chief of Ordnance, who had predicted prior to the war that pieces heavier than 75-mm. guns would be required to defeat a well-armed enemy.[101]

Although American guns fired furiously, field artillerymen had difficulties providing close support during the Aisne-Marne offensive. For example, Colonel Lucius R. Holbrook, Commander, 7th Field Artillery Regiment, recounted moving field pieces often to prevent them from being destroyed by German counterbattery work even though he fired his guns from concealed, protected positions for the most part. Through sound-and-flash ranging and aerial reconnaissance the Germans located American guns and poured fire on them. As potent as American counterbattery fire was, it did not completely neutralize German artillery. The Germans still had the capacity to disrupt American field artillery action.[102]

The lack of good observation and communications further hampered the field artillery's ability to help the infantry. Because of the scarcity of trees, church towers, or other means to elevate spotters above ground level on 18 July, the field artillery supporting the 1st Division relied upon unobserved fire by using maps that frequently did not accurately indicate the most recent German positions nor their strength and did not furnish observed fire, provide close, continuous support to the infantry, or hit targets that required additional shelling. As a result, the Germans came out of their trenches and set up machine gun nests and stoutly resisted the advancing American infantry when the opening barrages passed. Poor communications also restricted artillery support. Because the 1st Division's commander could not get counterbattery fire from corps artillery on 19 July, German field pieces and small arms fire swept American infantry without any opposition.[103]

The problem often stemmed from the inability of the infantry and forward observers to identify targets. Without this information corps artillery simply could not effectively respond since it did not know the direction to fire and the nature of the target. Addressing the problem of

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100. Comparato, *Age of Great Guns*, p. 110; Col M.E. Locke, Lecture, Army Staff College, AEF, 28 Oct 1918, in Morris Swett Library; Operations Order No. 1, I Corps, AEF, 20 Jul 1918, in *United States Army in the World War, 1917-1918*, Vol. 5, p. 428; Annual Report, Chief of Field Artillery, 1923-24, in *Field Artillery Journal*, Mar-Apr 1925, p. 132.

101. Locke, Lecture, AEF, 28 Oct 1918; Operations Order No. 1, I Corps; Millett, "Cantigny, 28-31 May 1918," pp. 151-52.

102. Cdr, 7th FA, to Cdr, 1st Div, subj: Report on Operations South of Soissons, 4 Aug 1918, in Morris Swett Library; Summary of Intelligence, I Army Corps, AEF, 26 Jul 1918, No. 22, in *United States Army in the World War, 1917-1918*, Vol. 5, p. 447; Summary of Intelligence, I Army Corps, AEF, 30 Jul 1918, No. 26, in *United States Army in the World War, 1917-1918*, Vol. 5, p. 461.

103. Capt Elmer Goegert, "Operations of the 1st Division American Infantry," *US Army Infantry School Monograph of the World War*, p. 440; Rpt, Cdr, 1st FA Brigade, to Cdr, 1st Div, subj: Report on Operations South of Soissons, 18-24 Jul 1918, 4 Aug 1918, in Morris Swett Library.

communications, Colonel P.D. Glassman, Commander, 103rd Field Artillery, complained that information obtained from observers when they were used and the infantry during the Aisne-Marne offensive was generally inaccurate and often too late to be of any value for artillery support. He added that he seldom obtained accurate locations of machine gun nests and other targets. This often left the division without any counterbattery fire to silence enemy guns and machine gun nests that were mercilessly hitting the attacking American infantry.[104]

Like their European counterparts, American field artillerymen understood the criticality of good communications for effective observed indirect fire. W.F. Kernan and Henry T. Samson of the 103rd Field Artillery recalled that the field artillery occasionally surmounted communication difficulties and furnished solid observed fire. Quoting an anonymous historian for one of the divisions fighting in the Aisne-Marne offensive, they wrote, "Thus the artillery support was perfect. It was no mere mechanical protective fire, regulated by a theoretically correct timetable, which aided the infantry that afternoon."[105] The field artillery had well-sited observers that followed the infantry and adjusted fire on positions that required additional shelling. The bombarding was flexible, varied in intensity according to the requirements of the moment, and provided a moving barrier just ahead of the infantry. In this instance, forward observers provided continuous support.[106]

Generally, the field artillery did not have the capabilities to provide such support. Even though commanders established observation posts manned by forward observers, attached field artillery liaison officers to the infantry, and used telephones, radios, and other means of communications, the unreliable technology and inadequately trained officers and men hampered artillery and infantry coordination. Unable to tie the combat arms into an effective communication network, commanders had to depend upon elaborate plans and rigid schemes of barrages of unobserved fire during the Aisne-Marne offensive and seldom employed observed fire like that described by Kernan and Samson. At any given time, corps artillery would fire a barrage on predetermined targets (hostile batteries, reserve locations, ammunition dumps, exposed flanks, or anything else deemed important) that had been located on a map, while division artillery provided rolling barrages as a means to support the infantry. This intricate planning, which often occurred in a vacuum and excluded input from the infantry, minimized the need for good communications and highly trained personnel and dominated artillery action during the Aisne-Marne offensive since it was more reliable and easier to conduct than observed fire. Consequently, gun crews did not shift observed fire around the battlefield as conditions changed. Elaborate plans were designed to provide the needed support, but they did not guarantee effective close support for the infantry when required. Battle conditions, terrain, weather, and other factors generally prevented the infantry from following closely behind the rolling barrage and often hampered counterbattery work. Close, continuous fire support simply did not exist during the Aisne-Marne offensive.[107]

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104. Cruikshank, Lecture, 7 Apr 1919; W.F. Kernan and Henry T. Samson, *History of the 103rd Field Artillery* (Providence, RI: Remington Printing Company, n.d.), p. 82.

105. Kernan and Simson, *History of the 103rd Field Artillery*, p.67.

106. *Ibid.*

107. Millett, "Cantigny, 28-31 May 1918," pp. 161, 181-82; Field Orders No. 9, undated, extract, in *United States Army in the World War, 1917-1919*, p. 416; Operations Order No. 13, extract, I Corps Artillery, AEF, 18 Jul 1918, in *United States Army in the World War, 1917-1919*, p. 421; Ltr, CG, 51st Field Artillery Brigade, to CG, 26th Division, 7 Aug 1918, extract, in *United States Army in the World War, 1917-1919*, p. 516-17; Jennette, "Mass Fire in World War I," pp. 43-44.

Following the American and French success against the Marne salient and later the French and British victory at Amiens, the Americans attacked St. Mihiel as the Germans were beginning a tactical withdrawal. With a force of 550,000 divided into three American and one French corps, 260 tanks, 1,500 aircraft, and 2,975 cannons, the Americans hit St. Mihiel, which was heavily fortified. On the night of 11-12 September, army and corps artillery pounded crossroads, command posts, and railroad lines, while division artillery concentrated on cantonments, barbed wire entanglements, and machine gun nests. After four hours of shelling, the Americans thrust out their infantry under the cover of rolling barrages of smoke, high-explosive shrapnel, and gas shells. Major General Hunter Liggett's I Corps and Major General Joseph T. Dickman's IV Corps formed the main attack and hit the southern face of the salient as Major General George H. Cameron's V Corps made a secondary attack against the western face.[108] In the meantime, the French corps organized a holding attack at the salient's apex. As tanks and the infantry pressed forward, corps artillery, following an intricate map firing plan developed prior to the battle, continued bombarding the rear areas, communication lines, and German batteries. Together, the rolling barrage by division artillery and counterbattery fire facilitated the advance that defeated the Germans, who had virtually no artillery in position. Those German batteries that were still firing had almost run out of ammunition. By 13 September the Americans had destroyed the salient.[109]

Even though the Americans fired over one million rounds at St. Mihiel over a period of four days, the battle revealed several weaknesses. Elaborate preparations prior to the battle outlined the desired barrages and identified targets that required neutralization. Once the battle began, coordination broke down. The rolling barrages were uniform along each corps front. As a result, they moved too fast in some sectors because the infantry could not wade through the mud created by the overnight rains and progressed too slowly in others. This caused the AEF to allow each division to determine the rate of the rolling barrage's advance because the corps, which coordinated the division's rolling barrages, was too far removed from the scene of action. Moreover, depending upon map data for unobserved fire that had been collected through sound-and-flash ranging, aerial photographs, and captured enemy documents rather than exploiting ground observers seriously restricted artillery support at St. Mihiel. Gun crews lacked the most recent information about enemy positions and missed key targets. Broken ground, barbed wire entanglements, and other obstacles also hindered close support because field artillerymen could not move their guns, especially division pieces, forward rapidly, and this frequently left the infantry on its own, especially after most of the tanks fell victim to mechanical failures or mud.[110]

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108. Spaulding, *Notes on Field Artillery for Officers of All Arms*, pp. 83, 173; Bishop, *Elements of Modern Field Artillery*, pp. 3, 75, 76, 79; Millett, "Cantigny, 28-31 May 1918," p. 161; Maj Gen William S. McNair, Chief of Army Artillery, 1st Army, Lecture, 23 Dec 1918, subj: Explanation and Execution of Plans for Artillery for St Mihiel Operations and Argonne-Meuse Operations to November 11, 1918, in Morris Swett Library; *Final Report of General John J. Pershing, Commander in Chief, AEF* (Washington: Government Printing Office, 1920), p. 41; Donald Smythe, "St. Mihiel: The Birth of An American Army," *Parameters*, Jun 1983, p. 48; Rpt, 1st FA Brigade, 19 Sep 1918; Col Conrad H. Lanza, "What the Artillery Accomplished at St. Mihiel," *Field Artillery Journal*, Nov-Dec 1932, p. 595; Cyril Falls, *The Great War, 1914-1918* (New York: Capricorn Books, 1959), p. 381.

109. Lanza, "What the Artillery Accomplished at St. Mihiel," p. 597-600; *Final Report of General John J. Pershing*, p. 42; *Report of the First Army, AEF* (Leavenworth, Ks: The General Service Schools Press, 1923), p. 28; Smythe, "St. Mihiel," p. 53.

110. *Report of the 1st Army, AEF*, p. 36; Smythe, "St. Mihiel," pp. 55-56; Leonard P. Ayres, *The War with Germany: A Statistical Summary* (Washington: Government Printing Office, 1919), p. 97; Lanza, "The Artillery Support of the Infantry in the A.E.F.," *Field Artillery Journal*, Jan-Feb 1936, pp. 65-66.

Imitating a tactic developed earlier in the war by the Germans, the Americans employed accompanying artillery at St. Mihiel. To make the field artillery more responsive to the infantry's needs during rapid advances when they occurred, the AEF attached 75-mm. gun batteries to the infantry on the basis of one battery to an infantry brigade. Although accompanying artillery's effectiveness varied, it found favor with the infantry. It shelled machine gun nests and strong points and furnished close support. Yet, field artillery officers opposed accompanying artillery. They argued that detaching a battery from division artillery to serve as accompanying artillery decreased their ability to mass fire.[111]

The appearance of the accompanying gun represented more than just a need for close, continuous field artillery support. It was also a fight over the control of the artillery.With the development of indirect fire, the infantry commander had lost the influence over the artillery that he had had during the age of direct fire. Indirect fire gave field artillerymen more freedom to control their pieces than they had ever had. Equally important, indirect fire made the artillery less responsive than it had been with direct fire because it could no longer see the infantry's movements and had to depend on forward observers and effective communications to attack targets. Yet, field artillery officers advocated indirect fire because it meant greater safety for them and their guns, while the infantry wanted direct fire because it furnished immediate, decisive action. As such, the accompanying gun arose as a compromise between indirect and direct fire. It furnished the infantry with a few guns for close support, permitted the field artillery to employ indirect fire, and reflected the difficulties of moving from the old method of fire to the new.

While the Americans fought at St. Mihiel, Foch finalized his plans for a major offensive to end the war in 1918. Doubting his ability to destroy the German army, Foch decided to push it out of France rapidly and force it to leave valuable stores behind and sue for peace because of the lack of sustenance. To prevent the Germans from retreating with the supplies, he determined to capture the key junctions of Aulnoye and Mezieres and to advance all of the Allied army simultaneously. Beginning on 26 September, the Americans would drive northward toward Mezieres.The French would strike at the Aisne River line to prevent the Germans from dispatching forces to protect their wings, and the British would attack towards Aulnoye.[112]

On the appointed time an American force of 1,250,000 attacked. Following a three-hour artillery bombardment by 3,980 guns, the infantry jumped off into a sector bounded by the Meuse River on the right and the Argonne Forest on the left. Under the cover of a rolling barrage by division artillery and counterbattery fire by corps and army artillery, the infantry encountered a stiff German defense dug into four successive lines. Vast networks of uncut wire, deep ravines, dense woods, myriads of shell craters, and a heavy fog slowed down the advance and hindered coordination

111. Ltr, Chief of FA to CGs, FA Brigades, COs, FA Activities, subj: Information Bulletin, No. I. 20 Dec 1918, p. 2; "An Artillery Study Made in the AEF," p. 55; Brig Gen Lesley McNair," Infantry Batteries and Accompanying Guns," *Field Artillery Journal*, Mar-Apr 1921, p. 125; Office of the Chief of Artillery, Report of a Board of Officers Appointed to Make a Study of the Experiences Gained by the Artillery in the AEF and to submit Recommendations Based upon such a Study (Hero Board), General Headquarters, 1918, pp. 696, 703; Gen Charles P. Summerall, "Field Artillery Progress," *Field Artillery Journal*, Nov-Dec 1930, p. 606; Jennette, "Mass Fire in WWI," *Field Artillery Journal*, Jul-Aug 1975, p. 18.

112. Williams, *The History of American Wars*, p. 412.

between the infantry and field artillery.The barrage ran away from the infantry at times because the foot soldiers had difficulties moving. Commenting on this, Major General William S. McNair, First Army, AEF, Artillery Chief, exclaimed in December 1918 that the rate of four minutes per one hundred meters was too rapid for crossing the broken terrain. This forced the field artillery to shell points that had already been fired on by the rolling barrage. Although the field artillery had observers and liaison officers attached to the infantry, it usually received no information from the front line or obtained it too late because of poor communications. As a result, gun crews depended upon rigid map firing. This reduced the field artillery's ability to adjust to changing conditions and limited its usefulness. Because of these problems and others, the Americans only pushed the Germans back three miles the first day.[113]

The next several days repeated scenes of the first. Under the cover of a rolling barrage reinforced by concentrations of fire on critical points by corps and army artillery, the infantry pressed its attack. When the foot soldiers moved out of range, chiefs of artillery moved their guns forward and opened fire again. To ensure that firing was not interrupted, the Americans generally relocated one battalion at a time. The Americans had advanced about twelve miles by 30 September and struck a critical blow at the Germans. Intermingling of units as they crossed the badly devastated land, nevertheless, severely taxed commanders and forced Pershing to halt on 1 October.[114]

Although the Americans breached the first German defenses by early October, General McNair commented on the field artillery's inability to stay up with the infantry. Narrow roads and roads destroyed by artillery bombardments made forward movement of the guns slow. Following the war, McNair said that it was not until nearly a week after 26 September that any considerable portion of army artillery was able to support the offense. This situation restricted fire support to corps and division artillery and severely reduced the field pieces available, especially heavy. While the corps provided interdicting and counterbattery fire, division artillery continued supplying rolling barrages to neutralize machine gun nests and other obstacles.[115]

After four days of little or no forward movement, the Americans renewed their offensive. Early in the morning of 4 October, the AEF opened a barrage by army, corps, and division artillery prior to the infantry attack. Throughout the rest of the month, the field artillery bombarded the enemy's rear areas, batteries, and trenches, furnished rolling barrages, and displaced forward as the infantry forged ahead. As the offensive began wearing down at the end of the month, Pershing assembled seven divisions to break through the American portion of the Hindenburg Line. Early on 1 November, the Americans attacked. After two hours of a violent artillery preparation on all known German batteries to neutralize them, the infantry moved out under the cover of a rolling barrage and with a few accompanying guns. Artillery barrages were so well-timed and so dense that the enemy was overwhelmed. By nightfall the Americans had cut through its segment

113. McNair, Lecture, 23 Dec 1918, pp. 15, 17-18; *Report of the First Army, AEF*, p. 50; Lanza, "The Artillery Support of the Infantry in the A.E.F.," pp. 66-67.

114. Operations Report, III Army Corps, AEF, 28 Sep 1918, in *United States Army in the World War, 1917-1918*, Vol. 9, pp. 175-76;; AEF, "The Employment of the Artillery of the V Corps in the Argonne-Meuse Operations, 26 October-11 November 1918," *Field Artillery Journal*, Apr-Jun 1919, pp. 152-53; *Report of the First Army, AEF*, pp. 53-54.

115. McNair, Lecture, 23 Dec 1918, p. 18; Operation Report, III Army Corps, AEF, 27 Sep 1918, in *United States Army in the World War, 1917-1918*, Vol. 9, pp. 170-71; Operations Report, III Army Corps, AEF, 28 Sep 1918, p. 175.

of the Hindenburg Line, captured some German artillery, and helped to precipitate a German retreat. Three days later, the AEF's continued advance helped force the Germans into a full retreat. Under heavy pressure from enemy artillery and infantry, the Germans crossed the Meuse River near Sedan, France, where they positioned themselves for a stand that never came. On 11 November 1918 an armistice ended the war.[116]

As in past combat, providing observed fire during the Meuse Argonne offensive proved to be difficult and elusive. Since the advent of indirect fire, the field artillery had stressed the requirement for observed fire for mobile war. Drill Regulation of 1916, for example, emphasized the necessity of observed fire for supporting the infantry effectively.[117] Along with smoke, dust, and erratic communication systems, the mediocre qualifications of officers, noncommissioned officers, and enlisted personnel, however, encouraged abandoning observed for unobserved fire. For the most part, the Army's field artillery furnished solid unobserved fire for trench warfare because it could be planned in great detail before the battle and permitted officers to take their time calculating fire direction data and to fire barrages without concern for their accuracy.[118]

Even when opportunities existed to employ observed fire, commanders preferred unobserved fire. Observed fire for hitting targets of opportunity or supporting mobile warfare demanded proficient field artillerymen. Headquarters, Army Artillery, 1st Army, AEF, recorded in November 1918 during the latter days of the Meuse-Argonne offensive that the field artillery had difficulties engaging targets that appeared suddenly and required adjustments to the fire plan. This stemmed from the lack of training. With insufficient training field artillerymen did not possess the skills to shift fire quickly and effectively around the battlefield. Likewise, field artillerymen had problems providing observed fire any time a battle became mobile because it meant rapid calculation of data and quick and numerous changes of position and reliance upon questionable communications technology.[119]

The dramatic expansion of the field artillery that had to be trained by a handful of competent officers and men and the pressure to produce field artillerymen as quickly as possible mitigated against quality and hindered the effectiveness of indirect fire. Because of the war, the School of

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116. *Report of the First Army, AEF*, pp. 51, 56, 85-87; *Final Report of General John J. Pershing*, pp. 49-51; Brig Gen Wendal C. Neville, USMC, Lecture, 21 Apr 1919, Army Center of Artillery Studies, in Morris Swett Library; Report, Brig Gen A.J. Bowley, Chief of Artillery, VI Corps, subj: Artillery, undated, in Morris Swett Library; Maj Gen Charles P. Summerall, Lecture, Army Center of Artillery Studies, 16 Dec 1918, in Morris Swett Library.

117. HQ Army Artillery, 1st Army, AEF, Memorandum No. 12, 6 Nov 1918, Ernest Hinds Papers, Morris Swett Library; Extract from "Notes on Recent Operations," by Brig Gen Lesley J. McNair, *Field Artillery Journal*, Oct-Dec 1918, p. 591.

118. Lt Col John B. Anderson, "Are We Justified in Discarding Pre-War Methods of Training," *Field Artillery Journal*, Apr-Jun 1919, p. 223; HQ Army Artillery, 1st Army, AEF, Memorandum No. 12, 6 Nov 1918.

119. Extract from "Notes on Recent Operations," p. 591; Anderson, "Are We Justified in Discarding Pre-War Methods of Training," pp. 223-25; "Fire Direction of Artillery Supporting Infantry," *Field Artillery Journal*, May 1921, pp. 508-10; HQ Army Artillery, 1st Army, AEF, Memorandum No. 12, 6 Nov 1918. Although it was in its infancy, aerial observation offered the field artillery the opportunity of providing effective observed indirect fire. However, rivalries between the Signal Corps (Air Service after May 1918) and field artillery, poorly trained officers, and unreliable communications technology hampered employing aerial observation except for a handful of times. For more information consult Hero Board Report. It has an outstanding section on aerial observation in World War I on pp. 25-27, 54-55, 662-66.

Fire and other training institutions simply did not have the time to produce qualified officers to direct battery fire or skilled noncommissioned officers to carry out the directions of their officers. According to Major Richard C. Burleson, whose article on the accompanying battery won the honorable mention prize in the *Field Artillery Journal's* essay contest in 1921, developing a qualified officer "to conduct the fire of a battery under all conditions requires a great deal of time. In fact it requires years."[120] Commenting on observed fire, Major General Edward F. McGlachlin, Chief of Artillery, 1st Army, AEF, wrote in November 1918, "This type [of fire] requires more skill than firing a barrage."[121] Inadequately trained personnel seriously hampered the field artillery's ability to support the other combat arms during the Meuse-Argonne and other campaigns with observed fire when battles were fluid and simultaneously encouraged reliance on unobserved fire to provide close support in most situations because it was less difficult to perform than observed fire was.

Lengthy barrages caused by trench warfare, inexperienced and inadequately trained field artillerymen, rapid-fire field artillery, and industrialization expended a tremendous amount of artillery rounds. During the Meuse-Argonne offensive, for example, the Americans fired over four million rounds. To keep the guns supplied the AEF shipped twelve to fourteen trainloads to the front daily and often had to bring divisions out of the line because of the lack of ammunition. Because of the vast defensive networks of trenches, barbed wire entanglements, machine guns, rapid-fire artillery (light and heavy), and small arms, commanders had to depend on artillery. An advance could not be made without a tremendous superiority of pieces to blast open a path for the infantry. American gun crews had to abandon supply economy practiced during peacetime since throwing huge quantities of high-explosive shell and shrapnel had become the key to victory. The ability to keep an army supplied with artillery ammunition had assumed as great importance as the quality of the field pieces and men.[122]

During the Meuse-Argonne offensive, the AEF also felt the impact of motorized field artillery for the first time. Although the Army had first used trucks for its supply columns in Pershing's expedition of 1916, it regarded them as substitutes for railroads and not horses.[123] Despite this thinking and the poor performance of motor vehicles in Mexico, the Field Artillery Board and several other boards continued testing tractors and trucks for pulling field artillery in 1917-18. Influenced by the tank's success in crossing devastated ground in 1916 and by improvements in tractors and trucks in 1915-17, many American field artillery officers changed their attitudes about motorization. Yet, they supported tractor-drawn rather than truck-drawn artillery since the latter still had problems moving cross-country or over shell-torn ground. In the St. Mihiel offensive in the summer of 1918, the AEF had a few heavy field pieces mounted on caterpillar tractors, but these self-propelled guns lacked sufficient mobility and did not contribute much.[124] Even

120. Burleson, "Some Observations," p. 525.

121. HQ Army Artillery, 1st Army, AEF, Memorandum No. 6, 6 Nov 1918.

122. Huston, *The Sinews of War*, pp. 382, 386, 398; Comparato, *Age of Great Guns*, pp. 108-09.

123. Huston, *The Sinews of War*, p. 298.

124. Hogg, *The Guns*, pp. 149-52; Ltr, FA Board to Adjutant General, subj: Motor Traction, FA, 5 Jun 1917, File No. 2259480, RG 94; Ltr, Board of Officers Appointed by Paragraph 51, SO 98, War Department, 1917, to Adjutant General, subj: Motor Traction, FA, 5 Jun 1917, File No. 2259480, RG 94; War Department, SO 98, 28 Apr 1917, File No. 2259480, RG 94; Memo for Adjutant General, 27 Apr 1917, File No. 2572812, RG 94.

though motorized field artillery had an inauspicious birth in September 1918 as the Meuse-Argonne offensive started, the War Department decided to convert all 155-mm. howitzers in the division and one regiment of 75-mm. guns in each division from horse- to tractor-drawn because the number of horses suitable for military service was beginning to dwindle. Before the War Department could carry out its plans, the war ended with only eleven tractor-drawn 155-mm. howitzer regiments in existence.[125]

Nevertheless, the field artillery reached an important milestone in the fall of 1918. Until then, the field artillery had been associated solely with horses. In a memorandum in December 1918, General Snow commented, "The advantages of caterpillar over tractor or horse artillery are so great that a general study should be made to determine whether caterpillar traction cannot be applied to all artillery."[126] Motor vehicles had not been extensively employed during the war for pulling guns and howitzers, but many field artillery officers realized that they could replace the horse but not without further development and experimentation.

Although the field artillery had doctrine for employing gas shells, Americans used gas sparingly during the Meuse-Argonne offensive. Prior to the Meuse-Argonne campaign, the First Army Headquarters disseminated literature that described how the Germans had literally smothered the Allies with gas in their spring offensives of 1918 and urged commanders to utilize gas lavishly. Nevertheless, the final decision to employ gas was left to corps and division commanders. With little or no training and experience, they utilized gas minimally in the Meuse-Argonne as they had done at St Mihiel and never mastered employing gas shells. As a result, the field artillery had limited opportunities to practice its gas doctrine in combat.[127]

Action in the war furthered the revolution of the field artillery. Using sound-and-flash ranging, telephones, forward observers, maps, charts, and other equipment and employing indirect fire for the first time in combat, American field artillerymen shelled enemy batteries and trenches, bombarded rear areas, and developed doctrine to govern the employment of gas. Persuaded by the appearance of the new technology, field artillery officers changed tactics and doctrine. Charging around the battlefield trying to follow the infantry had become hopelessly antiquated and dangerous. Because of the guns' longer ranges and indirect fire, batteries did not have to follow the infantry as closely as they had done in the past. Yet, mobility still concerned many officers since the guns often could not follow the infantry even at a safe distance because of battlefield conditions.

Indirect fire, rapid-fire field pieces, and their associated equipment and material, therefore, brought mixed blessings. As a team, they allowed the field artillery to fire huge amounts of rounds, but hitting targets with indirect fire depended upon effective communications and competent officers and men and made providing close, continuous support more difficult than it had been during the days of direct fire. The war quickly revealed the inherent weakness of indirect fire. Without dependable means of communication and qualified personnel, the field artillery could not effectively employ observed indirect fire. Since telephones, radios, runners, signal flags, and

125. Huston, The Sinews of War, p. 324; Ayres, *The War with Germany*, p. 80; Harry G. Bishop, "The Trends of Field Artillery," *Field Artillery Journal*, Mar-Apr 1931, p. 125.

126. Snow, *Signposts of Experience*, p. 303.

127. Heller, *Chemical Warfare in World War I*, p.87.

other forms of communications designed to tie the infantry, observers, and guns together were vulnerable to enemy action, field artillerymen resorted to unobserved indirect fire to minimize reliance upon tenuous communication systems and forward observers. Yet, unobserved fire did not solve the problem of providing effective close support, made field artillery support rigid and often limited, and caused the infantry to adopt accompanying artillery as a means of having quick, accurate support. Although the reforms in guns, materiel, tactics, and organization during the years since 1898 had revolutionized the field artillery, solving the communication problem and developing field artillerymen were imperative before indirect fire could be truly exploited.

Table 4

AMERICAN FIELD ARTILLERY CAPABILITIES-1913

Weapon	Projectile	Elevation in degrees	Range in Yards
M1902 3-inch Gun	Shrapnel high explosive shell	15	6,000
M1904 4.7-inch Gun	Shrapnel high explosive shell	15	8,750
M1905 3.8-inch Howitzer	Shrapnel high-explosive shell	45	6,300
M1906 6-inch Howitzer	Shrapnel high-explosive shell	45	8,700
M1907 4.7-inch Howitzer	Shrapnel high-explosive shell	45	6,600

Source: Crdnance Department, *Table of US Cannon (Washington: Government Printing Office, 1913), pp. 4-5.*



A section of the famous Utah Battery in action at Coloocan, Philippines, 1898, armed with Model M1885 3.2-inch field pieces.



5th Field Artillery, M1902 3-inch section going into battery, 1913, Fort Sill, Okla.



The M1897 75-mm. gun which fired the first American shot in World War I in its original position, 1917.

Chapter VII

THE INTERWAR YEARS: 1919-1939

Following the Great War, various boards made recommendations for implementing the lessons of 1914-18 and improving the field artillery. Over the next two decades, pacifism, a surplus of materiel from the war, conservatism, limited budgets, and problems associated with new technology influenced rearming the field artillery and developing new tactics and techniques.

Unfulfilled Hopes

The War Department moved into the 1920s with great expectations for modernizing its field artillery, but opposition stalled serious progress. As far as many Americans were concerned, the November 1918 armistice had ushered in an era of endless peace.[1] The desire for peace continued into the 1930s, and the growing pacifism and the Great Depression influenced Americans to seek isolation and eventually led to the passage of neutrality acts in 1935 and 1937. The drive for neutrality and the avoidance of war in the 1920s and 1930s meant that the War Department did not feel pressure from the American people to modernize its weapons because disarming was more important than rearming.[2]

Despite the general mood of pacifism in the country, the War Department searched for a viable policy to prepare for a war. In 1919 the Chief of Staff, General Peyton C. March (1918-1921), devised a plan to build a large standing army. Basing his calculation on an invasion of the country, he advocated a large Regular Army of 500,000 men organized as an expansible force that could serve as a half-strength skeleton field army of five corps. To fillout the Regular Army, March and the General Staff proposed drawing on reserves formed by a system of universal military training and relegated the National Guard to third place behind the Regular Army and its conscripted reserves.[3]

The plan shocked Congress because of its desire to withdraw from foreign responsibilities and opposition to military commitments and a large army. Republican Senator James W.

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1. Boyd L. Dastrup, *A Centennial History: The US Army Command and General Staff College* (Manhattan, Ks: Sunflower University Press, 1982), p. 61; Russell F. Weigley, *History of the United States Army* (New York: Macmillan Publishing Company, Inc., 1967), pp. 395-96.

2. Dastrup, *A Centennial History*, p. 61.

3. *Ibid.*, p. 62.

Wadsworth of New York, Chairman of the Senate Military Affairs Committee and an advocate of military preparedness, found it to be amusing and ironic that the War Department would push and even foster a plan closely resembling the German military system that it had just fought to eliminate. After months of inconclusive debate in 1919-20, the committee heard testimony from Colonel John McAuley Palmer, who enjoyed the support of General John Pershing. Palmer rejected the General Staff's and March's proposal. According to Palmer, the effective work of American citizen soldiers in France refuted the necessity of a large standing army. He suggested instead creating a small Regular Army to serve in an emergency and to train the citizen army.[4]

In response to the War Department's and Palmer's recommendations, Congress passed the National Defense Act of 1920. It authorized a force of 288,000, made provisions for a National Guard and Organized Reserves, and established a tactical as well as administrative peacetime organization that divided the country into nine corps areas, each under a Regular Army major general. At the same time, the act retained the coast artillery with its antiaircraft mission and the field artillery as separate branches. Some Army officers, however, argued that the use of heavy coast artillery as field pieces during the war, the practice of employing coast artillerymen to serve those guns, and the relative mobility of even the heaviest pieces had erased the traditional differences between the two branches.[5]

In the meantime, the Army examined its performance during the war. The General Headquarters, American Expeditionary Forces (AEF), convened the Board to Study the Experience Gained by the Artillery in the AEF. Chaired by Brigadier General Andrew Hero, the board, better known as the Hero Board, met from December 1918 through March 1919. After travelling through Europe and interviewing commanders of field artillery brigades, regiments, ammunition trains, and schools in the AEF about training, organization, motorization, weapons, tactics, and equipment, the Hero Board submitted its report. Although the board's most detailed comments addressed training, it also examined the proper kind of field guns. Because the AEF had depended upon France and Great Britain for field artillery during the war, the Hero Board pointed out the need for a system of mutually dependent light, medium, and heavy pieces. The Army required medium and heavy artillery to bombard fortifications and break holes in the enemy's defenses and light division artillery to follow the infantry and exploit the gaps in the enemy's lines.[6] To ensure that mobility would not be compromised, the board recommended assigning regiments of 75-mm. guns or 3-inch guns, a regiment of 120-mm. howitzers, and a battalion of 3-inch mountain guns to the division and placing a regiment of 155-mm. howitzers in the corps.[7] Concurrently, the board proposed attaching heavy tractor, railway, trench, and antiaircraft artillery to the general headquarters reserves where mobility was not a requirement.[8]

4. Weigley, *History of the United States Army*, pp. 397-400.

5. Dastrup, *A Centennial History*, p. 62; Weigley, *History of the United States Army*, p. 400; Larry H. Addington, "The US Coast Artillery and the Problem of Artillery Organization, 19071954," *Military Affairs*, Feb 1976, pp. 2-3.

6. US Army, AEF, Report of the Board to Study the Experience Gained by the Artillery of the AEF, 1918, pp. I, 3, 10-13, hereafter cited as Hero Board Report, in Morris Swett Library, Fort Sill, Ok.

7. *Ibid.*

8. *Ibid.*, pp. 11-12.

Besides addressing the need for a field artillery system, the Hero Board criticized aerial observation. Outside of a few isolated cases, aerial observation had been unsatisfactory during the war. Poor liaison between the field artillery and the Aviation Section of the Signal Corps (the Air Service after May 1918), the lack of field artillery training for observers, the tendency of commanders to relegate reconnaissance missions to secondary importance behind combat missions, and the Signal Corps' control of observation assets prevented effective aerial observation.[9] Notwithstanding these problems, most field artillery officers found aerial observation to be essential for observed indirect fire and to hold great promise. Brigadier General Albert J. Bowley, 6th Corps Artillery, wrote, "Aerial observation in my experience has been conspicuous by its absence . . . .Aerial observation is very essential and should be developed."[10] Expressing his displeasure with aerial observation under the Signal Corps, Brigadier General Adrian S. Flemming, 158th Field Artillery Brigade, noted, "The only solution I see is to assign certain aeroplanes and balloons to the artillery for the purpose of observing and permit them to do no other work."[11] In a short statement Brigadier General T.N. Horn, 7th Field Artillery Brigade, explained, "So far as has been observed a field artilleryman can become an aerial observer but an aerial observer can do very little for the field artillery unless he be a field artilleryman."[12]

After assimilating the various views on ways of improving aerial observation, the Hero Board issued its position. To realize the benefits of aerial observation, the board recommended placing it under the control of the field artillery and employing field artillery officers as observers. This would ensure aerial observation when needed and provide observers with the appropriate skills.[13]

To enhance the field artillery's mobility as a part of an overall upgrading of the branch, the Hero Board addressed motor traction. The board encouraged adopting tractors to pull the 155-mm. howitzer and small motor vehicles for light artillery as soon as adequate ones could be developed.[14] In a memorandum to the Hero Board's report, Major General Ernest Hinds, Chief of Artillery, AEF, endorsed motorizing the field artillery. Nevertheless, he cautioned against totally discarding horse-drawn light artillery for the division because motor vehicles still had weaknesses that needed to be eliminated before they would be dependable. Conservatives in the Army, such as Hinds, knew that motorization was the wave of the future, but their ties with the horse, their worries about the availability of spare parts, gasoline, trained drivers, and the slow speeds and unreliability of early motor vehicles prevented unconditional support.[15]

For the most part the Hero Board outlined a modest agenda for the field artillery. Besides recommending improved training, the board saw the need to create organic air observation and to

9. *Ibid.*, p. 25.

10. *Ibid.*, p. 663.

11. *Ibid.*, p. 664.

12. *Ibid.*, p. 665.

13. *Ibid.*, pp. 25-26, 665-71, 823-40.

14. Larry H. Roberts, "American Field Artillery," unpublished master's thesis, Oklahoma State University, 1977, p. 13; Hero Board Report, p. 13.

15. Memo, Office of the Chief of Artillery, AEF, 9 Dec 1918, in Hero Board Report, pp. 41, 43; Memo for Gen Kuhn, subj: Motor Traction, FA, 13 Jun 1917, in File No. 257812, RG 94, National Archives.

employ field artillerymen as observers to enhance observed fire. The distaste for trench warfare of the recent war caused the board to preach arming the division with light pieces and attaching the heavier ones to the corps or higher to ensure mobility. With the exception of advising the development of the 120-mm. howitzer, the board only pushed arming the field artillery with the existing weapons. Procuring new ones was not included since other boards were considering the proper armament.[16]

While the Hero Board discussed the appropriate calibers, aerial observation, motorization, and other related matters, Headquarters, Third Army, AEF, assembled a board of officers to investigate motorizing division artillery. Chaired by Major General William Lassiter, Chief of Artillery, Third Army, AEF, the board tested tractor-drawn field artillery in June 1919. At the conclusion of the trial, First Lieutenant Guy Taylor of the 76th Field Artillery Regiment wrote about the superiority of motorized field artillery. Motor vehicles gave the field artillery speed, power, and the ability to take longer marches.[17] Later, Brigadier General William M. Cruikshank, Commanding General, 3rd Field Artillery Brigade, supported motorizing the field artillery because of the success of the test.[18] Backed by these favorable endorsements and its own observations, the Lassiter Board concluded that tractors could be relied upon, that the division's 155-mm. howitzer regiment and one of the two 75-mm. gun regiments should be motorized, and that the division's other 75-mm. gun regiment should be converted to motor transport as soon as the equipment was available.[19]

As the Lassiter and Hero Boards studied the field artillery, the War Department formed an even more important board. At the promptings of Major General William J. Snow, Chief of Field Artillery (1920-1927), who had expressed grave concerns about the changes in tactics and technology and the AEF's dependence upon foreign artillery, the War Department convened a board of officers at Chaumont, France, to study the ammunition and field artillery used by the belligerents. Headed by Major General William I. Westervelt, the board, better known as the Westervelt or Caliber Board, interviewed French, Italian, British, and American field artillery officers and visited various artillery factories.[20] Upon returning to Washington in April 1919, the board digested its findings, consulted with the Chiefs of Ordnance, Coast Artillery, Field Artillery, and Chemical Warfare, and completed a lengthy report. The board concluded that every gun, howitzer, carriage, vehicle, and projectile needed to be replaced. The war, after all, had revealed the inadequacy of the field artillery.[21]

16. Hero Board Report, p. 12; William J. Snow, *Signposts of Experience: World War Experience* (Washington: US Field Artillery Association, 1941), pp. 196-97.

17. Ltr, Taylor to Lassiter Board, subj: Observations of Recent Test of Motorized Artillery, 25 Jun 1919, in Report of a Board of Officers Convened in Accordance with the Following Order: SO No. 162, HQ Third Army, AEF, 11 Jun 1919, hereafter cited as Lassiter Board Report, in Morris Swett Library.

18. Ltr, Cdr, 3rd Field Artillery Brigade, to President, Lassiter Board, subj: Test of Motorized Artillery, 26 Jun 1919, in Lassiter Board Report.

19. Lassiter Board Report, pp. 11-15.

20. Annual Report, Chief of Field Artillery, 1920, p. 6; War Department, Report of Board of Officers Convened Pursuant to the Following Order: SO No. 289, 11 Dec 1918, hereafter cited as Westervelt Board Report, in Morris Swett Library.

21. Westervelt Board Report, pp. 4, 24-25; Constance M. Green, Harry C. Thomson, and Peter C. Roots, *The Ordnance Department: Planning Munitions for War* (Washington: Office of the Chief of Military History, US Army, 1955), p. 171. Snow served as Chief of Field Artillery during World War I and retained that position after Congress made the Chief of Field Artillery permanent in 1920 as part of the National Defense Act of 1920.

After examining the various calibers of guns and howitzers used during the war, the Westervelt Board observed that each echelon from division to general headquarters reserves should have guns and howitzers of such mobility, power, variety, and number to ensure the success of the mission and enable it to be gained with a minimum of casualties. A gun-howitzer mix was imperative since the gun's flat trajectory made hitting the reverse slope of a hill impossible and finding a suitable firing position hard, while the howitzer could hit the reverse slope and fire from almost any position.[22]

Seeking the proper gun-howitzer combination for each echelon, the board outlined ideal and practical alternatives.The board's ideal or long-term solution for division or light artillery involved adopting a 75-mm. to 3-inch gun with an elevation of eighty degrees and a range of 15,000 yards and a 105-mm. howitzer with an elevation of sixty-five degrees and a range of 12,000 yards. Corps or medium artillery required a 4.7-inch to 5-inch gun with an elevation of eighty degrees and a range of 18,000 yards and a 155-mm. howitzer with an elevation of sixtyfive degrees and a range of 16,000 yards. Army or heavy artillery needed a 155-mm. gun with an elevation of sixty-five degrees and a range of 25,000 yards and an 8-inch howitzer with an elevation of sixty-five degrees and a range of 18,600 yards. Intent on totally rearming the field artillery with new pieces, the board's ideal solution meant developing weapons of all sizes with longer ranges, 360-degree traverses to provide better support for the large fronts, more mobility, and more power than those in use.[23] In contrast, the board's practical or short-term (also less expensive) answer involved upgrading the French M1897, the American M1916, and the British M1917 75-mm. guns and the French M1918 155-mm. Schneider howitzer for division artillery, the American M1906 4.7-inch gun, the British 5-inch gun, and M1918 155-mm. Schneider howitzer for corps artillery, the French 155mm. GPF gun and British 8-inch howitzer for army and general headquarters artillery, and other existing guns and howitzers of super heavy weight and caliber, such as the M1918 240-mm. howitzer, until the ideal ones could be fielded.[24]

The Westervelt Board's recommendations signalled a significant departure for the field artillery. Influenced by the war and the War Department's inability to supply its own field pieces, the board urged the acquisition of a balanced field artillery system of light, medium, and heavy pieces. As the Hero Board had advised, the Westervelt Board also pointed out the need for medium and heavy guns with greater destructive power and longer ranges to allow the Army to attack fortifications and interdict communication lines behind the front lines, while light field pieces would be assigned to the division to furnish close support to the infantry. Although it emphasized mobility, the board's conclusions suggested that interdicting fire was becoming more important than it had been so that the Army could restrict the flow of reserves and supplies to the front. Yet, this evoked a controversy since air power enthusiasts advocated employing aircraft to interdict communication lines.[25]

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22. Westervelt Board Report, pp. 4, 24-25; Green, Thomson, and Roots, *The Ordnance Department*, p. 171.

23. Westervelt Board Report, pp. 24-25.

24. Westervelt Board Report, pp. 23-29; The Field Artillery School, *Field Artillery Material* (Fort Sill, Ok: The Field Artillery School, 1934), pp. 16-22.

25. Chief of Field Artillery, *Information Bulletin*, No. 45, 1922, p. 9; Westervelt Board Report, p. 10.

As the Hero, Lassiter, and Westervelt Boards' reports revealed, many field artillery officers understood the requirement for making significant changes in the field artillery. The officers wanted to introduce new technology to improve the field artillery's lethality and mobility. Rather than depending upon other countries, the War Department had to produce guns, howitzers, and motor transportation. European domination had to end.

After each combat arm or branch of the service had investigated its performance during the war and outlined ways to modernize, the War Department took steps to incorporate the findings into organization and tactics. Unhappy with the cumbersome four regiment (square) division with its field artillery brigade of a regiment of 155-mm. howitzers (twenty-four) and two regiments of 75-mm. guns (forty-eight), General Pershing wanted a more maneuverable division. He contemplated a division with an infantry brigade of three regiments, an artillery regiment of 75-mm. guns (thirty-six guns), a cavalry squadron, and combat support and service support units. Pershing's plan reduced division artillery's firepower and transferred the general support mission from the division to the corps. Exhibiting an open mind and following the suggestions of his staff, Pershing convened a review panel, the Superior Board, to examine the recent war and to find lessons that might create organizational and tactical changes. After studying the records of the war, the board recommended retaining the World War I division with minor increases in manpower. The board thought that the wartime division of 29,000 men would have sufficient power and mobility to fight a war of movement and have adequate resources. In comparison, officers at the Infantry School desired a smaller, mobile division of four infantry regiments, favored cutting the size of all divisional units except infantry, and urged abandoning the 155-mm. howitzer because the piece was too heavy. In the meantime, the War Plans Division in the War Department supported adopting a 24,000-man division and wanted to eliminate the 155-mm. howitzer and keep one field artillery brigade of two 75-mm. gun regiments (forty-eight guns).[26]

To resolve differences of opinion over the proper organization of the division, Secretary of War Newton D. Baker (1916-1921) appointed a special committee in 1920. Trying to solve the division's organizational problems, the committee identified several options in July. The War Department could retain the square division of 28,000 men, develop a triangular division of three infantry regiments, or reduce the size of the wartime square division to fewer than 20,000 men. After concluding that the square division was too large and unwieldy, the committee examined the triangular division and a small square division. Rather than dramatically overhauling the division, the committee decided that the square division could be reduced to less than twenty thousand men to improve mobility without sacrificing firepower. The committee decreased each infantry regiment by seven hundred men, revamped service units, introduced organic air reconnaissance assets, and dropped the 155-mm. howitzer regiment for a 105-mm. howitzer regiment as recommended by the Westervelt Board. Impressed with the committee's proposals, General March approved the committee's division for adoption in August 1920. As a result, the War Department started reorganizing its divisions in the fall of 1920 and planned to arm each division

26. Janice McKenney, "More Bang for the Buck in the Interwar Army: The 105-mm. Howitzer," *Military Affairs*, Apr 1978, pp. 81-82; John B. Wilson, "Mobility Versus Firepower: The PostWorld War I Infantry Division," *Parameters*, Sep 1983, pp. 47-52; Report, Virgil Ney, subj: Evolution of the US Army Division: 1939-1968, Combat Operations Research Group, 1969, pp. 29-31, hereafter cited as Ney Report.

with a field artillery brigade of two regiments of 75-mm. guns (forty-eight guns) and to reinstate a howitzer regiment of twenty-four howitzers as part of the brigade as soon as a satisfactory 105-mm. howitzer could be developed.[27]

The decision to arm the division with 75-mm. guns and 105-mm. howitzers generated a controversy over the proper field artillery weapons for the division. Upon hearing that the 105-mm. howitzer would replace the 155-mm. howitzer, many field artillery officers openly expressed opposition. They argued that the 105-mm. howitzer should supplant the 75-mm. gun because the gun was too light and had a flat trajectory. The gun's opponents also pointed out that the United States and France had been the only belligerents during the war to be equipped with the 75-mm. gun because other countries had discarded it for a light, mobile field howitzer with a high rate of fire.[28] Despite these arguments, Chiefs of Field Artillery and the War Department enthusiastically endorsed the 75-mm. gun and 105-mm. howitzer for the division early in the 1920s. In 1926 they received additional support when the Ten Year Ordnance Program for Rearmamentand Extended Service Test standardized the 75-mm. gun and 105-mm. howitzer for division artillery.[29]

During the controversy over the proper combination of guns and howitzers for the division, the War Department launched ambitious rearmament programs to introduce modern 75-mm. guns and 105-mm. howitzers. Using the experience gained developing the M1916 75-mm. gun during the war, the Ordnance Department constructed several different 75-mm. guns between 1920 and 1925. As new tubes were being produced, the War Department built different models of split-trail and box-trail carriages. After the Field Artillery Board had thoroughly tested the various gun and carriage combinations, the War Department standardized the M1923E split-trail 75-mm. gun in 1926. This gun had better stability and greater elevation and traverse than any of the 75-mm. box-trail guns had or even the M1920 75-mm. split-trail gun had and had a range of 14,880 yards. With the adoption of M1923E 75-mm. gun, later designated the Ml 75-mm. gun, the War Departmenthad four 75-mm. guns—the French M1897, the American M1916, the British M1917, and the Ml. Nevertheless, the Ten Year Ordnance Program for Rearmament and Extended Service Test of 1926 supported using only the Ml since it most closely met the Westervelt Board's standards of the ideal field gun.[30]

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27. McKenney, "More Bang for the Buck in the Interwar Army," pp. 81-82; Wilson, "Mobility Versus Firepower," pp. 47-52; Ney Report, pp. 29-31.

28. McKenney, "More Bang for the Buck in the Interwar Army," p. 82; Annual Report, Chief of Field Artillery, 1924-25, in *Field Artillery Journal*, Mar-Apr 1926, pp. 198-99.

29. Annual Report, Chief of Field Artillery, 1923-24, in *Field Artillery Journal*, Mar-Apr 1925, pp. 135-37; Annual Report, Chief of Field Artillery, 1924-25, p. 200; Annual Report, Chief of Field Artillery, 1925-26, in *Field Artillery Journal*, Jan-Feb 1927, pp. 4, ll; Annual Report, Chief of Field Artillery, 1929, in *Field Artillery Journal*, Jan-Feb 1930, p. 14; Annual Report, Chief of Field Artillery, 1930, in *Field Artillery Journal*, Jan-Feb 1931, p. 13; Annual Report, Chief of Field Artillery, 1931, in *Field Artillery Journal*, Nov-Dec 1931, p.589.

30. Maj William E. Burr, "Some Aspects of American Field Artillery," *Field Artillery Journal*, May-Jun 1922, p. 182; MG Snow, "The Development of Field Artillery," *Military Engineer*, Jan-Feb 1923, p. 47; Annual Report, Chief of Field Artillery, 1923, in *Field Artillery Journal*, Mar-Apr 1924, pp. 118-22; Annual Report, Chief of Field Artillery, 1926-27, in *Field Artillery Journal*, Jan-Feb 1928, p. 4; Annual Report, Chief of Field Artillery, 1931, in *Field Artillery Journal*, Nov-Dec 1931, pp. 588-89; Maj Ralph McT. Pennell, "A Field Artillery Viewpoint of Ordnance Development," *Field Artillery Journal*, Mar-Apr 1926, pp. 227-28; Green, Thomson, and Roots, *The Ordnance Department*, pp. 186-87.

Although the War Department retained the other 75-mm. guns, it announced a plan to arm its field batteries with the M1 after sufficient numbers had been manufactured. Yet, only a few Ml 75-mm. guns were purchased. A surplus of 75-mm. guns from the war and devotion to economy in government prevented Congress from authorizing procuring the Ml. Consequently, the War Department continued using the M1916, the M1917, and the M1897 into the thirties. However, the introduction of light field howitzers with greater power, longer ranges, and equal mobility made these 75-mm. guns obsolete.[31]

The high cost of manufacturing the Ml 75-mm. gun to meet mobilization requirements along the lines of the Great War eventually stimulated finding a less expensive way of equipping the division with a modern 75-mm. gun. Because of the large stock of M1897 75-mm. guns on hand, the War Department decided early in the 1930s to improve the field gun's range and mount the weapon on a modern carriage. In 1930-31 the Ordnance Department developed a high-explosive shell that used trinitrotoluene, commonly called TNT, amatol, and explosive D as propelling and bursting charges for the M1897 to give the piece a range of 13,600 yards. Subsequently, the Field Artillery Board tested the gun in 1932-34 and found it to be acceptable. In view of this, the War Department designated the gun the M2 75-mm. and put it into limited production in 1936. Meanwhile, the War Department started work on a carriage for towing at high speeds behind a motor vehicle.[32]

By the 1930s a well-developed arsenal system for field artillery existed. Watervliet, New York, produced finished guns. Watertown, Massachusetts, made gun castings, carriages, and recoil mechanisms for seacoast and antiaircraft guns. Frankfort, Kentucky, supplied fire control instruments, and Rock Island, Illinois, made carriages and recoil mechanisms. These arsenals constituted a ready source for field artillery, but they could furnish only a small fraction of the Army's demands during time of war. This meant that the War Department would have to rely on private industry that had neither expertise nor experience constructing artillery.[33]

While the War Department searched for a suitable 75-mm. gun for the division, it developed a 105-mm. howitzer.[34] Using captured German 105-mm. howitzers as models, field artillery and ordnance officers built four 105-mm. howitzers in 1920. Since the howitzers and carriages were too heavy and clumsy to be easily maneuvered by hand with a normal gun crew, structurally weak, and generally unsuitable for standardization, the Ordnance Department tested various box-trail and split-trail carriages with improved American 105-mm. howitzers mounted on them. At

31. W.J. Savoy, "The Evolution of the American Modern Light Field Gun," unpublished master's thesis, US Army Command and General Staff College, 1978, p. 65.

32. The Field Artillery School, Field Artillery Materiel (Fort Sill, Ok: The Field Artillery School, 1942), pp. 153-54; Maj Gen Upton Birnie, Jr., Lecture, US Army Command and General Staff College, 13 May 1937, pp. 13-14, in Morris Swett Library; Annual Report, Chief of Field Artillery, 1930, in *Field Artillery Journal*, Jan-Feb 1930, pp. 15-16; Annual Report, Chief of Field Artillery, 1932, in *Field Artillery Journal*, Nov-Dec 1932, pp. 585-86; Maj Gen Robert M. Danford, Lecture, Army War College, 23 Sep 1938, pp. 4-5, in Morris Swett Library; Annual Report, Chief of Field Artillery, 1923, in *Field Artillery Journal*, Nov-Dec 1924, p. 122; Savoy, "The Evolution of the American Modern Light Field Gun," pp. 65, 72-74.

33. Harry C. Thomson and Lida Mayo, *The Ordnance Department: Procurement and Supply* (Washington: Office of the Chief of Military History, US Army, 1960), pp. 72-73.

34. McKenney, "More Bang for the Buck in the Interwar Army," p. 82.

the same time the Field Artillery Board mounted captured German 105-mm. howitzers that had been rechambered for American ammunition on split-trail carriages and rigorously tested them. Pressured by field artillery officers, who endorsed the German pieces, the Field Artillery Board favored adopting them until a satisfactory American howitzer could be manufactured. The shortage of ammunition, the cost of putting the German howitzers into serviceable condition, and the lack of uniformity of those available from which to prepare drawings for production caused the Chief of Ordnance to protest. This led the War Department to abandon the superior German howitzers and place them in storage in 1925 and allowed the department to concentrate its limited funds on building an American howitzer and carriage. Pressed by the requirement for a companion piece for the 75-mm. gun and by General Snow, who insisted that developing a satisfactory 105-mm. howitzer was the most pressing ordnance problem, the Ordnance Department constructed a new American 105-mm. howitzer and mounted it on a split-trail carriage for testing. Supported by trials that demonstrated the howitzer and carriage were satisfactory, the War Department standardized them in 1928 as the horse-drawn Ml 105-mm. howitzer.[35]

The inability to produce enough Ml 105-mm howitzers because of limited funds forced the War Department to revamp division artillery. In 1929 the War Department reinstated the M1918 155-mm. howitzer in the division. This gave the division a field artillery brigade of one regiment of tractor-drawn 155-mm. howitzers and two regiments of horse-drawn 75-mm. guns commanded by a brigadier general. Each 75-mm. gun regiment had two battalions, six batteries, and twenty-four pieces, and the 155-mm. howitzer regiment had three battalions, six batteries, and twenty-four howitzers. Yet, integrating the 155-mm. howitzer back into the division was a temporary expedient because the War Department still planned to use a 105-mm. howitzer for general support when sufficient numbers of the weapon were available.[36]

Even before the Ml 105-mm. howitzer went into production, the War Department modified the field piece to load shrapnel as fixed ammunition to complement high-explosive shell and chemical shell of smoke or gas. In 1930 Chief of Field Artillery, Major General Harry G. Bishop (1930-1934), reported that ten altered Ml howitzers, redesignated the M2 105-mm. howitzer, were being manufactured. The following year, the War Department sent four M2 howitzers to Battery F, 1st Field Artillery Regiment, The Field Artillery School, Fort Sill, for testing. At the conclusion of the trials, the school reported in 1931 that the M2 howitzer tube was satisfactory but that the carriage could not be towed at a high-speed by a motor vehicle and required a recoil pit for high-angle fire missions. Even though the school found the M2 howitzer to be inadequate, it still

35. Maj Maxwell Murray, "The Place of Light Field Artillery Howitzer in Division Artillery," *Field Artillery Journal*, Nov-Dec 1925, p. 540; Ltr, Chief of Field Artillery to President, FA Board, subj: Test of Divisional Artillery, 20 Dec 1922, File No. 472.22, RG 177, National Archives; Green, Thomson, and Roots, *The Ordnance Department*, pp. 186-87; Annual Report, Chief of Field Artillery, 1925-26, p. 5; Annual Report, Chief of Field Artillery, 1928, in *Field Artillery Journal*, Nov-Dec 1928, p. 585; Annual Report, Chief of Field Artillery, 1926, in *Field Artillery Journal*, Mar-Apr 1926, pp. 198-99; Annual Report, Chief of Field Artillery, 1929, p. 14; Annual Report, Chief of Field Artillery, 1930, in *Field Artillery Journal*, Nov-Dec 1931, p. 590; Brig Gen John P. Lucas, "The 105-mm. Howitzer," *Field Artillery Journal*, Feb 1941, p. 68; The Field Artillery School, *Associated Arms* (Fort Sill, Ok: The Field Artillery School, 1934), p. 6.

36. Harry G. Bishop, *Field Artillery: King of Battle* (Boston:Houghton Mifflin Company, 1935), p. 24; The Field Artillery School, *Organization of the Field Artillery* (Fort Sill, Ok: The Field Artillery School, 1935), pp. 6-10; War Department, *Field Artillery Drill Manual*, 1931, p. 6 and Table I.

expressed faith in motor-drawn field artillery.[37] Limited funds, however, forced the War Department to stop the manufacture of the M2 howitzer in 1934 and the development of a carriage, left the division without a light howitzer for general support, and compelled keeping the M1918 155-mm. howitzer in the division.[38]

As the War Department fought an uphill struggle to adopt new field pieces, it searched for a motor vehicle to tow light artillery. Despite endorsements by many field artillery officers and the modest success of motor-drawn (towed) artillery during the war, an officer in the War College Division in June 1917 found the caterpillar tractor to be too slow for light artillery. Other field artillery officers preferred the horse because it did not require spare parts, did not run out of gas, and did not need repairs as motor vehicles did.[39] These evaluations highlighted the basic arguments surrounding motorizing light artillery in the twenties and early thirties and hampered adopting motor-drawn guns. Rather than advocating a wholesale and quick conversion and eagerly accepting the new technology, conservative Army officers opposed a rapid transition from horse-drawn to motordrawn field artillery, especially for the division. Moving slowly permitted leisurely testing and experimenting and forestalled dislocation and confusion. Supporting this rationale, Major William E. Burr wrote a prize-winning article for the *Field Artillery Journal* essay contest in mid-1922. He pointed out that the tractor had revolutionized the field artillery's ideas regarding the means of pulling guns and howitzers on the battlefield. Tractors had great possibilities. However, they had to be improved before they would be satisfactory traction for field guns because they were unreliable and slow.[40] The following year, General Snow urged retaining horse-drawn light artillery. Writing in his annual report in 1923, he explained that motor vehicles were slow and were better than horses but only under "certain circumstances." As a result, division artillery should remain horse-drawn. Although he had reservations about motordrawn light artillery at the time, he still envisioned it as the trend of the future.[41]

Such thinking by Snow, Burr, and other field artillery officers strongly influenced the War Department. Following the war, it conducted various test and development programs to determine the suitability of motor vehicles for towing artillery. Based upon existing evidence, the War Department had to motorize medium and heavy artillery because horses simply could not pull such pieces. In contrast, the War Department displayed less enthusiasm for motorizing light division artillery. Even though the War Department realized that motor-drawn and even self-propelled artillery would eventually supplant horse-drawn guns, it did not intend to

37. Annual Report, Chief of Field Artillery, 1931, p. 581; Green, Thomson, and Roots, *The Ordnance Department*, pp. 186-87; Riley Sunderland, *History of the Field Artillery School*, Vol. I (Ft. Sill, 1942), p. 130.

38. McKenney, "More Bang for the Buck in the Interwar Army," p. 82; Annual Report, Chief of Field Artillery, 1930, p. 590; Annual Report, Chief of Field Artillery, 1933, in *Field Artillery Journal*, Jan-Feb 1934, p. 23; Lucas, "The 105-mm Howitzer," p. 68-69; Green, Thomson, and Roots, *The Ordnance Department*, pp. 186-87; Sunderland, *History of the Field Artillery School*, p. 130.

39. Memo for Gen Kuhn, subj: Motor Traction, Field Artillery, 13 Jun 1917, File No. 257812, RG 94; Green, Thomson, and Roots, *The Ordnance Department*, p. 203.

40. Burr, "Some Aspects of American Field Artillery," p. 183.

41. Annual Report, Chief of Field Artillery, 1923, p. 117.

motorize light artillery until motor traction had proven itself to be mobile and dependable.[42]

Despite the War Department's and field artillery's desire to test motor vehicles further, congressional action stalled serious progress. Budget cuts in 1922 compelled the War Department to direct the elimination of all experimental motorized division artillery except for one battalion of the 83rd Field Artillery Regiment at Fort Benning, Georgia, and part of the lst Field Artillery Regiment at Fort Sill, Oklahoma, both of which were school units, and to abandon ambitious research programs with motorized light artillery. Despite this setback, testing tractors and trucks over the next several years continued but on a much smaller scale than before 1922.[43] Without sufficient funding for adequate evaluation and with support from the Field Artillery Board, which opposed motorizing light artillery, the War Department announced in November 1928 its decision to retain horse-drawn artillery for the division for the foreseeable future.[44]

Tests conducted through 1928 might have indicated that motor vehicles had a promising future, but the War Department still doubted their quality and reliability for division artillery and insisted that the horse provided the maximum mobility under all conditions for light artillery. Mobility was critical for light division artillery more so than for medium and heavy artillery for the corps and army since it had to provide close, continuous support to the infantry in a war of movement. As a result, the War Department held fast to the principle that division artillery was horse-drawn and was not willing to expand the number of motorized division artillery units beyond the experimental light regiments in the Hawaiian Division, one battalion at The Field Artillery School, and one battalion of the 6th Field Artillery Regiment. Division artillery would remain horse-drawn even though medium and heavy artillery was being motorized during the 1920s. Because of the lack of funds, fears about motor traction's dependability and mobility, the belief in the horse's superiority over motor vehicles, and conservatism, the War Department refused to motorize light division artillery and make a complete break with the horse in the 1920s.[45]

Introducing self-propelled artillery, another goal outlined by the Westervelt Board, encountered similar difficulties. During the 1920s, the ordnance board developed several selfpropelled gun mounts, also called motor carriages. After testing the Holt Mark VI and Christie self-propelled

42. Col Harry G. Bishop, "What of the Future," *Field Artillery Journal*, Sep-Oct 1922, p. 368; Annual Report, Chief of Field Artillery, FY 1922, in *Field Artillery Journal*, Nov-Dec 1922, pp. 458, 459, 472; Annual Report, Chief of Field Artillery, 1923, p. 117.

43. Annual Report, Chief of Field Artillery, FY 1922, pp. 458, 459, 472; Annual Report, Chief of Field Artillery, 1923, p. 117; Annual Report, Chief of Field Artillery, 1923-24, p. 137; Annual Report, Chief of Field Artillery, 1924-25, in *Field Artillery Journal*, Mar-Apr 1926, pp. 201, 206; Annual Report, Chief of Field Artillery, 1925-26, p. 6; Annual Report, Chief of Field Artillery, 1926-27, pp. 6-7; Annual Report, Chief of Field Artillery, 1928, in *Field Artillery Journal*, Nov-Dec 1928, pp. 584-85.

44. Ltr, Bishop to Adjutant General, subj: Motorization of Light Field Artillery, 1 Sep 1931, in Morris Swett Library; Annual Report, Chief of Field Artillery, 1923-24, p. 137; Annual Report, Chief of Field Artillery, 1923, in *Field Artillery Journal*, Mar-Apr 1924, p. 117; Cpt W.D. Dunwoody, "Problems of Mobility in Motorized Artillery," *Field Artillery Journal*, Jul-Aug 1925, p. 330; "Division Light Artillery to Remain Horse-Drawn," *Field Artillery Journal*, Jan-Feb 1929, p. 84; Annual Report, Chief of Field Artillery, 1925-26, p. 11; Annual Report, Chief of Field Artillery, 1929, pp. 22-23; Annual Report, Chief of Field Artillery, 1930, in *Field Artillery Journal*, Jan-Feb 1931, p. 12; Annual Report, Chief of Field Artillery, 1932, p. 589; Green, Thomson, and Roots, *The Ordnance Department*, p. 203.

45. Ltr, Bishop to Adjutant General, subj: Motorization of Light Field Artillery, 1 Sep 1931; Annual Report, Chief of Field Artillery, 1929, pp. 21-22; Bishop, *Field Artillery*, pp. 66-67; Annual Report, Chief of Field Artillery, 1930, p. 126.

chassis, the field artillery arrived at the conclusion in 1923 that they were useless for light guns and howitzers and noted that introducing self-propelled artillery in its present state of development would be sheer madness. Moreover, the field artillery did not want to adopt self-propelled pieces because they presented a big silhouette that was easy to hit with counterbattery fire, because they were too heavy, and because they were unreliable. Influenced by these liabilities and the Field Artillery Board's recommendation to cease testing self-propelled artillery for service in the division, the Ordnance Department turned its attention to self-propelled 155-mm. guns and 8-inch howitzers. Limited funds and apathy on the part of the field artillery for the same reasons that produced resistance to introducing self-propelled division artillery, however, halted serious work by the middle of the 1920s.[46] Chief of Field Artillery, Major General Fred T. Austin (1927-1930), explained the dilemma of adopting motor-drawn light artillery in the twenties. In his annual report for 1929, he wrote that he would have encouraged the War Department to motorize light artillery faster than it was doing but that inadequate funding retarded testing to find the right vehicle.[47]

Because of the inability to tow 75-mm. guns behind a motor vehicle, General Bishop took aggressive action to find a solution shortly after taking office in 1930. Bishop openly criticized the War Department's reluctance to adopt motorized guns and howitzers for the division. In September 1931 Bishop pointed out that those units that had violated the directive of 1922 to eliminate motor-drawn light artillery were having success with it. At the end of a letter to the Adjutant General on 1 September 1931, Bishop wrote, "Long continuous study, experimentation and tests have convinced this office [Office of the Chief of Field Artillery] that the prime mover problems can be solved by the use of Ford vehicles (or their equivalent)."[48] Even though rapid improvements in motor transportation and the lack of funds prevented his office from reaching definitive conclusions about the best motor vehicle for division artillery, Bishop still found motor-drawn light field pieces to be practical.[49]

Bishop correctly evaluated the advancements in motor vehicles. During the twenties and early thirties, General Motors, International Harvester Company, Marmon-Herrington Company, Ford Motor Company, and other companies were building four- and six wheel trucks with cross-country capabilities, while the Cleveland Tractor Company, Allis Chalmers Company, the Caterpillar Tractor Company, and Holt Tractor Company were producing dependable and sturdy track tractors with cross-country abilities. Because of these trucks and tractors, Bishop simply could not understand why the War Department cautiously approached motorizing division artillery. As far as the General was concerned in 1931, only the scarcity of money stood in the way of motorizing all of the division's artillery.[50]

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46. Annual Report, Chief of Field Artillery, FY 1922, p. 471; Annual Report, Chief of Field Artillery, 1928, p. 584; Green, Thomson, and Roots, *The Ordnance Department*, pp. 203, 314.

47. Annual Report, Chief of Field Artillery, 1929, p. 22.

48. Ltr, Bishop to Adjutant General, subj: Motorization of Light Field Artillery, 1 Sep 1931.

49. *Ibid.*

50. Daniel R. Beaver, "Politics and Policy: The War Department Motorization and Standardization Program for Wheeled Transport Vehicles, 1920-1940," *Military Affairs*, Oct 1983, p. 104; Memorandum for Commandant, Army War College, subj: Motorization of Divisional Artillery, 6 May 1929, pp. 3-11; The Field Artillery School, *Field Artillery Military Motor Transport*, 1935, pp. 29-40; Maj J.H. Wallace, Lecture, Motor Transportation School, 18 Jan 1934, pp. 108, in Morris Swett Library; Annual Report, Chief of Field Artillery, 1929, p. 22.

At Bishop's urging the War Department directed the Field Artillery Board in 1931 to test four M1897 75-mm. guns mounted on carriages suitable for towing behind trucks. Upon receiving four M1897 guns with carriages adapted for high-speed movement, the Field Artillery Board conducted tests between May 1932 and March 1933. After evaluating the findings of the trials, the board recommended testing a battalion of towed 75-mm. guns. Although the lack of funds prevented the battalion trial, General Bishop accepted the results of the battery test as evidence that light trucks were suitable for towing light artillery.[51]

However, more work had to be done before selecting a particular truck. Because of insufficient money and rapid, continuous improvements in motor transportation, the field artillery could not decide which motor vehicle was best. Even though all of the results of the Field Artillery Board's tests were not available yet and the type of motor vehicle was still unsettled, Bishop pointed out late in 1932 the practicality of motor transportation for light division artillery. Based upon this supposition, the War Department could not stall the conversion to towed artillery any longer because the technology existed.[52]

Unlike motorizing light field artillery, acquiring medium field pieces did not create excitement. In fact, it was an uneventful process. In 1926 the Field Artillery Board tested a pilot model of an American-built 4.7-inch gun with the intention of using it in the corps. Although the board found the gun to be satisfactory, the War Department suspended development in 1928 because its experimental 155-mm. gun met the requirement for a medium gun, and eliminating the 4.7-inch gun meant a reduction in the number of calibers and monetary savings. The successful construction of a new 155-mm. howitzer further obviated the need for a 4.7-inch gun. The War Department planned to develop the 155-mm. howitzer, but financial constraints prevented producing it until the mid-1930s and left the French 155-mm. GPF gun from the Great War as the sole corps field artillery piece.[53]

Procuring heavy artillery for the army and general headquarters reserve also did not fare well in the 1920s. Insufficient funds slowed down modifications of the 8-inch howitzer and development of the 9.2-inch howitzer and 8-inch gun and forced keeping the M1918 240-mm. howitzer operational even though it was obsolete, difficult to maneuver, and an inadequate substitute for the 8-inch howitzer. Without heavy field pieces the field artillery's harassment and interdiction missions would suffer. According to air power enthusiasts, the role of harassing and interdicting the enemy's rear areas would pass to the air force anyway, and the War Department accepted their assertions. Because of this and the War Department's belief that heavy field artillery was

51. Maj Gen Paul B. Malone, "The Significance of the TruckDrawn Battery of 75-mm. Guns," *Field Artillery Journal*, May-Jun 1933, pp. 205-08; "Truck-Drawn 75-mm. Gun Battery and Battalion," *Field Artillery Journal*, Jul-Aug 1933, p. 293; Maj J.H. Wallace, "Test of the Truck-Drawn 75-mm. Battery," *Field Artillery Journal*, Jul-Aug 1933, p. 301; Capt M.R. Cox, "Truck-Drawn Artillery," *Field Artillery Journal*, May-Jun 1931, pp. 224, 230.

52. Annual Report, Chief of Field Artillery, 1932, pp. 589-90.

53. Birnie, Lecture, US Army Command and General Staff College, 13 May 1937, p. 4; Bishop, Field Artillery, pp. 26, 273; Green, Thomson, and Roots, *The Ordnance Department*, pp. 178-79; Danford, Lecture, Army War College, 23 Sep 1938, p. 6; Annual Report, Chief of Field Artillery, 1931, p. 590; The Field Artillery School, Field Artillery Material (Fort Sill, Ok: The Field Artillery School, 1937), p. 165; Annual Report, Chief of Field Artillery, 1930, in *Field Artillery Journal*, Jan-Feb 1931, pp. 13-14.

outmoded, the pressure to develop heavy pieces did not exist.[54]

Thus, a modern field artillery system desired by the War Department at the beginning of the 1920s had not materialized. Research and development projects that had started energetically in 1920 and 1921 stalled because of the reduction of funds later in the twenties, conservatism, and war surplus that could be modified less expensively or used until it was worn out. As a result by the mid-1930s, field pieces and materiel from the Great War still dominated the inventory.

A Change of Direction

Pushed by General Bishop, the Army War College, and the existence of obsolescent guns, howitzers, organization, and technique, the War Department stepped up the pace of modernizing its field artillery in the 1930s. Because of the decline in the horse population in the United States and a modernization program initiated in 1933 by Chief of Staff, General Douglas MacArthur (1930-1935), the War Department decided to motorize fifty percent of its light field artillery. As an expedient, it adapted old M1897 75-mm. gun carriages for towing behind a truck until a new carriage could be developed. Supported by funds provided by the Public Works Administration, by 1936 the War Department developed carriages with pneumatic tires, antifriction bearings, and springs to give the 75-mm. gun two types of carriages—a modified M1897 carriage and a totally new one. Although resistance from conservative field artillery officers hindered adopting towed light artillery, the War Department motorized fifty-six of its eighty-one 75-mm. gun batteries by 1940 and had even developed an experimental motor-drawn M2 105-mm. howitzer.[55] Motorizing seventy-five percent of division artillery (75-mm. guns and 155-mm. howitzers) in approximately seven years represented a giant leap forward and a shift in attitudes toward motor vehicles by the War Department and field artillery and compared favorably with developments in Europe and Japan.[56]

Although the field artillery and War Department finally accepted towed division artillery in principle, they still resisted developing self-propelled artillery. From 1933 onward, field artillery officers consistently contended that motor-drawn artillery was more maneuverable, less conspicuous, and less likely to be deadlined for repairs than self-propelled artillery and, therefore, opposed

54. Annual Report, Chief of Field Artillery, 1933, in *Field Artillery Journal*, Jan-Feb 1934, p. 24; Maj Jay M. MacKelvie, Lecture, Quartermaster School, 12 Jan 1941, pp. 4-6, in Morris Swett Library; Thompson and Mayo, *The Ordnance Department*, p. 68.

55. McKenney, "More Bang for the Buck in the Interwar Army," p. 82; Lucas, "The 105-mm Howitzer," p. 69; Thomson and Mayo, *The Ordnance Department*, p. 72; Maj Max Beasley, Lecture, Quartermaster School, 6 Mar 1939, p. 10, in Morris Swett Library; Birnie, Lecture, US Army Command and General Staff College, p. 22; Memorandum for Cmdt, Army War College, subj: Motorization of Division Artillery, 26 Apr 1929, in Morris Swett Library; "Tests of Mechanical Prime Movers," *Field Artillery Journal*, Jan-Feb 1931, p. 110; The Field Artillery School, *Field Artillery Materiel* (Fort Sill, Ok: The Field Artillery School, 1932), pp. 18-19; Green, Thomson, and Roots, *The Ordnance Department*, p. 187; Allan R. Millet and Peter Maslowski, *For the Common Defense: A Military History of the United States of America* (New York: The Free Press, 1984), p. 380.

56. Frank E. Comparato, Age of Great Guns: *Cannon Kings and Cannoneers Who Forged the Firepower of Artillery* (Harrisburg, Pa: The Stackpole Company, 1965), p. 352; Lucas, "The 105-mm Howitzer," p. 69; Thomson and Mayo, *The Ordnance Department*, p. 72; Report, Chief of Army Field Forces, subj: Artillery Conference, 23-25 Jun 1954, p. 64, in Morris Swett Library; Beasley, Lecture, Quartermaster School, 6 Mar 1939, p. 10; Birnie, Lecture, US Army Command and General Staff College, 13 May 1937, p. 22; Memorandum for the Commandant, Army War College, subj: Motorization of Division Artillery, 26 Apr 1929; Danford, Lecture, Army War College, 28 Sep 1938, pp. 12-16.

the latter. In fact, Chief of Field Artillery, Major General Robert M. Danford (1938-1942), adamantly refused to introduce self-propelled artillery because towed artillery was better as far as he was concerned.[57]

Early in the fall of 1939, General Danford expressed his and other field artillery officers' feelings about towed and self-propelled artillery. In September 1939 he told Army War College students that the motor surpassed the horse in some situations, while the horse was better in others. He explained further, "For light division artillery, the horse still remains superior as the prime mover off roads, through the mud, the darkness and the rain. . . .To discard him during peace in favor of the motor, 100 per cent, is simply putting all our eggs in one basket, and is, in my judgement, an unsound policy."[58] Danford cautiously supported motorization, but like others he fought to preserve some horse-drawn light artillery. Because of this, field artillerymen had to be prepared to serve in towed and horse-drawn artillery units. In view of this, courses at the Field Artillery School at Fort Sill continued teaching animal management, equitation, and other related courses to officers and enlisted personnel as late as 1941.[59]

Caught in the middle of a technological revolution, many field artillery officers had problems accepting the changes around them. Even though their fears about the reliability of motor vehicles discouraged motorization, most officers knew that horse-drawn artillery had to be abandoned because it was becoming obsolete. Yet, influenced by their apprehensions and not technically oriented and faced with the possibility of restructuring tactics, doctrine, and organization, many field artillery officers kept their horses and had a mixture of horse- and motordrawn light artillery in 1941.[60]

As such, the field artillery reached an important milestone in 1933. Ironically at the height of the Great Depression, the War Department received funds to motorize. As a result, the field artillery no longer could use the scarcity of money as a reason for moving so methodically. After 1933 conservative field artillery officers challenged the reliability and mobility of motor vehicles to slow down converting from horse-drawn light artillery even though General Bishop found motor vehicles to be suitable.

Prompted by improvements in motor transportation and the appearance of a mobile 155-mm. howitzer carriage, pressure from eager reformers, and the desire to stay abreast of developments in foreign armies, in June 1938 Danford directed the Field Artillery School to determine the best combination of weapons for division artillery. Specifically, he wanted to know whether the 105-mm. howitzer should be used with the 75-mm. gun in the division or whether it should be the sole weapon. The school categorically rejected replacing the 155-mm. howitzer with the 105-mm. howitzer as a companion piece for the 75-mm. gun because it only offered mobility. In a lengthy

57. Annual Report, Chief of Field Artillery, 1930, p. 14; "Forecast of Field Artillery Progress During Next Five Years," *Field Artillery Journal*, Nov-Dec 1933, p. 510; Green, Thomson, and Roots, *The Ordnance Department*, pp. 203, 314; Danford, Lecture, Army War College, 23 Sep 1939, p. 17.

58. Danford, Lecture, Army War College, 23 Sep 1939, p. 19.

59. Danford, Lecture, Army War College, 23 Sep 1939; Sunderland, *History of the Field Artillery School*, pp. 198, 199, 214.

60. "Forecast of Field Artillery Progress During the Next Five Years," p. 510; Comparato, *Age of Great Guns*, p. 226; Beaver, "Politics and Policy," pp. 105-06.

report the school explained that experience with the 155-mm. howitzer had demonstrated the piece's mobility and suitability as a general support weapon for the division.[61] The school also pointed out, "To replace it [the 155-mm. howitzer] piece for piece, by the 105-mm. howitzer would be at the sacrifice of much artillery fire-power, which we can ill afford to lose, and at a gain which is, in the main illusory."[62] Understanding that the War of 1914-18 and the Spanish Civil War had reaffirmed the importance of firepower, the school opposed any reduction in firepower in 1938. At the same time, employing the 105-mm. howitzer as the sole weapon had merit. Such an arrangement would simplify supply, maintenance, training, in some instances organization, and increase firepower, but it would reduce mobility unless a larger truck was used to pull the piece. Assaulting the orthodox position of a 75-mm. gun and 105-mm. howitzer combination for the division and realizing that motorization had improved mobility the Field Artillery School wanted 105-mm. and 155-mm. howitzers as division artillery. Yet, the school understood that the surplus of 75-mm. guns and ammunition would probably delay scrapping the 75-mm. gun for the 105-mm. howitzer.[63]

Other field artillery officers also challenged the War Department's decision to strip the division of the 155-mm. howitzer for the 105-mm. howitzer. They argued that tractors and trucks had dramatically increased the 155-mm. howitzer's mobility. As a result, they wanted 105-mm. and 155-mm. howitzers as companion pieces for the same reasons that their predecessors of the 1920s had outlined.[64]

In the meantime, the War Department tested the 75-mm. gun and 105-mm. howitzer combination as part of its effort to develop a more mobile division. Prodded by officers, who found the 22,000-man square division created after the Great War to be cumbersome, the War Department directed the 2nd Division at Fort Sam Houston, Texas, in 1936 to test a triangular division of three infantry regiments, a motorized field artillery regiment of three direct support battalions of 75-mm. guns (twenty-four) and one general support battalion of 105-mm. howitzers (eight), and support units. Trials in 1937 substantiated the division's mobility and the suitability of the four-battalion field artillery organization but simultaneously demonstrated field artillery's lack of firepower. In response to this revelation, test participants, especially Brigadier General Lesley J. McNair, Commander, 2nd Field Artillery Brigade, 2nd Division, urged arming the division with heavier field pieces. Consequently, the War Department restructured the triangular division's artillery late in 1938 into three battalions of 75-mm. guns (thirty-six), one battalion of 105-mm. howitzers (eight), and one battalion of 155-mm. howitzers (eight) for testing. Trials in 1938-39 by the 2nd Division reaffirmed the soundness of four artillery battalions for division artillery and the 155-mm. howitzer's superiority over the 105-mm. howitzer because it had more firepower. Yet, the War Department ignored the test results. Upon approving the triangular division for adoption, the War Department supplied it with 75-mm. guns and 105-mm. howitzers even though the

61. The Field Artillery School, A Study of the 105-mm. Howitzer with particular regard to the practical aspects of certain features of design, Sep 1938, pp. 1-2, in Morris Swett Library, hereafter cited as Study of the 105-mm. Howitzer.

62. *Ibid.*

63. *Ibid.*, pp. 2, 19, 42.

64. Birnie, Lecture, US Army Command and General Staff College, 13 May 1937, A Study of the 105-mm. Howitzer, p. 1; McKenney, "More Bang for the Buck in the Interwar Army," pp. 8485.

combination lacked the desired firepower.[65]

The triangular division consisted of combat infantry and supporting arms and services. The division had three infantry regiments, a reconnaissance troop, engineer battalion, medical battalion, quartermaster company, ordnance company, signal company, military police platoon, a band, and division artillery. Commanded by a brigadier general, division artillery had 144 officers and 2,439 enlisted personnel and was composed of three 75-mm. gun battalions (thirty-six guns) for direct support and one 155-mm. howitzer battalion (twelve howitzers) for general support because sufficient quantities of 105-mm. howitzers were unavailable. Each field artillery battalion was commanded by a lieutenant colonel and had three firing batteries of four pieces each. The battery was commanded by a captain and had 4 officers and 104 enlisted men. The gun crew consisted of a section chief, who ensured that all duties were properly performed, that all commands were executed, and that all safety precautions were observed, a gunner, who laid the piece, and five cannoneers for the 75-mm. gun and twelve for the 155-mm. howitzer, who loaded and fired their weapon.[66]

As the new division artillery organization indicated, the War Department still refused to abandon the 75-mm. gun and 105-mm. howitzer mix. The War Department saw the 75-mm. gun as an all purpose weapon and noted in 1939-40 that the M2 105-mm. howitzer's range was shorter than the M2 75-mm. gun's, that it took longer for the howitzer to go into action, that the howitzer had still not been proven in battle, that there was a surplus of 75-mm. guns and ammunition, and that replacing the 75-mm. gun with the 105-mm. howitzer would be expensive. In fact, Chief of Staff, General George C. Marshall (1939-1945), opposed abandoning the 75-mm. gun and ammunition. Like many of his predecessors, Marshall was reluctant to spend money on new weapons in peacetime when a surplus from the Great War existed.[67]

Events in 1940 finally forced the War Department to recast its division artillery. Reports prepared by field artillery officers during maneuvers in April and May reaffirmed the necessity of supplanting the 75-mm. gun with the 105-mm. howitzer. Moreover, the Germans' success with pieces heavier than the 75-mm. gun in its division artillery convinced the War Department to reevaluate keeping the 75-mm. gun. In June 1940 after Germany had signed an armistice with France, the Organization and Training Division (G-3) of the General Staff sent General Danford a memorandum announcing its decision to arm division artillery with 105-mm. and 155-mm. howitzers. Nevertheless, many divisions continued equipping their field artillery with 75-mm. guns until 1943 when 105-mm. howitzers became available in large numbers.[68]

Adopting other new field pieces in the 1930s fared as poorly as the conversion to the M2

65. McKenney, "More Bang for the Buck in the Interwar Army," 82-84; Ney Report, pp. 36-37; Weigley, *History of the United States Army*, pp. 461-63; Jonathan M. House, "Designing the Light Division: 1935-44," *Military Review*, May 1984, pp. 41-47.

66. Jonathan M. House, *Towards Combined Arms Warfare: A Survey of Tactics, Doctrine, and Organization in the 20th Century* (Fort Leavenworth, Ks: Combat Studies Institute, US Army Command and General Staff College, 1984), p. 74; The Field Artillery School, Instruction Memorandum, 1942, pp. 1-19; Field Manual 685, 1939, pp. 33-34. 17; Field Manual, 6-55, 1939, pp. 22-23.

67. McKenney, "More Bang for the Buck in the Interwar Army," pp. 84-85; MacKelvie, Lecture, Quartermaster School, 12 Jan 1941, p. 5.

68. McKenney, "More Bang for the Buck in the Interwar Army," p. 85.

105-mm. howitzer. In 1937 the Field Artillery School commented, "It cannot be expected that this reserve [M1897, M1916, and M1917 75-mm. guns, M1918 155-mm. howitzers, M1918 155-mm. guns, and M1918 240-mm. howitzers] will be replaced, in peace, with more modern materiel, because of the great cost involved."[69] After acknowledging that new designs were being developed, the school added, "However, so long a time is required for production, issue, and training with new types that it is safe to assume that any war fought by the United States during this generation will be begun and continued during a considerable period with modified World War materiel."[70] In light of the war surplus, Congress' reluctance to fund developing new weapons during peace, and the time required to introduce new weapons, the school viewed the field artillery's future pessimistically in 1937.[71]

Besides encouraging the War Department to employ the 155-mm. howitzer and 105-mm. howitzer combination in the division, motorization also persuaded a serious reexamination of fire direction techniques. Since the inception of indirect fire at the beginning of the twentieth century, the battery had been the firing unit with fire direction data being calculated there. Higher headquarters from battalion to brigade determined how, where, and when the fire would be placed. This method of fire direction revolved around the concept that the battery was the fire unit and that the battalion was the tactical unit.[72]

With the battery serving as the firing unit, the field artillery had two methods of massing observed fire of several batteries. When a map was available, the observer would designate one or two points on a map as targets. The observer would then send grid coordinates to the batteries for plotting and computing firing data. Although this was satisfactory for static warfare, it was too slow for mobile warfare. When a map was unavailable and when all of the observers could see the target, the batteries, and the aiming point, field artillerymen adjusted one battery on the target and employed it as a base for the rest to determine their fire. This way was also slow. However, it worked as long as the batteries adjusted successively. When they adjusted simultaneously, this method produced confusion because forward observers could not tell which battery was hitting the target. As a result, close support was intermittent and often entirely lacking during World War I, and flexibility did not exist.[73]

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69. Field Artillery School, *Field Artillery Materiel*, 1937, p. II.

70. *Ibid.*

71. Field Artillery School, *Field Artillery Materiel*, 1937, p. II; Mark S. Watson, *Chief of Staff: Prewar Plans and Preparations* (Washington: Historical Division, US Army, 1950), pp. 31-40.

72. Chief of Field Artillery, *Digest of Field Artillery Developments* (Fort Sill, Ok: The Field Artillery School, 1935), pp. I-2; US Forces, European Theater, General Board, Report on Study of Field Artillery Gunnery, No. 64, undated, pp. 21-22, in Morris Swett Library.

73. US Forces, European Theater, Report on Study of Field Artillery Gunnery, No. 64, undated, pp. 21-22; Ltr, Maj Gen Carlos Brewer to Cmdt, The Field Artillery School, 5 Feb 44, in Development of Fire Direction File (FDC) File, Morris Swett Library; Ltr, Brig Gen R.C. Barkalow to Cmdt, The Field Artillery School, subj: Development of the Field Artillery FDC, 4 Feb 1944, in Correspondence of Development of FDC Filed; Ltr, Maj Gen H.L.C. Jones to Cmdt, The Field Artillery School, 23 Feb 44, in Development of FDC File; Lt Col Frank G. Ratliff, "The Field Artillery Battalion Fire-Direction Center—Its Past, Present, and Future," *Field Artillery Journal*, May-Jun 1950, p. 117; Russell Gugeler, "Fort Sill and the Golden Age of Field Artillery," unpublished manuscript in Morris Swett Library, pp. 6-7.

Critiquing fire direction procedures as they existed, progressive field artillery officers in the 1920s knew that they would be inadequate for a motorized army. Targets would be moving faster, causing more confusion, while forward observers would be dispersed more than before and frequently be unable to see other batteries' targets. Motorization was revolutionizing the battlefield and making the ways of 1917-18 of massing fire dangerously obsolete.[74]

Without a method of massing fire quickly and effectively on the mobile battlefield, field artillery officers searched for one. Inspired by Lieutenant Colonel Neil Fraser-Tytler's *Field Guns in France* (1929), in which he described his ability to shift fire around the battlefield in World War I, Major (later Major General) Carlos Brewer, director of the Gunnery Department at the Field Artillery School, and his instructors dramatically overhauled fire direction procedures. In 1931 Major Brewer concluded that using terrain features or giving "guessed at" coordinates of the target to the batteries to plot was part of the problem of inadequate close support in 1917-18. Brewer and his instructors revised observation methods, created a firing chart on which the base point (the target) was plotted, and located battery positions through survey. In the spring of 1931, they used these innovations to mass battalion fire accurately after registering one battery on a target without all forward observers being able to see the target and without maps. Yet, Brewer did not centralize computing firing data at the battalion even though some officers at the school thought that it was the proper firing unit. He kept this function in the battery because he could not find a rapid method of centralizing computing firing data at the battalion to make it a firing unit.[75]

Major (later Major General) Orlando Ward, Brewer's successor, and his instructors continued the work to find a satisfactory method of massing fire quickly and accurately. In 1932-34 they established the fire direction center to centralize computing firing data in the battalion. The battalion commander would dispatch forward observers from the batteries and battalion, who would report their observations back to the center using radios rather than telephones. The center would then prepare firing data rather than the forward observer party, apply the necessary corrections, conduct the adjustments, and synchronize fire on the most dangerous target. The center allowed the battalion to shift fire rapidly to mass on a single target and deliver a hammer blow when only one observer could see the target. With accurate maps a battalion could mass fire within ten minutes after receiving a call for fire from a forward observer, while a battery could provide fire within five minutes. Without maps the battalion generally took longer. Although the system

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74 Comparato, *Age of Great Guns*, pp. 240-41; Ltr, MG Carlos Brewer to Cmdt, The Field Artillery School, 5 Feb 1944; Memo, Col Francis M. Boucher, undated, in Correspondence on Development of FDC File; Riley Sunderland, "Massing Fire and the FDC," Army, May 1958, p. 58; Gugeler, "Fort Sill and the Golden Age of Field Artillery," p. 6.

75. Ltr, Brewer to Cmdt, The Field Artillery School, 5 Feb 1944; Ltr, Col Sidney F. Dunn, former instructor in Gunnery Department, to Cmdt, Field Artillery School, subj: Development of the Field Artillery Fire Direction Center, 21 Feb 44, in Development of the FA FDC, US 401st FA Group File, Morris Swett Library; Ltr, Field Artillery School to Col Sidney F. Dunn, 10 Mar 44, The FDC File, Morris Swett Library; Ltr, Brig Gen R.G. Barkalow to Cmdt, The Field Artillery School, subj: Development of the FA FDC, 4 Feb 1944; Ltr, Dunn to Cmdt, The Field Artillery School, subj: Development of the Field Artillery Fire Direction Center, 21 Feb 44; Ratliff, "The Field Artillery Battalion Fire Direction Center," pp. 117-18; Gugeler, "Fort Sill and the Golden Age o Field Artillery," pp. 8-10; Sunderland, *History of Field Artillery School*, pp. 129-30; Sunderland, "Massing Fire and the FDC, p.58.

could only handle observed fire, the fire direction center surpassed anything in Europe.[76]

Besides allowing gunners to mass fire rapidly, the fire direction center altered the battalion's role. Prior to the development of the center, the battery commander directed fire, while the battalion commander assigned duties and tasks to each battery commander, supervised the expenditure of ammunition, and kept his battery commanders informed about the situation. He rarely interfered with actual firing. With the introduction of the fire direction center, the battalion commander also assumed responsibility for fire direction. The battalion directed the fire, and the battery commander conducted the fire. In effect, the battalion replaced the battery as the field artillery's firing unit.[77]

Drawing upon their days as battery commanders, many senior field artillery officers opposed placing the battalion commander in charge of directing fire. In emotional arguments and articles they insisted that the battery commander was "king in his own right, and that no one but the battery commander could give orders" to fire.[78] In fact, the Chief of Field Artillery, Major General Upton Birnie, Jr. (1934-1938), was the greatest obstacle. He opposed taking any prerogatives away from the battery commander and stubbornly fought against introducing the fire direction center. In the meantime, many veteran field artillery officers wanted the forward observer to talk directly to the battery doing the firing, while others claimed attempts to mass fire from a battalion on one single target by adjusting one battery was not practical and dismissed the development of the fire direction center. Supported by fiery opposition and its own conservatism, the War Department refused to accept the fire direction center.[79]

As tension in Europe increased, Lieutenant Colonel (later Major General) H.L.C. Jones, who became the director of the Gunnery Department at the Field Artillery School in 1939, and his staff refined the fire direction center to make it acceptable. Based upon Jones' experience as a commander of the 2nd Battalion, 77th Field Artillery, the Gunnery Department made the battery commander responsible for observed fire and the battalion commander for unobserved fire, centralized computation for observed and unobserved fire at the fire direction center, and increased the number of people in the center. The department also stressed that the entire battalion should fire on critical targets and that simultaneous opening of fire by all batteries on critical targets was normal unless the need for early fire was pressing. After demonstrating the improved fire direction methods to the Commandant of the Field Artillery School, Brigadier General George R. Allin

76. Ltr, Col Sidney F. Dunn to Cmdt, The Field Artillery School, subj: Development of FA FDC, 21 Feb 1944, in Correspondence on Development of FDC; Memo, Boucher, undated, pp. 5, 10; Ltr, Ward to Cmdt, The Field Artillery School, 15 Jun 1944, in Correspondence on Development of FDC; Comparato, *Age of Great Guns*, p. 242; "Field Artillery Notes," *Field Artillery Journal*, Jan-Feb 1932, p. 111; "Field Artillery Notes," *Field Artillery Journal*, Nov-Dec 1932, p. 631; Sunderland, "Massing Fire and the FDC," pp. 58-59.

77. Ratliff, "The Field Artillery Battalion Fire-Direction Center," p. 116; Chief of Field Artillery, *Digest of Field Artillery Developments*, 1935, pp. 1-2.

78. Ltr, Dunn to Cmdt, The Field Artillery School, 25 Feb 1944, p.4.

79. Ratliff, "The Field Artillery Battalion Fire-Direction Center," p. 118; Ltr, Ward to Cmdt, The Field Artillery School, 15 Jun 44, Development of FDC File; Gugeler, "Fort Sill and the Golden Age of Field Artillery," pp. 17-18; Ltr, Dunn to Cmdt, The Field Artillery School, subj: Development of the Field Artillery FDC, 21 Feb 44; Sunderland, "Massing Fire and the FDC," p. 59.

(1941-1942), Jones finally convinced him to accept the fire direction center early in 1941.[80]

Aware of the success of the fire direction center and the growing possibility of war, the War Department subsequently adopted it for the division. In 1941 General Marshall witnessed massed fire from a division with a fire direction center. Using a system similar to the battalion's, the division fire direction center employed one gun from each battalion to adjust fire. Later in the year, General Danford observed another demonstration and approved employing the fire direction center in the division. By utilizing the center field artillerymen could mass fire from a battalion or division within minutes and put a maximum number of rounds on the right place at the right time with or without maps. As a result, the field artillery acquired the capability of delivering massed fires rapidly and shifting fire around the battlefield at will.[81]

In the meantime, improved field artillery fuses appeared. Based upon the Westervelt Board's recommendation for bore-safe fuses to prevent detonation of the main charge before the shell had left the gun's muzzle, the Ordnance Department developed a system of fuses during the 1930s that combined the firing mechanism, the detonator, and booster into one unit and would not explode the bursting charge prematurely. As a result, the fuses could be shipped assembled in the shell. The first to be introduced was a 30-second mechanical M34 time fuse. The second, adopted by the War Department in 1938, was a combination super quick-delay action M48 fuse. This point detonating fuse was safe, reliable, easily set, and accurate. After 1938 the Ordnance Department produced additional superquick-delay action fuses. These fuses detonated high-explosive steel shell, forged steel shrapnel, and white phosphorous smoke shell. With the introduction of these fuses, field artillerymen no longer had to carry superquick, quick, or delay fuses in the field as they had done during World War I to burst rounds above the ground or to permit rounds to penetrate the target before exploding.[82]

Unlike motorization, the fire direction center, and better fuses that improved the field artillery's capacity to perform its traditional role of supporting the infantry and cavalry, the possibility of using field pieces to fight tanks had the potential of forging a new and controversial mission. Based on the German experience in 1914-18, the Americans decided to place 75-mm. field guns forward of the main defensive lines in camouflaged positions to command the most likely approaches to allow batteries to hit the flanks of the tanks with direct fire.[83] Although they had faith in their ability to stop the lumbering tanks of the era, many American field artillery officers of the twenties favored employing a tank armed with 75-mm. cannon as an antitank weapon because it was more mobile than a field piece.[84]

Over the next several years, field artillery officers refined their antitank tactics. In the 1930s

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80. Ltr, H.L.C. Jones to Cmdt, The Field Artillery School, 23 Feb 1944, pp. 1-4; Ratliff, "The Field Artillery Battalion Fire-Direction Center," pp. 118-19; Sunderland, *History of the Field Artillery School*, pp. 210-11.

81. Comparato, *Age of Great Guns*, pp. 243-45; Ltr, Asst Cmdt, The Field Artillery School, to Cmdt, The Field Artillery School, 25 Jan 44, Development of FDC File; Sunderland, "Massing Fire and the FDC," p. 59.

82. Green, Thomson, and Roots, *The Ordnance Department*, pp. 174-75; Field Artillery School, *Field Artillery Materiel*, 1937, pp. 145-54.

83. Lt Col C. Deems, "A Doctrine for the Use of Anti-Tank Guns," *Field Artillery Journal*, Jul-Aug 1923, pp. 287-89.

84. Maj Frank B. Jordan, "Artillery and Tanks," *Field Artillery Journal*, Sep-Oct 1924, p. 437.

they stressed employing indirect fire from medium and heavy pieces to bombard tank assembly areas and all routes leading from them.[85] Through massed indirect fire cannoneers planned to interdict tanks before they were ready to attack. In fact, field artillery doctrine emphasized that "fire on tanks in assembly areas is particularly effective and always sought."[86]

After 1934 field artillery officers, therefore, envisioned a two-phase antitank defense. Long-range indirect fire formed the first phase, in which batteries massed fire on tanks and their supporting elements as soon as they assembled. This barrage would knock out some tanks and reduce the offense's striking power. When those tanks that had escaped moved in closer, the second began. At that time gun crews aimed their 75-mm. and 37-mm. guns at individual tanks.[87]

Although field artillery officers saw the need for antitank tactics, they clung tightly to those missions that pre-dated tanks. For example, Colonel Allen J. Greer wrote in the *Field Artillery Journal* in 1937 that division artillery should be armed and organized to carry out its mission to fire on personnel and their accompanying weapons, mainly machine guns, that corps and general headquarters reserve artillery should furnish counterbattery fire, prepare for infantry attacks, and supply harassing and interdicting action, and that shelling tanks was not a primary mission for the artillery. It should be left to the infantry and special units equipped for antitank work.[88]

Speaking before students at the US Army War College in September 1938, General Danford echoed Greer's remarks. In a brief comment Danford said, "The artillery should not be diverted from its primary role solely for antitank defense except in real emergencies."[89] Supporting the infantry was more important than using field artillery against tanks. In his effort to define the field artillery's role against tanks, he emphasized developing mobile antitank weapons and attaching them to the division or corps. Guns and howitzers simply lacked sufficient mobility to fight tanks, which made them vulnerable to being overrun and captured. Steeped in the tradition of aggressive offensive warfare, Danford also opposed antitank warfare because it would give the field artillery a defensive role. Under Danford's direction the field artillery pushed the development of antitank guns and special units for employment against tanks so that it could concentrate on providing close support and counterbattery work.[90]

The field artillery also had a narrow view of the tank's role in offensive combat. Although Major Adna R. Chaffee's work at Camp Meade, Maryland, in the 1920s with mechanized regiments of tanks, motorized infantry, and motorized artillery demonstrated that the tank could be the core of a new arm, the field artillery still saw the tank as an aid to the infantry. As the literature at the Field Artillery School indicated, field artillery officers understood the tank's potential for dramatically restructuring tactics and organization. Like the War Department, the officers did

85. The Field Artillery School, *Tactical Employment of Field Artillery* (Fort Sill, Ok: The Field Artillery School, 1931), pp. 141-42.

86. The Field Artillery School, *Tactical Employment of Field Artillery* (Fort Sill, Ok: The Field Artillery School, 1934), p. 204.

87. *Ibid.*

88. Col Allen J. Greer, "Artillery Missions and Doctrines," *Field Artillery Journal*, May-Jun 1937, pp. 191-202.

89. Danford, Lecture, US Army War College, 28 Sep 1938, p. 28.

90. *Ibid.*

not integrate tanks, infantry, and field artillery into formations as the Germans were developing with Blitzkrieg warfare or as B.H. Liddell Hart or J.F.C Fuller were promoting in Great Britain to avoid positional warfare along the lines of the Great War. As a result, the field artillery failed to develop tactics to support armored thrusts.[91] Creating an effective team of field artillery, infantry, armor, and air power did not come until the War Department and field artillery had digested the lessons of the Spanish Civil War of 1936-39.[92]

Consequently, with the exception of adoption of the M2 105-mm. howitzer and M1 155-mm. gun in 1940, the development of improved fuses, and the creation of the fire direction center during the 1930s, the field artillery had not changed much since 1918. On the eve of World War II, antiquated weapons and thinking characterized the field artillery. Some progressive officers had tried to move the field artillery forward, but conservatism, limited funds, and pacifism overwhelmed them, limited serious reform and rearmament, and left the field artillery poorly prepared, technologically and tactically, to fight armies that were adopting the latest weapons and innovative tactics.

91. The Field Artillery School, *Tactical Employment of Field Artillery* (Fort Sill, Ok: The Field Artillery School, 1938), pp. 16, 289.

92. War Department, *Field Service Regulations*, 1939, pp. 7, 137; Russell F. Weigley, "Shaping the American Army of World War II: Mobility Versus Power," *Parameters*, Sep 1981, pp. 15-16; Danford, Lecture, US Army War College, 28 Sep 1938, p. 28; Russell F. Weigley, *The American Way of War: A History of United States Military Strategy and Policy* (New York: Macmillan Publishing Company, Inc., 1973), pp. 212-19; Weigley, *History of the United States Army*, 410, 411, 414; Col Conrad H. Lanza, "Lessons from Spain," *Field Artillery Journal*, May-Jun 1938, pp. 191, 196.

Table 5

SELECT AMERICAN FIELD ARTILLERY IN 1938

Weapon	Ammunition	Range in yards	Traverse in degrees	Elevation in degrees
M2 75-mm. Gun (modernized)	Mark I HE Shell Mark IV HE Shell	8,800 12,700	85	46
M1897 75-mm. Gun	Mark II Chemical Shell M48 HE Shell Mark I Shrapnel	8,800 13,600 6,700	NA	NA
M2 105-mm. Howitzer (experimental)	M1 HE Shell	12,150	45	65
M1918A1 155-mm. Howitzer	Mark I Shell Mark II Chemical Shell Mark I Shrapnel	12,400 12,400 10,800	6	42
M1918 155-mm. Gun (GPF)	Mark III HE Shell Mark VII Chemical Shell Mark I Shrapnel	18,000 18,000 15,800	60	NA
M1918 240-mm. Howitzer	Mark III HE Shell	16,400	20	NA

Source: The Field Artillery School, *Field Artillery Fundamentals* (Fort Sill, Ok: Printing Plant, The Field Artillery School, 1942), p. 42; The Field Artillery School, *Tactical Employment of Field Artillery* (Fort Sill, Ok: Printing Plant, The Field Artillery School, 1938), p. 3.

Chapter VIII

FIELD ARTILLERY IN WORLD WAR TWO: 1939-1945

Motorized field pieces, the fire direction center, radio equipped forward observers, and technological and organizational developments increased the field artillery's ability to support the other combat arms as well as wreak destruction. Beginning in 1942 and continuing through 1945, field artillerymen massed fire to cut apart offensive thrusts, tear holes in defensive lines, or pin down the enemy to allow the offense to attack.

War in Europe

With the invasion of Poland in September 1939, Adolph Hitler smashed twenty years of uneasy peace in Europe. As the field artillery blasted holes in Polish lines, German tanks and infantry poured through with impunity. Simultaneously, German air forces bombed critical communication lines, prevented the Poles from bringing up reinforcements and supplies, and destroyed many aircraft on the ground before they could get airborne. By the last week of September, German and Soviet military forces had partitioned Poland.[1]

To ensure fire support the Germans had to modify field artillery tactics. Prior to the invasion they massed their field artillery to silence Polish batteries. Once the Germans had cut through the initial defense and as the first wave of tanks had disclosed enemy strongholds and other defenses, gun crews shifted their fire from the area of the breakthrough to screen the flanks of the first wave of advancing tanks. Shortly after, the second wave with close support from self-propelled and towed artillery hit antitank guns and field artillery positions that had not already been neutralized.[2] Subsequent tank waves struck any remaining points of resistance and cleared a path for infantry and horse-drawn artillery to follow.[3] Realizing that close cooperation between the field artillery and the other combat arms was paramount, the Germans assigned radio-equipped forward observers to the leading armor and infantry elements to direct fire, kept their guns so close

1. Richard A. Preston and Sydney F. Wise, *Men in Arms: A History of Warfare and Its Interrelationships with Western Society* (New York: Holt, Rinehart and Winston, 1979), pp. 295-96.

2. Military Intelligence Division, War Department, Tentative Lessons Bulletin, 23 Jun 1941, pp. 3-8, in Morris Swett Library, Fort Sill.

3. Military Intelligence Division, War Department, Tentative Lessons Bulletin, 23 Jun 1941, pp. 7-8; Office of the Chief of Field Artillery, Field Artillery Intelligence Digest, 7 Aug 1941, pp. 9-12.

to the front that gun crews frequently had to use direct fire, attached an artillery battalion to an armor or infantry regiment, and allowed their artillery battalions to operate independently of each other.[4] Because of these practices, the Germans generally massed their field guns only for breakthroughs or when resistance stiffened.[5]

Although German field artillery certainly did not lead the bold thrusts into Poland, it along with aggressive aerial attacks tore gaps in Polish defenses to allow tanks and mechanized infantry to roll through. Observing the German successes in Poland, Major General Robert M. Danford, Chief of US Field Artillery (1938-1942), commented that effective combined arms warfare had produced the quick victory over Poland.[6]

After eight months of preparation and after attacking Norway and Denmark, Hitler struck France in May 1940. The Germans used parachute troops to clear difficult obstacles, dive bombers to give close support to the ground forces, and tanks to probe, pierce, and fan out behind Allied lines.[7] When the Germans hit the Low Countries, France and Great Britain quickly shifted their defenses from their right along the incomplete Maginot Line to their left. This action absorbed their most mobile units and left their right flank unguarded and open to attack. In concert with the secondary thrust into the Low Countries, the German main force advanced through the woody and hilly country of the Ardennes, which many military experts thought was impassible for tanks and mechanized infantry, and surprised the Allies by breaking through at Sedan, France, in mid-May. Under the cover of aircraft rather than field artillery because their horse-drawn and even towed guns could not keep up with the other combat arms, the Germans crushed their opposition.[8] Trained in the ways of the Great War of 1914-18, French and British commanders simply could not react fast enough to stop the onslaught. After the British evacuated the continent at Dunkirk, the Battle for France ensued. Within nine days the Germans captured Paris and grabbed control of western Europe.[9]

At the outbreak of war in Europe in 1939, the US Army found itself poorly prepared for combat. The Army lacked airplanes, tanks, combat and scout cars, antiaircraft artillery, searchlights, fire control equipment, and other equipment. Based upon experience gained in France in 1918, the Army's offensive operations featured heavy artillery preparations, rolling barrages, the employment of tanks to assist the infantry to move through barbed wire entanglements and other obstacles, and massive infantry advances designed to engage the enemy in hand-to-hand combat. Although the Army boldly

4. Chief of Field Artillery, Field Artillery Intelligence Bulletin, 3 May 1941, p. 3; Military Intelligence Division, Tentative Lessons Learned Bulletin, 19 Jul 1940, p. 5.

5. Office of the Chief of Field Artillery, Field Artillery Intelligence Digest, 7 Aug 1941, p. 11; The Field Artillery School, Advanced (Special) Course Report, subj: German Operations in Poland, 1939, 16 Apr 1941, pp. 8, 10, 19; The Field Artillery School, Advanced (Special) Course Report, subj: German Operations in Poland, 1939, 6 Dec 1940, p. 5; Maj Gen Robert M. Danford, Lecture, Army War College, 23 Sep 1939; Charles von Luttichau, "Notes on German and US Artillery," Foreign Studies Branch, Office of the Chief of Military History, May 1957, p. 3.

6. Office of the Chief of Field Artillery, Field Artillery Intelligence Digest, 7 Aug 1941, p. 12.

7. Preston and Wise, *Men in Arms*, p. 299.

8. B.H. Liddell Hart, *History of the Second World War*, Vol I (New York: Capricorn Books, 1972), pp. 67-70. Even though the Germans had motorized field artillery, approximately fifty percent of their field artillery remained horse-drawn until the end of World War II.

9. Theodore Ropp, *War in the Modern World* (New York: Collier Books, 1959), pp. 318-19; War Department, Tentative Lessons Learned Bulletin, 11 Jul 1940, pp. 1-5.

proclaimed adherence to offensive and aggressive tactics and was converting to the triangular division to improve mobility, its doctrine relegated aircraft, tanks, machine guns, and field artillery to secondary roles to the infantry. The Army was simply more attuned to combat styles of 1918 than those of 1939-40 and resembled its French and British counterparts that the Germans had easily defeated.[10]

Yet, German successes in 1939 and 1940 dispelled any lingering doubts in the War Department about towed and self-propelled artillery.[11] Although the field artillery embraced towed artillery by abandoning horse-drawn artillery, many field artillery officers were reluctant to use self-propelled artillery because they persisted thinking that it was too unreliable and conspicuous. Despite high-level opposition from General Danford, resistance to change from many field artillery officers, and technological problems, necessity finally compelled the War Department to introduce self-propelled field artillery.[12]

At the recommendation of the Board of Officers on the Development of Equipment for Armored Divisions, Secretary of War Henry H. Woodring (1936-1940) directed the Ordnance Department in June 1940 to develop a motorized mount, also called a gun motor carriage, for the 75-mm. gun. The department advocated using commercially-built, high-speed tractors and the 3-inch gun, while the newly created Armored Force wanted self-propelled 105-mm. howitzers. Influenced by the movement towards heavier guns in Europe with the ability to follow the infantry, the Ordnance Department eventually substituted the 105-mm. howitzer for the 75-mm. gun. Even though this was comparatively easy, finding a high-speed, light-weight mount was difficult. Driven by expediency, the department experimented with wheeled carriages, half-tracks, and medium tank chassis rather than constructing a mount designed especially for the 105-mm. howitzer. In view of the need for mobility, the Ordnance Department picked a medium tank chassis. It reduced the chassis' armor, dispensed with the closed turret, deliberately rejected incorporating 360-degree traverse because it would increase the weight of the weapon, placed a M2 105-mm. howitzer on the vehicle, and named the weapon the M7 105-mm. self-propelled howitzer. Because of the M7's pulpit-like machine gun turret, the weapon was better known as the Priest. The Ordnance Department then rushed the M7 to the British in Africa early in 1942. Concurrently, the department installed 105-mm. howitzers on half-tracks built by the International Harvester Company and issued them to tank destroyer units in 1942.[13]

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10. Martin Blumenson, "Kasserine Pass: 30 January-22 February 1943," in Charles E. Heller and William A. Stofft, eds., *America's First Battles: 1776-1965* (Lawrence, Ks: University Press of Kansas, 1986), pp. 226-28.

11. Charles M. Baily, *Faint Praise: American Tanks and Tank Destroyers During World War II* (Hamden, Ct: Archon Books, 1983), p.6.

12. Constance M. Green, Harry C. Thomson, and Peter C. Roots, *The Ordnance Department: Planning Munitions for War* (Washington: Office of the Chief of Military History, US Army, 1955), pp, 203, 276.

13. Green, Thomson, and Roots, *The Ordnance Department*, pp. 314-15; Ltr, Subcommittee on Automotive Equipment, Ordnance Department, to the Ordnance Technical Committee, Ordnance Department, subj: Carriage, Motor, 240-mm. Howitzer, T92; Carriage, Motor, 8-inch gun, Y93—Development and Procurement of Pilots Recommended, 4 Jan 1945, in Morris Swett Library, Fort Sill; Harry C. Thomson and Lida Mayo, *The Ordnance Department: Procurement and Supply* (Washington: Office of the Chief of Military History, US Army, 1960), pp. 100-01; Report, Office of Chief of Army Field Forces, subj: Artillery Conference, Fort Monroe, 2325 Jun 1954, pp 63-4; Ian V. Hogg, *The Guns: 1939-45* (New York: Ballantine Books, 1970), p. 38; Ltr with annexes, Col Thomas B. Hedekin, Observer, Army Ground Forces, to Cmdt, Field Artillery School, subj: Report of Observer to North African Theater, 5 Jul 1943, Appendix C, p. 26, in Morris Swett Library.

The introduction of self-propelled artillery represented improvisation at its best. After expressing little interest with this form of field artillery for two decades and even opposing it, the War Department and field artillery officers abruptly changed their position after war in Europe had broken out. To stay abreast of the German juggernaut, they decided to obtain self-propelled artillery as soon as possible. Without the benefit of a solid research and development program, the Ordnance Department did nothing more than weld a M2 105-mm. howitzer to a medium tank chassis and send the weapon to the field.

Converting to self-propelled and towed artillery opened a new era. With support from the field artillery, the War Department started arming the division with the towed (also horse-drawn) M1897 75-mm. gun, the towed M1916A1 75-mm. gun, the towed M1917Al 75-mm. gun, the towed M2 75-mm. gun, the towed M2 105-mm. howitzer, the self-propelled M7 105-mm. howitzer, and the towed M1918 155-mm. howitzer during 1942. Simultaneously, the War Department took steps to equip the corps with the towed M1 155-mm. gun, the towed M1 8-inch howitzer, and the towed M1918A 240-mm. howitzer. With the introduction of totally new field pieces to replace World War I guns and howitzers, the field artillery acquired the speed and mobility required to keep up with mobile armored and mechanized units being formed in the Army. By late 1942 a new family of field artillery weapons existed. M2 105-mm. howitzers, self-propelled M7 105-mm howitzers, Ml 4.5-inch guns, Ml 155-mm. guns, self-propelled M12 155-mm. guns, M1 8-inch howitzers, and towed M2 8-inch guns began to dominate the field artillery. These weapons had greater ranges than World War I artillery and even modernized World War I pieces. They fired high-explosive shell, chemical shell, steel shrapnel, and shot to pierce armor. To eliminate the necessity of carrying several kinds of fuses, field artillerymen detonated their ammunition with combination superquick-delay action fuses that could be set at the time of firing.[14]

Concurrently, the War Department restructured air observation. The introduction of more powerful field guns, the growing use of camouflage, and deeply defiladed battery positions made ground observation more formidable. In some cases only air observation could detect targets. In light of this, the field artillery set out to make aerial observation more responsive to its needs. As early as 1935, former Chief of Field Artillery, Major General Harry G. Bishop (1930-1934), openly opposed using Air Corps personnel as observers because they did not know the field artillery's requirements. Like many other field artillery officers, he wanted observers to be artillerymen because only they could best understand the needs of the field artillery.[15]

Several years later in May 1941, a committee at the Field Artillery School under Colonel P.M. Hanson called for organic air observation for the field artillery as the best answer to meeting the arm's needs. To the committee the increased mobility of combat forces in the 1930s and early 1940s multiplied the difficulties of ground observation and threatened the field artillery's ability to provide close support on the mobile battlefield. Besides being under the control of the field

14. Frank E. Comparato, *Age of Great Guns: Cannon Kings and Cannoneers Who Forged the Firepower of Artillery* (Harrisburg, Pa: The Stackpole Company, 1965), pp. 123-25; War Department, Field Manual 6-130, Field Artillery Field Manual, Reference Data (Washington: Government Printing Office, 1940), pp. 8-11; The Field Artillery School, Characteristics of Weapons Chart, 1 Mar 1940, in Morris Swett Library; The Field Artillery School, *Field Artillery Fundamentals* (Fort Sill, Ok: The Field Artillery School, 1942), pp. 177-78.

15. Harry G. Bishop, *Field Artillery: King of Battle* (Boston: Houghton Mifflin Company, 1936), pp. 130-35.

artillery, organic air observation offered the prospect of tracking a mobile enemy more easily over greater distances and detecting more targets than ground observation permitted. From the school's perspective, organic aerial observation was essential for exploiting the battalion fire direction center's ability to mass fire.[16]

At the same time field artillery officers outside of the school led by General Danford had their own reasons for wanting organic aerial observation. Influenced by this dissatisfaction, Aeronca, Piper, and Taylorcraft aircraft manufacturers offered their light aircraft complete with pilots to senior commanders participating in the Army maneuvers in 1941 for testing in artillery observation and liaison roles. Chief of the Air Corps, General Henry "Hap" Arnold, approved using the light aircraft and assigned them to squadrons of 0-49 observation aircraft for employment in the maneuvers. These light aircraft, named "Grasshoppers" by Major General Innis P. Swift, Commanding General, lst Cavalry Division, Fort Bliss, Texas, flew over 400,000 miles during the maneuvers, completed more than 3,000 missions without losing one plane, and demonstrated their utility for air observation, courier, and reconnaissance missions.[17]

Notwithstanding the success of the light aircraft in observation missions, field artillery officers, participating in the Louisiana maneuvers, expressed their desire to have control of air observation. Criticizing aerial observation being furnished by the Air Corps, the officers explained that they never knew when air observation would be available, that the diversion of aircraft to other missions disrupted observation, that coordination between the field artillery and the Air Corps was difficult, and that there was never enough aircraft for artillery missions. Given these conditions, the field artillery lacked the ability to detect targets beyond the line-of-sight of ground observers. The field artillery required organic air observation and field artillery observers.[18]

Despite resistance from the Air Corps, which did not want to lose the observation mission, the War Department ordered a test of organic air observation for the field artillery. Using various models of light aircraft, experiments at Camp Blanding, Florida, and Fort Sam Houston, Texas, in February and March 1942 demonstrated the timeliness of organic air observation. In view of the

16. Field Artillery School, Committee Study, subj:The Observation Aviation Required for Artillery Missions, 14 May 1941, in Morris Swett Library.

17. Laurence B. Epstein, "Army Organic Light Aviation," *US Army Aviation Digest*, Jun 1977, pp. 11-17; William W. Ford, "Grasshoppers," *US Army Aviation Digest*, Jun 1982, pp. 3-4. This article, written by one of the founding fathers of organic air observation, is part of a five-part series entitled "Forty Years of Army Aviation," *US Army Aviation Digest*, 1982.

18. Ltr, Danford to Chief of Staff, Army, subj: Air Observation, 8 Oct 1941, Tab D, in Memorandum to the Chief of Staff, War Department, Washington DC, subj: Air Observation, 8 Oct 1941, in Morris Swett Library; Maj H.W. Blakely, "We Must See With Our Own Eyes," *Field Artillery Journal*, May-Jun 1939, pp. 215-18; "Aerial Observation for Field Artillery," *Field Artillery Journal*, Mar-Apr 1928, pp. 138-40; Memorandum to the Chief of Staff, War Department, Washington DC, subj: Air Observation, 8 Oct 1941; Ltr, Col Fred C. Wallace, Office, Chief of Field Artillery, to Adjutant General, subj: Air Observation for Field Artillery, 15 Jul 1940, in Tab B, Memorandum to the Chief of Staff, War Department, subj: Air Observation, 8 Oct 1941; Ltr, Dept of Tactics and Communications, Field Artillery School, to Cmdt, Field Artillery School, subj: Air Observation for Field Artillery, 4 Aug 1941, in Tab F, Memorandum to the Chief of Staff, subj: Air Observation, 8 Oct 1941; Ford, "Grasshoppers," pp. 3-4; Ltr, Wallace to AG, 15 Jul 1940; Ltr, Dept of Tactics and Communications to Cmdt, Field Artillery School, subj:Air Observation for Field Artillery, 4 Aug 1941; Maj William A. Ford, "Wings for Saint Barbara," *Field Artillery Journal*, Apr 1941, pp. 232-34.

success of the trials, the board of officers, conducting the tests, found organic air observation to be essential for the effective operations of the field artillery especially when terrestrial observation was not possible and recommended implementing this form of observation without delay. Based upon the board's report, the War Department approved establishing organic air observation for the field artillery. A War Department directive of 6 June 1942 allotted two planes, two pilots, and one mechanic to each field artillery battalion and the same to each group, division, and corps artillery headquarters.[19]

Although combat in Europe encouraged the field artillery to accept self-propelled and organic air observation, many field artillery officers still opposed adopting antitank and antiaircraft missions. In 1942 the field artillery continued to view supporting the infantry and furnishing counterbattery fire as its primary missions. Despite pressure to accept prominent roles in antitank and antiaircraft work, the field artillery successfully resisted adding these missions because the War Department organized tank destroyer units of towed and self-propelled guns and because the coast artillery retained responsibility for antiaircraft artillery.[20]

In the meantime, the field artillery rapidly expanded. In 1937 the Army had one hundred firing batteries. Five years later, it had 568 batteries (142 battalions of four batteries each). To accommodate this growth the War Department dramatically increased training programs. Between 1935 and 1940 the Field Artillery School's officer courses (Regular, Refresher, Advanced Communications, Advanced Motors, and Advanced Horsemanship) produced 1,006 officer graduates, while the school's enlisted courses trained 1,167 personnel. During the first nine months of 1941, six officer courses (Battery Officers, Advanced, Field Officers, Communications, Motors, Horsemanship, and Officers Candidate) turned out 4,396 graduates, while enlisted courses (Communications, Motors, Battery Mechanics, Saddlers, Horseshoers, and Horsemanship) trained 4,196 people.[21] Through the efforts of the Field Artillery School and field artillery training centers at Fort Bragg, North Carolina, Camp Roberts, California, and Fort Sill, field artillery units received skilled enlisted soldiers and officers for collective training.[22]

As the rapid growth in training reflected, the war years of 1939-42 generated profound changes in the field artillery.The acceptance of motorized artillery as the norm even though vestiges of horse-drawn artillery were still hanging on, determined efforts to introduce new weapons, and the adoption of organic air observation and the fire direction center revolutionized the field artillery. Even so, field artillery officers could only speculate about how effectively they could mass fire and provide close, continuous support under combat conditions.

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19. Maj Delbert L. Bristol, "Air OP Is Here to Stay," *Field Artillery Journal*, Oct 1946, p. 586; Lt Col Lowell M. Riley, "Organic Air Observation for Field Artillery," *Field Artillery Journal*, Jul 1942, p. 498; Capt Angus Rutledge, "Organic Air Observation for Field Artillery," *Field Artillery Journal*, Jul 1942, p. 498; Ford, "Grasshoppers," pp. 8-10; Report of Board of Officers Appointed to Test Organic Short-Range Air Observation for Field Artillery, 18 Apr 1942, in Morris Swett Library.

20. Bailey, *Faint Praise*, p. 10; Larry H. Addington, "The U.S. Coast Artillery and the Problem of Artillery Organization, 1907-1954," *Military Affairs*, Feb 1976, p. 5.

21. Riley Sunderland, *History of the Field Artillery School*, Vol. I (Fort Sill, Ok: The Field Artillery School, 1942), pp. 190, 232-33.

22. Robert R. Palmer, Bell I. Wiley, and William R. Keast, *The Procurement and Training of Ground Combat Troops* (Washington: Office of the Chief of Military History, Department of the Army, 1948), pp. 373-73.

While the field artillery was mobilizing and the War Department was gleaning the lessons of 1939-41, the United States declared war on Japan and Germany in December 1941. Although public opinion pressed President Franklin D. Roosevelt to avenge the Japanese attack on Pearl Harbor, he thought that Germany presented a graver danger to American security. It had the manpower, industrial strength, and military capacity to ensure an Axis victory whereas Japan did not. Prompted by this reasoning and British Prime Minister Winston Churchill's influence, Roosevelt directed American energies towards defeating Germany first and then Japan.

Early in 1943, combat in North Africa provided the field artillery with one of its first opportunities to fight on a mobile battlefield. To defeat the Germans, who had established a defensive line in Tunisia running from Cape Serrat in the north to El Guettar in the south, General Dwight D. Eisenhower, commander of the Allied forces in North Africa, moved Major General Lloyd R. Fredendall's inadequately trained American II Corps into southern Tunisia to support poorly equipped French troops holding Fondouk, Faid, and Maizila Passes and Gafsa, an important road center. Just before dawn on 30 January 1943, German Field Marshall Irwin Rommel's main attack struck Faid Pass as secondary assaults hit to the north. To bolster collapsing Allied defenses Fredendall hastily rushed portions of his scattered command forward. Even though batteries had been parcelled out to infantry and armor battalions to give them more firepower and were committed piecemeal into battle, American field artillery fire slowed down the Germans. Despite the resistance, the Germans seized the pass. Coupled with other attacks, this action gave the Germans control of the passes leading to Kasserine Pass and demonstrated Fredendall's limited knowledge about the proper employment of field artillery because he reduced its ability to mass fire by decentralizing command.[23]

After staging local counteroffenses during the first part of February 1943, the Allies prepared to defend against an expected German thrust. With the objective of taking Sidi Bou Zid, the Germans' main effort poured through Faid on the fourteenth during a sandstorm as a secondary thrust moved through Maizila Pass. Badly outnumbered and still scattered, the Americans bravely resisted even though some gun crews abandoned their pieces and fled. Although the Germans had grabbed the initiative, they chose to regroup to oppose an American counterattack. On the fifteenth the Americans struck with inadequate field artillery support because it was still dispersed. Soon, German tanks emerged from hiding and encircled the Americans. After fierce fighting the Americans retreated. By the time that the fighting was over around Sidi Bou Zid, the Americans had lost 2,500 men, 100 tanks, 280 vehicles, and 30 field guns. Along with a successful push that drove the Americans westward from Gafsa, the German triumph at Sidi Bou Zid put the Axis in position to move into Kasserine Pass.[24]

As Fredendall's corps was struggling to hold the passes, Eisenhower dispatched reinforcements

23. Blumenson, "Kasserine Pass, 30 January-22 February 1943," pp. 245-46; David W. Hazen, "Role of the Field Artillery in the Battle of Kasserine Pass," unpublished masters thesis, US Army Command and General Staff College, 1973, pp. I-11; George F. Howe, *Northwest Africa: Seizing the Initiative in the West* (Washington: Office of the Chief of Military History, Department of the Army, 1967), pp. 451-55; See Blumenson's Kasserine Pass (New York: PBJ Books, 1983) for an indepth study of the battle.

24. Blumenson, "Kasserine Pass, 30 January-22 February 1943," pp. 250-55; Hazen, "Role of the Field Artillery in the Battle of Kasserine Pass," pp. 51-58.

from Algeria to Tunisia. After several days of forced marches through snow and mud, Brigadier General S. LeRoy Irwin's division artillery of three battalions and two cannon companies from the 9th Infantry Division reached Thala to bolster British defenses. On 21 February Irwin's twenty-four 105-mm. and twelve 155-mm. howitzers, twelve 75-mm. guns, and antitank guns moved into position. With thirty-six other pieces of various calibers manned by British stragglers under his direction, Irwin massed fire on the Germans on 22 February. Unable to continue under such destructive fire, the Germans retreated to Kasserine Pass. Meanwhile, Brigadier General Clift Andrus, Commander, lst Infantry Division Artillery, took control of the field artillery on the road to Tebessa, massed fire on the Germans and Italians as they were driving out of Kasserine Pass towards Tebessa, and forced them retire back towards the pass.[25]

Although the field artillery played a dominant role in stopping the German offensive, American participants expressed mixed observations. Joseph B. Mittelman, a soldier in the 9th Division, recalled that turning back the Germans meant the virtual elimination of an infantry battalion and two supporting companies. "However, the gallant stand of Divarty [division artillery] and its cannon company support overshadowed any losses which the Division might have had," Mittelman wrote.[26] Despite Mittelman's complimentary remarks about the field artillery, commanders still had to master the fire direction center and centralize command to mass fire on the mobile battlefield. After all, effective field artillery support during the battles around Kasserine Pass came only when command was centralized.[27]

After pushing Rommel back, the British and Americans then drove the Axis out of North Africa. Taking advantage of the fire direction center, radio-equipped observers attached to infantry or armor units or sent aloft in organic spotter aircraft, and centralized command, field artillerymen repeatedly massed fire on German positions and targets of opportunity. As division artillery furnished rolling barrages to allow the infantry to catch the enemy while it was still recovering or still seeking cover, corps artillery fired interdicting and harassing missions on assembly areas and installations. During the Battle of El Guettar early in the spring of 1943, for example, II Corps artillery shelled German tanks as they prepared to attack on 23 March. Together with tank destroyers, American field artillery knocked out nearly thirty German tanks before they could overrun friendly infantry. Later in the day, the lst Infantry Division's artillery shattered another German attack led by thirty-eight tanks. Following the Battle of El Guettar, an enthusiastic report recorded that American artillery had crucified the Germans with high-explosive shells.[28] Based upon El Guettar and other battles in North Africa where division and corps

25. Blumenson, "Kasserine Pass, 30 January-22 February 1943," pp. 255-62; Howe, *Northwest Africa*, p. 466; Hazen, "The Role of Field Artillery in the Battle of Kasserine Pass," pp. 97-111.

26. Joseph B. Mittelman, Eight Stars to Victory: *A History of the Veteran Ninth U.S. Infantry Division* (Columbus, Oh: The F.J. Heer Printing Company, 1948), p. 92.

27. Blumenson, "Kasserine Pass, 30 January-22 February 1943," p. 262.

28. Lt Col Paul W. Thompson, "Close Support in Tunisia," *Field Artillery Journal*, Jul 1943, p. 836; Col C.C. Benson, "Some Tunisian Details," *Field Artillery Journal*, Jan 1944, pp. 482-84; Rpt, HQ II Corps, subj: Employment of Field Artillery of the II Corps in Northern Tunisian Campaign, undated, pp. 1-10, in Morris Swett Library; Rpt, HQ II Corps, subj: Employment of the Artillery of the II Corps during Gafsa-El Guettar-Maknassy Campaign, 1 May 1943, p. 8, in Morris Swett Library; Howe, *Northwest Africa*, pp. 560-62.

commanders often massed up to twelve battalions (144 guns) to attack enemy positions, field artillerymen found artillery to be one of the dominating factors on the battlefield when it was employed in mass.[29]

For the most part, commanders favorably commented about the field artillery's performance during the drive to push the Axis out of North Africa. Reflecting on the effectiveness of his field artillery, Major General Manton Eddy, Commander, 9th Division, recorded, "One Nazi who had served on almost every German front said that the American artillery fire was the most deadly that he had experienced." After driving the Axis out of North Africa, Lieutenant General Omar Bradley, Commanding General, II Corps, commented, ". . .the American field artillery technique of massed fires was a major contributing factor toward the early and successful conclusion of the operation" at Gafsa and El Guettar.[30]

Given the opportunity, the Army's field artillery demonstrated the impact of the fire direction center, ground and organic air observation, and motorized light artillery.[31] In most cases observed fire proved to be more effective than unobserved fire because the hills and ridges in Tunisia provided excellent positions for observation and because each field artillery battalion had at least ten observers to adjust fire through the fire direction center.[32] Addressing the center, General Eddy said that it united observers and battalions into an effective network. In one instance a forward observer on the northern flank of Eddy's division sector conducted fire for a battalion of 155-mm. howitzers on the southern flank.[33]

As Eddy suggested, the fire direction center allowed artillery commanders to crush the enemy and supply flexibility to hit targets of opportunity. The commander of the lst Armored Division's artillery reported that any one of his observers could adjust fire for any battery in the division because of the center. In an interview the commander wrote, "On any important target I usually mass all the artillery of the division [forty-eight howitzers]."[34] At the conclusion of the campaign in North Africa, General Bradley readily admitted that any observer in his corps could adjust fire for any battery and bring the fire of all of the corps' artillery (324 howitzers and guns) onto a single target if required because of the fire direction center.[35] Equally important, the fire direction center and radio-equipped observers tied the field artillery, armor, and infantry into an

29. Col Douglas J. Page," El Guettar: March 25-Apr 8, 1943," *Field Artillery Journal*, Sep 1943, pp. 646-47; Lt Col Paul W. Thompson, "Close Support in Tunisia," p. 836; Col C.C. Benson, "Some Tunisian Details," pp. 482-84; Rpt, HQ II Corps, subj: Employment of Field Artillery of the II Corps in Northern Tunisian Campaign, undated, pp. 1-10; Rpt, HQ II Corps, subj: Employment of the Artillery of the II Corps during Gafsa-El Guettar-Maknassy Campaign, 1 May 1943, p. 8; Howe, *Northwest Africa*, pp. 560-62; Field Artillery School, Review of Confidential Information, 10 Aug 1943, pp. 5, 50, in Morris Swett Library.

30. "Official Commendation," *Field Artillery Journal*, Sep 1943, p. 652.

31. Ltr with Annexes, Hedekin to Cmdt, The Field Artillery School, 5 Jul 1943, Appendix C.

32. War Department, *Lessons of the Tunisian Campaign* (Washington: Government Printing Office, 1943), pp. 22-25, in Morris Swett Library.

33. Ltr, Eddy to CG, Allied Forces Headquarters, 21 Jun 1943, in Report on Operations Conducted by 9th Infantry Division, in Morris Swett Library.

34. Ltr with Annexes, Hedekin, to Cmdt, The Field Artillery School, 5 Jul 1943, Appendix C, p. 21.

35. *Ibid.*, Appendix C, p. 19.

effective combined arms team.[36]

As General Bradley suggested, organic air observation played a critical role in North Africa. In a brief article in *Field Artillery Journal* in 1944, Major Edward A. Raymond, a field artillery officer, explained that air observation had "come into its own."[37] In fact, the Battles of El Guettar, Mateur, and Bizerte silenced detractors. Although the enemy was a master of camouflage, air observers repeatedly identified gun flashes from almost perfectly concealed positions for corps artillery to engage. Hostile antiaircraft fire might have prevented air observers from flying behind enemy lines on occasion, but observers still picked out enemy batteries for neutralizing or adjusted fire on targets over ten thousand yards away. As a result, flying behind lines was not critical for effective fire support. During the action near Hill 609 by Sidi Nsir late in April and early in May 1943, for example, organic air observers located so many targets that the 34th Infantry Division's artillery "could hardly haul in ammo fast enough" to respond to calls for fire. Organic aerial observation also had a side benefit. During the Battles of El Guettar, Mateur, and Bizerte, observation planes flying over enemy lines frequently caused hostile batteries to cease firing to prevent disclosing their positions, which allowed the Americans to mass fire with impunity. As a whole, organic air observation was timely and solved the artillery's need for observation to hit targets beyond the view of ground observers.[38]

At the same time, self-propelled and towed artillery vindicated themselves. Although self-propelled artillery was not any faster than towed artillery on the road, it had the ability to move into position more rapidly to deliver fire, then to displace quickly to avoid counterbattery fire, and to follow armor over terrain impassable for towed artillery. As a result, the self-propelled M7 could be used aggressively on the offense. An article in *Field Artillery Journal* in March 1944 reported that the M7 105-mm. howitzer was not only mobile but also offered the crew protection from small arms fire and shell fragments so that the weapon could be sited forward and closely support any action. Based upon combat in North Africa, towed and self-propelled field artillery silenced critics by becoming acknowledged assets by mid 1943.[39]

Although the field artillery group for corps artillery had been recently introduced early in 1943, it proved its utility in North Africa. Seeking flexible combat organizations, the Army Ground Forces restructured corps artillery in 1942-43. It abolished the brigade system with its three organic field artillery regiments (two regiments of 155-mm. howitzers and one regiment of 155-mm. guns) for a flexible corps organization of a group with only a headquarters battery as an organic element and a variable number of self-sufficient attached field artillery battalions. This arrangement allowed the battalions to be moved from corps to corps more easily than the brigade allowed. The first field artillery group, the 5th Armored Field Artillery Group with three battalions of M7 105-mm. howitzers (thirty

36. *Ibid.*, Appendix C, pp. 19-21.

37. Maj Edward A. Raymond, "Air Operations," *Field Artillery Journal*, May 1944, p. 274.

38. Lt Col Paul W. Thompson, Lecture, Field Artillery School, 26 Jun 1943, p. 22, in Morris Swett Library; Capt Woodrow M. Smith, "A Summary of Tunisia,' *Field Artillery Journal*, Nov 1943, p. 836; Howe, *Northwest Africa*, pp. 631-39; Field Artillery School, Review of Confidential Information, 10 Aug 1943, p. 8, in Morris Swett Library.

39. Col Lowell M. Riley, "Armored Artillery Action," *Field Artillery Journal*, Mar 1944, p. 179; Lt Col Douglas G. Dwyre, "The Field Artillery Puts on Armor," *Field Artillery Journal*, Dec 1943, pp. 917-18; War Department, *Lessons of the Tunisan Campaign*, pp. 17-18; The Field Artillery School, "Artillery in Combat," Aug 1944, p. 14; Field Artillery School, Review of Confidential Information, 10 Aug 1943, p. 8.

six), arrived in North Africa in January 1943 but did not see any combat until March 1943 when it reached Tebessa, Tunisia, where it was attached to II Corps. Because of the presence of a corps field artillery brigade, II Corps employed the 5th Armored Field Artillery Group with its attached battalions almost exclusively as a pool to reinforce division artillery. Consequently, II Corps operated with a mixture of old and new corps artillery organizations to support division artillery of three battalions of 105-mm. howitzers (thirty-six) and one battalion of 155-mm. howitzers (twelve).[40]

Notwithstanding the general consensus on the effectiveness of field artillery support in North Africa, some Army officers saw the need for changes. General Irwin's desire for even more firepower in the division influenced him to support expanding the light battery from four to six pieces. Colonel George B. Barth, Chief of Staff, 9th Division, also favored a six-gun battery because it would increase firepower by fifty percent without causing the artillery commander to lose control.[41]

Irwin's and Barth's conclusions paralleled those of the Field Artillery School. In a confidential review of information in August 1943, the school pointed out that II Corps' 324 field pieces fired over 23,000 rounds a day in North Africa. Although this number of guns and ammunition expenditure rate seemed imposing, it was not. Because of the failure of the Germans to mass their artillery effectively and their lack of artillery and ammunition, II Corps had enough field artillery. With this in mind, the school then warned against drawing any false conclusions from the North African campaign concerning the amount of field artillery required to support a campaign. According to the Field Artillery School, the division's organic artillery was the bare minimum, while the corps required more field artillery than II Corps had in North Africa when the US Army invaded Europe because of the vast concentration of enemy artillery on the continent.[42]

After defeating the Axis in North Africa and Sicily, the Allies invaded Italy in September 1943. By pushing up the coasts they planned to outflank Rome and force the Germans to retreat. Nevertheless, the Germans constructed strong defensive lines in the rugged Apennine Mountains to compel the Allies to fight hard for every inch of ground.

Fighting in the mountains presented new challenges for the field artillery. Positioned on high ground that provided excellent observation of Allied movements, the Germans shelled Allied batteries effortlessly. Under the pressure of heavy enemy artillery barrages, the Americans had to pick out battery positions and fire direction center sites during the day, had to move into them under the cover of darkness, and had to stress camouflaging, sandbagging, and digging in to conceal their guns.[43]

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40. Russell A. Weathersby, "The Field Artillery Group in Support of the Corps and Field Army, 1942-1953," unpublished masters thesis, US Army Command and General Staff College, 1965, pp. 1-8, 14-18. II Corps had a field artillery group and field artillery brigade because the War Department decided to delay restructuring units already in combat to minimize confusion and to phase in the artillery group.

41. Ltr, Hedekin to Cmdt, The Field Artillery School, 5 Jul 1943, Appendix C, pp. 30-31; Dwyre, "The Field Artillery Puts on Armor," p. 918.

42. Field Artillery School, Review of Confidential Information, Nov 1943, p. 4; Field Artillery School, Review of Confidential Information, 10 May 1943, p. 22, in Morris Swett Library.

43. The Field Artillery School, "Artillery in Combat," Aug 1944, pp. 26, 28, 33; Report, Col N.P. Morrow, Army Ground Forces Board, subj: Field Artillery Technique and Procedure, 7 Jan 1944, pp. 4, 6, in Morris Swett Library, hereafter cited as Morrow Report; Report, Col L.S. Griffing, Army Ground Forces Board, 29 May 1944, p. 7, in Report, US Army Ground Forces Board, subj: Artillery in the Initial Breakthrough, Garigliano Offensive, in Morris Swett Library, hereafter cited as Griffing Report.

The mountains also restricted the availability of good firing positions and forced commanders to position their guns close together, which made them easier targets for counterbattery fire. Reflecting on the difficult terrain, Lieutenant Colonel R.D. Funk, Commander, 158th Field Artillery Battalion, recounted in an after action report, "We have had some pretty tight areas assigned to us. We have had batteries firing over each other and practically interlaced."[44] Long periods of fire at slow rates and time-on-target (TOT) fire in which gun crews adjusted their field pieces on one target and timed their firing so that the rounds would hit at the same time regardless of the different ranges of their field pieces destroyed the prepared defenses and helped the infantry batter its way up the rugged peninsula. Addressing the artillery's contribution through early 1944, Brigadier General David G. Barr, Chief of Staff, Headquarters, North African Theater of Operations, US Army, reported that it played a vital role in making the advance up the peninsula possible because of the liberal expenditure of ammunition.[45]

Prodded by the need for more firepower to break through well-prepared German defenses in Italy, American commanders used tank destroyers as field artillery. Based on the precedent set in North Africa, commanders attached one tank destroyer battalion (thirty-six guns) to the division. This increased the division's firepower by the equivalent of three light artillery battalions and broadened the destroyer's role. From mid-1943 onwards tank destroyers served more increasingly as field artillery as the demand for firepower grew and as the need for antitank weapons diminished even though Lieutenant General Lesley J. McNair, Commander, Army Ground Forces, and others still perceived that the destroyer's primary role was antitank warfare.[46]

After hitting the Gustav Line for almost five months and not being able to break it, the Allies abandoned their frontal assaults. They decided that the British would hit the line along the seacoast, that the Americans would drive across the Rapido River and through Cassino, and that a British-American force would land at Anzio. On 17 January 1944 the British crossed the lower Garigliano River and gained a foothold. Simultaneously, a British-American force landed at Anzio, while the American II Corps attacked Cassino, which was the most heavily fortified town yet encountered in Italy.[47]

After constant artillery and tank destroyer bombardments failed to weaken German resolve at Cassino, the Allies intensified their efforts. On the morning of 15 March 1944, Allied aircraft dropped almost one thousand tons of bombs on German defenses in the Cassino area, while field

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44. Memo, HQ North African Theater of Operations, subj: Lessons from the Italian Campaign, 10 Mar 1944, pp. 91-95, in Morris Swett Library.

45. Morrow Report, pp. 7-8, 12; Griffing Report, p. 4; Liddell Hart, *History of the Second World War*, pp. 456-74; The Field Artillery School, Report of Confidential Information, No. 5, Feb 1944, p. 14, in Morris Swett Library; Rpt, HQ II Corps, subj: Employment of Field Artillery with II Corps, Italian Campaign, 18 Nov 1943-26 Feb 1944, undated, p, 6; Report, HQ North African Theater of Operations, US Army, subj: Lessons form the Italian Campaign, 10 Mar 1944, pp. 72, 75.

46. Report, HQ North African Theater of Operations, US Army, subj: Lessons from the Italian Campaign, 10 Mar 1944, pp. 83-85, 117-18; Griffing Report, p. 10; Christopher R. Gabel, *Seek, Strike, and Destroy: U.S. Army Tank Destroyer Doctrine in World War II* (Fort Leavenworth, Ks: Combat Studies Institute, US Army Command and General Staff College, 1985), pp. 20, 21, 39, 40, 41, 45, 50.

47. Chester G. Starr, From Salerno to the Alps: *A History of the Fifth Army, 1943-45* (Washington: Infantry Journal Press, 1948), p. 80.

artillery and tank destroyers shelled the target between the waves of aircraft. This deadly combination reduced the town and monastery atop a nearby hill, which the Germans were using for observation, to rubble. Following this pounding, 746 guns and howitzers delivered 2,500 tons of high explosives in front of the assaulting infantry and an additional 1,500 tons on pre-selected targets. In eight hours Allied field artillery fired almost 200,000 rounds. Yet, the Germans still did not surrender or retreat because they found protection in bunkers, caves, and tunnels and returned to their defensive positions when the cannonades had stopped as their predecessors had done during World War I and hit Allied infantry and armor. To break the stubborn German defense the Allies moved more divisions into position at Cassino, which raised the number from twenty to twenty-eight by the first of May. As this was taking place, the American II Corps and British artillery launched a smoke program to hamper German counterbattery work and to cover moving 155-mm. guns, 240-mm. howitzers, 8-inch howitzers, and other field pieces within 1,500 yards of the enemy. By the time that the Allies had finished, they had over two thousand guns, including tank destroyers, on a front of approximately twenty-five miles that ran from the mouth of the Garigliano River to the mountains just beyond Cassino. On 11 May 1944 a massive Allied artillery barrage totally surprised the Germans. Allied corps and division artillery hit all known and suspected enemy batteries for sixty minutes. Following this, corps artillery and tank destroyers shelled road junctions, command posts, lines of communication, bridges, and enemy installations and reinforced division artillery as required.[48] After a week of intensive Allied bombardments in which the Allies fired between twenty and thirty rounds for every one the enemy shot and aggressive infantry charges, the Germans finally retreated. Reflecting on field artillery fire, especially that of 11-12 May 1944, II Corps Artillery said that the operations "proved again the inestimable value in. . .massing artillery fire."[49]

In the meantime, the Allies landed a force at Anzio. Under perfect weather conditions they hit the beaches late in January 1944. As the Allies consolidated their gains, the Germans assembled a strong counterattack force, the equivalent of five divisions and forty-two batteries, by the first of February. Employing field artillery and aircraft flown in from southern France, the Germans halted advances off the beachhead.[50]

In mid-February the Germans counterattacked. They hit the western side of the beachhead where the American 45th Infantry Division was posted. After several diversionary attacks the Germans struck their main blow along the Albano-Anzio Road. Unable to drive the Allies off the beach because artillery and tank destroyers in the threatened sector went into action, the Germans renewed their offensive on the sixteenth. This pressure forced the 45th Infantry Division to move in additional field artillery, tanks, and antiaircraft guns to prevent the American line from collapsing.[51]

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48. Starr, *From Salerno to the Alps*, p. 117; Report, HQ II Corps Artillery, subj: Minturno to Rome, 23 Jun 1944, pp. 1-6; Martin Blumenson, *Salerno to Cassino* (Washington: Office of the Chief of Military History, US Army, 1969), pp. 438-42.

49. Report, HQ II Corps Artillery, subj: Minturno to Rome, 23 Jun 1944, p. 5.

50. Report, Supreme Allied Commander, Mediterranean, to Combined Chiefs of Staff on the Italian Campaign, 8 Jan to 10 May 1944, pp. 17-22.

51. Griffing Report, p. 1.

Despite intense German artillery fire, Allied infantry, machine gunners, mortarmen, and tankers refused to budge, while American artillery massed fire. By the time that the fighting had ended along the Albano-Anzio Road, American field artillery, tank destroyers, and tanks had converted the landscape into a mass of craters and ruins. In his report to the Combined Chiefs of Staff, General Sir Henry Maitland Wilson, Supreme Allied Commander, Mediterranean Theater, credited field artillery and airpower with the successful defense along the Albano-Anzio Road. He wrote, "The enemy attack was halted because of. . .combined Artillery and Air action."[52] Brigadier General Raymond McLain, Commander, 45th Division Artillery, told Colonel L.S. Griffing of the Army Ground Forces Board in April 1944, "Our only salvation on the beachhead has been the use of mass fires and an effective counter-battery system."[53]

After the initial offensive had failed, the Germans attacked again on 20 February. This time they hit the opposite side of the beachhead. There, the American 3rd Infantry Division concentrated artillery fire on two critical areas to stop the Germans from massing on any particular point.[54] This permitted the Allies to launch an offensive to link their forces that had finally penetrated the Gustav Line near Cassino.

The field artillery received praise for its action in Italy. "The mass of available artillery of all calibers, skillfully controlled and accurately directed, so effectively neutralized the enemy counter-metal [artillery] that the break-through of the line of the GARIGLIANO and the break-out from the Beachhead were assured," Headquarters, Mediterranean Theater of Operations, US Army, wrote in early 1945.[55] Resembling World War I combat all over again, counterbattery fire from corps artillery silenced enemy guns, destroyed lines of communication, and reinforced division artillery, while the latter knocked out all obstacles in the path of the advancing infantry. Seeking to destroy determined enemy resistance in prepared defensive positions, the Army massed fire in unprecedented proportions in Italy. For example, the US Fifth Army had twice the number of field pieces of all sizes during the push up Italy than employed in Tunisia and Sicily combined.[56]

Besides reaffirming the wisdom of concentrating fire, the Italian Campaign strengthened the importance of the fire direction center and air observation. The center allowed commanders to disperse batteries in the face of difficult terrain and destructive German counterbattery fire but still mass fire quickly and accurately. In a memorandum in March 1945, General Barr wrote that the fire direction center allowed "massing of fires up to seven battalions after the adjustment of observed fire by one battalion or by one forward observer" to become routine. The center permitted the field artillery to fire devastating TOT missions to surprise the enemy and prevent it from

52. Starr, From *Salerno to the Alps*, p. 144; Report, Supreme Commander to Combined Chiefs of Staff on the Italian Campaign, 8 Jan 1944 to 10 May 1944, p. 26.

53. Griffing Report, p. 10.

54. Starr, *From Salerno to the Alps*, p. 163.

55. Memo, HQ Mediterranean Theater of Operations, US Army, subj: Lessons from the Italian Campaign, 15 Mar 1945, p. 83, in Morris Swett Library.

56. Memo, HQ Mediterranean Theater of Operations, US Army, subj: Lessons from the Italian Campaign, 15 Mar 1945, p. 83; Blumenson, *Salerno to Cassino*, pp. 438-42; Comparato, *Age of Great Guns*, pp. 248-49; Report, HQ North African Theater of Operations, US Army, subj: Lessons from the Italian Campaign, 10 Mar 1944, p. 82.

escaping into bunkers or other forms of protection.[57]

In fact, massing artillery fire from an entire corps was not unusual in Italy. The American II Corps and VI Corps did it regularly. For example, VI Corps artillery concentrated fire on a force of 2,500 Germans on 17 February 1944 before it could attack. In the span of one hour, VI Corps gun crews shelled five separate targets, helped stop the enemy, and also reinforced division artillery.[58] Field artillerymen generally conceded that mastering the fire direction center permitted them to mass fire "to an extent never before equalled in any American campaign in the present war" and "exceeded all previous experience."[59] Discussing air observation in Italy, General Barr pointed out that it had been outstanding. Although the mountains limited the operations of light aircraft to some extent, organic air observation was frequently the only means of spotting enemy targets.[60]

In addition, the Italian campaign demonstrated the value of the artillery group for corps artillery. Initially, the field artillery brigade dominated corps artillery organization in Italy.When there was a need for combining two or more battalions of different calibers to perform a particular mission, brigade commanders formed a group of two to three battalions under the control of one of the three corps artillery regiments. To provide more flexibility and facilitate command functions, reconnaissance, and communications, artillery brigade commanders also divided their artillery at times into groups of two or three battalions under a group commander with the rest of the corps artillery under the brigade commander. With the arrival of more nondivisional (corps) separate artillery battalions in the fall of 1943, creating groups assumed greater importance since some brigades had as many as thirteen battalions and required an intermediate headquarters to reduce the number of battalions under the direct control of the brigade commander. As the build-up of nondivisional artillery continued with the appearance of separate battalions and group headquarters late in 1943 and early in 1944 and as the demand for flexibility mounted, the artillery group headquarters with its attached battalions supplanted the brigade for corps artillery by March 1944. Reviewing the contribution of the group to corps operations in June and July 1944, the VI Corps commander reported that the group made possible the rapid, flexible, and efficient organization of corps artillery into the size and composition required for a particular mission.[61]

Shortly after breaking out of the Anzio Beachhead and cutting through the Gustav Line, the Allies invaded northern France. Under the cover of naval guns and light self-propelled artillery that fired from landing craft, the Americans hit the beaches of Normandy on 6 June 1944. Examining the impact of self-propelled field pieces, the First US Army candidly admitted that attaching them to the assaulting parties greatly expedited establishment of a fire base during the

57. Report, HQ North African Theater of Operations, US Army, subj: Lessons from the Italian Campaign, 10 Mar 1944, p. 100; Memo, HQ Mediterranean Theater of Operations, US Army, subj: Lessons from the Italian Campaign, 15 Mar 1945, p. 84.

58. Memo, HQ North African Theater of Operations, US Army, subj: Lessons from the Italian Campaign, 10 Mar 1944, pp. 82-83.

59. The Field Artillery School, Report of Confidential Information, No. 5, Feb 1944, p. 99.

60. Report, HQ North African Theater of Operations, US Army, subj: Lessons from the Italian Campaign, 10 Mar 1944, p. 107.

61. Report, HQ North African Theater of Operations, US Army, subj: Lessons from the Italian Campaign, 10 Mar 1944, pp. 79-82.

initial stages of the landing. Self-propelled guns sustained only small losses during the landing, crossed the beaches rapidly, and were the only field pieces ashore during the early stages of the landing. By 10 June, however, the Americans had 624 towed and self-propelled pieces ashore, which gave them a density of approximately one gun per one hundred yards of front.[62]

Although the Germans reacted lightly at first to the invasion, they responded resolutely upon realizing that the Normandy landings were the main ones. In the face of Allied air superiority, the Germans pushed reinforcements forward to keep the Allies from breaking out and committed most of their armored forces around Caen, a critical road center, where the British were driving hard. To the west the Americans slugged their way through the hedgerows, which were earthen dikes about four feet in height and covered with tangled hedges, bushes, and even trees. Apart from the few main roads, only sunken lanes often screened by a canopy of tree branches offered passage and transformed hedgerow country into a labyrinth of covered ways that concealed the defender and confused the attacker. To advance from pasture to pasture, the Americans had to break a path through the hedgerows in the face of heavy enemy fire. As they climbed the hedgerows, tanks exposed their unprotected bellies to German antitank weapons, while infantrymen often got caught in the bushes.

American field artillerymen also experienced the difficulties of fighting in hedgerow country. On the one hand, the hedgerows provided natural cover, concealed muzzle blasts, and offered good observation posts at times. For example, as the 12th Infantry Regiment of the 4th Infantry Division attacked northwestward towards the high ground north of Neville-au-Plain, a strong German counterattack hit it. When American 81-mm. mortars could not stop the Germans, Captain Morrisett, B Battery, 42nd Field Artillery Battalion, climbed atop a hedgerow to his battery's front and directed artillery fire to smash the Germans and save the 12th Infantry.[63] On the other hand, the hedgerows hampered mobility and handicapped ground observation because they restricted visibility to one to two pastures at a time. Lieutenant Colonel Lewis R. Soffer wrote that his battalion could not use the mobility of its self-propelled M12 155-mm. guns, which had just been adopted, effectively in hedgerow country because the guns had to fight their way from field to field or move single file down the sunken lanes. Despite Morrisett's example, the field artillery generally depended on organic air observation to adjust fire, and in some instances it furnished the only observed fire.[64]

The Battle for St. Lo climaxed fighting in the hedgerows. By possessing the city the Americans would have a road center that rivaled Caen and put them in a position to breakout of the hedgerows into terrain favorable for maneuver warfare. Early on 7 July, nine XIX Corps field artillery battalions silenced enemy batteries and disrupted communication lines. Shortly after, division artillery laid down a rolling barrage that moved just ahead of the attacking infantry and

62. Report, The Supreme Commander to the Combined Chiefs of Staff on the Operations in Europe of the Allied Expeditionary Force, 6 Jun 1944 to 8 May 1945, p. 22, in Morris Swett Library; Report, First Army, 21 Jun 1944, p. I, Morris Swett Library; Report, The General Board, USFET, subj: Study of Field Artillery Operations, undated, pp. 6-11.

63. Col Howard W. Blakely, "Artillery in Normandy," *Field Artillery Journal*, Mar-Apr 1949, p. 53.

64. Soffer, "An M12 Battalion in Combat," *Field Artillery Journal*, Jan 1945, p. 170; Blakely, "Artillery in Normandy," p. 54; Report, VII Corps Artillery, 25 Jul 1944, p. I, in Morris Swett Library.

armor.[65] After being viciously hit and pushed back for two days, the Germans counterattacked, but American artillery, infantry, tank destroyers, and armor stopped them and permitted XIX Corps to continue its advance.[66] Two days later on 11 July, a strong German armor attack struck XIX Corps. Working under extreme difficulties because of the hedgerows and confronting stiffening resistance, XIX Corps artillery shelled the Germans to prevent them from bringing up their reserves. Division artillery, in the meantime, pounded the Germans so hard that their avenue of approach became a death trap.[67] Just as the Germans hit XIX Corps, V Corps to the left of XIX Corps bombarded Hill 192 that offered good observation of St. Lo with nine artillery battalions. After this shelling division artillery covered the attacking infantry and armor with a rolling barrage to help them seize the hill.[68]

After being slowed down by the stiff German defense, the Americans resumed their offensive. Operating to the right of XIX Corps, VII Corps seized the Periers-St. Lo road. In the meantime, XIX Corps captured Hill 122 and Martinville Ridge to give the Americans total control of the high ground to the east and north of the city as V Corps pressed down the road to St. Lo. While XIX and V Corps infantry and armor advanced from hedgerow to hedgerow, fire from field artillery and tank destroyers compelled the Germans to abandon their positions and seek cover. After several days of fierce small arms and artillery fire, the Germans retreated from St. Lo.[69]

On 25 July First Army launched Operation Cobra to break out of the hedgerows into country more suitable for maneuvering. Realizing that the Germans would offer obstinate resistance, First Army supported the infantry and armor with over 1,000 artillery pieces and 1,800 aircraft. At the point of penetration, First Army positioned one artillery piece for every fourteen yards of front.[70] In mid-morning front line troops withdrew 1,200 yards from the forward edge of the jump off line as Allied fighter-bombers dropped over 4,700 tons of bombs on the St. Lo-Perier Road. As in the case of the aerial bombardment of Caen a week earlier, the air blow of the twenty-fifth did not cause a large number of casualties because the Germans had retreated to dug-in positions. Nevertheless, it produced confusion, stunned the enemy, cut communication lines, and allowed the infantry and armor to attack.[71] As the maneuver arms pushed through, observed and unobserved artillery fire blew up known enemy installations, masked friendly troop movements with smoke rounds, and silenced German batteries. By the time that the Americans had broken through, gun crews had fired over 130,000 rounds but not as many as they desired. Difficulties unloading at the beaches and moving the ammunition to the front restricted the quantity on hand

65. Historical Division, War Department, *St. Lo* (Washington: Historical Division, War Department, 1946, reprinted by Center of Military History, US Army, 1984), p. 9.

66. Report of Operations, First Army, 20 Oct 1943 to 1 Aug 1944, pp. 89-91, in Morris Swett Library.

67. St. Lo, p. 90; Mittelman, Eight Stars to Victory, pp. 191-92; Report of Operations, First Army, 20 Oct 1943 to 1 Aug 1944, p. 90.

68. Martin Blumenson, *Breakout and Pursuit* (Washington: Office of the Chief of Military History, US Army, 1961), pp. 15152; Report of Operations, First Army, 20 Oct 1943 to 1 Aug 1944, p. 91.

69. Report of Operations, First Army, 20 Oct 1943 to 1 Aug 1944, pp. 90-91.

70. Report, The General Board, USFET, subj: Study of Field Artillery Operations, undated, p. 19.

71. Report, The Supreme Commander to the Combined Chiefs of Staff on the Operations of the Allied Expeditionary Force, 6 Jun 1944-8 May 1945, p. 36, in Morris Swett Library; Report of Operations, First Army, 20 Oct 1943-1 Aug 1944, p. 97.

and led to rationing. Even though commanders had sufficient artillery ammunition to perform their mission, they complained about inadequate supplies because they wanted to fire more rounds than they were allotted.[72]

Uncertain intelligence data also plagued the field artillery during Cobra. Recalling his unit's difficulties, Colonel Carl I. Hutton, Commander, 67th Armored Artillery Regiment, noted that he lacked information about key enemy positions on which to base his planned fire. This caused him and others in similar circumstances to select points on a map that appeared to be critical and to mass fire on them. Even though this limited the effectiveness of the shelling since important positions were often missed, many field artillery officers repeatedly used it to conduct planned fire throughout Cobra.[73]

In an after action report First Army also indicated that organic air observation provided a vital service during Cobra. Air observers' presence in the air over enemy lines caused the Germans to curtail their artillery firing to avoid disclosing their batteries and helped American artillery hit targets that could not be engaged by any other means. Equipped with radios, air observers ranged behind enemy lines, directed fire on batteries that had been elusive despite sound-and-flash ranging, and sealed off the battlefield by adjusting fire on targets of opportunity as they appeared far behind the front.[74]

Once the Americans broke out of hedgerow country, they swept through France and Belgium with a heavily armed force. In 1944 the Americans equipped their army in Europe with twenty-three field pieces per thousand combat soldiers as compared to four per thousand in World War I. Unlike World War I where American artillery networks were segregated and operated by autonomous artillery headquarters that did little coordinating with other arms, the fire direction center and practice of attaching observers to the infantry, armor, and tank destroyers created a combined arms team that was new to the Army. This arrangement and the availability of towed and self-propelled artillery supplied fire at the right time and place with few exceptions, reduced enemy strongholds, and allowed the maneuver arms to move. Commenting upon the field artillery's ability to support the other combat arms, a General Board, US Forces, European Theater (USFET), report of 1946 noted that the artillery group had been the key to success because it permitted commanders to move artillery battalions from army to army, corps to corps, or division to division with ease and furnish additional artillery support where it was needed.[75]

Although the Americans rationed ammunition during the race across France, it did not create

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72. Report, The General Board, USFET, subj: Study of Field Artillery Operations, undated, pp. 21-22; Report, The General Board, USFET, subj: Ammunition Supply for Field Artillery, undated, pp. 14-15, 46; Roland G. Ruppenthal, *Logistical Support of the Armies: September 1944-May 1945* (Washington: Office of the Chief of Military History, US Army, 1959), p. 247; Ruppenthal, *Logistical Support of the Armies: May 1941-September 1944* (Washington: Office of the Chief of Military History, Department of the Army, 1953), pp. 445-48.

73. Report, The General Board, USFET, subj: Study of Field Artillery Operations, undated, p. 22; Carl I. Hutton, "An Armored Artillery Commander in the European Theater," unpublished manuscript, pp. 104-08, 114, in Morris Swett Library.

74. Report of Operations, First Army, 8 Oct 1943-1 Aug 1944, pp. 123-24.

75. Report, The General Board, USFET, subj: Study of Field Artillery Operations, undated, pp. 30, 31, 33, 35, 36; Report, The General Board, USFET, subj: The Study of the Organization and Equipment of Field Artillery Units, undated, pp. 24-29, in Morris Swett Library.

problems. The rapid advance and lack of organized enemy resistance reduced the expenditure of rounds to well below established allowances. Consequently, field artilleryman had more than they required or even wanted despite the restrictions imposed by rationing.[76]

Slowed by long supply lines and stiffening German resistance, the Allied drive ended in September 1944 as it drew closer to the German frontiers. On the Allied right the American Third Army commanded by Lieutenant General George S. Patton encountered strong defenses around Metz and Nancy in the Lorraine.[77] Fortunately, the end of the rapid advance allowed Third Army to bring up heavy field pieces and corps artillery and to organize nondivisional artillery into groups of three to four battalions each and tie them into division artillery through one fire direction center. While this arrangement permitted the corps artillery commander to coordinate every piece within the corps, it caused problems. Since Third Army's corps fronts were so wide, one fire direction center could not control all of the artillery. As a result, corps artillery commanders often created a second fire direction center as the XX Corps artillery commander did in September.[78]

Early in September, Patton opened his offensive to capture Nancy and Metz. Under the cover of artillery, XII Corps attacked Nancy on 5 September. Unable to advance across the Moselle River during the initial thrust, Major General Manton Eddy, Commander, XII Corps, struck again on 11 September after regrouping his forces. With artillery support the 35th Infantry Division pushed towards Nancy from the south as the 4th Armored Division encircled the city from the south and north to cut off any lines of retreat. During the pincer movements, gun crews shelled German observation posts with smoke rounds, fired harassing and interdicting missions, but often had problems supporting the infantry and armor because of the fluid operations and shortages of ammunition.[79] After fierce fighting Combat Command B of the 4th Armored Division, pushing from a bridgehead south of Nancy, joined with Combat Command A of the 4th Armored Division, moving from the north, to cut off the city. Subsequently, the 35th Division captured Nancy on 15 September.[80]

In the meantime, XX Corps hit Metz. Supported by artillery barrages, the 5th Infantry Division opened the assault on 7 September. Strong German resistance threw the division back and forced Major General Walton Walker, the commander, to revise his strategy. Rather than continuing his futile frontal attack, he decided to encircle the city. The 5th Division crossed the Moselle River south of the city under the cover of thirteen artillery battalions.[81] Although American

76. Karl Thoholte, General of the Artillery, German Army, "A German Reflects Upon Artillery," *Field Artillery Journal*, Dec 1945, p. 714; Report, The General Board, USFET, subj: Study of Field Artillery Operations, undated, pp. 22, 195-97; Report, The General Board, USFET, subj: Ammunition Supply for Field Artillery, undated, pp. 33-34.

77. Report of the Supreme Commander to the Combined Chiefs of Staff on the Operations in Europe of the Allied Expeditionary Force, 6 Jun 1944-8 May 1945, p. 66; Report, HQ Third Army, Office of the Artillery Officer, 13 Sep 1944, p. 2, in Morris Swett Library; Report, The General Board, USFET, subj: Ammunition Supply for Field Artillery, undated, pp. 18-29.

78. History of XX Corps Artillery, 21 Oct 1943-9 May 1945, p. 21, in Morris Swett Library; Report, HQ Third Army, Office of the Artillery Officer, 9 Sep 1944, p. 2, in Morris Swett Library.

79. Reports, HQ Third Army, Office of the Artillery Officer, 12-13 Sep 1944, p. 2, in Morris Swett Library.

80. Hugh M. Cole, *The Lorraine Campaign* (Washington: Historical Division, US Army, 1950), pp. 69-96.

counterbattery fire forced German guns to move frequently during the offensive, XX Corps could not push the Germans out of Metz.[82] Using old forts as shelters and positioning artillery inside their steel and concrete walls, the Germans skillfully and stubbornly fought back. This coupled with diminishing ammunition supplies forced XX Corps to cut back its artillery missions in mid-September to build up sufficient stocks for a major drive.[83] Nevertheless, logistical shortages of all kinds halted Patton's offensive late in September and forestalled capturing the city.[84]

After building up reserves throughout October, XX Corps opened another offensive early in November. Because of a fortyfive mile long corps front, the corps artillery commander divided his artillery into two groups with each possessing a fire direction center. One supported the 5th Division, while the other assisted the 90th Infantry Division and 10th Armored Division. In the darkness of the eighth of November after an intensive corps artillery preparation on enemy command posts, communication centers, and concentration areas, the 5th Division jumped off. As the division attacked, its artillery smoked observation posts and neutralized enemy strong points and forward defenses as corps artillery shelled all known enemy batteries. To preserve secrecy XX Corps did not provide any preparation fire to the north. At the jump off time division artillery blasted entrenchments, automatic weapons, and mortars, while corps artillery bombarded casemates, forts, pillboxes, known batteries, and long range targets as the 90th Division and 10th Armored Division moved out.[85] With over seven hundred artillery pieces for support, the Americans slugged their way towards Metz. By 15 November the 5th Division had captured several of the forts to the south and west of the city, and the 95th Infantry Division, moving in from the west, had destroyed several forts to the north. Five days later, the 5th and 95th Divisions entered the city. Shortly thereafter, elements of the 5th and 90th Divisions linked together to the east of Metz. After a hard battle that lasted almost fourteen days, the Third Army finally crushed the Germans. Together, the seizure of Metz and Nancy left Patton's army poised to strike into Germany.[86]

Although rationing restricted the availability of ammunition and hampered operations, the field artillery still played a critical role in the Lorraine Campaign. By carefully planning operations and wisely expending existing supplies, field artillerymen supported river crossings, shelled the approaches to Metz, Nancy, and other crucial places, blasted the enemy, and opened the way for the infantry and armor to attack. During the two-week offensive against Metz, for example, the field artillery bombarded the Germans with over 130,000 rounds with almost 100,000 coming from 105-mm. howitzers and 25,000 coming from 155-mm. howitzers.[87] Unable to use air power because of adverse weather, Patton depended on field artillery to batter the Germans into submission.[88]

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81. Report, HQ Third Army, Office of the Artillery Officer, 14 Sep 1944, p. 2.
82. *Ibid.*
83. Report, HQ Third Army, Office of the Artillery Officer, 20 Sep 1944, p. 2; Report, The General Board, USFET, subj: Ammunition Supply for Field Artillery, undated, pp. 24-27, 46.
84. Cole, *The Lorraine Campaign*, pp. 117-83.
85. Report, The General Board, USFET, subj: Study of Field Artillery Operations, undated, pp. 84-87.
86. Report, Third Army, subj: A Brief Summary of Operations, 10 Jun 1945, pp. 3-4; Report, The General Board, USFET, subj: Study of Field Artillery Operations, undated, p. 87.
87. Report, The General Board, USFET, subj: Study of Field Artillery Operations, undated, pp. 84-87; Report, The General Board, USFET, subj: Ammunition Supply for Field Artillery, undated, pp. 18, 19, 24, 26, 27, 29, 30.

To the north of Lorraine, the American First Army also blasted the the German army. Field artillery and tank destroyers neutralized enemy pieces and strong points and pinned down the Germans to permit friendly infantry and armor to advance. After weeks of hard fighting, First Army approached Aachen, Germany. On 11 October the Americans assaulted. That day corps and division artillery bombarded the city with over 169 tons of shell as the infantry attacked. The following day American artillery expended five thousand more rounds to support the continued advance. After forcing the Americans to employ tank destroyers, 155-mm. howitzers, and 155-mm. guns in street fighting for almost ten days, German resistance finally ended, but not until field artillery and tank destroyers had pulverized the city. Thirty division batteries with eleven attached batteries and thirty-three corps batteries fired upon Aachen and its environs to help subdue the Germans. Not counting field artillery under the control of First Army or adjacent divisions, the Americans employed at the minimum seventy-four batteries (296 guns) to defeat the Germans at Aachen.[89]

In the meantime, the right wing of First Army pushed towards Schmidt, a crucial crossroads atop one of the highest ridges in the Huertgen Forest west of the Roer River. After failing to capture the village in October, the V Corps tried again. On the second of November, field artillery poured more than four thousand rounds on the village during a preliminary barrage. Fifteen minutes before the ground attack, division artillery shifted to targets to the immediate front of the infantry and armor. Because of difficult terrain and German artillery and small arms fire, many American infantry assaults dissolved into small unit actions. Despite aggressive fighting, the Americans did not take Schmidt from the Germans until February 1945.[90]

The battles along the Siegfried Line, such as at Aachen and Schmidt, reflected the American reliance upon fire support. Encountering strong defenses, rugged terrain that favored the defenders, and poor weather that restricted tactical air support, the field artillery massed barrages, fired TOTs, cleared paths for the infantry and armor, and repulsed local German counterattacks. Reflecting on the effectiveness of American artillery work, a captured German soldier commented that his comrades could see American aircraft coming in time to dive into a trench and could hit American tanks with antitank weapons. Yet, they could not withstand American field artillery fire because it smothered their positions without warning. With armor augmenting artillery First Army simply relied upon firepower in its attempts to break through the Siegfried Line. Even though ammunition rationing curtailed shelling to a degree, fire direction centers permitted commanders to exploit existing ammunition.[91]

As the Allies closed in on the German borders, the Germans unleashed a desperate offensive to breakthrough to Antwerp, Belgium, and split the British and Americans into two parts. Under cover of inclement weather, the Germans formed two panzer armies and one infantry army. On 16

88. Report, HQ Third Army, subj: A Brief Summary, 10 Jun 1945, p. 5.

89. Report of Operations, First Army, 1 Aug 1944-22 Feb 1945, Annex 4, pp. 6-7, in Morris Swett Library; Charles B. MacDonald, *The Siegfried Line Campaign* (Washington: Office of the Chief of Military History, US Army, 1963), p. 318.

90. MacDonald, *The Siegfried Line Campaign*, pp. 348, 373-74.

91. Report of Operations, First Army, 1 Aug 1944-22 Feb 1945, Annex 4, pp. 1, 24-25.

December 1944 German tanks pierced the Ardennes Forest of Belgium and Luxembourg on an eighty-mile front (the weakest point in the Allied lines), rolled over green American divisions of First Army, and forged onwards in a devastating surprise attack. The invasion overran forward observations posts and sound-and-flash bases, deprived corps artillery of observation and counter-battery capabilities, and forced forward positions to be abandoned. The inexperienced American 106th Infantry Division with eight battalions of corps artillery from VIII Corps in position to reinforce its artillery, for example, held a relatively quiet front when the Germans struck. Because division leaders prohibited field artillery battalions from firing into another battalion's sector to hit targets of opportunity, division artillery had difficulties massing fire on 16 December. Unable to respond effectively with field artillery or small arms fire, the 106th Division's defenses eventually collapsed as the Germans pushed around the division. By 17 December the Germans had trapped the division in a pincer movement and cut it off from other units. VIII Corps artillery also had difficulties resisting the attack. Positioned forward to support the 106th Division, corps artillery could not react to the fast-moving ground offensive. As the enemy swept around the 106th Division, corps artillery had to displace rearward. Towed 155-mm. and 8-inch howitzer battalions took long to limber and to find a place on the crowded roads that led west. As a result, some fell victim to German infantry and tanks.[92]

Despite these reverses and others, some field artillery units succeeded, if only temporarily, in checking the onslaught along part of the front. In the 99th Infantry Division's sector division artillery massed fire until V Corps artillery took over and bombarded the Germans with over 11,500 rounds during the night of 17 December. On the American right division howitzer batteries retained their link with their observation posts overlooking the Sure River and succeeded in delaying the German bridging efforts for many hours.[93]

Of all the artillery operations during the first days of the Battle of the Bulge, action centering around Monschau, Germany, in the northern sector illustrated the decisive impact of massed field artillery fire. When German tanks attempted to smash through the area, a thin screen of mechanized cavalry with artillery support stopped them. The hostile tanks launched a second heavy assault, but stout American defenses threw them back once again. By the time that the Germans mounted a third attack, V Corps had four battalions of 105-mm howitzers, six battalions of 155-mm. howitzers, one battalion of 4.5-inch guns, two battalions of 155-mm. guns, two battalions of 240-mm. howitzers, and one battery of 8-inch howitzers on line. Even though this German drive had greater strength than the two previous ones, American field artillery decimated it so badly that only one enemy battalion breached the American cavalry screen. This tough defensive show by the field artillery contained the Germans and eventually crushed them.[94]

Although bac weather restricted air and ground observation for the next five days on the American left, the field artillery managed to provide support. As the 7th Armored Division moved with little organic artillery towards St. Vith, a vital road center, VIII Corps artillery slowed down

92. Hugh M. Cole, *The Ardennes: Battle of the Bulge* (Washington: Office of the Chief of Military History, Department of the Army, 1965), pp. 141, 151-57, 196-97, 657-58.

93. Cole, *The Ardennes*, pp. 658-59; Report of Operations, First Army, 1 Aug 1944-22 Feb 1945, Annex 4, pp. 1, 24-25.

94. Report of Operations, First Army, 1 Aug 1944-22 Feb 1945, Annex 4, p. 9.

an enemy column by massing fire on it. This permitted the 7th Armored Division to win the race to St. Vith. American artillery effectively used every round of a diminishing supply, but the German onslaught finally penetrated east and south of the town and compelled the Americans to evacuate the salient on 21 December.[95] Meanwhile, just north of Elsenborn, American lst, 2nd, and 99th Infantry Divisions concentrated sixteen artillery battalions. Division artillery shot massive barrages to break up three German attacks as the infantry counterattacked and dug in. This infantry-artillery team held the critical Berg-Butgenbach-Elsenborn area for future use and prevented the German right from sweeping through.[96]

On the American right near Bastogne, Belgium, another critical road junction, a combined arms team of infantry, field artillery, and armor also contained a strong German offensive. Caught in the town as the Germans surged past on both sides and eventually encircled, the Americans gathered together approximately 130 field pieces of varying sizes and calibers and shelled the enemy with direct fire. After pounding the beleaguered garrison and requesting it to surrender, which it refused, the Germans launched a full-scale attack on Christmas Day. Together, air power and ground defenses in Bastogne kept the town from being overrun. After fighting its way from the south with fire support from thirty-five artillery battalions, the 4th Armored Division made contact with Bastogne on 26 December to help lift the siege. In the meantime, Third Army concentrated 108 artillery battalions along the left flank of the bulge and shelled the German thrust, while First Army massed one hundred battalions on the opposite side of the bulge. One of First Army's battalions, the 18th Field Artillery Battalion with three batteries of 4.5-inch rockets fired from twelve-tube launchers blasted the Germans. As it had done earlier in the Huertgen Forest in November 1944, the 18th Field Artillery Battalion laid down rocket barrages. On one occasion the battalion blasted the Germans with approximately 1,800 rockets within eighteen minutes to blunt an attack. Hit by staggering firepower from tube and rocket artillery, the German offensive in the Ardennes finally collapsed.[97]

As soon as they had assessed the German threat, the Allies organized an overwhelming counterattack. On the German northern flank the Allies gave General Sir Bernard Montgomery temporary control of the American Ninth Army and all but one corps from the American First Army. On the southern the Allies unleashed the American Third Army. Employing projectiles with recently introduced variable time (VT) fuses that detonated the round a given distance from the target through reflected radio waves, American field artillerymen helped to erase the Bulge after a hard-fought campaign, destroy the Germans' ability to wage war, and launch the Allies' last offensive that ended the war.[98]

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95. *Ibid.*

96. Report of Operations, First Army, 1 Aug 1944-22 Feb 1945, Annex 4, p. 9; Joseph R. Reeves, "Artillery in the Ardennes," *Field Artillery Journal*, Mar 1946, p. 178.

97. Comparato, *Age of Great Guns*, pp. 257, 295; Charles B. MacDonald, *A Time For Trumpets: The Untold Story of the Battle of the Bulge* (New York: William Morrow and Company, Inc., 1985), p. 503; Office of Scientific Research and Development, *U.S. Rocket Ordnance: Development and Use in World War II* (Washington: Joint Board on Scientific Information Policy, n.d.), pp. 45-47; Report, The General Board, USFET, subj: Study of Field Artillery Materiel, 1946, p. 4; Ltr, HQ 18th Field Artillery Battalion to CG, lst Army, subj: Rockets, 11 Feb 1945, in Report, the Rocket Board, subj: Review of Rocket Board's Activities, 1 Mar 1944-10 Aug 1945, 14 Aug 1945, Enclosure 5, in Morris Swett Library.

98. Comparato, *Age of Great Guns*, p. 267; Green, Thomson, and Roots, *The Ordnance Department*, pp. 365-66.

Reflecting upon the war in Europe, US Forces, European Theater (USFET), concluded late in 1945 that firepower and maneuver were the fundamental elements of combat. The application of firepower preceded successful maneuver to permit the infantry and armor to take objectives without serious loss of life or injury. Operations were quick when ammunition was plentiful and when massed artillery fires were employed to the maximum extent possible. To prevent hampering operations the field artillery required an unrestricted supply of ammunition. The American Sixth Army Group reaffirmed the necessity of huge ammunition expenditures. Commenting on rationing, the group wrote that a larger supply of rounds in the hands of the field artillery than it had had during operations in Europe would have reduced friendly casualties, would have killed more Germans, and would have ended the fighting sooner. Although the field artillery had adequate supplies of ammunition and delivered devastating barrages, field artillerymen desired even more ammunition since nothing substituted for massed fire and the lavish use of rounds.[99]

Combat operations in North Africa and Europe indicated the fire direction center, organic air and ground observers, and self-propelled and towed artillery brought a new dimension to the field artillery. While motorized field pieces gave the field artillery mobility to stay abreast of infantry and armor columns, the fire direction center and observers with radios permitted massing fire, shifting it rapidly and accurately from one point to another, keeping field artillery battalions dispersed to protect them better from counterbattery fire, exploiting the available ammunition, and supporting the other combat arms.The combination of motorized guns, the fire direction center, and forward observers supplied the Army with unprecedented firepower and mobility and integrated the combat arms into an effective team for the first time since the introduction of indirect fire.

War in the Pacific

Field artillerymen in the Pacific theater had the same guns, equipment, organization, and doctrine as their peers in Europe had, but the terrain forced them to adapt. Employing little used or even discussed techniques and fighting on small fronts and at close ranges, gun crews massed fire to clear the way for the infantry and armor to attack.

Even though the European theater received priority, Japanese activities in the Pacific forced the United States to direct its attention there. Beginning in December 1941 and continuing through mid-1942, the Japanese experienced repeated successes in their bid to create their Greater East Asia Co-Prosperity Sphere. They bombed Pearl Harbor in December 1941 and conquered Guam, Wake Island, and Hong Kong in December 1941, Singapore in February 1942, Java in March 1942, and the Philippines in May 1942. In the meantime, Japanese forces moved into Burma, seized the Solomon Islands and the Bismarck Archipeligo, threatened India and Australia, and controlled much of the Pacific Ocean by mid 1942.

The Battle of the Coral Sea in May 1942 marked the high point of the Japanese initiative in the Pacific and opened the way for the United States and Great Britain to strike. Hoping to break

99. Report, The General Board, USFET, subj: Study of Field Artillery Operations, undated, pp. 22, 87, 95, 96, 106, 107; Report, The General Board, USFET, subj: Ammunition Supply for Field Artillery, undated, pp. 46-47.

the Japanese hold on the Solomons and the Bismarcks, the Army and the Navy planned an offensive against Rabaul, a heavily fortified Japanese port, on New Britain Island. When intelligence reports showed that the Japanese were constructing an airstrip, later called Henderson Field, on Guadalcanal, the Americans invaded that island in August 1942 and seized the airstrip.[100] Preoccupied with their own offensive in New Guinea, the Japanese reacted slowly to the landing because they thought that the Americans were merely conducting a raid. When the Japanese realized that American activity was not a raid, they dispatched six thousand soldiers to push the Marines off the island.[101] On 23 October the Japanese struck Henderson Field. Savage fighting broke out. American field artillery and small arms fire repulsed the attacks that night only to face more the following night. Although the Japanese failed to capture the field, they inflicted heavy casualties and began what turned out to be several weeks of intense fighting that lasted through mid November.[102]

After receiving command of the newly formed American XIV Corps composed of the 2nd Marine Division and the Army's Americal and 25th Infantry Divisions, Lieutenant General Alexander M. Patch opened a drive in December 1942. Early in the morning of 27 December, field artillerymen opened a barrage to knock out Japanese pillboxes on the hill overlooking Henderson Field. After the artillery preparation had lifted, the infantry rushed up the hill under the cover of 155-mm. howitzer fire. As the Americans approached the summit, cross fire from Japanese small arms cut down many attackers, while enemy mortars pinned down others. Unable to move, forward observers called in more supporting fire. Within minutes American gun crews from positions less than two thousand yards from the enemy increased the intensity of their barrages on Japanese positions on the forward and reverse sides of the hill's steep slopes and finally compelled the enemy to withdraw.[103]

Early in 1943, Patch launched a major offensive to seize the island. Supported by naval guns, twenty-eight 75-mm. pack guns, thirty-six 105-mm. howitzers, twelve 155-mm. howitzers, and six 155-mm. guns, Patch's corps pushed towards the southwestern portion of the island.[104] Close support from artillery facilitated the infantry advance and caused the Japanese to evacuate the island by February 1943.[105]

Combat on Guadalcanal presented field artillerymen with difficulties employing official field

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100. Fairfax Downey, *Sound of the Guns: The Story of American Artillery* (New York: David McKay Company, Inc., 1955), p. 241.

101. Ronald H. Spector, *Eagle Against the Sun: The American War with Japan* (New York: The Free Press, 1985), p. 197.

102. Report, Col Henry C. Demuth, subj: The Battle of Guadalcanal, 24 Feb 1943, pp. 1-2, in Morris Swett Library, hereafter cited as Demuth Report; Spector, *Eagle Against the Sun*, pp. 210-13; The Field Artillery School, "Artillery in Combat," Jul 1945, p. 4.

103. Spector, *Eagle Against the Sun*, pp. 213-14; Demuth Report, pp. 1-2; Cpt John F. Casey, "An Artillery Forward Observer on Guadalcanal," *Field Artillery Journal*, Aug 1943, pp. 56465; Report, Headquarters Americal Division Artillery, subj: Employment of the Field Artillery on Guadalcanal, 21 Mar 1943, p. 2, in Morris Swett Library.

104. Spector, pp. 213-14; Demuth Report, pp. 1-2.

105. Spector, pp. 213-14; Demuth Report, pp. 1-2, 43; Report, Headquarters Americal Division Artillery, subj: Employment of the Field Artillery on Guadalcanal, 21 Mar 43, p. 2; Lt Col Robert C. Gildart, "Guadalcanal's Artillery," *Field Artillery Journal*, Oct 1943, p. 339.

artillery doctrine. Facing the Japanese army that used encircling tactics, American field artillerymen had to provide fire over a 360-degree circle.[106] Taught at the Field Artillery School to fire on a 180-degree arc, gun crews had to position a battery of guns in an irregular diamond pattern to fend off attacks from any direction. [107] Fortunately, the Japanese launched only one major attack (October 1942) that could have forced the Americans to fire in a 360 degree circle. Moreover, sniper fire and infiltration tactics compelled the Americans to surround their batteries with foxholes, machine gun nests, and barbed wire obstacles. Safe positions far to the rear of the front lines did not exist on Guadalcanal. As a result, field artillerymen had to protect themselves while simultaneously furnishing fire support and conducting counterbattery fire.[108]

Fighting in dense jungles and at close ranges on Guadalcanal also compelled employing high-angle fire to hit targets. Outside of brief references to high-angle fire for jungle or mountainous warfare in training manuals, Army field artillerymen of the twenties and thirties concentrated on learning low-angle fire that was suited for long ranges. In fact, the Field Artillery School paid scant attention to high-angle fire and devoted most of its time to low-angle fire. Because of this, field artillerymen were poorly prepared for combat on Guadalcanal and had to learn to move their guns up close and employ high-angle fire during the heat of battle.[109]

Once Guadalcanal, Papua, and Tulagi had been seized, the Americans completed plans for operations along the New Guinea coast and up the Solomon Islands to neutralize Rabaul.[110] In mid-1943 Admiral William F. Halsey landed two forces near Munda, a Japanese airstrip on New Georgia in the Solomons. The Marines came ashore at Rice Anchorage to prevent Japanese reinforcements from nearby Kolombangara Island from reaching Munda. Meanwhile, to the south of Munda, the 169th and 172nd Regiments of the Army's 43rd Infantry Division advanced on the main Japanese forces surrounding the airstrip.[111] As the regiments closed in, Marine and Army field artillerymen from 155-mm. and 105-mm. howitzer batteries on neighboring islands opened fire on rear areas, lines of communications, suspected bivouac areas, and command posts.[112] In one hour Brigadier General Harry F. Barker's division artillery poured over 5,800 high-explosive rounds onto the Japanese. Even though artillery fire tore apart Japanese positions, the 169th and 172nd Regiments' offensive of early July stalled because of poor leadership, inexperience, the lack of food, and a resolute enemy defense.[113]

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106. Military Intelligence Division, "Reports on the United Nations," 15 Oct 1943, p. 25; Casey, "An Artillery Forward Observer on Guadalcanal," p. 740, 744.

107. Casey, "An Artillery Forward Observer on Guadalcanal," p. 744.

108. *Ibid.*

109. The Field Artillery School, *Tactical Employment of the Field Artillery*, 1938, pp. 366-67.

110. Spector, *Eagle Against the Sun*, pp. 225-26.

111. *Ibid.*, pp. 234-37.

112. Report, Brig Gen Harold R. Barker, Corps Artillery Commander, XIV Corps, subj: Artillery Operations Report Covering the New Georgia Campaign, British Solomons, undated, pp. 1-4, in Morris Swett Library, hereafter cited as Barker Report; John Miller, Jr., *Cartwheel: The Reduction of Rabaul* (Washington: Office of the Chief of Military History, Department of the Army, 1959), p. 110.

113. The Field Artillery School, "Artillery in Combat," Jul 1945, pp. 7-9; Artillery Operations Report, Munda Campaign, New Georgia Occupation Force, undated, pp. 45, 58, in Morris Swett Library; Miller, *Cartwheel*, p. 111.

The Americans launched another attack on Munda late in July 1943 after the initial one had failed. Artillery barrages hit enemy strongholds, ripped away foliage concealing Japanese positions, sometimes penetrated pillboxes, or drove the enemy into the open where they could be cut down by machine gun or rifle fire.[114] After this a rolling barrage fell one hundred to two hundred yards in front of the infantry and cut paths through the jungle. By keeping the rolling barrages close to the attacking troops, gun crews minimized casualties from Japanese automatic weapons and rifles and helped drive the enemy from the Munda airstrip to Kolombangara Island.[115] Commenting on the field artillery's contribution on New Georgia, General Barker noted, "One of the most gratifying results of the. . .Campaign from the Artillerymen's viewpoint was the *confidence and enthusiasm displayed by the Infantry for its Artillery.*"[116]

Although pre-war doctrine noted that field artillery was unsuited for jungle warfare, combat on Guadalcanal and New Georgia indicated otherwise. In fact, the field artillery played a major role. Constant artillery shelling demoralized the Japanese because their counterbattery work could not silence the American guns. During an interrogation, one of the few Japanese prisoners-of-war commented on his army's fear of American field artillery.[117] The hostile jungle terrain might have restricted the field artillery's mobility, but gunnery techniques, especially high-angle fire, and the extensive use of organic air observation permitted hitting targets with uncanny accuracy.[118]

Field artillery work on Bougainville reaffirmed the lessons of Guadalcanal and New Georgia. Once Army and Marine gun crews had waded ashore, they set up their battery positions, established strong perimeter defenses, and laid out 360-degree fields of fire. Once again, high-angle fire predominated because the rugged terrain and short ranges left no other choice. Supporting the infantry with massed fire from 190 field pieces, field artillerymen blasted paths through the jungle and destroyed Japanese defenses. In one particular instance, an artillery barrage in December 1943 placed over four tons of rounds onground targets.[119] By the time that the fighting had stopped in March 1944, American field artillerymen had shot over 250,000 rounds and demonstrated once more their ability to provide support in the jungles.[120]

As the field artillery struggled in Bougainville and New Guinea, the Joint Chiefs of Staff revised its plans for Rabaul. Rather than invading Rabaul, it decided to bypass the island and directed General Douglas MacArthur to continue his advance up New Guinea. Following MacArthur's triumph in the Admiralty Islands in March 1944 that forced the Japanese to withdraw their fleet and air units that had survived the air bombardments to the Marianas, the Philippines, Formosa, and Southeast Asia, the Joint Chiefs of Staff added the Philippines as an objective.[121]

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114. Artillery Operations Report, Munda Campaign, New Georgia Occupation Force, undated, p. 28; The Field Artillery School, "Artillery in Combat," Jul 1945, p. 9; Barker Report, pp. 18-19.

115. Barker Report, p. 7; Miller, *Cartwheel*, p. 161.

116. Barker Report, p. 7.

117. *Ibid*, pp. 5-7.

118. *Ibid*, pp. 15-17.

119. Capt John C. Guenther, "Artillery in the Bougainville Campaign," *Field Artillery Journal*, Jun 1945, p. 331.

120. Guenther, "Artillery in the Bougainville Campaign," p. 334.

121. Spector, *Eagle Against the Sun*, pp. 276-85.

Following intensive naval and air bombardments on Japanese pillboxes, heavy guns, blockhouses, strong points, troop concentrations, and beach defenses, the American Sixth Army under Lieutenant General Walter Krueger invaded the Island of Leyte in the Philippines in October 1944.[122] The bombardments forced the Japanese to withdraw from their beach positions along the east coast. By late afternoon on the twentieth, gun crews started delivering harassing fire on all enemy installations and crossroads.[123] Over the next several weeks, the field artillery furnished lengthy preparations prior to each infantry attack. Nevertheless, field artillerymen soon discovered that much of their shelling was wasted. Whenever a field artillery barrage opened, Japanese troops immediately dug in and remained in their foxholes until the cannonade had stopped. At that time they popped out and offered stiff resistance to the American infantry. To offset this the artillery unleashed thirty minute preparations, ceased until five to ten minutes before the attack, and then fired short preparations. This tactic proved to be effective because it surprised the Japanese.[124] Equally important, the Japanese seldom massed their guns or engaged in counterbattery duels. Consequently, American field artillery could focus on supporting the infantry or harassing the rear areas and could follow the infantry closely on Leyte. This allowed the infantry to seize many well-organized and heavily manned defensive positions with light casualties during the advance towards Ormoc, the most important city on the west coast of Leyte.[125]

As the Americans drove toward Ormoc, the Japanese strengthened their defenses along the mountain approaches to the city. As they had done in other places, they dug in deeply, exploited natural camouflage, placed guns and automatic weapons in concealed positions even if this meant sacrificing fields of fire, and honeycombed the ridges with hidden trenches.[126] Early in November 1944, the Americans hurled themselves against Japanese positions along Breakneck Ridge. Adverse weather, rugged terrain, and strong enemy defenses slowed down the American offensive. Heavy artillery barrages of high-explosive and white phosphorus shells and fire on targets of opportunity tore up the ground but failed to dislodge the defenders, who now numbered as many as their attackers. As a result, the Americans could not overwhelm them with sheer numbers alone and employed field artillery to give them the edge.[127] After shelling the enemy for several days, the 226th and 465th Field Artillery Battalions finally tore up Japanese defenses sufficiently by 12 November to allow tanks and tank destroyers to drive the Japanese toward Ormoc.[128]

Shortly after, the American 77th Infantry Division opened up a second front when it landed south of Ormoc. As the Americans, who were pushing south from Breakneck Ridge, continued

122. The Field Artillery School, "Artillery in Combat," Jul 1945, p.96.

123. *Ibid*, pp. 99-100.

124. The Field Artillery School, "Artillery in Combat," Jul 1945, p. 105; Report, HQ 419th Field Artillery Group, subj: Action Against Enemy—From Marianas Campaign to Philippine Campaign (Leyte Island), p. 13, in Morris Swett Library.

125. Report, HQ 419th Field Artillery Group, subj: Action Against Enemy—From Marianas Campaign to Philippine Campaign (Leyte Island), p. 102.

126. Spector, *Eagle Against the Sun*, pp. 413-14; M. Hamlin Cannon, *Leyte: The Return to the Philippines* (Washington: Office of the Chief of Military History, Department of the Army, 1954), p. 211.

127. Spector, *Eagle Against the Sun*, p. 514; Cannon, Leyte, pp. 212-20.

128. Cannon, *Leyte*, p. 220.

their drive, the 77th Division attacked the city. After fierce fighting the division finally pushed the Japanese out.[129] Although the Japanese planned to counterattack, constant artillery shelling compelled them to break up into small groups. Using artillery concentrations, the Army then chased these small bands into the mountains.[130] Fighting continued for several more weeks, but the real contest for Leyte had ended when the Japanese split their forces into small units.[131]

Throughout operations on Leyte, the field artillery played a conspicuous role. Using radio-equipped ground and organic air observers and fire direction centers, field artillerymen massed preparatory and supporting fire, followed the infantry and armor as closely as possible despite the mud and rain, and demoralized the Japanese with TOTs.[132] Although artillerymen seldom varied from accepted doctrine, the terrain often forced them to emplace their batteries along small fronts and fire over each other from ranges as close as five hundred yards from the enemy.[133] Discussing field artillery missions on the island, the Field Artillery School wrote in July 1945 that artillery fire "enabled attacking infantry to seize many well-organized positions with light casualties" and was extremely effective in "repulsing and decimating attacking enemy forces." Even though the field artillery had difficulty destroying enemy defenses, especially along Breakneck Ridge, and occasionally faced ammunition shortages because of the problems of transporting ammunition through mountainous terrain, massed artillery fire disrupted enemy communications and observation, prevented the construction of additional defensive positions in depth, and disorganized the movement of reserves. As a result, the infantry often became too dependent upon the artillery and expected gun crews to do its work because artillery fire proved to be effective.[134]

Upon breaking Japanese opposition on Leyte, the Americans invaded Luzon in January 1945. Rather than defending Manila or the Bataan Peninsula, the Japanese withdrew to strongholds from which they could conduct a prolonged defense and inflict heavy casualties.[135] Moving to protect the left flank of the American XIV Corps, I Corps encountered stiff Japanese resistance to the north and east of Lingayen Gulf. As usual, the Japanese constructed mutually supporting defenses in caves and tunnels and concealed their field artillery in caves on high ground along the routes of advance.[136] Although they showed little offensive inclinations, the Japanese hit the Americans hard with small arms and artillery fire and refused to retreat.[137] Despite massed artillery fire's effectiveness at forcing the enemy to seek cover, I Corps could not reduce the Japanese positions and had to use flame throwers and small arms, which was slow and costly.[138]

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129. Report, 77th Infantry Division, subj: Operation Summary, 23 Nov-25 Dec 1944, pp. 13-13, in Morris Swett Library; Report, 77th Infantry Division Artillery, subj: Operations Summary, 23 Nov-25 Dec 1944, in Morris Swett Library.

130. Report, CG, Eighth Army, subj: Leyte-Samar Operations, 26 Dec 1944-8 May 1945, p. 9, in Morris Swett Library.

131. Spector, *Eagle Against the Sun*, p. 517.

132. The Field Artillery School, "Artillery in Combat," Jul 1945, pp. 102-14.

133. Report, 77th Infantry Division Artillery, subj: Operations Summary, 23 Nov-25 Dec 1944.

134. The Field Artillery School, "Artillery in Combat," Jul 1945, p. 107; Cannon, pp. 211-20, 231-33, 246, 306-12.

135. Spector, *Eagle Against the Sun*, p. 519.

136. *Ibid.*

137. *Ibid.*, p. 520.

138. Report, 25th Infantry Division, 11 Jan-30 Jun 1945, pp. 8-10, in Morris Swett Library; Report, Sixth Army, subj: Luzon Campaign, 30 Jun 1945, pp. 20-21, in Morris Swett Library.

As I Corps struggled on the American left, XIV Corps advanced on Manila. After cutting through resistance just north of Manila, the Americans burst into the city's suburbs. In contrast to the rapid movement that had characterized XIV Corps' operations so far, wresting the city from the Japanese proved to be difficult. Composed of reinforced concrete buildings designed to resist earthquakes and old Spanish fortifications, the city offered the crumbling Japanese army strong defensive positions.[139] The Japanese desperately defended the thick-walled buildings and individual fortresses by locating pill boxes at key intersections, mounting field pieces atop buildings, and mining and barricading streets.[140] To dislodge the enemy the Americans called for fire by giving the names of buildings and street intersections. In many instances field artillerymen encircled a building with their pieces and fired at point-blank range with concrete piercing shells. Riflemen, grenadiers, and flame throwers then assaulted the breaches. On 23 February the field artillery reached Intramuros, the portion of the city that was ringed with thick walls. Concentrating eleven artillery battalions, ranging from 155-mm. to 8-inch guns, field artillerymen shelled the Intramuros with 7,896 rounds to give the Americans complete control of it within twenty-four hours. Despite this, the battle for Manila still raged. For the next nine days, the Americans had to take one building at a time. Resorting to earlier tactics, they placed 155-mm. guns in a semi-circle around each building and poured in hundreds of concrete-piercing shells. The Americans finally captured Manila on 3 March after intensive artillery shelling.[141]

As in other parts of the Pacific theater, field artillerymen on Luzon faced ammunition shortages stemming from transportation problems from the ships to the front. This compelled the American Sixth Army to impose a strict rationing system. Although some units lacked the artillery support that they wanted, rationing had little impact on the outcome of the campaign since commanders had sufficient ammunition for their needs. Nevertheless, the desire for unlimited field artillery support caused infantry commanders to complain frequently about rationing because they wanted more ammunition than they were allotted.[142]

While MacArthur drove towards the Philippines, Admiral Chester Nimitz launched a campaign of amphibious assaults. In November 1943 he hit Tarawa, a tiny atoll in the Gilbert Islands. As the Americans came ashore, Japanese small arms, machine guns, and artillery greeted them. Under heavy fire from enemy artillery, the Americans shelled Japanese pillboxes that could only be knocked out by a direct hit, grenades, or satchel charges. After several days of artillery barrages and infantry attacks, the Marines seized the atoll. To provide better support on small islands like Tarawa, gun crews had to position their guns on adjacent islands, which meant seizing secondary targets before the main one, so that they could have artillery fire.[143]

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139. Maj Nelson H. Randall, "The Battle for Manila," *Field Artillery Journal*, Aug 1945, pp. 453-55; Report, Sixth Army, subj: Operations, 30 Jun 1945, p. 37.

140. Report, Sixth Army, subj: Operations, 30 Jun 1945, p. 37.

141. Randall, "The Battle for Manila," pp. 452-56; Report, Sixth Army, subj: Luzon Campaign, 9 Jan-30 Jun 1945, p. 40.

142. Robert R. Smith, *Triumph in the Philippines* (Washington: Office of the Chief of Military History, Department of the Army, 1963), p. 656.

143. Spector, *Eagle Against the Sun*, pp. 259-66; Downey, Sound of the Guns, pp. 250-51.

Kwajalein reaffirmed the worth of such tactics. Following an intense naval bombardment, battalions of 105-mm. and 155-mm. howitzers went ashore early in January 1944 on adjacent unfortified islands from which they plastered Japanese defenses with high explosives. Minutes before the landings, field artillerymen moved their barrage inland to force the defense to seek cover. Because of this, Army and Marine landings did not face stiff resistance like those at Tarawa.[144]

After grabbing Saipan in June and Guam in July 1944, Nimitz's command continued its push. In the Palau Islands, the 81st Army Infantry Division invaded Angaur Island to capture it for use as a bomber base. Since there were not any nearby islands, field artillerymen had to fire at targets at less than minimum effective range. Realizing that the infantry would take heavy casualties without artillery support, gun crews fired diagonally across the island into the neighboring regiment's zone. This gave field artillerymen sufficient range and allowed them to exploit their guns' firepower to help clearthe island.[145] On Peleliu Island, another island in the Palaus, the situation again forced field artillerymen to improvise. Once Marine gun crews got their howitzers ashore, they lined them up hub-to-hub, bombarded the defense, and even employed direct fire at times. Generally, forward observers crawled to vantage points and brought barrages of rounds on pillboxes, dugouts, caves, buildings, bridges, and ammunition dumps. Seventeen days after the initial landing, the Marines completed sweeping the island of Japanese.[146]

After slugging their way across Iwo Jima, the Americans encountered totally different Japanese artillery tactics on Okinawa. For the first time, the Japanese extensively employed their field artillery. They had used field pieces to defend their other islands when the Americans hit the beaches or assaulted defensive positions. For the most part, however, the Japanese did not mass fire on targets of opportunity but only shelled pre-registered areas with one or two and occasionally four guns because they placed their obsolete guns in caves to protect them from American counterbattery fire. This practice limited fields of fire and prevented shifting from target to target easily and massing fire.[147]

In April 1945 the Marines and Army hit Okinawa. Knowing that failing to hold this island meant the possibility of the home islands being invaded, the Japanese employed every available resource to stop the Americans.[148] Although the Japanese had an abundance of well-sited artillery, they dispersed it as a defense against American bombing and shelling. Nevertheless, the Japanese integrated their field artillery into a general tactical scheme and indoctrinated their gun crews with the importance of protecting adjacent positions as well as their own. Rather than defending the beaches and two nearby airstrips, the Japanese established a system of strong concentric defensive perimeters around the town of Shuri in the south-central portion of the island. From here, they planned to fight to the last man to prevent the Americans from seizing the island

144. Downey, *Sound of the Guns*, p. 251.

145. *Ibid.*

146. *Ibid.*, p. 252.

147. "Weekly Intelligence," Vol I, No. 47, 4 Jun 1945, p. 25, in Morris Swett Library; Comparato, *Age of Great Guns*, pp. 267-68.

148. Roy E. Appleman, James M. Burns, Russell A. Gugeler, and John Stevens, *Okinawa: The Last Battle* (Washington: Historical Division, Department of the Army, 1948), p. I; Liddell Hart, *History of the Second World War*, p. 684.

and using it as a base for offensive operations against the home islands.[149]

Under the cover of the heaviest naval fire ever to support a landing in the Pacific and field artillery fire from the 420th Field Artillery Group of two 155-mm. gun battalions and one 8-inch howitzer battalion from a nearby island, assault troops landed on Okinawa.[150] Following the assault waves, tanks, division artillery, and antiaircraft artillery rolled on to the beaches. By nightfall the Americans had established a beachhead that stretched fifteen thousand yards long and in places about five thousand yards deep and had all their division artillery in position ashore. The next day, three 155-mm. howitzer battalions of the 419th Field Artillery Group landed. Realizing that battle on the well-defended island would require more nondivisional artillery than had characterized combat in the Pacific so far, the American Tenth Army requested seven field artillery groups but received only two Army groups and one Marine group because shipping and beach operations could not support seven groups.[151]

As the Marines drove northward after pushing across the island, the Army turned towards Shuri. Early in April, the Army bumped up against the first line of defense around the city. The Americans attacked with a heavy preparation for a half an hour. Hoping to catch the enemy out of its holes, corps and division artillery shelled the defenses again. When this was finished, the 96th Infantry Division fought its way forward about three hundred to four hundred feet when Japanese machine gun fire started cutting it down.[152] Naval and air bombardment on the rear areas silenced enemy artillery, but the infantry still could not move. Commenting on the enemy's artillery fire, Colonel Bernard S. Waterman of the 96th Division pointed out that the heavy concentrations of artillery surprised the Americans because this was the first time that the Japanese had responded so intensely with field artillery. Although the defenders could not mass a large number of guns on a single target, the Americans still had to disperse their field pieces more than they had done previously in the Pacific.[153]

Once the Americans fully understood the change in Japanese artillery tactics, they started exploiting corps artillery far more for counterbattery work than they had done earlier in the Pacific. Using air spotters, sound ranging, and fire direction centers, corps artillery concentrated TOT missions.When the TOTs did not work, forward observers adjusted fire from individual pieces on guns that had been located to knock them out. If artillery and tanks could not destroy enemy pieces, the infantry had to reduce them with satchel charges, flame throwers, or grenades.[154]

After battering the defensive lines in front of Shuri for several weeks and imposing strict

149. Appleman, Burns, Gugeler, and Stevens, *Okinawa*, pp. 91, 250; Spector, *Eagle Against the Sun*, p. 533.

150. Col Bernard S. Waterman, "The Battle of Okinawa," *Field Artillery Journal*, Sep 1945, p. 523; Biennial Report, Chief of Staff of US Army, 1 Jul 1943-30 Jun 1945, to Secretary of War, p. 80, in Morris Swett Library; Weathersby, "The Field Artillery Group in Support of Corps and Field Army, 1942-1953," pp. 108-09.

151. Appleman, Burns, Gugler, and Stevens, *Okinawa*, pp. 6876; Waterman, "The Battle of Okinawa," p. 523; Weathersby, "The Field Artillery Group in Support of Corps and Field Army, 19421953," p. 108.

152. Capt Lauren K. Soth, "Cassino of the Pacific," *Field Artillery Journal*, Aug 1945, p. 465.

153. Waterman, "The Battle of Okinawa," p. 525.

154. Soth, "Cassino of the Pacific," p. 465.

artillery ammunition rationing early in April to build up a reserve that had been depleted because resupply efforts could not keep pace with the expenditure of rounds, the Americans renewed their attack. On 19 April they opened the greatest concentration of artillery ever employed in the Pacific. That day twenty-seven battalions of corps and division artillery (324 pieces), ranging from 105-mm. howitzers to 8-inch howitzers and averaging seventy-five field pieces to every mile of front, fired their first rounds at dawn. For twenty minutes gun crews blasted the Japanese. They then lifted their fire as the infantry feigned an attack. Following this, the field artillery shelled the enemy for another ten minutes.[155] Despite this tremendous barrage, the infantry could not break through. Unable to gain the initiative, the offensive stalled. Everywhere along the line, the Japanese had stopped the Americans.[156]

Denied the decisive advance, the Americans resumed their offensive. Between 20 and 24 April, the field artillery pulverized enemy artillery as the infantry attacked.[157] The constant pounding wore down the enemy. Pressed by the unremitting shelling and faced with declining reserves, the Japanese withdrew from their first line of defense on 24 April.[158]

Over the next month, the American infantry-artillery-armor team continued hitting the remaining defenses. Despite a shortlived Japanese counterattack, the Americans kept the enemy pinned down on the defensive. On 10 May 1945, XIV Corps launched a major offensive. Rather than a heavy general artillery preparation just before the jumpoff, the field artillery only shelled known artillery positions and other strong points because it realized that mass preparations had failed so far to destroy the enemy's elaborate system of underground positions and that precision fire was needed to neutralize them.[159] Although the Japanese had bolstered their sagging defense, the American 7th Infantry Division finally penetrated down the east coast to outflank Shuri. In the meantime, the 96th Division captured Conical Hill on the eastern flank of the Japanese line.[160] Those successes along with advances on the American right caused the Japanese to evacuate Shuri and fall back into a smaller enclave in the southernmost part of the island.[161] By this time the Japanese no longer could hold out as an organized force. Unable to continue the fight, the Japanese surrendered in late June.[162]

As the Battle for Okinawa came to a close, the Americans started gearing to invade the Japanese home islands. For the proposed attack they planned unprecedented artillery support because of the stiff resistance already encountered in the Pacific. Tank destroyer battalions were converted from 75-mm. to 90-mm. guns in anticipation of formidable cave defenses and new self-propelled M2 8-inch howitzers and towed Ml 240-mm. howitzers were shipped to the Pacific.

155. Appleman, Burns, Gugeler, and Stevens, *Okinawa*, pp. 194, 410-11.

156. *Ibid.*, p. 207.

157. Report, The Field Artillery School Committee, subj: Battle of Okinawa, undated, pp. 12-13, Morris Swett Library.

158. Appleman, Burns, Gugeler, and Stevens, *Okinawa*, p. 248; After Action Report, 96th Infantry Division, 28 Jul 1945, Pt VII, p. 22, and Pt VIII, pp. 3-4.

159. Appleman, Burns, Gugeler, and Stevens, *Okinawa*, p. 312.

160. Waterman, "The Battle of Okinawa," p. 527; After Action Report, 96th Infantry Division, 28 Jul 1945, Pt. VIII, p. 5.

161. Appleman, Burns, Gugeler, and Stevens, *Okinawa*, p. 387.

162. *Ibid.*, p. 471.

Discarding mobility, the field artillery stockpiled heavier pieces to destroy the defenses. Before field artillerymen could use their arsenal, the United States dropped two atomic bombs on Japan in August 1945 to end the need for an invasion.[163]

Although field artillerymen had to adapt to conditions on the Pacific islands that differed significantly from those where they had been trained, they generally applied standard field artillery tactics. Employing the fire direction center, ground and organic air observers, and field artillery group, they massed fire, expended vast quantities of ammunition, taxed the logistical system's ability to supply sufficient quantities of rounds, and helped push the Japanese out of their strong defensive positions. Unlike their counterparts in Europe, gun crews in the Pacific used high-angle fire, fought at closer ranges, and faced less aggressive counterbattery fire.

As combat in the Pacific and Europe revealed, field artillerymen did not fight a war of movement that they had so desperately desired. Outside of racing across France in the summer of 1944 when the Allies were chasing a fleeing enemy, field artillerymen did not displace their pieces often during the course of a battle to stay abreast of rapidly advancing infantry and armor columns. Rather, they methodically moved their guns forward as weather, terrain, and combat permitted, overpowered the enemy with intense bombardments, slugged their way through heavily fortified enemy defenses, and demonstrated the Americans' superiority in firepower. American field artillerymen succeeded in overpowering the Germans and Japanese precisely because they could maneuver huge numbers of pieces around the battlefield and concentrate vast quantities of ammunition on a target despite rationing. Thus, after years of trying to imitate the Europeans and advance to their level of artillery sophistication, the Americans surpassed them and now set the example.

163. Comparato, *Age of Great Guns*, p. 272.

Table 6

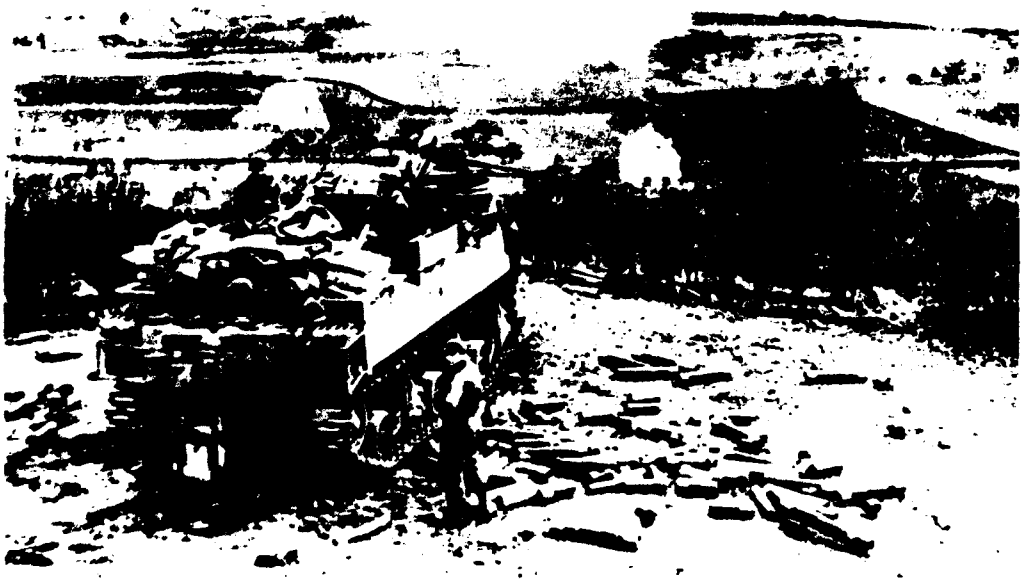
MAJOR AMERICAN FIELD ARTILLERY PIECES IN 1942

Weapon	Range in Yards	Prime Mover
M1 105-mm. Howitzer	12,150	truck/tractor
M1 105-mm. Howitzer	12,150	motor/carriage
M1 4.5-inch Gun	20,500	truck/tractor
M1918A/M1917A 155-mm. Howitzer	12,400	truck/tractor
M1 155-mm. Howitzer	16,350	truck/tractor
M2 155-mm. Gun (GPF modified)	20,100	truck/tractor
M12 155-mm. Gun	18,750	motor/carriage
M1/M1A1 155-mm. Gun	25,715	tractor
M1 8-inch Howitzer	18,510	tractor
M2 8-inch Gun	35,000	tractor
M1918A2 240-mm. Howitzer	16,390	tractor

Source: Field Artillery School, *Characteristics of Major Artillery Weapons*, January 1943.



The 6th Field Artillery in its old and new uniform battle dress, with M2A3 75-mm. gun, 1942.



An American M7 105-mm. self-propelled howitzer fires on German positions, France, 1944.



Model M12 155-mm. self-propelled gun in action in Germany.



M2 155-mm. "Long Toms" firing on Carigara, Leyte, November 1944.

Chapter IX

COLD WAR YEARS: 1945-1954

Following World War II, the field artillery outlined an aggressive program to incorporate the lessons of the war. Between 1945 and 1950 it tested guided missiles, free-flight rockets, and multiple rocket launchers; pushed to introduce new field pieces; restructured division and corps artillery; and merged the field artillery and coast artillery into one branch. Before the effect of the reforms could be felt, however, the Korean War broke out.

Early Goals

As the United States demobilized its military force in 1945 and 1946, the Army eagerly investigated the field artillery's performance during World War II. In June 1945 only weeks after victory in Europe, the Seventh Army convened a conference for field artillery officers in Augsburg, Germany. Convinced that "division artillery [forty-eight howitzers]. . .represented the very minimum in artillery support to which the infantry is entitled and upon which it has become increasingly prone to depend," field artillery officers advocated increasing the number of field guns in the division. One solution involved adding more 155-mm. howitzer battalions to give the division three 105-mm. howitzer battalions and two or three 155-mm. howitzer battalions for a total of sixty to seventy-two field pieces. Even though such a reform could make division artillery unwieldy, field artillery officers preferred increasing the number of field pieces by adding battalions rather than shifting battalions from the corps to division and back as had been done during the war when the division required additional fire support. Moreover, additional 155-mm. howitzer battalions would provide sufficient support when corps artillery was unavailable.[1] As an alternative, these officers suggested adopting a six-gun battery. This would give the division fifty percent more cannons by raising the number of tubes from forty-eight to seventy-two, allow division artillery to cover wider fronts than it had during the war, and permit greater firepower during displacements. Regardless of the organization, field artillery officers reasoned that the division required more artillery than it had had during the war and decided that any course of action to increase firepower was acceptable.[2]

Aware that the practice of moving the group from corps to corps, division to division, and

1. Report, Seventh Army, subj: Seventh Army Artillery Officer's Conference, 9-10 Jun 1945, pp. 3-4, in Morris Swett Library, Fort Sill.

2. *Ibid.*

even army to army disrupted the chain of command and was difficult to manage, Seventh Army field artillery officers also found the group to be unsatisfactory. In fact, they wrote that the success of corps artillery during operations in Europe was because of excellent leadership, superbly trained small units, the will of officers and men to make the system work, and an enemy that had insufficient artillery and not the flexibility offered by the group. In other words, the group had not been the key to success at corps level as many field artillery officers had claimed during the war.[3]

Although they still wanted to retain the group's flexibility, Seventh Army field artillery officers sought better command and control of corps artillery than the group offered. They, therefore, recommended creating a headquarters and headquarters battery, an adequate staff to permit complete tactical and administrative control, an observation battalion, photographic interpretation teams, an ordnance maintenance company, an organic complement of approximately fifteen battalions of various calibers of artillery (three 105-mm. howitzer, six 155-mm. howitzer, and three 8-inch howitzer, and two 155-mm. gun battalions and one 240-mm. howitzer battalion), and an appropriate number of subordinate groups or regiments. By giving the corps organic artillery and dividing it into groups or regiments, Seventh Army artillery officers hoped to blend the tactical flexibility offered by the group and the strong chain of command inherent in organic artillery. Such an arrangement would allow the corps artillery commander to move subordinate units intact across his front and yet maintain a strong chain of command.[4]

Shortly after the Seventh Army conference, the United States Forces, European Theater (USFET), General Board distributed its study on the organization, equipment, and performance of the field artillery during the war. Early in 1946, the board concluded that division artillery supplied insufficient firepower because of the broad divisional fronts in Europe. Realizing that division artillery repeatedly required support from corps artillery to perform its mission, the board proposed adding one more 155-mm. howitzer battalion. Moreover, the board wanted even more mobility for the division's artillery even though field artillerymen had praised its mobility during the war. So that the guns could keep up with fast-moving armor columns better, the board wanted the armored division's artillery to be entirely self-propelled. Yet, the board did not see any reason to abandon towed and self-propelled artillery for the infantry division since it did not require as much mobility.[5]

Arguing that the group was unsatisfactory for the same reasons that Seventh Army artillery officers had already advanced, the board adopted the concept of an artillery division for corps artillery that had been developed by Major General John A. Crane, who had commanded the 13th Field Artillery Brigade in North Africa.[6] The USFET General Board suggested creating an

3. Report, Seventh Army, subj: Seventh Army Artillery Officer's Conference, p. 6; Ltr, HQ Seventh Army to Distribution, subj: Reorganization of Corps Artillery, 18 Jun 1945, Exhibit C, in Report, Seventh Army, subj: Seventh Army Artillery Officer's Conference.

4. Report, Seventh Army, subj: Seventh Army Artillery Officer's Conference, pp. 7-8.

5. Report, USFET General Board, subj: Study of the Organization and Equipment of Field Artillery Units, Study No. 59, 1945, pp. ll, 14, 43-46, in Morris Swett Library.

6. Crane, "Field Artillery Groups," *Field Artillery Journal*, Oct 1945, p. 579; Brig Gen Charles E. Hart, "Artillery with an American Army in Europe," *Military Review*, Sep 1945, p. 3l; Report, USFET General Board, subj: Study of the Organization and Equipment of Field Artillery Units, Study, No. 59, pp. 23-24, 273l; Report, USFET General Board, subj: Study of the Field Artillery Group, No. 65, 1945, pp. ll, 12, 17-23; George F. Howe, *Northwest Africa: Seizing the Initiative in the West* (Washington: Office of the Chief of Military History, Department of the Army, 1957), p. 546.

artillery division of three battalions of self-propelled 105-mm. howitzers, three battalions of towed 155-mm. howitzers, two battalions of towed 155-mm. guns, one battalion of self-propelled 155-mm. guns, three battalions of towed 8-inch howitzers, and one battalion of towed 240-mm. howitzers. Because thirteen organic battalions would be difficult to manage, the board urged establishing a sufficient number of groups or regiments to act as subordinate commands. This arrangement would strengthen the chain of command and simultaneously promote flexibility because the corps commander could move a group or regiment any place along his front and still have control.[7]

Influenced by their appraisals of the field artillery during the war, the USFET General Board and Seventh Army endorsed sweeping organizational changes. Even though they differed over the details, they agreed that increasing the number of field pieces in each division, reestablishing organic corps artillery, and keeping the group in some form was imperative to improve firepower and command and control. After all, the necessity of firepower and centralized command were the overriding lessons from the war.

Concurring with the USFET General Board and Seventh Army artillery officers, Lieutenant General Jacob L. Devers, the Commanding General, Army Ground Forces, on 4 December 1945 directed the field artillery to make a detailed examination of its organization, equipment, and techniques. In response, the Field Artillery School conducted a conference in March 1946 at Fort Sill, Oklahoma. At that time representatives from the War Department General Staff, Army Air Forces, Navy, Marine Corps, Headquarters Army Ground Forces, and all components of the Army Ground Forces studied ways to improve the field artillery to provide better support.[8]

In an extensive report the Committee on Organization urged abandoning the current mix of towed and self-propelled field pieces. Pushing for more mobility, the committee advocated making the field artillery one hundred percent self-propelled.[9] With World War II experiences to draw upon, the committee argued that towed artillery was useless in fast-moving situations. It lacked the ability to respond quickly to highly mobile threats and could not move and fire simultaneously. In comparison, self-propelled artillery could travel more easily cross country and move and shoot simultaneously. Even though self-propelled artillery was too heavy and lacked high-angle fire capabilities, the committee concluded that converting from a mix of towed and self-propelled artillery in the division to self-propelled field pieces should be the field artillery's highest long-range priority.[10]

The proposal to abandon towed artillery for self-propelled artillery signified an important shift in attitudes. Through the end of 1945, many field artillery officers still wanted a combination of towed and self-propelled artillery for the division.[11] This stemmed from experience during the

7. Crane, "Field Artillery Groups," p. 582; Report, USFET General Board, subj: Study of the Organization and Equipment of Field Artillery Units, Study No. 59, pp. 47-48.

8. Maj Gen Louis E. Hibbs, "Report on the Field Artillery Conference," *Field Artillery Journal*, Jul 1946, pp. 407-13.

9. Report, Field Artillery School, subj: Artillery Conference, 18-29 Mar 1946, 23 Apr 1946, Pt. 2, p. 1, in Morris Swett Library.

10. *Ibid.*, Annex B, pp. 1-4.

11. *Ibid.*, p. 5.

winter of 1944-45 when the snow- and ice-covered roads of Europe hampered moving batteries. Officers learned that truck-drawn artillery was easier to transport on the snow and ice than either tractor-drawn or self-propelled artillery.[12] Yet, the advantages of self-propelled guns and howitzers outweighed their disadvantages. With this in mind, some field artillery officers completely rejected towed artillery by early 1946. Participants at the Fort Sill Artillery Conference of 1946 proposed relying totally on self-propelled field pieces since they combined mobility and firepower.[13]

Going beyond its recommendation to drop towed artillery, the Committee on Organization advised the reorganization of division artillery. The division required more artillery to provide better support. As a result, the committee endorsed adding one more 155-mm. howitzer battalion to the infantry division to give it sixty pieces and two 155-mm. howitzer battalions to the armored division to give it seventy-two. Like most field artillery officers, those at the Fort Sill conference wanted to increase the number of field pieces in the division to make it less dependent upon corps artillery.[14]

Equally important, the Committee on Organization wanted to revitalize corps artillery. The committee found corps artillery organization to be unsatisfactory for the same reasons that Seventh Army artillery commanders and the USFET General Board had outlined. The committee wrote, "There must be a more permanent organization for administration and parent headquarters must be provided for nondivisional battalions."[15] It recommended establishing an artillery division with a minimum number of organic, self-sustaining artillery battalions and dividing them into permanent groups or regiments of the same or mixed calibers of weapons. This would preserve the flexibility of the group without destroying continuity, permit control, avoid the tendency of hastily throwing together battalions to be used as corps artillery, and give the corps sufficient artillery for almost any situation.[16]

Knowing that abandoning towed for self-propelled artillery and restructuring division and corps artillery alone would not improve mobility and firepower, the Artillery Conference considered future weapons. Even though the Committee on Equipment advised keeping the 75-mm. gun, the 105-mm. howitzer, the 155-mm. gun, the 155-mm. howitzer, the 8-inch gun, and 240-mm. howitzer because they were "adequate and modern for the postwar army," it proposed developing a new heavy piece that could fire a 200-pound projectile fifty thousand yards for employment when tactical air support was unavailable.[17] Moreover, the committee endorsed guided missiles and rockets and even projected that they would eventually render heavy artillery obsolete sometime in the future.[18]

The conference's most controversial proposal involved consolidating coast and field artillery

12. Report, USFET General Board, subj: Study of Field Artillery Materiel, Study No. 67, 1945, p. 5, in Morris Swett Library.
13. Report, Field Artillery School, subj: Artillery Conference, 18-29 Mar 1946, Annex B, pp. 1-4.
14. *Ibid.*, Annex C, pp. 1-2.
15. *Ibid.*, Annex A, Question 5.
16. *Ibid.*, p. 1.
17. *Ibid.*, Part 2, p. 5, Annex B, pp. 1-3, Tab 10.
18. *Ibid.*, Part 2, pp. 1-9, Annex D, pp. 2-3.

into one branch. Discussing the rationale for such a merger, the Committee on Organization pointed out that coast and field artillery were separated in 1907 because the field artillery was the only artillery arm at the time capable of accompanying the other combat arms into the field. Because of improvements in technology, especially transportation, this was no longer true in the 1940s. During the war, the antiaircraft arm of coast artillery, the forerunner of air defense artillery, followed infantry and armor in Europe, while coast artillery supported the ground attack in the Pacific. Even though coast and antiaircraft artillery missions differed from the field artillery's, they had served as field artillery because they had mobile guns and because firepower was needed to overcome stiff defenses. Coast artillery's ability to follow the infantry and armor and augment the field artillery plus the requirement for common training on radar, computers, radio communications, and other equipment suggested that the two artilleries could be combined. Joining the two would conserve scarce manpower, broaden personnel capabilities, permit exploitation of all artillery weapons, facilitate the development and standardization of weapons and gunnery techniques, and foster greater coordination of artillery organization and planning. Equally important, the Army feared losing antiaircraft artillery to the Army Air Force that was seeking independence and control of antiaircraft artillery. This possibly meant that the field artillery might not have antiaircraft artillery to augment its field pieces when necessary. Although a merger could inhibit specialization that was becoming more crucial with the appearance of more sophisticated weapons, the need for increasing firepower, retaining control over antiaircraft artillery, and economizing were more important and pushed to unite the artilleries into one branch.[19]

Integrating the artilleries rested on another important assumption. Advocates in 1946 envisioned fighting the next war along the lines of World War II. They theorized that the Army would require more antiaircraft artillery in the early stages when the enemy had command of the air. After the United States had gained air superiority, it could convert surplus antiaircraft units into field artillery.[20]

In keeping with the movement to reform the artillery, the War Department Equipment Board chaired by General Joseph Stilwell issued its report in May 1946. The board insisted that future artillery pieces should be more mobile, that the Army required a heavier piece than the 240-mm. howitzer, and that the Army should develop rockets and guided missiles to give the service long-range, all-weather weapons to be employed when tactical air could not be deployed. Rather than endorsing wholesale rearmament, the War Department Equipment Board focused its attention on introducing only a few new weapons. This approach would be less expensive, less radical, and more acceptable as the United States demobilized.[21]

Thinking that division and corps artillery needed to be reorganized to improve firepower and

19. Report, Field Artillery School, subj: Artillery Conference, 18-29 Mar 1946, Annex A, Question 4; William F. Brand, Jr., "A Re-examination of the Integration of the Artilleries," unpublished thesis, US Army War College, 1963, pp. 6-8.

20. Ltr, Cmdt, The Artillery and Guided Missile School, to CG, Continental Army Command, subj: Integration of the Artillery, 16 May 1956, in US Army Artillery Center, Consolidation of the Artillery School, in Morris Swett Library.

21. Report, US Army Field Forces Advisory Panel on Field Artillery, subj: Study of Implementation to Date of the Requirements Established by the Field Artillery Conference, 18-29 Mar 1946, and the War Department Equipment Board Report, 29 May 1946, Tab I, in Morris Swett Library.

command and control, that heavier pieces were needed to reduce the Army's dependence on airpower, and that mobility was critical, most field artillery officers readily admitted by mid-1946 that reforming the field artillery was imperative. Based upon wartime experiences and visions of future warfare, they outlined a broad program to restructure the field artillery.

Influenced by the conferences, boards, and Chief of Staff, General Dwight D. Eisenhower's (1945-1948) letter of August 1946 that directed cutting costs, the Army quickly acted to reform the field artillery.[22] To exploit scarce manpower in the wake of demobilization, budget reductions, and new weapons, prevent antiaircraft artillery from being controlled by the Army Air Force, provide more flexibility in officer assignments, and improve morale and promotion potential, the Army consolidated the field artillery and coast artillery. In the fall of 1946, it announced its decision to merge the Field Artillery School at Fort Sill, Oklahoma, the Sea Coast Artillery School at Fort Scott, California, and the Antiaircraft Artillery School at Fort Bliss, Texas, into one school.[23] Subsequently in January 1947, War Department General Order No. 11 redesignated the Field Artillery School as The Artillery School with the Antiaircraft Artillery School and Seacoast Artillery School as branches.[24] To accommodate this change The Artillery School revamped its curriculum in the fall of 1947 to include instruction on all artillery weapons. Later in 1947, General Devers stressed that specialized training was being deemphasized. Field artillery officers would be ground force officers first and gunners second. Ironically, this came at the precise time when technology was becoming even more sophisticated and required even more specialized training than in the past.[25] Three years later in 1950, Congress picked up where the Army had left off. Early in that year, it passed the Army Reorganization Act to consolidate the field artillery and coast artillery into one artillery branch to economize.[26]

Notwithstanding the need to ecomomize, the Army forged research and developments programs for guided missiles to determine if they could be used to deliver an atomic warhead and furnish long-range, all-weather fire support. During the last four years of the 1940s, the Ordnance Department contracted with private industry to develop systems, conducted research to improve missile design and technology, gathered information on supersonic flight and jet propulsion, and tested numerous missiles at White Sands Proving Ground, New Mexico, which had been established in 1944. As distinguished from the other missiles, the Corporal, which was developed to

22. Study, Army Ground Forces, subj: Integration of the Field Artillery and the Coast Artillery Corps into a single Artillery of the Ground Forces, 9 Sep 1946, p. 4, in Morris Swett Library; Brand, "A Re-examination of the Integration of the Artilleries," p. 2.

23. Ltr, War Department to CG, Army Air Forces and Army Ground Forces, subj: Enforcement of Economies, 22 Aug 1946, in Report, US Artillery Center, subj: Consolidation of the Artillery School, undated, in Morris Swett Library; Brand, "A Re-examination of the Integration of the Artilleries," pp. 2-9.

24. Brand, "A Re-examination of the Integration of the Artilleries," p. 2; Ltr, Artillery School to CG, Continental Army Command, subj: The Artillery and Guided Missile School, May 1956, in Report, US Artillery Center, subj: Consolidation of the Artillery School, undated; Report, US Artillery Center, subj: Consolidation of the Artillery School, undated, in Morris Swett Library; Robert W. Whitfield, Jr., *History of the U.S. Army Artillery and Missile School*, Vol III (Fort Sill, Ok:The US Army Artillery and Missile School, 1957), pp. 17-18, 86.

25. Devers, "Artillery Integration," *Field Artillery Journal*, Sep-Oct 1947, p. 303.

26. Brand, "A Re-examination of the Integration of the Artilleries," pp. 3, 9; Report, The Artillery Center, subj: Proceedings of a Board of Officers, 1 Nov 1949, in Morris Swett Library.

counter the German V-2 rocket and launched for the first time in 1947, was the first completely American designed and engineered missile. Besides being developed to provide the Army with an atomic delivery system, it incorporated control features to launch the missile and direct it in flight and was the most advanced Army missile.[27] Although it was a prototype missile and not intended for operational missions yet, the Corporal represented a major breakthrough. Despite success with the Corporal and the Hermes missiles, Congress still believed that the Air Force's strategic weapons made the United States invulnerable. Furthermore, Congress and the Joint Chiefs of Staff thought that atomic weapons were too powerful for the tactical battlefield and did not seriously consider the Army effort through mid-1949.[28]

Although Congress and the Joint Chiefs of Staff failed to perceive the requirement for tactical atomic weapons, efforts to write doctrine for conventional and atomic guided missiles stayed abreast of system developments. Lieutenant Colonel Wilford W. Wood of the Antiaircraft Artillery and Guided Missile Branch briefed participants at an artillery conference at Fort Bliss in May 1950. He informed them that surface-to-surface guided missiles could engage surface targets in conjunction with tube artillery or aircraft or be used independently. Missiles with conventional warheads could increase corps artillery's range and attack enemy personnel, materiel, and communications. Equally important, guided missiles with atomic warheads would also be employed to destroy or neutralize large troop concentrations or force the enemy to disperse to avoid destruction. If the enemy, meaning the Soviet army, dispersed, it would then lose its manpower advantage.[29]

Implicit in Wood's statement was the belief that missiles with atomic warheads would allow a smaller army to defeat a larger one. For the United States, this was particularly crucial because its army was smaller than its Soviet counterpart and because such thinking fit neatly with the growing stress that the United States was placing upon atomic weapons. Moreover, atomic surface-to-surface guided missiles would give the Army a role in atomic warfare and hopefully break the Air Force's monopoly on atomic warfare.[30]

Although the field artillery had visions about the roles of guided missiles, it also dealt with

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27. Army Ground Forces, Trends in Development, Sep 1947, p. ll; Army Ground Forces, *Trends in Development*, Jan 1947, p. 45; Phillip H. Stevens, *Artillery Through the Ages* (New York: Franklin Watts, Inc., 1965), p. 166; Report, The Artillery School, subj: The Artillery Conference, 8-12 May 1950, pp. CBl-9, CCl-7, in Morris Swett Library; Maj Gen H.N. Toftoy, "Army Missile Development," *Army Information Digest*, Dec 1956, pp. 24-32; James F. Hewes, Jr., *From Root to McNamara: Army Organization and Administration, 1900-1963* (Washington: Center of Military History, US Army, 1975), p. 159; Lecture, Air University, subj: US Guided Missile Development Program, Class 46-47, pp. 12-13; Wheeler, "Missiles on the Firing Line," *Army Information Digest*, Dec 1956, p. 4l. Specifically, the Army tested the WAC Corporal, Corporal, Hermes I and II, and Neptune. They were surface-to-surface missiles. The Army also tested captured German V-2 rockets at White Sands.

28. Nels A. Parson, Jr., *Guided Missile in War and Peace* (Cambridge, Ma: Harvard University Press, 1956), pp. 2l, 23, 25; Army Ground Forces, *Trends in Development*, Sep 1947, p. ll; Army Ground Forces, *Trends in Development*, Jan 1947, p. 45; Stevens, *Artillery Through the Ages*, p. 169; James N. Gibson, "History of the Army's Nuclear Capable Rocket Program," *Field Artillery*, Aug 1987, p. 2l; Report, The Artillery School, subj: Artillery Conference, 8-12 May 1950, p. CG3.

29. Report, The Artillery School, subj: Artillery Conference, 8-12 May 1950, pp. CGl-7; Guided Missile Department, Antiaircraft and Guided Missile Brand, The Artillery School, Proposed Statement of Doctrine for the Employment of Army Guided Missiles, Jan 1950, pp. l-3, in Morris Swett Library.

30. Report, The Artillery School, subj: Artillery Conference, 8-12 May 1950, pp. CBl, CG19-20.

reality. Knowing that missiles were expensive and that their supply would be limited, at least at first, the field artillery stressed in 1948 that they should never be used where conventional pieces were capable of accomplishing the same mission.[31] Two years later, the Antiaircraft Artillery and Guided Missile Center reaffirmed this concept. It wrote, "They [missiles] will be used as an extension of... [tube] artillery.... when they are the most effective means from a tactical and logistical viewpoint."[32] In other words, missiles would not be used indiscriminately. Commanders had to consider their employment carefully before launching them.

Proponents of guided missiles found themselves trapped in a dilemma. Through mid-1949 they had pushed hard to write doctrine. Yet, they had to curb their ambitions because the missiles were expensive, could not be wasted on any target, and were still being developed. Lacking an operational model, they speculated about the proper way to employ missiles and simultaneously encouraged the Army to adopt them as field artillery weapons because of their range and capacity to carry a conventional or atomic warhead.[33]

With the development of guided missiles, the field artillery found itself caught in the middle of a firepower revolution. Major General J.L. Homer, Commanding General, Antiaircraft Artillery and Guided Missile Center, wrote in *Military Review* in 1947, "If you are planning the Grand Strategy for tomorrow's war, you must consider seriously the impact of guided missiles. . . .It is apparent that this weapon may be developed to strike any portion of the globe from any geographical position."[34] Succinctly stated, the United States had lost the insular protection of two oceans, was vulnerable to attacks from foreign powers armed with missiles, and had to pursue developing missiles more seriously than it was. The country simply could not ignore them because of economic considerations.[35]

General Homer's concern assumed an even greater importance in 1949. In August the Soviet Union denotated its own atomic weapon. Shortly thereafter, the Joint Chiefs of Staff announced a plan to arm the field artillery with atomic warheads to counter the Soviet move. Although Congress withheld permission in 1949 to produce tactical atomic warheads, it authorized funds in 1950 for development of such warheads and feasibility studies on the Honest John free-flight rocket with atomic and conventional warheads. This decision to produce the Honest John along with the already growing missile program caused the Army to reactivate two adjacent wartime ammunition manufacturing installations in Huntsville, Alabama, as the Redstone Arsenal to oversee the Ordnance Department's worldwide missile activities and its Guided Missile School to train civilian and military personnel to handle and maintain guided missiles and rockets.[36]

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31. Report, Antiaircraft Artillery and Guided Missile Center, subj: Current Army Concepts on Organization and Tactical Employment of Guided Missiles, 1 Jul 1948, p. 56, in Morris Swett Library.

32. Guided Missile Department, Antiaircraft and Guided Missile Branch, Proposed Statement of Doctrine for the Employment of Army Guided Missiles, Jan 1950, p. 1.

33. Guided Missile Department, Antiaircraft and Guided Missile Branch, Proposed Statement of Doctrine for the Employment of Army Guided Missiles, Jan 1950, p. 2; Gibson, "History of the Army's Nuclear Capable Rocket Program," p. 21.

34. Homer, "Guided Missile and Future Warfare," *Military Review*, Nov 1947, p. 13.

35. *Ibid.*, pp. 19-20.

36. Gibson, ""History of the Army's Nuclear Capable Rocket Program," p. 21; Toffoy, "Army Missile Development," pp. 33-34.

The field artillery simultaneously found multiple rocket launchers equally attractive. The firepower demonstration of the 18th Field Artillery Battalion during the Battle of the Huertgen Forest and Battle of the Bulge along with tests conducted in 1944 and 1945 at Fort Sill, Oklahoma, and in Europe convinced advocates that multiple rocket launchers greatly enhanced firepower and were suitable for concentrating large amounts of fire on area targets in a short time.[37]

Inspired by these successes and driven by the desire to give the field artillery more firepower, the Army pursued improving multiple rocket launchers. In February 1946 Army Ground Forces Board No. One recommended launching a basic research program to build better rockets and launchers. Likewise, the War Department Equipment Board of 1946 concluded that the Army should develop multiple rocket launchers to supplement tube artillery.[38] Backed by these recommendations and others, in July 1946 Secretary of War Robert P. Patterson (1945-1947) authorized procuring one thousand rockets and two multiple rocket launcher platforms for engineering and service testing.[39]

Over the next several years, the Army successfully developed rockets with more accuracy and longer ranges than their wartime predecessors. Late in 1948, the Army announced completion of a 24-tube launcher for the 4.5-inch rocket with a range of 8,500 yards that could lay down a concentration the equivalent of thirty-six 105-mm. howitzer battalions in ten seconds.[40] That rocket, the 6.5-inch with a range of fifteen thousand yards, and various others in development only gave the field artillery the potential of delivering tremendous amounts of firepower. Despite this, the Army Field Forces, formerly Army Ground Forces, boasted in June 1948 that rocket artillery could replace tube artillery in several years when the rocket's range, dependability, and accuracy had been improved and expressed satisfaction with the progress made through 1948.[41]

Although experiments in progress promised to make multiple rocket launchers more suitable, tube artillery, free-flight rockets, and guided missiles overshadowed them. Field artillery officers stuck by their field pieces because they were more accurate and dependable and by missiles and rockets because they could carry an atomic warhead and were also more accurate.[42]

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37. Ltr, HQ 18th Field Artillery Battalion to CG, 1st Army, subj: Rockets, 11 Feb 1945, in Report, The Rocket Board, subj: Review of Rocket Board's Activities, 1 Mar 1944-10 Aug 1945, 14 Aug 1945, Enclosure 5, in Morris Swett Library; Frank E. Comparato, *Age of Great Guns: Cannon Kings and Cannoneers Who Forged the Firepower of Artillery* (Harrisburg, Pa: The Stackpole Company, 1965), p. 295.

38. Army Field Forces Board No. 1, Development Brochures, 1948, p. 125, in Morris Swett Library.

39. US Proving Ground, Aberdeen, Maryland, Information on (Rocket) Field Artillery Battalion, Jan 1951, p. 2; Minutes, Ordnance Committee Meeting, Item 30696, 13 Jun 1946, in Morris Swett Library; Minutes, Ordnance Committee Meeting, Item 30784, 9 Jul 1946, in Morris Swett Library. Army Ground Forces Board No. One oversaw the acquisition of aircraft, communications, electronic, special airborne, maintenance, and special air support equipment and heavy weapons as part of its responsibilities.

40. Army Ground Forces, *Trends in Development*, Sep 1947, pp. 19-20; Army Field Forces, *Trends in Development*, Jun 1948, p. 8; Comparato, *Age of Great Guns*, p. 295; Army Field Forces Board No. 1, Development Brochures, 1948, p. 127.

41. Army Field Forces Board No. 1, Development Brochures, 1948, pp. 7-8, 127-30; Report, The Artillery School, subj: Report of Artillery Conference, 8-12 May 1950, p. CO13.

42. Report, the Artillery School, subj: The Artillery Conference, 8-12 May 1950, pp. 1, CD6-8, CO13; Comparato, *Age of Great Guns*, p. 296.

Other field artillery developments advanced just as slowly. Despite the rationale for abandoning towed artillery for self-propelled artillery, existing stockpiles of towed pieces and limited budgets discouraged making the field artillery one hundred percent self-propelled. Because of these conditions, the Army restricted its efforts to designing self-propelled pilot models for testing. During the late 1940s, the Army produced models for an 8-inch howitzer, a 240-mm. howitzer, and an 8-inch gun and began working on prototypes for a 105-mm. howitzer, a 155-mm. howitzer, and a 155-mm. gun to carry out the War Equipment Board's recommendations that were serving as the basis for rearmament. In each case the prototypes being tested and those on the drawing boards had longer ranges and more firepower and were lighter and more mobile than their World War II ancestors.[43] Yet, the Army did not expect the new weapons to be introduced for years.The President of the Army Field Force Board No. One pointed out in May 1950 that if the United States had to go to war in the next several years, the Army would start out with essentially the same equipment and field artillery that had been used in World War II.[44]

Outside limited progress made with free-flight rockets and guided missiles, the Army had a sterile research and development program through 1950. Severe budget cuts during the postwar years forced the Army to restrict its efforts to the more glamorous weapons, such as missiles, get along with guns, howitzers, and multiple rocket launchers left over from the war, and initiate small research and development projects. Ironically, what money the Army did have was spent on maintaining its current arsenal at the expense of the future. The lack of money and the channelling of funds towards preserving existing weapons indicated that research and development was not a major activity even though Army rhetoric suggested otherwise.[45]

Organizational reforms fared better since they were less expensive ways of increasing firepower. During the last years of the 1940s, the Army adopted the six-gun battery for all light and medium division and nondivisional batteries because this was a more economical way of enhancing firepower than adding battalions. With the appearance of six-gun batteries, the battalion had eighteen pieces rather than twelve, while the division had seventy-two howitzers. Peacetime economy measures, however, left the battery with four field guns and the division with forty-eight guns.[46]

Revamping corps artillery also did not accomplish the desires of the reformers of 1946. Reorganization created a headquarters and headquarters battery, an observation battalion, and groups of artillery attached on a semi-permanent basis to allow the number to vary from corps to corps as needed and the corps artillery commander to attach the group to a division. Although the corps lacked organic artillery, the field artillery modified the group to eliminate command and

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43. Army Field Forces Board No. 1, Development Brochures, 1948, pp. 138-41, 275-82; Briefing to Chief of Staff, US Army, subj: Comparison of Current and Future Capabilities of US and Soviet Artillery, 6 Jul 1949, Tab C, pp. 1-3, Tab D, pp. 1-4, in Morris Swett Library; Army Ground Forces, *Trends in Development*, Sep 1947, pp. 18-19; Report, The Artillery School, subj: The Artillery Conference, 8-12 May 1950, p. CD13.

44. The Artillery School, General Comparison Chart, Field Artillery Weapons, 1948 and 1950, in Morris Swett Library; Report, The Artillery School, subj: The Artillery Conference, 8-12 May 1950, p. CD1-CD13.

45. Hewes, *From Root to McNamara*, pp. 244-45, 258.

46. "Artillery Tactics," *Field Artillery Journal*, Jul-Aug 1947, p. 242; Jonathan M. House, *Towards Combined Arms Warfare: A Survey of Tactics, Doctrine, and Organization in the 20th Century* (Fort Leavenworth, Ks: US Army Command and General Staff College, n.d.), p. 148.

control problems of the war. Rather than permit battalions to float from group to group, it assigned battalions permanently to a group. This promoted continuity, reduced the need to shift battalions, gave corps artillery flexibility, and concurrently fostered better command and control than corps artillery had in World War II. In effect, the new corps artillery structure blended the flexibility of the World War II group and the rigid brigade organization of the 1920s and 1930s.[47]

Despite the mixed successes of reforming the field artillery's organization and introducing more powerful and mobile weapons, the Army comprehended more had to be done. In July 1949 at a briefing for the Army Chief of Staff, General Devers, Chief of the Army Field Forces, addressed the field artillery's future. He explained, "We must give due attention to the probable future use of atomic bombs and guided missiles and the overall increase in lethality of conventional weapons. . ."[48] This placed a premium on greater mobility, deeper dispersal, faster emplacement and displacement, greater protection of personnel, and better communications. Although the field artillery might be satisfactory in 1949, it lacked the accuracy, mobility, and firepower to fight on the battlefield of the late 1950s and early 1960s. Consequently, the field artillery had to pursue developing new weapons aggressively by making system acquisition a top priority. This was particularly critical as the Cold War intensified.[49]

Ambivalence characterized the field artillery late in the 1940s. Field artillery officers saw no real reason to modify doctrine because of the successes of World War II and moved methodically to introduce new weapons. After all, during the late 1940s, most Americans, including many field artillery officers, questioned the role of ground forces in the atomic age and envisioned airpower as the key in defending the country. This made the Army and field artillery irrelevant. Because of this attitude, limited budgets, the lack of a hostile ground force that could actually attack the United States, and war surplus, a sense of urgency simply did not exist to promote the rapid development of new weapons. Yet, as General Devers had indicated, the field artillery knew that current inventories of guns and howitzers might be suitable in 1949 but that new weapons had to be introduced to exploit the latest technology.[50]

Despite Devers' and a few other field artillery officers' desire to reform the field artillery, it had seen little progress. The field artillery did not standardize any new weapons between 1945 and 1950 because developing new technology took time, because Congress restricted budgets for procurement, and because a complacent mood permeated the United States. The field artillery still had a mixture of towed and self-propelled artillery and preserved division and corps artillery essentially as they had been during World War II. The inability to carry out the intended reforms during the last years of the 1940s prevented increasing firepower and mobility and revealed the moribund

47. Russell A. Weathersby, "The Field Artillery Group in Support of the Corps and Field Army, 1942-1953," unpublished masters thesis, US Command and General Staff College, 1965, pp. 114-22; Maj Paul E. Pigue, "Corps and Army Artillery," *Field Artillery Journal*, Jan-Feb 1950, pp. 11-13.

48. Briefing to US Army Chief of Staff, subj: Comparison of Current and Future Capabilities of US and Soviet Artillery, 6 Jul 1949, Tab C, p. 1.

49. *Ibid.*, Tab C, pp. 1-2, 7.

50. Russell F. Weigley, *History of the United States Army* (New York: Macmillan Publishing Company, 1967), pp. 500-01; Allan R. Millett and Peter Maslowski, *For the Common Defense: A Military History of the United States of America* (New York:The Free Press, 1984), p. 477.

state of the field artillery. Battalions equipped with guided missiles, free-flight rockets, improved multiple rocket launchers, and pieces larger than the 240-mm. howitzer still lay in the future.

The Korean War and After

In June 1950 the Korean War erupted. Moving south on a broad front, the North Koreans pressed their main attack to Seoul and the Han River. To slow down this advance the South Koreans blew up bridges and laid antitank mines on all likely routes leading south to the city. Early on the thirtieth of June, North Korean field artillery pounded South Korean positions to the east of Seoul to allow the infantry to seize the city. Although the South Koreans inflicted heavy casualties once they had recuperated, the North Koreans broke loose on 4 July, rolled southward into Suwon, captured Yoju and Wonju, and ultimately hoped to seize Pusan, the only port that could accommodate a modern military force.[51]

When the war broke out, the North Korean and South Korean armies contrasted significantly. The North Korean army of 135,000 men had eight full infantry divisions each with twelve 122-mm. howitzers, twenty-four 76-mm. guns, and twelve self-propelled guns, two infantry divisions at half strength, two separate regiments, an armored brigade with 120 Soviet tanks, five border constabulary brigades, and 180 Soviet aircraft. Five of the divisions and the armored brigade had well-trained personnel with many soldiers having combat experience with the Chinese communist and Soviet armies in World War II. In comparison, the South Korean army of 95,000 men had eight divisions with only four near full strength. The South Koreans lacked armor, training above the company, and combat experience. Each of their divisions had fifteen 105-mm. howitzers, which were greatly outranged by their North Korean counterparts.[52]

In the meantime, the US Army found itself in a weak position to respond to the invasion. Half of the Army's major combat units were deployed overseas. Of the Army's ten divisions, four infantry divisions were part of the Far East Command on occupation duty in Japan. Another division was with the European Command in Germany. The remaining divisions constituted the General Reserve and were stationed in the United States to meet emergency situations. Prompted by World War II experience, the Army had restructured its divisions. Under new tables of organization and equipment, the division received more firepower and mobility with the addition of a tank battalion and an antiaircraft battalion and more field artillery. Postwar economies had restricted training and left the field battery with four guns and forced the Army to skeletonize its combat units. Nine of the ten divisions were understrength. For example, infantry regiments had only two of three required battalions. Most field artillery battalions had only two of three firing batteries. Equally important, no unit had its wartime complement of weapons, while those weapons on hand were generally wornout leftovers from World War II. As a result, the Army's combat units lacked the firepower and manpower that the

51. Roy K. Flint, "Task Force Smith and the 24th Division: Delay and Withdrawal, 5-19 July 1950," in Charles E. Heller and William A. Stofft, eds., *America's First Battles: 1776-1965* (Lawrence, Ks: University Press of Kansas, 1986), p. 275; Roy E. Appleman, *South to the Naktong, North to the Yalu: June-November 1950* (Washington: Office of the Chief of Military History, Department of the Army, 1961), pp. 17-18.

52. Appleman, South to the Naktong, *North to the Yalu*, pp. 8-18.

new tables of organization and equipment allotted and were not in any position to fight a war.[53]

Despite the Army's poor state of readiness, President Harry Truman committed ground forces early in July 1950 as part of a United Nations effort to stop North Korean aggression. That month General Douglas MacArthur, Commander in Chief of the US Far East Command, ordered Major General William F. Dean, Commanding General, 24th Infantry Division, to send an infantry-artillery task force from Japan to stop the North Koreans as far north of Pusan as possible.[54] General Dean rushed a task force commanded by Lieutenant Colonel Charles B. Smith (Task Force Smith) and composed of a skeleton battalion of the 21st Infantry Regiment and one battery of the 52nd Field Artillery Battalion forward to the town of Osan. Here, Smith situated his force on a hill overlooking the approach that the North Koreans would most likely take. He placed his six 105-mm. howitzers about two thousand yards behind the infantry and prepared for the inevitable attack. Early on 5 July, American field artillery opened fire on eight North Korean tanks as they approached. The forward observer quickly adjusted the fire, and shells soon began landing among the tanks. Undeterred by high explosive and a few high-explosive antitank (HEAT) rounds, the tanks pressed forward under the cover of counterbattery fire. They slashed through the infantry, severed all communications between the infantry and field artillery, and hit the field artillery. Firing at ranges as close as 150-300 yards, American gun crews futilely attempted to stop North Korean armor but could not. Their shells only bounced off the tanks and did little damage. Once this wave of tanks had passed, another one followed and moved through the Americans.[55]

After all the tanks had pushed through, a North Korean infantry column attacked. Because his communication lines had been cut by enemy tanks, Smith's howitzers could only fire interdictory rounds on the probable lines of attack. Consequently, targets of opportunity escaped shelling. Using mortars and machine guns, Smith swept the enemy to prevent it from making a frontal assault. Even though Task Force Smith caused the enemy to deploy and cost it an unexpected delay, the North Koreans proceeded to encircle the Americans. After fighting about six hours and using most of his ammunition, Colonel Smith withdrew to a more defensible position, abandoned all his machine guns, field pieces, and heavy equipment, and returned with a little over half of his original five hundred men.[56]

As Task Force Smith retreated, General Dean attempted to slow down the North Korean offensive by deploying various elements of the 24th Division as they arrived from Japan. Without field artillery and antitank support the lst Battalion, 34th Infantry Regiment advanced to meet the attacking enemy, but it could not hold a line running from Ansong to P'ongt'aek. Only blown bridges over the river to its front and the enemy's halt to wait for its tanks kept the battalion from

53. Maurice Matloff, ed., *American Military History* (Washington:Center of Military History, US Army, 1985), p. 542; Weigley, *History of the United States Army*, pp. 502-03.

54. Flint, "Task Force Smith and the 24th Division," p. 276; Matloff, *American Military History*, p. 549.

55. Flint, "Task Force Smith and the 24th Division," pp. 277-81; Appleman, *South to the Naktong, North to the Yalu*, pp. 68-72; Brig Gen George B. Barth, "The First Days in Korea," *Combat Forces Journal*, Mar 1952, pp. 21-23; Barth, "Tropic Lightning and Taro Leaf in Korea," unpublished manuscript, Chief of Public Information Division, Department of the Army, pp. 1-4, in Morris Swett Library.

56. Appleman, *South to the Naktong, North to the Yalu*, pp. 72-74; Flint, "Task Force Smith and the 24th Division," pp. 28082; Barth, "The First Days in Korea," p. 23.

being overrun before it withdrew. Dean then sent the 3rd Battalion, 34th Infantry Regiment forward to fight a delaying action, but it also failed to stop the North Koreans. Unable to slow down the enemy thrust, Dean established a position on the Kum River. Field artillery on the 21st Infantry's front turned back a frontal assault and with tactical air support checked flanking movements. In the meantime, the 19th and 34th Infantry Regiments fought a series of delaying actions, relying upon air superiority to stem North Korean advances. Despite field artillery and air support, the regiments finally withdrew across the Kum River and fell back to Taejon on 16 July. As the North Koreans crossed the river to hit the 34th Infantry, they sent a force into the hills about three miles south of the 63rd Field Artillery Battalion and hit it from both flanks and the rear. This caught the battalion by surprise and drove it from its position in confusion.[57]

In the meantime, General MacArthur sought more field artillery. Since he did not have enough division artillery batteries with many having only four rather than six guns, early in July he requested eleven 105-mm. howitzer batteries to augment the existing ones. Although the Army had a shortage of General Reserve artillery units to carry out emergency missions, it, nevertheless, shipped the desired number late in July. In doing so, it seriously weakened the General Reserve's ability to respond to other threats. Knowing that he also had insufficient nondivisional artillery, MacArthur asked the Joint Chiefs of Staff for fifteen nondivisional battalions. However, the Army had only eleven, and all were below war strength. Only four 105-mm. howitzer battalions, five 155-mm. howitzer battalions, one 155-mm. gun battalion, and one 8-inch battalion could be expected to be partially effective. Of these eleven, the Army sent three 155-mm. howitzer battalions, the 8-inch howitzer battalion, an observation battalion, and the 5th Field Artillery Group headquarters to Korea in July 1950. Since his fighting in the Pacific during World War II had taught him the importance of nondivisional artillery, MacArthur protested vigorously. With an eye to launching offensive operations, he argued that a field army could sustain itself, especially on the offensive, in difficult terrain against a determined enemy only if it had one nondivisional field artillery battalion for every division artillery battalion. Firepower was undoubtedly the key. His estimation of the need for more field artillery was certainly correct since the Americans in Korea could only mass at best three batteries at any one given time and frequently had to piecemeal them into battle in July. Consequently, the Americans lacked the firepower to stop the North Koreans.[58]

As MacArthur urgently sought more guns and as the 24th Division vainly fought to stem the tide, additional American units entered the fight. In mid-July the 25th Infantry Division advanced to block the enemy's drive from Hamchang to Taegu. In the meantime, the lst Cavalry Division landed in Korea. Even though the Eighth US Army had grown stronger, continued North Korean pressure forced Lieutenant General Walton Walker, Commanding General, Eighth Army, to order

57. Flint, "Task Force Smith and the 24th Division," pp. 282-96; Appleman, *South to the Naktong, North to the Yalu*, pp. 130-8l; Barth, "The First Days in Korea," p. 24.

58. James F. Schnabel, *Policy and Direction:The First Year* (Washington: Office of the Chief of Military History, US Army,1972), pp. 43-44, 89-92, 96-97; Fairfax Downey, *Sound of the Guns: The Story of American Artillery* (New York: David McKay Company, Inc., 1956), p. 273; Matthew B. Ridgway, *The Korean War* (Garden City, NY: Doubleday and Company, Inc., 1967), p. 29; Lt Col Robert F. Cocklin, "Artillery in Korea," *Combat Forces Journal*, Aug 19<l, p. 23.

his army on 1 August to retire behind the Naktong River. This shortened the general's front, utilized the natural barrier offered by the river, and marked a new phase in the war. Previously, Walker's three divisions had operated independently with unprotected flanks. By August the Americans and their South Korean allies had contracted their defensive positions to a point that a continuous defensive line, known as the Pusan Perimeter, had been formed. It ran approximately one hundred miles northwards from the Korea Strait and then eastward fifty miles to the Sea of Japan.[59]

Those hectic days of July and early August produced lessons that the field artillery quickly absorbed. Fearing American guns, the North Koreans sought to neutralize them through infiltration tactics. They pushed mortars and machine guns as close to the artillery positions as possible and then opened fire with their mortars. When the crews reacted, the North Koreans then fired their machine guns. This combination disrupted operations, allowed North Korean infantry to overrun the field artillery, and inflicted staggering losses at a time when field artillery was scarce. With the disappearance of traditional front lines, American gun crews had to defend their positions as well as possible. When the situation permitted, commanders grouped their batteries in a compact area to be mutually supporting as Dean had done at Tajeon to mass fire more easily and frequently dug gun pits to permit 360-degree traverse to hit an encircling enemy with artillery fire.[60]

Brigadier General George B. Barth, 24th Division's artillery commander and a veteran of the European theater in World War II, supported these defensive tactics. Reflecting upon the experience of the 21st and 34th Infantry Regiments, he wrote in March 1952 that the attack on the 63rd Field Artillery Battalion in July 1950 was the first of many infiltration attacks against artillery positions. "Profiting by this early disaster," he recounted, "we learned that there were not 'front lines' as we had understood them before." Gun crews had to defend their field pieces, establish observation posts, and provide security detachments. Equally important, infantry and armor commanders had to have plans to assist the field artillery when it was being assaulted.[61]

Interestingly, General Barth completely overlooked the field artillery's experience in the Pacific during World War II where gun crews had to erect perimeter defenses and defend themselves against encircling Japanese tactics. Given the emerging Soviet threat and preoccupation with war in Europe, Barth and others had conditioned themselves to think that all wars would be like that in Europe in 1939-45. As a result, they found that combat in Korea was different from what they had expected. Repulsing infantry charges surfaced once again, forced gun crews to defend their field pieces from hostile infantry, and did not allow the luxury of concentrating upon counterbattery work and supporting the infantry.[62]

As field artillery officers absorbed the lessons of the war, MacArthur regrouped his United

59. William G. Robertson, *Counterattack on the Naktong, 1950* (Fort Leavenworth, Ks: Combat Studies Institute, US Army Command and General Staff College, 1985), pp. 10-11.

60. Appleman, *South to the Naktong, North to the Yalu*, p. 147; Lt Col Leon F. LaVoie, "Make Mine SP," *Combat Forces Journal*, Feb 1952, p. 34; The Artillery School, Combat Information Bulletin, No. 1, 4 Oct 1950, p. 3, in Morris Swett Library; The Artillery School, Combat Information Bulletin, No. 5, 17 Nov 1950, p. 7, in Morris Swett Library; 1st Lt Edward T. Klett, Jr., "Solving the 6400-mil Nemesis," *Combat Forces Journal*, Jul 1951, p.34.

61. Barth, "The First Days in Korea," p. 24.

62. Barth, "The First Days in Korea," p. 24; Robert A. Doughty, *The Evolution of US Army Tactical Doctrine, 1946-76* (Fort Leavenworth, Ks: Combat Studies Institute, US Army Command and General Staff College, 1976), pp. 1-7.

Nations forces to break out of the Pusan Perimeter. Before the enemy could jump off near Chinju and penetrate the perimeter from the southwest, Major General William B. Kean's task force composed of the 25th Division, a Marine brigade, and the 5th Regimental Combat Team formed the first strong American counterattack of the war. On 7 August after the field artillery had fired a twenty-minute preparation, the 35th Infantry Regiment moved out along Kean's right flank.The 5th Regimental Combat Team advanced along the center, and the 5th Marines proceeded along the left. Driving to secure the left of the Pusan Perimeter, Task Force Kean met heavy resistance when the enemy responded in its usual fashion of infiltrating the rear. For example, one large band of North Koreans appeared behind the 35th Infantry and attacked two batteries of the 64th Field Artillery Battalion on the night of 7-8 August. American gun crews fired their 105-mm. howitzers at point-blank range and finally repulsed the infiltrators. Two days later, a strong enemy attack struck the 555th Field Artillery Battalion supporting the 5th Regimental Combat Team. Heavy mortar and artillery fire poured onto the guns for several hours. Because of so many casualties, Lieutenant Colonel John P. Daley, battalion commander, had to reorganize his three four-gun batteries hastily into two six-gun batteries to continue fighting.[63]

Despite the North Korean attacks, the Americans pressed forward. The Marines continued moving along the coast, while the 5th Regimental Combat Team and the 25th Division drove up the center and right flank of the American offensive. In the early hours of 12 August, enemy armor, antitank guns, small arms, and mortar fire hit American artillery at Taejong-ni in the 5th Regimental Combat Team's sector from three sides. The 555th Field Artillery Battalion engaged the tanks, but its fire was ineffective against the heavily armored Russian T-34s. In the meantime, the 90th Field Artillery Battalion shelled the enemy with direct fire but could not depress the tubes of its 105-mm. howitzers sufficiently to hit the tanks and antitank guns. Finally, after several hours of fighting, the North Koreans overran the artillery positions and captured twelve field pieces.[64]

Uninhibited by this failure and the difficulties of holding the Pusan Perimeter during North Korean offensives of August and early September, General MacArthur landed the American X Corps at Inchon on 15 September 1950 following a heavy air and naval bombardment. The X Corps caught the North Koreans by surprise, severed their supply lines, and linked up with Walker as he pushed out from the Pusan Perimeter. Trapped by MacArthur's offensive, North Korean forces disintegrated and hastily retreated across the 38th Parallel.[65]

The offensive of mid-September allowed the field artillery to return to more familiar tactics even though it still had to be prepared to fight infiltrators. Heavy Marine and Army field artillery preparations cleared paths for the infantry and armor to attack and capture Seoul as MacArthur's invasion forces pushed eastward.[66] To the south Walker's army depended upon artillery barrages

63. Barth, "Tropic Lightning and Taro Leaf in Korea," pp. 16-17; Appleman, *South to the Naktong, North to the Yalu*, pp. 266-77.

64. Barth, "Tropic Lightning and Taro Leaf in Korea," pp. 18-19; Appleman, *South to the Naktong, North to the Yalu*, pp. 277-86.

65. Larry H. Addington, *The Patterns of War Since the Eighteenth Century* (Bloomington, In: Indiana University Press, 1984), p. 256.

66. Appleman, *South to the Naktong, North to the Yalu*, pp. 515, 516, 518, 520, 525, 532; Eighth Army, A Study of the Employment and Effectiveness of the Artillery with the Eight Army during the period, October 1951-July 1953, p. xi.

to rout the enemy from its defensive lines and keep it disorganized, but a shortage of ammunition limited the number of rounds that gunners could fire daily. This forced the 25th Division to attack on narrow frontages. Nevertheless, combined with tactical air support, the artillery-infantry-armor team caused the North Koreans to withdraw.[67]

In the meantime, the United Nations General Assembly passed a vaguely worded resolution that favored restoring peace and security throughout all Korea. Given this broad guideline, President Truman concluded that the United Nations had approved the invasion of North Korea already underway. For the United States and the United Nations the intervention changed dramatically with the invasion. They were now fighting to unite all of Korea under one government.[68]

After warning the United Nations that it would enter the war if its forces came too close to the Yalu River, the People's Republic of China marched. In October and early November 1950 the Chinese provided only sufficient soldiers to drive the Eighth Army back from the Yalu River and to bolster the North Korean army. After pushing United Nations forces back, the Chinese withdrew during the second week of November behind a screen of North Korean soldiers to regroup. On 26 November 1950 a three hundred thousand-man Chinese army launched a massive counteroffensive.[69]

Unprepared for such an aggressive attack, United Nations forces hastily withdrew. Disorganized and demoralized, the South Korean army retreated. In the meantime, the Chinese assaulted the Eighth Army's right wing. Fanatic Chinese charges compelled field artillerymen to fire at point-blank range to save themselves and their pieces and protect the infantry withdrawal. One 8-inch howitzer battery found itself firing at targets as close as 1,300 yards, while other calibers hit enemy troops at even closer ranges. Normally positioned to the rear of the infantry, 2nd Infantry Division's artillery, for example, formed the rearguard during a bitter retreat over a single traffic-clogged road through the Kuneri Pass. Confronted by Chinese machine gunners and riflemen attacking from flanking ridges, field artillerymen fought them off with machine guns and blasted them with their guns and howitzers as they withdrew. Gun losses were in relation to their place in the line of retreat. Irrespective of weight, batteries at the head of the withdrawal lost the fewest pieces because they traveled the road when it was least clogged with damaged vehicles.[70] For example, the 17th Field Artillery Battalion lost two pieces, while the 37th Field Artillery Battalion near the rear lost ten.[71]

As fierce air strikes began to take their toll and as Chinese and North Korean supply and communication lines grew longer, the Communist pressure eased and allowed the retreating United Nations to form a defensive line. Under the command of General Matthew Ridgway, who had replaced Walker when he was killed in a jeep accident in December 1950, the Eighth Army

67. Barth, "Tropic Lightning and Taro Leaf in Korea," pp. 36-43; Appleman, *South to the Naktong, North to the Yalu*, pp. 542, 676, 690.

68. Addington, *The Patterns of War Since the Eighteenth Century*, p. 256.

69. Comparato, *Age of Great Guns*, p. 274.

70. S.L.A. Marshall, "They Fought to Save Their Guns," *Combat Forces Journal*, May 1953, pp. 10-18.

71. "Artillery at Kunu-ri," in Russell A. Gugeler, *Combat Actions* (Washington: Association of the U.S. Army, 1954), pp. 53-61.

recaptured Seoul. Although the Chinese and North Koreans mounted two more offensives in the spring of 1951 and could mass artillery fire, they could not break the United Nations line, and a stalemate ensued. This led the combatants to peace negotiations that started in July 1951 and lasted until July 1953 before an agreement was reached to conclude the conflict.[72]

While diplomats discussed terms, the fighting resembled that of World War I. Although trenches, bunkers, barbed wire, mines, and heavy artillery positions existed, they did not form a continuous line like those in 1914-18. Unable to erect defenses in depth because of the broken terrain, United Nations forces built outposts in front of the main line of resistance to provide mutual support for each other, serve as patrol bases, and help limit enemy infiltration of the main line. Since these outposts occupied key terrain and were the first line of defense, the enemy repeatedly attacked them under the cover of intense artillery bombardments.[73]

As the static nature of the war continued, the field artillery's significance grew. Because of improvements in the fire direction center following World War II, veteran and inexperienced American field artillerymen massed fire in Korea even faster than had been done in 1941-45 and provide counterbattery fire against an opponent that had accumulated more field pieces and was growing more skilled in gunnery techniques. This along with the tendency of commanders to use artillery fire to offset the numerical superiority of the Chinese and North Korean armies led to tremendous artillery barrages.[74] At the Battle of Soyang (17-23 May 1951) twenty-one artillery battalions, including four Marine and two South Korean battalions, supported X Corps by firing over three hundred thousand rounds. Four months later in August and September 1951, five battalions supporting the 2nd Division expended more than a one million rounds in a three-week period. Accurate prediction of a Chinese attack on Arrowhead Ridge in October 1952 enabled 2nd Division's artillery to support the defensive effort. Even though smoke hampered forward observation, gun crews fired planned barrages and TOTs continuously on the night of 6 October and contributed to the decisive defeat of the enemy. Nearly twenty thousand rounds set up a steel curtain that night in front of the ridge and allowed only a few attackers to reach the top of the hill.[75] At Porkchop Hill in April 1953, nine battalions fired over thirty seven thousand rounds in twenty-four hours.[76] These barrages and others strained the supply system that had difficulties moving ammunition over the rugged terrain, caused local shortages at times, protected frontline soldiers during enemy attacks, and reaffirmed the American reliance upon massed artillery to stop enemy attacks.[77]

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72. Addington, *The Patterns of War Since the Eighteenth Century*, pp., 257-58; Millet and Maslowski, *For the Common Defense*, p. 501.

73. Comparato, *Age of Great Guns*, p. 275; House, *Towards Combined Arms Warfare*, pp. 150-52; Doughty, *The Evolution of US Army Tactical Doctrine, 1946-76*, p. li.

74. Comparato, *Age of Great Guns*, pp. 275-77; Eighth Army, A Study of the Employment and Effectiveness of the Artillery with the Eighth Army during the period, October 1951-July 1953, pp. 39-41.

75. *The Second United States Infantry Division in Korea, 1951-1952* (Tokyo: Toppan Printing Company, Ltd., n.d.), pp. 138-40.

76. Comparato, *Age of Great Guns*, p. 277.

77. James A. Huston, *The Sinews of War: Army Logistics, 1777-1953* (Washington: Office of the Chief of Military History, US Army, 1966), pp. 630-32. In A Study of the Employment and Effectiveness of the Artillery with the Eighth Army during the period, October 1951-July 1953, on page 43 revealed that the Eighth Army used 25,348,054 artillery rounds, while the North Koreans and Communist China expended 1,908,000 artillery rounds.

Army commanders coupled this awesome artillery firepower with unprecedented air and naval support. Because of the development of the fire support coordination center after World War II to synchronize tactical air, naval gunfire, and artillery support, an artillery commander could deliver any kind of fire and devastate targets of opportunity. The center allowed an air strike to take place without interfering with artillery fire and gave the forward observer the added responsibility of being the eyes of the field artillery and advising the fire support coordinator on where, when, and what type of fire should be used.[78]

Even though commanders and field artillery officers conceded that the artillery provided solid support during those months of static warfare, they still expressed reservations. Reflecting upon their dependence on the guns and fearing massive enemy assaults, they maintained early in 1952 that they required even more artillery if the enemy launched offensive operations.[79] Later in the year, they still claimed that they needed more guns but added that the field pieces should be heavy calibers since the enemy had increased its complement of artillery and since light pieces could not destroy dug in enemy mortars and artillery.[80]

In November 1951 an article entitled "Modernize the Field Artillery" in *Combat Forces Journal* eloquently explained a gunner's feelings about firepower. The author wrote that the Army's field guns and howitzers were as good as any other army's and that the artillery's communication network was the envy of other armies. Yet, the field artillery faced a dilemma in Korea. According to the author, "A given American artillery battery or battalion can probably outshoot its counterpart in any other army. But, the ability to shoot is only part of the issue.We face a contest where the edge our artillery may enjoy in professional excellence could be wholly blunted by inferiority in numbers."[81] Continuing, the article noted, "It is not enough for American artillery to be faster and more flexible than our enemy when. . .*his* infantry, artillery, and armor can smother us by sheer number. To answer this challenge we must develop *more fire power* per artilleryman."[82] Field artillerymen simply required more from their guns. Although the author did not mention atomic tube artillery, it was implicit that it was one option of enhancing firepower.[83]

Influenced by the war that reinforced the need for more firepower and the shortage of self-propelled artillery, the Army accelerated rearming its field artillery with the help of increased defense appropriations from Congress. Early in 1951 prior to the completion of pilot models of the self-propelled M52 105-mm., M44 155-mm., and M55 8-inch howitzers, the Army opted to go

78. *The Second United States Infantry Division in Korea, 1951-1952*, p. 134; Capt Patrick W. Powers and Capt Josiah A. Wallace, Jr., "For Battlefield Teamwork: Fire Support Coordination Center," *Combat Forces Journal*, May 1953, pp. 24-26; Lt Col Carl W. Schaad, "Fire Support Coordination," *Combat Forces Journal*, Sep 1952, pp. 39-41; Eighth Army, A Study of the Employment and Effectiveness of the Artillery with the Eighth Army during the period, October 1951-July 1953, pp. 7-8.

79. Report, Office, Chief of Army Field Forces, subj: Report of Army Field Forces Observer Team No. 6, 7 May 1952, p. F5, in Morris Swett Library.

80. Report, Office, Chief of Army Field Forces, subj: Report of Army Field Forces Observer Team No. 7, 2 Dec 1952, pp. E1-8, in Morris Swett Library.

81. Col T.O. Tee, "Modernize the Field Artillery," *Combat Forces Journal*, Nov 1951, p. 31.

82. *Ibid.*

83. *Ibid.*, pp. 32-33.

into production with these weapons without any testing to meet the emergency and simultaneously made provisions for improvements to be phased in as soon as possible. These weapons represented the most advanced thinking of senior American field artillery officers. Nevertheless, these new field pieces lacked 360-degree traverse to allow crews to hit targets on their front, flanks, or rear easily and 75-degree elevation for high-angle fire. As a result, they were marginally better than their predecessors of World War II. The pressing requirement for more artillery compelled getting the experimental self-propelled artillery to the field quickly and prevented adding 360-degree traverse, 75-degree elevation capabilities, or other desired characteristics. Despite the efforts to speed up fielding, the pieces did not see combat. The M44 went into production in 1954, while the M52 and M55 were not standardized until the following year. Understanding that these field pieces were inadequate for future needs on the atomic battlefield, in the meantime, the Army decided in January 1951 to design a totally new family of self-propelled howitzers with greater lethality and ranges, 360-degree traverse, and 75-degree elevation. Such weapons would provide qualitative improvements over World War II self-propelled artillery and those being introduced.[84]

Because of the urgency for more firepower in Korea, the Army also accelerated the introduction of nuclear guided missiles. Through a crash program the contractor delivered the Corporal missile with a range of eighty miles to the field artillery late in 1953 months ahead of schedule for training, flight testing, and engineering improvements. Yet, operational Corporal missiles did not exist until 1955. At the same time that the Corporal moved into the production stage in July 1951, the Army decided that the Corporal, Hermes A3, which was later terminated because of limited funds, and the proposed Redstone, which was introduced in1956, would compose the field artillery's family of surface-to-surface missiles. They would carry three different sizes of warheads and provide all-weather, 24-hour fire support, the capability of delivering nuclear or conventional warheads, and independence from tactical air support.[85]

Simultaneously, the Army expedited fielding free-flight rockets. By 1954 it had the solid propellant Honest John surface-to-surface rocket that carried a conventional or nuclear warhead and had a range of thirty miles. In an article in *Army Information Digest* in 1956, Major General Earle C. Wheeler, Director of Plans, Office of the Deputy Chief of Staff for Military Operations and later Army Chief of Staff (1962-1964), explained that the rocket formed the backbone of the Army's tactical atomic missile system and presented a grave atomic threat to a hostile force. As a result, it would be a prime target for enemy fire. Even so, the Honest John's accuracy left much to be desired, and the rocket was too heavy to be airlifted, which was becoming more important because the Army envisioned that the mobility offered by aircraft was a way to neutralize tactical

84. Report, The Artillery School, subj: Artillery Conference, 23 Jun 1954, pp. 3-9, 61, Tab D, in Morris Swett Library; Ltr, HQ 8th Army to Cdr in Chief, Far East, subj: Artillery Armament, 10 Jul 1951, in Miscellaneous Papers on Self-propelled Artillery, Tab A, in Morris Swett Library; Callum A. MacDonald, *Korea: The War Before Vietnam* (New York: The Free Press, 1986), pp. 37-38, 138.

85. Report, subj: Corporal Planning Information, 23 Sep 1957, pp. I, 3, II, in Morris Swett Library; Ltr, The Firestone Tire and Rubber Company, to CG, Redstone Arsenal, 23 Sep 1957, in Report, subj: Corporal Planning Information, 23 Sep 1957; Toffoy, "Army Missile Development," pp. 28, 32; Hewes, *From Root to McNamara*, pp. 217, 258; Comparato, *Age of Great Guns*, p. 298; Maj Gen Earle G. Wheeler, "Missile on the Firing Line," *Army Information Digest*, Dec 1956, pp. 40-41; A.J. Bacevich, *The Pentomic Era: The US Army Between Korea and Vietnam* (Washington: National Defense University Press, 1986), p. 88.

atomic weapons' firepower.[86]

As well as accelerating the introduction of guided missiles and free-flight rockets, the Korean War also intensified the Army's efforts to field atomic tube artillery. Even though the Army had discussed the use of tactical atomic tube artillery during the 1940s, the Ordnance Department did little to make it a reality and concentrated upon designing a more powerful 240-mm. gun. Influenced by the decision of the Joint Chiefs of Staff in 1949 to develop atomic field artillery, the department chose to produce a 280-mm. piece to fire conventional and atomic rounds and abandoned any further development on the 240-mm. gun in May 1950. At the same time the department indicated that a pilot of the 280-mm. gun could be produced by June 1951. In July 1950 just subsequent to the invasion of South Korea, Secretary of the Army Frank Pace, Jr., (1950-1953), approved development of the gun.[87] Two years later in May 1953, the field artillery shot an atomic shell from the 280-mm. gun, known as Atomic Annie, to become the first artillery weapon to fire an atomic warhead successfully.[88]

Unable to use the gun in Korea because the war ended in July 1953, the Army shipped three 280-mm. guns to Europe but quickly found that they were inadequate. The gun was difficult to move and had a range of only thirty thousand yards that fell short of the anticipated forty-five thousand to forty-nine thousand yards. In view of the limited range, the piece had to be positioned too near the front to hit worthwhile targets and would be vulnerable to hostile action and require extensive protection. Although the 280-mm. gun represented a breakthrough, it simply did not satisfy the demand for atomic tube artillery. The Army required mobile atomic artillery that packed a punch.[89]

Despite the limitations of the first atomic artillery weapons, they revolutionized warfare. They brought unprecedented firepower to the battlefield and greatly extended the range of the field artillery, especially guided missiles and free-flight rockets. Such weapons allowed commanders to stop reserves from being moved forward before they could ever join the main forces and disrupted communication lines. Equally important, atomic field artillery would cause the enemy to disperse in order to negate the impact of an atomic explosion. This led Army Chief of Staff, General J. Lawton Collins (1949-1953), to comment in the *Combat Forces Journal* in March 1952 that "human waves" of infantry as the Chinese used in Korea would be suicidal against atomic artillery. Because of this, mass attacks were no longer possible. For the Army, this was important since it was smaller than the Soviet army that was the most likely opponent in a future war.[90] In February 1953 Secretary Pace wrote that atomic artillery along with other developments during the post-World War II years had produced the swiftest and hardest hitting battle team that the country had ever seen. Atomic tube and missile artillery certainly opened a new era, but the

86. Wheeler, "Missile on the Firing Line," pp. 36-39, 42; Bacevich, *The Pentomic Era*, p. 94.

87. Comparato, *Age of Great Guns*, p. 308; Huston, *The Sinews of War*, pp. 686-87; Minutes, Ordnance Committee Meeting, Item 32732, 23 Feb 1949, in Morris Swett Library; Minutes, Ordnance Committee Meeting, Item 33285, 25 May 1950, in Morris Swett Library; Minutes, Ordnance Committee Meeting, Item 33338, 6 Jul 1950, in Morris Swett Library; MacDonald, pp. 38, 79, 132, 263.

88. Doughty, *The Evolution of US Army Tactical Doctrine, 1946-76*, pp. 13-15.

89. Bacevich, *The Pentomic Era*, pp. 82-84.

90. "Atomic Projectiles for Artillery," *Combat Forces Journal*, Mar 1952, p. 17.

quantities of new weapons operational in 1953 when Pace made his bold pronouncement did not warrant such glowing optimism.[91]

Even though atomic weapons attracted attention, the Army hotly debated their role. Secretary Pace and Army officers envisioned atomic artillery as a supplement to conventional artillery. Pace wrote in February 1953, "However, even with the amazing developments of science, there is not reason to believe that warfare in the future would not require many of our current conventional weapons."[92] Push-button warfare existed only in the realm of science fiction.[93] In comparison, Senator Brian McMahon, Chairman of the Joint Congressional Committee on Atomic Energy, proposed establishing an atomic army, an atomic navy, and an atomic air force because they would be cheaper than conventional ones.[94] Pace's, the Army's, and McMahon's differences of the early 1950s when atomic tube artillery, guided missiles, and free-flight rockets were just appearing portended future debates over the proper mix of atomic and conventional artillery.[95]

Eight years after the pivotal Artillery Conference of 1946 and War Department Equipment Board decisions, the field artillery finally introduced some of the new technology so desired. New self-propelled artillery and lethal missiles and rockets with the ability to carry atomic warheads were appearing by the early 1950s. Yet, this did not mean that the field artillery was capable of devastating an opponent on the battlefield through Atomic barrages because the Army lacked sufficient numbers of operational atomic-capable field artillery.

91. "Weapons and Men for the Future," *Combat Forces Journal*, Feb 1953, p. 16.

92. "Weapons and Men for the Future," p. 16; Bacevich, *The Pentomic Era*, pp. 63, 66.

93. "Weapons and Men for the Future," p. 16.

94. "Time for An Atomic Artillery?" *Combat Forces Journal*, Nov 1951, p. 30.

95. John P. Rose, *The Evolution of U.S. Army Nuclear Doctrine, 1945-1980* (Boulder, Co: Westwiew Press, 1980), p. 32.

Table 7

MAJOR AMERICAN FIELD ARTILLERY WEAPONS IN 1946

Weapon	Prime Mover	Range in Yards
M2 105-mm. Howitzer	truck	12,205
M37 105-mm. Howitzer	self-propelled	12,205
M1 155-mm. Howitzer	tractor/truck	16,355
M41 155-mm. Howitzer	self-propelled	16,355
M2 155-mm. Gun	tractor/truck	25,715
M40 155-mm. Gun	self-propelled	25,715
M2 8-inch Howitzer	tractor/truck	18,510
M43 8-inch Howitzer	self-propelled	18,510
M1 8-inch Gun	tractor	35,490
M1 240-mm. Howitzer	tractor	25,255

Source: The Field Artillery School, ***General Comparison Chart, Field Artillery Weapons,*** *October 1946.*

Table 8

MAJOR AMERICAN FIELD ARTILLERY WEAPONS IN 1950

Weapon	Prime Mover	Range in Yards
M2 105-mm. Howitzer	truck	12,205
M37 105-mm. Howitzer	self-propelled	12,205
M1 155-mm. Howitzer	tractor/truck	16,355
M41 155-mm. Howitzer	self-propelled	16,355
M2 155-mm. Gun	tractor/truck	25,715
M40 155-mm. Gun	self-propelled	25,715
M2 8-inch Howitzer	tractor/truck	18,510
M43 8-inch Howitzer	self-propelled	18,510
M1 8-inch Gun	tractor	35,490
M1 240-mm. Howitzer	tractor	25,255

Source: The Field Artillery School, ***General Comparison Chart, Field Artillery Weapons,*** May 1950.



American M2 105-mm. howitzers in action in Korea, July 1950.

Chapter X

FROM THE PENTOMIC TO THE HEAVY DIVISION: 1955-1980

During the years from 1955 through 1980, the field artillery underwent many changes to satisfy the requirements of combat in the nuclear age. In the mid-1950s the Army introduced new field artillery to replace World War II and Korean War vintage artillery. Dissatisfied with these weapons, the Army standardized more powerful and mobile guns, howitzers, rockets, and guided missiles early in the 1960s. Following the Vietnam War, the Army embarked upon an ambitious effort to rearm its field artillery with the latest technology.

Building a Nuclear Artillery

Seeking to limit defense spending as one of many ways to balance the federal budget and preserve American security, President Dwight D. Eisenhower directed the Department of Defense late in 1953 to equip all of the military services with nuclear weapons. In concert with this, Secretary of State John Foster Dulles (1953-1959) announced in January 1954 the country's intentions to rely upon massive retaliation to deter communist-inspired local wars. Along with the President he feared involvement in another Korean-like war. As a result, the Eisenhower administration devised a concept of depending upon air power as a means of stopping aggression throughout the world.[1]

Arguing that massive retaliation, or the "New Look" as it was often called, tied the country's hands by compelling it to respond to aggression with nuclear weapons, the Army counterattacked on several fronts. Late in 1953, the Army questioned the rationale of laying waste to the Soviet countryside. It insisted that the National Security Council had not considered the political, economic, and moral ramifications of massive retaliation. Nuclear war would make Eastern Europe a nuclear battleground and discourage it from defecting from the Soviet camp as desired because digging out from the ashes of such a war would be even more difficult than rebuilding after World War II had been. After failing to convert the President to its way of thinking, the Army shifted its focus of attack. In 1954 it pointed out that the Soviet Union would possess the capacity to wreak unacceptable nuclear destruction by the 1960s. When this point was reached, the nuclear

1. Allan R. Millett and Peter Maslowski, *For the Common Defense: A Military History of the United States* (New York: The Free Press, 1984), pp. 508-14; A.J. Bacevich, *The Pentomic Era: The U.S. Army Between Korea and Vietnam* (Washington: National Defense University Press, 1986), pp. 11-15.

arsenals of the United States and Soviet Union would cancel each other out. Under this shield of mutual nuclear deterrence, the Soviet Union could then promote local aggression. Under such conditions the United States had to have a ground force to defend its interests. Rather than relying upon the Air Force's Strategic Air Command to deliver nuclear bombs, the country required a balanced military force to reply to any kind of threat.[2]

The Army's opposition did not mean that it denounced nuclear weapons. Rather, it differed over the perceived nature of the next war. As outlined by President Eisenhower and other advocates, the New Look excluded the Army, relegated it to second class citizenship, and reinforced the service's irrelevance in the nuclear age. As expected, the Army maintained that ground fighting would take place in the future and that tactical nuclear weapons could decide the outcome of the next war.

In the meantime, the Army set out to devise doctrine and organizations for tactical nuclear warfare. Although the basic principles of war had not changed, Colonel George C. Reinhardt, who co-authored *Atomic Weapons in Land Combat* (1953) with Colonel William R. Kintner, wrote in *Military Review* in 1952 that the frontal assault, which was the most direct way to the enemy's vitals but also the most bloody and costly, might become the cheapest route with nuclear weapons. Rather than searching for the opponent's weakest point, an army equipped with nuclear weapons could deliberately shatter the enemy's strongest points and then exploit the destruction by pushing swift armored columns through the gap. Nuclear weapons made flanking maneuvers obsolete because they had the power to crush even the strongest defenses.[3] Several years later in 1956, Brigadier General William F. Train, Assistant Commandant, US Army Command and General Staff College, Fort Leavenworth, Kansas, commented that nuclear weapons empowered the offense to rupture the defense more easily than it had been able to do in the past. Consequently, frontal assaults might become preferable to envelopments. Such analyses stressed firepower and suggested that bludgeoning an opponent with nuclear weapons was possible.[4]

Knowing that the Army could also be the object of a nuclear attack, strategists also explored ways to minimize its impact. As early as 1950, General Leslie R. Groves, who had headed the Manhattan District Project to develop the atomic bomb during World War II, advocated using dispersed, small forces to neutralize the impact of nuclear weapons.[5] Pointing out that nuclear weapons would be aimed against troop concentrations, the most logical target, Colonel Frank J. Sackton, who served on the Army General Staff, explained in *The Army Combat Forces Journal* in 1954 the necessity of dispersing on the battlefield to survive.[6] In 1956 General Train emphasized that massing for attack would be achieved by rapid movement from relatively scattered assembly areas so that the assault elements would arrive moments prior to the attack. Following the atomic bombardment and attack, the attackers would speedily disband to prevent forming an

2. Bacevich, *The Pentomic Era*, pp. 19-32.

3. Reinhardt, "Notes on the Tactical Employment of Atomic Weapons," *Military Review*, Sep 1952, pp. 29-30.

4. Fact Sheet, subj: Artillery, 1954, p. 17; Reinhardt, "Notes on the Tactical Employment of Atomic Weapons," pp. 29-30; Train, "The Atomic Challenge," *Military Review*, Oct 1956, pp. 89.

5. John P. Rose, *The Evolution of U.S. Army Nuclear Doctrine, 1945-1980* (Boulder, Co: Westview Press, 1980), p. 62.

6. Sackton, "Atomic Weapons for the Battalion Commander," *The Army Combat Forces Journal*, Dec 1954, p. 44.

inviting target to the enemy.[7] In October 1957 Lieutenant Colonel Robert M. Walker, a faculty member at the US Army Command and General Staff College, explained, "The consensus seems to be that the day of the continuous battleline is over. Instead of a dug-in and strongly held main line of resistance, a defense indepth with comparatively isolated strong points is contemplated."[8]

Yet, offensive action required concentrating. As Sackton, Walker, Train, and others outlined, commanders faced a dilemma. They had to mass their forces quickly after the nuclear artillery preparation to go on the offensive and then spread out as rapidly as the situation permitted.[9]

Even though dispersion was not an innovation of the atomic and later nuclear age, it assumed greater importance with the introduction of nuclear weapons because commanders had to reduce the size of the target. This involved increasing the distance between units, not individuals. Dispersion also demanded more mobility because units would have to travel over larger battlefields than ever before and had to be able to concentrate or scatter rapidly. Because of dispersion and larger battlefields, units had to be self-contained.[10] This led tacticians to envision a fluid battlefield composed of small, self-contained battle groups armed with nuclear weapons replacing mass armies facing each other from formal entrenched positions.[11]

In 1954 the Army made its first attempt to convert these concepts into tactics and doctrine. That year it published a new *Field Service Regulation.* Although the manual discussed nuclear weapons, its tactics did not differ appreciably from those used in World War II or in the Korean War. In contrast to earlier field manuals, which envisioned only one type of defense, the 1954 version outlined position defense and mobile defense. The former descended from previous methods, emphasized defense in depth, and minimized the idea of a main line of resistance. In the mobile defense the commander retained the bulk of his force as a striking force, while the remainder occupied the forward points of resistance to channel the attacking force and delay or disorganize it. This allowed the striking force to destroy the enemy at the time and place most favorable to the defender. Given the scenario of a dispersed battlefield, the mobile defense emphasized armored units and seemed to resolve the perplexing problem of balancing the need for dispersion and the need for mass.[12]

Although the 1954 manual offered hope, many Army officers realized that the end of the American monopoly of tactical nuclear weapons would compel major organizational and tactical changes to be made. In 1954 General Matthew B. Ridgway, Army Chief of Staff (1953-1955), pointed out that the Army had to be prepared to fight outnumbered and that it had to increase its mobility and firepower. That same year, Major General James M. Gavin, Commanding

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7. Train, "The Atomic Challenge," pp. 9-12.

8. Walker, "The Night Attack Blueprint for Atomic Victory," *Military Review*, Oct 1957, p. 52.

9. Walker, "The Night Attack Blueprint for Atomic Victory," p. 54; Sackton, "Atomic Weapons for the Battalion Commander," p. 44.

10. Rose, *The Evolution of U.S. Army Nuclear Doctrine, 1945-1980*, pp. 66-72.

11. Rose, *The Evolution of U.S. Army Nuclear Doctrine, 1945-1980*, pp. 66-72; Walker, "The Night Attack Blueprint for Atomic Victory," p. 53.

12. Robert A. Doughty, *The Evolution of U.S Army Tactical Doctrine, 1946-1976* (Fort Leavenworth, Ks: Combat Studies Institute, US Army Command and General Staff College, 1979), p. 15.

General, US VII Corps, Germany, held exercises to determine the suitability of World War II organizations for the nuclear battlefield. Finding that these organizations could not adapt and had to be changed, General Gavin stressed redesigning the division around relatively autonomous and widely dispersed groups capable of fighting alone. This exercise and studies in 1954 supported Gavin's findings and prodded the Army to restructure the division into battle groups.[13]

Even though many field artillery officers did not think that nuclear weapons would change artillery tactics, which were already based on firepower, dispersion, and mobility, they feared the implication of battle groups. So that the groups would have fire support, the Army thought about attaching field guns to each one. This would provide direct support. In an article in *The Army Combat Forces Journal* in July 1955, Commandant of the Artillery and Guided Missile School, Major General Edward T. Williams (1954-1956), openly opposed the drive to parcel out field artillery. Such action would decentralize control and decrease firepower. Although this arrangement would undoubtedly give the group fire from a full battalion whenever needed, it would hinder massing fire from more than one battalion. Citing the critical impact that massing fire had had in World War II, General Williams wrote that field artillery battalions had to be mutually supporting to harness their collective firepower. Centralized artillery would allow several battalions to assist any unit in need and permit echeloning fire for continuous help in moving situations. Decentralizing the artillery by attaching it to a small battle group, in contrast, would require the field artillery to move with its unit, and guns on the road were not "shooting" artillery. According to General Williams, the formation of new doctrine that overlooked massing fire would be ill-advised, untimely, and jeopardize the success of the infantry and armor.[14]

Other field artillery officers reluctantly accepted attaching field artillery to battle groups. Discussions at The Artillery and Guided Missile School revealed that field artillery officers understood that World War II and Korean War organizations were outmoded. Yet, decentralization as projected by the Army would reduce the division artillery commander's control of his guns, since many would be under another's direction and restrict massing fire. This violated two sacred artillery tenets—unity of command and massing fire. As a result, field artillery officers did not enthusiastically embrace organizations for nuclear warfare that involved decentralization. In fact, The Artillery and Guided Missile School stubbornly clung to old practices until it became obvious that attaching artillery to a group would be an integral aspect of Army organization.[15]

Despite opposing the new emerging concepts for field artillery organization, field artillery officers supported introducing new weapons. During the mid-1950s, the Army standardized new self-propelled cannons (M52 105-mm., M44 155-mm., and M55 8-inch howitzers, and M53 155-mm. gun).[16] Commenting on the quality of the new artillery, Colonel R.R. Mace of the Office of the Chief of the Army Field Forces explained in June 1954 that the M52, which was

13. *Ibid.*, p. 16.

14. Fact Sheet, subj: Artillery, 1954, p. 17; Maj Gen Edward T. Williams, "Effective Artillery Support Isn't Accidental," *The Army Combat Forces Journal*, Jul 1955, pp. 26-29.

15. Memorandum for Record, Director, Department of Tactics and Combined Arms, 17 Oct 1956, in Morris Swett Library, Fort Sill.

16. Report, Chief of Army Field Forces, subj:Artillery Conference, 23-25 Jun 1954, p. 61, in Morris Swett Library.

being upgraded, would only be "marginally satisfactory." Also, improvements being completed on the M55 were "far from what is really needed." In Mace's view neither piece would have the speed, traverse, nor firepower required for tactical nuclear warfare even after the enhancements had been completed. In fact, none of the new self-propelled pieces had adequate traverse, range, power, and mobility. Even developmental self-propelled 110-mm. and 156-mm. howitzers, which had been initiated in 1952 to replace the M52 and M44, represented only a modernization effort at best and approximated poor tanks because their tubes were mounted on tank chassis.[17]

With this situation in mind, Lieutenant General Lyman L. Lemnitzer, Deputy Chief of Staff for Plans and Research and later Army Chief of Staff (1959-1960), outlined recommendations for new field artillery. Influenced by the tactical nuclear battlefield with its wide fronts, he emphasized in 1954 the significance of increasing the field artillery's range, traverse, and lethality, adopting high-angle (75-degree) fire capabilities to hit targets on steep reverse slopes, and developing mobile field pieces. If vast improvements were not made, the field artillery would not have the capability to support the infantry or armor on the nuclear battlefield. In his comments General Lemnitzer issued a cry for equipping the field artillery with weapons specially manufactured for nuclear warfare and not modernizing old weapons.[18]

Because of the nuclear battlefield and the experience in Korea, 360-degree traverse took on a greater importance. Field artillery officers had desired full-circle traverse since 1919, but developers had been unable to design guns with this characteristic without making them too heavy. Consequently, field artillery officers accepted guns with less traverse as late as 1951 because they were mobile. Addressing the nuclear battlefield and the ability of the enemy to penetrate, infiltrate, and envelop as the North Koreans and Chinese had done, General Lemnitzer explained that the Army would have to protect its flanks and rear areas more than it had done in the past. Even though he supported 360-degree on-carriage traverse for self-propelled guns and howitzers, he pointed out the imperative of considering traversing the entire weapon if 360-degree on-carriage traverse interfered with mobility. The Army simply could not abandon 360-degree traverse. Field artillery of the future required mobility and the ability to traverse a complete circle. Whether that meant shifting the entire weapon or only the tube, Lemnitzer did not care.[19]

Other officers shared a similar position. Major General P.W. Rutledge of the Office of the Chief of the Army Field Forces pointed out in 1954, "Weapons should be capable of shifting their fire through 360 degrees with facility."[20] Echoing General Rutledge's comments, Major General J.M. Lentz of the same office said that it was futile to discuss anything but 360-degree traverse because of the enemy's ability to penetrate and the dispersed nature of the battlefield.[21]

Like General Lemnitzer and other advocates of rearmament, The Artillery and Guided Missile School championed the introduction of field artillery suited for fighting on the nuclear

17. *Ibid.*, pp. 3, 61.
18. *Ibid.*, pp. 8-9.
19. *Ibid.*, p. 8.
20. *Ibid.*, p. 61.
21. *Ibid.*, pp. 63-64.

battlefield. Besides addressing the need for greater traverse, range, lethality, and mobility in field pieces, the school reaffirmed the Army's decision of 1948 to develop air transportable field artillery. With the appearance of nuclear weapons, air transportability, especially for division artillery, became even more important. It would allow more rapid movement across the large nuclear battlefield than towed or even self-propelled artillery would permit. In a study conducted in 1955 and 1956, the Department of Tactics and Combined Arms in The Artillery and Guided Missile School explained that the M52, M44, M55, and M53 were heavier than those employed in World War II and Korea because modifications to the initial designs had increased weight. Even experimental 110-mm., 156-mm., and 8-inch howitzers and the 175-mm. gun, which were lighter than pieces just adopted, were still too heavy and could not be easily moved by air. Because of the importance of protecting crews from radiation and fighting on the move, the school favored light, air transportable, self-propelled pieces even though towed artillery was easier and cheaper to maintain, less expensive to produce, and lighter. Although the school reluctantly accepted proposals for a new field artillery organization, it endorsed making a radical departure in system acquisition. The school emphasized strongly that existing developmental projects and recently adopted weapons were inadequate and nothing more than attempts at modifications. The Army had to be more imaginative in developing artillery than it had been in the past.[22]

Colonel J.W. Milner, Director, Department of Motors, The Artillery and Guided Missile School, captured the essence of adopting new cannon artillery. Understanding the importance of speed and mobility, he explained, "In this era of a possible two sided atomic war, where movement and dispersion are so vitally important, both in the offense and defense, vehicle mobility is more a matter of life or death than ever before."[23] The field artillery could not have slow, ponderous weapons that would bring certain defeat and disaster.[24]

The Army and field artillery clearly recognized the dilemma. Just as they were pushing to develop tactics and doctrine for nuclear warfare in the mid-1950s, they were standardizing field artillery that was more suitable for conventional warfare than nuclear warfare. Because of this, the Army had to design new weapons to replace those being introduced. As a result, discussions of 1953-56 bore out the wisdom of the Army's decision of 1951 to develop totally new towed and self-propelled artillery pieces that were not just enhanced versions of older models.[25]

The drive to rearm also included acquiring new surface-to surface missiles. Although the Corporal and Redstone missiles greatly extended the power and range of the field artillery, their fiery blasts revealed their positions and invited counterbattery fire. Crews had to launch the

22. Study, The Artillery and Guided Missile School, subj: Towed Versus Self-propelled Artillery, undated, in Ltr, HQ CONARC to Cmdt, The Artillery and Guided Missile School, subj: Artillery Weapons, 9 Oct 1956, in Morris Swett Library; Disposition Form, subj: Study Towed Versus Self-propelled Artillery, 8 Feb 1956, in Ltr, HQ CONARC to Cmdt, The Artillery and Guided Missile School, subj: Artillery Weapons, 9 Oct 1956; Report, Chief of Army Field Forces, subj: Artillery Conference, 23-25 Jun 1954, pp. 5-7; Army Field Forces Board No. 1, Development Brochures, Self-propelled Artillery, 1 May 1948, pp. 1-7; Army Field Forces Board No. 1, Development Brochures, Brochure on Weight Reduction of Artillery Weapons, 1 May 1948, p. 5, Morris Swett Library.

23. Milner, "The New Family of Weapons," *Tactical and Technical Trends in Artillery for Instruction*, Apr 1957, p. 17.

24. *Ibid.*, pp. 17-18.

25. Report, Chief of Army Field Forces, subj: Artillery Conference, 23-25 Jun 1954, pp. 8-9.

missiles and move them quickly because they were appealing targets. Yet, the missiles' cumbersome sizes prevented rapid emplacement and displacement and made them a liability. Because of this, this first generation of nuclear missiles had to be replaced.[26]

The push to restructure the Army to fight on the nuclear battlefield ultimately led to the development of the pentomic division, new doctrine, and weapons. Based on tests in 1954 and 1955, the Army unveiled pentomic infantry, armor, and airborne divisions late in 1956. The new infantry division consisted of 13,748 officers and men and five self-contained, semi-independent, combined arms battle groups. Five rifle companies, a combat support company with a mortar battery, and a headquarters and service company formed the heart of the group and were supported by an armor battalion, a cavalry squadron, an engineer battalion, two field artillery battalions, and other units. Unlike the triangular infantry division with its three towed 105-mm. howitzer battalions (fifty-four howitzers) and one towed 155-mm. howitzer battalion (eighteen howitzers), the pentomic infantry division had one towed 105-mm. howitzer battalion of five batteries (thirty guns) and one composite (general support) battalion of two towed 155-mm. howitzer batteries (twelve howitzers), one towed 8-inch howitzer battery (four howitzers), and a self-propelled Honest John battery (two launchers). The reorganization included mortars as field artillery for direct support under the battle group commander, decreased the number of conventional artillery tubes, and added nuclear delivery means with the 8-inch howitzer and Honest John rocket. Division artillery had 131 officers, 8 warrant officers, and 1,624 enlisted soldiers. The 105-mm. howitzer battalion was composed of 71 officers, 3 warrant officers, and 823 enlisted soldiers, while the composite battalion had 38 officers, 3 warrant officers, and 635 enlisted men. Organization of the division's nine batteries was based upon the number of officers and men required to operate a particular weapon.[27]

Likewise, the reorganization divided the airborne division, which had been structured like the triangular infantry division, into five battle groups. The five battle groups--each with five rifle companies. The division had 11,486 officers and men, a headquarters company, a mortar battery, five 105-mm. howitzer batteries of 7 officers and 93 enlisted soldiers each, and 1 Honest John battery of 4 launchers, 9 officers, and 131 enlisted men.[28]

Although the pentomic reorganization significantly altered the infantry and airborne divisions, it

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26. Maj Gen J.P. Daley, "Missile Research and Development," *Army Information Digest*, Dec 1956, p. 47; Phillip H. Stevens, *Artillery Through the Ages* (New York: Franklin Watts, Inc., 1965), p. 181; Frank E. Comparato, *Age of Great Guns: Cannon Kings and Cannoneers Who Forged the Firepower of Artillery* (Harrisburg, Pa: The Stackpole Company, 1965), p. 300.

27. US Continental Army Command, *Division Artillery: Infantry Division*, Feb 1957, p. 4; Report, 25th Infantry Division, subj: ROCID (Reorganization Objectives, Current Infantry Division) Artillery, 1 Nov 1957, Annex A, in Morris Swett Library; Ltr, The Artillery and Guided Missile School to CG, US Army Continental Army Command, subj: Reorganization of the Infantry Division Artillery, 6 Feb 1958, in Morris Swett Library; Maj John H. Cushman, "Pentomic Infantry Division," *Military Review*, Jan 1958, pp. 20-21; Maj Robert M. Young, "Artillery of the Pentomic Infantry Division," *Military Review*, Apr 1958, pp. 32-33; Doughty, *The Evolution of US Army Tactical Doctrine, 19461976*, pp. 16-17; Myles G. Marken, Sr., "The Atomic Age Division," *Army Information Digest*, Sep 1965, pp. 58-61; US Army Artillery and Guided Missile School, Field Artillery Reference Data, May 1957, p. 2; *Artillery Trends*, Mar 1959, p. 5.

28. US Army Artillery and Guided Missile School, Field Artillery Reference Data, May 1957, p. 55.

had little impact on the armored division. The latter, which was composed of 14,617 officers and men, retained its three combat commands, four tank battalions, and four armored infantry battalions, acquired an aviation company to centralize aviation assets, and received one general support composite artillery battalion (twelve 155-mm. howitzers/four 8-inch howitzers/two Honest John rocket launchers) of 38 officers and 577 men. The composite battalion replaced the self-propelled 155-mm. howitzer battalion of the triangular armored division and augmented three self-propelled 105-mm. howitzer battalions (fifty-four howitzers) of 135 officers and 1,602 men each. While battery organization in the composite battalion varied according to the weapon, the 105-mm. howitzer battery had 24 officers and 321 enlisted men.[29]

For offensive operations the Army adopted penetration as the primary mode of fighting and abandoned its traditional reliance upon flanking maneuvers. Using nuclear artillery, the offense would blast gaps in the enemy front to allow the ground forces to pour through. Rather than deploying for heavy fighting characteristic of earlier penetration concepts, the offense now would exploit the badly shaken enemy. Realizing that nuclear weapons made linear formations dangerous, the Army devised the concept of area defense. Small, widely separated islands of resistance would fight independent battles to stop any enemy offensive. Such doctrine also tied the Army more tightly to nuclear weapons because they were the only means for the small groups to stave off defeat. Although conventional field artillery existed in the pentomic army, it was less important than nuclear artillery since action depended upon the ability of the nuclear weapons to rupture the enemy position or halt offensive strikes.[30]

Maneuvers and tests revealed startling weaknesses with pentomic field artillery, especially in the infantry division.[31] Following a field exercise in 1957, Brigadier General Donald B. Harriott, commander of the 10th Infantry Division's artillery, wrote Brigadier General Philip C. Wehle, Assistant Commandant, The Artillery and Guided Missile School, about his frustrations with pentomic division artillery. General Harriott explained that the new artillery organization and doctrine destroyed unity of command by placing direct support artillery, 4.2-inch mortars, under the battle group commander and reinforcing and general support artillery under the division artillery commander. Even though his division overcame this by giving the artillery commander technical and tactical supervision over the mortars, Harriott opposed the principle of splitting responsibility because it crippled the artillery's ability to mass fire. Rather than decentralizing command and control, he wanted the artillery commander to direct all of the division's artillery. Such an arrangement would give the commander the flexibility and power necessary to support the infantry and

29. Doughty, *The Evolution of US Army Tactical Doctrine, 1946-1976*, p. 17; Jonathan M. House, *Towards Combined Arms Warfare: A Survey of Tactics, Doctrine, and Organization in the 20th Century* (Fort Leavenworth, Ks: Combat Studies Institute, US Army Command and General Staff College, 1986), p. 157; Report, Virgil Ney, subj: Evolution of the US Army Division, 1939-1968, pp. 71-73, in Morris Swett Library, hereafter cited as Ney Report; US Continental Army Command, *Division Artillery: Armored Division*, Feb 1957, pp. 2-4; "New Divisional Artillery," *Army Information Digest*, May 1957, pp. 16-23; Report, Department of the Army, US Army War College, subj: Divisional Restructure Study, 19 Jan 1977, pp. B-17 - B-19, in Morris Swett Library; US Army Artillery and Guided Missile School, Field Artillery Reference Data, May 1957, pp. 29-29a.

30. Bacevich, *The Pentomic Era*, pp. 108-19; Doughty, *The Evolution of US Army Tactical Doctrine, 1946-1976*, pp. 17-18.

31. Lt Col Kenneth B. Stark, "Revision of Field Manual 6-20, Artillery Tactics and Technique," *Trends in Artillery for Instruction*, Feb 1958, p. 19.

armor.[32] Also, the mortar's maximum range of six thousand yards prevented massing, while the weapon's minimum range of one thousand yards forced the group commander to place it too close to the front. Even though the Honest John rocket and the 8-inch howitzer gave the field artillery unprecedented lethality, Harriott wanted even more firepower. He recommended replacing the mortars with 105-mm. howitzers for direct support and substituting the 155-mm. howitzer for the 105-mm. howitzer in the five-battery battalion. The changes would increase the range of direct support artillery and give the division more firepower.[33]

Other field artillery officers expressed similar concerns. In January 1958 field artillery officers in the 25th Infantry Division communicated their doubts about pentomic division artillery to General Wehle. Like Harriott, they opposed employing the 4.2-inch mortar as direct support artillery. The mortar's short range restricted massing on the envisioned broad fronts and was inadequate as a direct support weapon. Consequently, they urged replacing it with the 105-mm. howitzer. They also believed that the practice of creating two composite division artillery battalions by exchanging batteries between the five-battery battalion and the general support battalion during combat was unsound even though it promoted flexibility. Each battalion's organization was different and would not support the addition of batteries that were not compatible with its table of organization and equipment. Rather, field artillery officers in the 25th Division urged creating two composite division artillery battalions consisting of three 105-mm. howitzer batteries (eighteen pieces) and one 155-mm. howitzer battery (six pieces) and separate batteries of Honest John rockets (two launchers) and 8-inch howitzers (four pieces) each. The modifications would increase the division's conventional firepower that was seriously deficient under the existing organization and would decrease the need for corps and army artillery reinforcement. Although artillery officers of the 25th Division did not oppose splitting artillery responsibilities between the battle group commander and the division artillery commander, they thought that coordination between the two commanders could be better and advised establishing a command liaison link between the two. That would augment the established liaison between the reinforcing howitzer battery and the reinforced mortar battery.[34]

Even though artillery officers debated the merits and strengths of the new division's field artillery organization, they also found common ground for agreement. All questioned the field artillery's ability to support the infantry on the pentomic battlefield. The pentomic infantry division had more pieces than the old triangular division (eighty-eight versus seventy-two), but the broader fronts envisioned and the inclusion of forty 4.2 inch mortars as field artillery seriously reduced the number of indirect fire weapons available for direct support. Because of this, the division required large amounts of corps and army artillery for reinforcement, especially on the

32. Stark, "Revision of Field Manual 6-20, Artillery Tactics and Technique," p. 18; Ltr, Harriott to Wehle, 18 Nov 1957, in Report, 10th Armored Division Artillery, subj: Commander's Evaluation of the Artillery in the ROCID (Pentomic) Division, 8 Nov 1957, in Morris Swett Library; Report, 10th Armored Division Artillery, subj: Commander's Evaluation of the Artillery in the ROCID Division, 8 Nov 1957, pp. 3, 8.

33. Report, 10th Division Artillery, subj: Commander's Evaluation of the Artillery in the ROCID (Pentomic) Division, 8 Nov 1957, pp. 4-5, 13-16.

34. Report, 25th Infantry Division, subj: ROCID Artillery, 1 Nov 1957, pp. 1, 3, Annex A, Annex F, Annex J.

conventional battlefield, and had to rely on nuclear firepower.[35] In a trenchant assessment of the field artillery for the pentomic division, the Commandant of the Artillery and Missile School, Major General Thomas E. de Shazo (1956-1959), wrote in February 1958 that the new pentomic division lacked sufficient firepower for a conventional or nuclear battle and would have difficulties massing fire because of the broad fronts. The pentomic reorganization emasculated the artillery. To resolve this problem de Shazo recommended discarding the 4.2-inch mortar as an artillery weapon, increasing the number of 105-mm. howitzers from thirty to sixty and 155-mm. howitzers from twelve to thirty, and doubling the number of 8-inch howitzers from four to eight and Honest John launchers from two to four. These modifications would expand the number of indirect fire pieces from 48 to 102 and give the artillery enough firepower to fight on a conventional or nuclear battlefield.[36]

By 1958 a general consensus about division artillery for the pentomic division had emerged. Field artillery officers clamored for replacing 4.2-inch mortars with 105-mm. howitzers as direct support artillery in the battle group and placing the division's artillery under one person. These changes would give more flexibility, centralize control, and furnish more responsiveness. Equally important, the reforms would supply the artillery with more firepower by increasing the number of pieces. Field artillery officers, whose whole career depended upon providing fire for the infantry and armor, simply could not bear to allow the number of cannons to dwindle to accommodate the nuclear battle and wanted to readdress the changes wrought by the pentomic reorganizations. They feared that fewer field guns and howitzers meant defeat on the battlefield.[37]

After considering the response from field artillery officers and the requirements for nuclear and conventional warfare, The Artillery and Missile School with permission from the Army restructured the infantry division's artillery but left that in the armored and airborne divisions alone.[38] Seeking greater flexibility and more firepower than pentomic division artillery offered, the school created five direct support composite battalions of one 105-mm. howitzer battery (six howitzers) and one 155-mm. howitzer battery (six howitzers) each. Three of the battalions were towed, while the other two were self-propelled. Division artillery had 2,260 officers and men, while the towed battalions had 24 officers, 3 warrant officers, and 311 men. Self propelled battalions had 23 officers, 3 warrant officers, and 291 men, while battery organization varied according

35. Report, 25th Infantry Division, subj: ROCID Artillery, 1 Nov 1957, Appendix 5, Annex 4; Ltr, The Artillery and Guided Missile School to CG, US Continental Army Command, subj: Reorganization of the Infantry Division Artillery, 6 Feb 1958; Ltr, HQ 7th Infantry Division, to CG, US Continental Army Command, subj: Evaluation of New Infantry Division, 11 Dec 1957, with Enclosures, in Morris Swett Library.

36. Ltr, The Artillery and Guided Missile School to CG, US Continental Army Command, subj: Reorganization of the Infantry Division Artillery, 6 Feb 1958, with Enclosures.

37. Ltr, Arthur J. Read, US Army Infantry School, to LTC Tom Donnell, US Army Artillery and Missile School, 14 Jan 1958, with enclosures, in Morris Swett Library; Ltr, 1st Infantry Division to CG, US Continental Army Command, subj: Evaluation of New Infantry Division, 1 Aug 1957, with enclosures, in Morris Swett Library; Lt Col Arthur W. Knott, "The New Infantry Division Artillery," *Artillery Trends*, Mar 1959, p. 3; Report, I Corps, subj: Artillery Conference, 5 May 1958, pp. 53-60, in Morris Swett Library; Ltr, HQ 7th Infantry Division to CG, Continental Army Command, subj: Evaluation of New Infantry Division, 11 Dec 1957, in Morris Swett Library; Report, 25th Infantry Division, subj: Evaluation of ROCID Artillery, 1 Nov 1957, in Morris Swett Library; Report, 10th Division Artillery, subj: Evaluation of the Artillery of the ROCID Division, 11 Nov 1957, in Morris Swett Library; Ltr, Cmdt, Artillery and Missile School, to CG, US Continental Army Command, subj: Reorganization of the Infantry Division Artillery, 6 Feb 1958, in Morris Swett Library.

38. Marken, "The Atomic Age Division," p. 61.

to the weapon. The school further enhanced flexibility by organizing one general support battalion of 499 officers and men, one 8-inch howitzer battery (four howitzers), and one Honest John battery (two launchers). Altogether, the reform provided the infantry division with sixty-six artillery weapons, more mobility, and greater firepower, assured the battle group commander of having a minimum of one battalion of artillery supporting him, centralized command and control, and corrected the deficiencies of the previous pentomic artillery organization.[39]

Despite these changes, critics still pointed out serious problems with division artillery. Although division artillery had sixty conventional pieces, which were twelve less than the old triangular division had, it did not have enough field pieces to cover the extended fronts created by dispersing units on the battlefield. This restricted the division's ability to fight a conventional war and dictated resorting to nuclear weapons to prevent defeat against a numerically superior and well-armed opponent. Moreover, maneuvers indicated that the division was more suitable for the defense than for the offense because the battle groups were larger than a battalion but smaller than a regiment and lacked the power to maintain a drive. To fight a sustained operation commanders had to strip combat units to bolster service support units.[40]

Notwithstanding problems with the pentomic division, the Army reached an important milestone late in the 1950s. Through a crash modernization program the Army introduced nuclear weapons and developed a force structure to fight on the nuclear battlefield. Yet, fighting on the nuclear battlefield would be difficult for the field artillery. The Army had towed and self-propelled artillery with insufficient range, lethality, traverse, elevation, and mobility for nuclear warfare. Research and development programs initiated earlier in the 1950s to produce artillery suitable for the nuclear battlefield had not yielded any results as the fifties drew to a close. At the same time, the 280-mm. gun was cumbersome and difficult to move, while the Corporal missile was an unwieldy forty-six feet long and awkward to fire. Moreover, the Honest John rocket was inaccurate and too heavy to be transported by air, which was critical for a division artillery weapon. Although tactics, doctrine, and organization placed a heavy emphasis on nuclear warfare, the field artillery's nuclear weapons were too destructive, clumsy, and inaccurate to be employed effectively on a mobile battlefield, while its conventional weapons were antiquated.[41]

Criticisms from soldiers and civilians about an army that depended on nuclear weapons and would have difficulties fighting a conventional battle, the inadequacies of the pentomic division, and the Kennedy administration's support of flexible response as espoused by General Maxwell D. Taylor, Chief of Staff (1955-1959), prompted reorganizing the division.[42] Directed by General

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39. Knott, "The New Infantry Division," pp. 3-6; *Artillery Trends*, Mar 1959, p. 4.

40. Ney Report, p. 74; Bacevich, *The Pentomic Era*, pp. 13235.

41. Col Jack F. Diggs, "The Future of Cannon," *Artillery Trends*, Nov 1961, p. 21-22; "Standard Field Artillery Weapons Chart, *Trends in Artillery*, Oct 1957, p. 86; Marvin L. Worley, Jr., *A Digest of New Developments in Army Weapons, Tactics, Organization, and Equipment* (Harrisburg, Pa: The Military Service Publishing Company, 1958), pp. 8-34; Artillery and Missile School, Field Artillery Weapons, Nov 1960, pp, 6-16; "Field Artillery Weapons," *Artillery Trends*, Jul 1963, pp. 4-5, 30-32; *Artillery Trends*, Feb 1959, pp. 3-8; Bacevich, *The Pentomic Era*, pp. 82, 84, 86, 93, 94.

42. S.L.A. Marshall, "Arms in Wonderland," *Army*, Jun 1957, p. 19; Bacevich, pp. 129-42; Col Francis X. Bradley, "The Fallacy of Dual Capability," *Army*, Oct 1959, pp. 19-22; Col (later Lieutenant General) Arthur S. Collins, "The Other Side of the Atomics," *Army*, Nov 1959, pp. 18-19; Col (late General) William E. DePuy, "The Case for Dual Capability," *Army*, Jan 1960, pp. 32-38; Boyd L. Dastrup, *The US Army Command and General Staff College: A Centennial History* (Manhattan, Ks: Sunflower University Press, 1982), p. 108; Bacevich, *The Pentomic Era*, pp. 129-42.

George Decker, Army Chief of Staff (1960-1962), the Army developed the Reorganization Objective Army Divisions (ROAD) early in the 1960s to fight across the entire spectrum of conflicts.[43] Even though ROAD established four different divisions—infantry, armored, airborne, and mechanized, they shared a common division base of a division headquarters, three brigade headquarters, division artillery, a support command, aviation, engineer, and signal battalions, an armored cavalry squadron, and a military police company. Artillery for infantry, armored, and mechanized infantry divisions consisted of three 105-mm. howitzer battalions (fifty-four guns) with three batteries each and a composite battalion of three 155-mm. howitzer batteries (eighteen guns) and an 8-inch howitzer battery (four guns) and one rocket battalion of two Honest John batteries of two launchers each. This gave ROAD divisions twelve more conventional field pieces than the Pentomic division had and improved the field artillery's ability to fight on the conventional battlefield. Unlike the other divisions, the airborne division had three 105-mm. howitzer battalions of three batteries each (fifty-four howitzers) and one 155-mm. howitzer/rocket battalion of two Little John rocket batteries of two launchers each and one 155-mm. howitzer battery (six howitzers). Equally important, the reorganization provided self-propelled artillery for armored and mechanized infantry divisions and towed artillery for infantry and airborne divisions. The type of field piece in turn influenced the number of personnel in each division's artillery because self-propelled artillery required fewer people to operate. For example, the infantry division's artillery had 2,542 officers and men, while the armored and mechanized divisions' artillery had 2,437 officers and men. In comparison, the airborne division's artillery had only 1,976 officers and men.[44]

A varying number of maneuver battalions grouped into brigades completed the division. Although this represented a return to the triangular regimental system of World War II and the Korean War, the ROAD brigade was strikingly different. It had a highly flexible headquarters with battalions attached according to the mission.Generally, an infantry division had eight infantry battalions and two armored battalions. An armored division possessed six armored battalions and five mechanized infantry battalions. A mechanized infantry division consisted of three tank battalions and seven or more mechanized infantry battalions, and an airborne division had nine airborne infantry battalions.[45] Lacking organic battalions, the division commander could tailor his command by attaching battalions to the brigades to fit a particular situation or mission. The commander could even form a brigade into a powerful independent force by attaching the desired combat battalions and adding select elements from the division base.[46]

By design the ROAD reorganization ended the Army's reliance upon nuclear firepower. Because of the ability to mix nuclear and conventional arms, commanders could fight any intensity

43. Lt Col William H. Zierdt, Jr., "The Structure of the New Army Divisions," *Army*, Jul 1961, p. 49.

44. Field Manual 61-100, 4 Jan 1962, p. 22; "Field Artillery Organizations," *Artillery Trends*, Jul 1963, pp. 43-53; Andrew F. Krepnevich, Jr., *The Army and Vietnam* (Baltimore: The Johns Hopkins University Press, 1986), p. 116; *Artillery Trends*, Aug 1961; Department of the Army Pamphlet 355-200-13, Mar 1963, pp. 1-5.

45. Ney Report, pp. 76-78.

46. Department of the Army Pamphlet, 355-200-13, 1963, p. 6; House, *Toward Combined Arms Warfare*, p. 160; See Lt Col Forrest K. Kleinman's "Road Sign for Big Sixes" and "On The Road to ROAD," *Army*, Jul 1962, for additional information.

of warfare. Although units had to be prepared to fight a nuclear war, ROAD doctrine emphasized moving from the conventional to the nuclear battle rather than from the nuclear to the conventional as pentomic doctrine had stressed. With the flexibility offered by the ROAD division, the difficulty of converting from one to the other did not threaten commanders as much.[47]

The appearance of new field pieces also altered the field artillery early in the 1960s. To replace existing weapons the Army introduced self-propelled M108 105-mm., M109 155-mm., M110 8-inch howitzers and M107 175-mm. gun and towed M102 105-mm., M114 155-mm., and M115 8-inch howitzers. The new field pieces had greater ranges, lethality, traverses, and mobility than older weapons and employed point detonating, base detonating, time, and variable time fuses to explode high-explosive, high-explosive antitank, smoke, colored smoke, gas, and illuminating rounds. Only the 8-inch howitzer, the towed 155-mm. howitzer, and 280-mm. gun threw nuclear ammunition. In the meantime, the Army fielded its second generation of rockets and guided missiles (Pershing I, Sergeant, and Little John) and introduced aerial artillery (a helicopter with a rocket system attached) and the Field Artillery Digital Automatic Computer (FADAC) to compute firing data. Nevertheless, obsolete field artillery still remained in the inventory and would have been used during the initial stages of mobilization until sufficient numbers of the new artillery had been produced.[48]

Aerial artillery, also called aerial rocket artillery, represented the most dramatic field artillery innovation of the early sixties. In the search for mobility, the Army explored using the helicopter as the primary combat vehicle for rapid movement. Organized in February 1963 for testing the airmobile concept on the conventional battlefield, the 11th Air Assault Division had an air cavalry squadron, infantry, support units, and division artillery and depended upon helicopters for transportation. Division artillery had three towed 105-mm. howitzer battalions (fifty-four howitzers) of three batteries each, a Little John battalion (six rockets) of three batteries each, and an aerial artillery battalion (twelve helicopters) of two batteries. Direct support artillery consisted of 105-mm. howitzers moved by helicopter and had no ground vehicles as prime movers, while general support artillery was composed of Little John rockets, which were transported by helicopter, and aerial artillery. Uninhibited by roads and difficult terrain, aerial artillery demonstrated its ability to follow the contour of the land during the tests of 1963-65, fire its rockets at the target, and then

47. Comparato, *Age of Great Guns*, pp. 309-11; US Army Artillery and Missile School, *Field Artillery Weapons*, 1964, pp. 14-27; Briefing, subj: The New Family of Cannon/Rocket Material, 1961, in Senior Field Artillery Officer Course, 1961, in Morris Swett Library; Briefing, subj: Field Artillery Weapons; Weapons Systems; Organization; Artillery Use of Computers, 1961, in Senior Field Artillery Officer Course, 1961; 2d Lt Lawrence W. Zimmer, "Field Artillery Missiles: Present and Future," *Artillery Trends*, Feb 1959, pp. 3-10; Capt Patrick W. Powers, "The Pentomic Army's Missile Power," *Army*, Jul 1957, pp. 53-58; Maj Gen J.P. Daley, p. 47; Maj DeBow Freed, "Using Our Nuclear Weapons," *Military Review*, Mar 1959, p. 62; "Battalion Fire Volleys: Fire Direction in the New Division Artillery," *Artillery Trends*, Mar 1959, p. 38.

48. "Field Artillery Equipment," *Artillery Trends*, Jul 1963, pp. 4, 5, 30-32; Cpt Paul Donovan, "New Fire Direction Procedures," *Artillery Trends*, Jul 1959, p. 3; "Target Acquisition, Present and Future," *The Artillery Quarterly*, Jun 1957, p. 2; "Artillery Firing Times," *Trends in Artillery for Instruction*, Jun 1957, p. 18; Briefing, subj: History and Development of Army Automatic Data Processing Systems, 1961, in Senior Field Artillery Officer Course, 1961; Briefing, subj: FADAC and FIELDATA Equipment, 1961, in Senior Field Artillery Officer Course, 1961; "Need for Electronic Computers," *Trends in Artillery for Instruction*, Jun 1957, pp. 19-21; "First Round Hits with FADAC," *Artillery Trends*, Sep 1960, p. 9; Lt Col Louis R. Van De Velde, "Computers for Artillery," *Army*, Apr 1960, p. 53.

fly off to engage more targets. Moreover, aerial artillery could fire from the air or ground, furnish direct or indirect fire, enhance the artillery's mobility, and augment tube artillery.[49]

The successful testing of the 11th Air Assault Division and the appearance of the ROAD divisions ended a period of rapid transformation for the field artillery. Despite having the 280-mm. gun and Corporal missile, the field artillery was still designed in 1954 to fight a conventional war similar to World War II. Pressed by massive retaliation, the Army seized the opportunity to join the nuclear age. It introduced more lethal and mobile conventional field artillery, standardized more and better nuclear artillery, started adopting computerized gunnery, formed aerial artillery, and revised tactics, doctrine, and organization to permit fighting a conventional or nuclear battle. As many field artillery officers correctly proclaimed, these developments revolutionized the field artillery.

The Vietnam Years

While the Army modernized its field artillery, a crisis in Southeast Asia attracted American attention. After eight years of fighting to preserve its colonial empire, France finally suffered defeat at the hands of Ho Chi Minh, an ardent Vietnamese nationalist and communist, when Dien Bien Phu fell in March 1954. This along with communist rhetoric about picking up the banner of nationalism by supporting wars of liberation influenced the United States to consider sending troops. Provisional agreements reached at Geneva, Switzerland, prevented this, divided the country at the seventeenth parallel, and scheduled reunification to come through a general election in July 1956.[50]

Fearing that the communists would eventually gain power, the United States began pouring in economic and military aid to buttress South Vietnam against subversion by the Viet Cong, a contraction of Vietnamese Communists, and the threat of invasion by North Vietnam. Although the Army had been sending advisors to Vietnam since the early 1950s, President John F. Kennedy's decision in the spring of 1961 to increase the American commitment greatly expanded the Army's advisory effort. As quickly as the Army could train advisory teams, it dispatched them to South Vietnam. Each field artillery advisory team included an officer, generally a captain, and a senior noncommissioned officer and was assigned to an artillery battalion in South Vietnamese divisions and corps. While the officer provided guidance to improve overall unit effectiveness, the noncommissioned officer assisted the battalion operations officer and operations noncommissioned officer in training firing batteries and gun sections. In the meantime, an American artillery officer, normally a major, was assigned to each corps and division to counsel senior South Vietnamese commanders on artillery matters and coordinate the efforts of the advisory teams in subordinate battalions. Although the Americans faced soldiers with a different set of values, they produced a better led and trained South Vietnamese artillery by 1965 than the one encountered in 1961.[51]

In the meantime, North Vietnam built a military force to gain control of Vietnam. By the early 1960s North Vietnam had a formidable army that had been organized, equipped, and trained

49. Krepnevich, *The Army and Vietnam*, pp. 112-16; Artillery and Missile School, *Field Artillery Weapons*, 1964; "Field Artillery Weapons," *Artillery Trends*, Jul 1963, pp. 4-5, 58-62; David E. Ott, *Field Artillery: 1954-1973* (Washington: Vietnam Studies, Department of the Army, 1975), pp. 51-53.

50. Report on the War in Vietnam, Admiral U.S.G. Sharp, Cmdr in Chief Pacific and General W.C. Westmoreland, Cmdr, US Military Assistance Command, Vietnam, 30 Jun 1968, p. 98, in Morris Swett Library.

51. Ott, *Field Artillery*, pp. 22-37.

along Chinese lines and that relied upon stealth and foot mobility. North Vietnamese divisions had around ten thousand lightly armed and equipped men with a ready reserve of approximately five hundred thousand men. To compensate for the lack of firepower the North Vietnamese stressed rigorous discipline, tactical superiority, and careful preparation. The Viet Cong gave the North Vietnamese another tool to bring down the South Vietnamese government by infiltrating South Vietnam and conducting sabotage, terrorist, and propaganda campaigns.[52]

Encouraged by the deaths of Ngo Dinh Diem, the premier of South Vietnam, and President Kennedy, North Vietnam intensified its political and military offensive against South Vietnam in 1964.[53] To meet the external threat the Army abandoned its defensive strategy for aggressive offensive actions.[54] After a series of limited offensives, General William Westmoreland, Commander, US Military Assistance Command, Vietnam, opened a campaign to counter North Vietnamese moves to cut South Vietnam in half. After an attack on a special forces camp at Plei Me in October 1965, he sent the 1st Air Cavalry Division (Airmobile) under Major General Harry W.O. Kinnard to destroy the retreating North Vietnamese units responsible for the assault.[55]

Late in October 1965, the 1st Cavalry Division moved into the Ia Drang Valley. After several days of searching, the 1/9 Cavalry bumped into the enemy on 1 November. As the fighting grew hotter, the 1st Cavalry quickly concentrated by using the helicopter's mobility, defeated the North Vietnamese, and forced them to retreat. That same day, 1/9 Cavalry's airborne scouts spotted a battalion-size enemy force advancing towards the recent fight.The scouts fired on the North Vietnamese. Without any artillery support the 1/9 Cavalry along with reinforcements airlifted into the battle area repeatedly repulsed enemy assaults. The enemy's proximity to American troops precluded aerial artillery from being employed, while tube artillery was out of range. On 3 November the 1/9 Cavalry squadron began conducting a reconnaissance-in-force along the Cambodian border. After establishing a patrol base, it staked out ambushes to catch North Vietnamese units fleeing to safety. That night the North Vietnamese ferociously hit the 1/9 Cavalry. Aerial artillery and a dogged defense turned back many enemy attacks. Outside of aerial artillery, the 1st Cavalry's field artillery provided minimal support. The short, intense battles fought at distances beyond towed artillery's range simply precluded any help.[56]

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52. George C. Herring, "The 1st Cavalry and the Ia Drang Valley, 18 October-24 November 1965," in Charles E. Heller and William A. Stofft, eds., *America's First Battles, 1776-1965* (Lawrence, Ks: University Press of Kansas, 1986), pp. 300-01; Millet and Maslowski, *For the Common Defense*, pp. 547.

53. Report on the War in Vietnam, Admiral U.S.G Sharp, Cmdr in Chief Pacific and General W.C. Westmoreland, Cmdr, US Military Assistance Command, Vietnam, 30 Jun 1968, p. 98.

54. *Artillery Trends*, Jan 1967, p. 1; Ltr, HQ 2nd Battalion, 32nd Artillery, to CG, US Army Artillery and Missile School, subj: Heavy Artillery in the Guerrilla Warfare Environment, 24 Jan 1966, in Correspondence Received from Vietnam File, in Morris Swett Library; Herring, "The 1st Cavalry and the Ia Drang Valley, 18 October-24 November 1965," p. 306.

55. Herring, *America's Longest War: The United States and Vietnam, 1950-1975* (New York: John Wiley and Sons, 1979), p. 151; Herring, "The 1st Cavalry and the Ia Drang Valley, 18 October-24 November 1965," pp. 303-04; Lt Col Robert H. Scales, "Firepower and Maneuver in the Second Indochina War," *Field Artillery* Journal, Sep-Oct 1986, p. 48; Kinnard, "A Victory in the Ia Drang: Triumph of A Concept," *Army*, Sep 1967, p. 77.

56. Kinnard, "A Victory in the Ia Drang: Triumph of A Concept," pp. 78-83; After Action Report, 1st Cavalry Division, 23 Oct-26 Nov 1965, pp. 45, 51, 54, in Morris Swett Library.

During the second week of November, both sides opened offensives to gain control of the Ia Drang Valley. On 14 November CH47 Chinook helicopter airlifts placed two batteries at Landing Zone Falcon to support the 1/7 Cavalry's offensive at Landing Zone X-Ray. Gun crews concentrated their fire around the landing zone. As tube artillery lifted its fire, aerial artillery blasted the area to allow the infantry to land. This action totally disrupted North Vietnamese plans to attack Plei Me and put them on the defensive. Even though they were surprised, the North Vietnamese slugged the Americans viciously with small arms, rocket, and mortar fire. To repel the assaults the Americans airlifted in reinforcements throughout the day under the cover of artillery fire from Landing Zone Falcon. These bombardments along with small arms fire broke up several attacks during the day. Throughout the night the North Vietnamese continued their attempt to defeat the Americans, but intensive fire from two batteries at Landing Zone Falcon and aggressive fighting by the cavalry repulsed the charges.[57]

The battle at X-Ray carried on over the next two days. On the fifteenth the North Vietnamese repeatedly assaulted the Americans. Small arms fire became so intense that the forward observer from the most hard-pressed American company was pinned down and could not call in artillery fire. Fortunately, the artillery officer located back at 1/7's command post could see the fighting, adjusted artillery fire, and directed aerial artillery attacks and tactical air strikes. Despite effective air and artillery support, the enemy closed in on the perimeter and assailed it from all directions. Using colored smoke rounds to identify the precise outline of his perimeter, Lieutenant Colonel Harold G. Moore, the 1/7's commander, called for additional artillery support. Heavily armed helicopter gunships entered the fray, while the two batteries at Landing Zone Falcon and two at Landing Zone Columbus laid down a devastating shield of iron. This combination broke the enemy's attacks for the day. The following day, the North Vietnamese renewed their assaults but ran into a curtain of artillery rounds. Using this as protection, the Americans then pushed towards the North Vietnamese, who retreated.[58]

On the seventeenth the 2/7th Cavalry and the 2/5 Cavalry, which had joined Moore's command on the fifteenth at X-Ray, moved on a sweep north to cut off North Vietnamese elements moving towards Columbus and Falcon. The 2/5 Cavalry arrived at Columbus without contacting the enemy, but the 2/7 Cavalry bumped into North Vietnamese at Landing Zone Albany. The engagement quickly deteriorated into a wild melee. Unable to distinguish between friend and foe, gun crews from Landing Zone Columbus and airmen waited patiently for hours before they could respond. In mid-afternoon aerial and tube artillery and tactical air support joined the fight. Although the enemy applied pressure into the evening, a continuous ring of artillery shells and tactical air strikes kept it from breaching the perimeters. Unable to take such punishment, the

57. Kinnard, "A Victory in the Ia Drang: Triumph of A Concept," pp. 84-86; Scales, "Firepower and Maneuver in the Second Indochina War," pp. 49-50; After Action Report, 1st Cavalry Division, 23 Oct-26 Nov 1965, p. 84; Rpt, CG, 1/7th Cavalry, 1st Cavalry Division (Airmobile), subj: After Action Report, IA DRANG Valley Operation, 1st Battalion, 7th Cavalry, 14-16 November 1965, pp. 3-11, in Morris Swett Library.

58. After Action Report, 1st Cavalry Division, 23 Oct-26 Nov 1965, p. 87; Herring, "The 1st Cavalry and the Ia Drang Valley, 18 October-24 November 1965," p. 319; Kinnard, "A Victory in the Ia Drang: Triump of A Concept," pp. 86-87; Scales, "Firepower and Maneuver in the Second Indochina War," p. 50; Rpt, CG, 1/7th Cavalry, 1st Cavalry Division (Airmobile), subj: After Action Report, IA DRANG Valley Operation, 1st Battalion, 7th Cavalry, 14-16 November 1965, pp. 13-15.

North Vietnamese finally abandoned their drive to destroy the artillery that had been so destructive at X-Ray. The North Vietnamese hit Columbus with mortar and machine gun fire on 18 November and battled the Americans at several other locations, but the fighting at Albany marked the last of major combat in the Ia Drang.[59]

After the Battle of Ia Drang, General Kinnard had nothing but praise for his field artillery. "Using Chinooks, we had been able to position tube artillery in the midst of a literally trackless jungle where it provided close support to our infantry and gave them a vital measure of superiority," Kinnard wrote in *Army* in 1967.[60] Besides lauding tube artillery, he boasted that aerial artillery had matured in the Ia Drang by supplementing tube artillery and in some cases providing the only firepower. Taking his argument even further, Kinnard insisted that the 1st Cavalry lured the enemy into battle by teasing it with a "seemingly unprotected airmobile infantry battalion." Once the enemy struck, the 1st Cavalry hit it hard with "massive artillery support."[60] Simply stated, the battles of Ia Drang vindicated the airmobile concept and showed the field artillery's capacity to provide close support in difficult terrain.[61]

Lieutenant Colonel Lloyd J. Picou of the 1st Cavalry's artillery responded with the same enthusiasm. Writing in *Artillery Trends* in August 1967, Picou explained that airmobile artillery proved its versatility and mobility, its ability to displace quickly, and its mastery of airmobile artillery techniques.[62] The following year, Picou explained in *Military Review*, "From the division artillery viewpoint, the most significant outcome of this campaign [Ia Drang] was the use of aerial artillery."[63] Aerial artillery gunships flew to the scene and were able to locate and attack enemy forces. Pilots contacted ground units and then adjusted tube artillery on the fringes of the battlefield. As his article indicated, he believed that the field artillery had made a significant breakthrough with aerial artillery because it provided effective support to airmobile units.[64]

The Army and 1st Cavalry Division drew two more conclusions. Both pointed out that operations in the Ia Drang revealed the importance of having mutually supporting field artillery positions.Towed 105-mm. howitzers could not be used in a direct fire role on a landing zone surrounded by dense vegetation without causing extensive casualties to the security force. To protect one landing zone and its batteries, the field artillery had to site at least two batteries within range of each other. Because of guerrilla warfare, commanders simply could not position their field artillery without adequate protection.[65]

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59. After Action Report, 1st Cavalry, 23 Oct-26 Nov 1965, pp. 93-94; Herring, "The 1st Cavalry and the Ia Drang Valley, 18 October-24 November 1965," p. 320; Kinnard, "A Victory in the Ia Drang: Triumph of A Concept," pp. 88-89; Ott, *Field Artillery*, pp. 94-95.

60. Kinnard, "A Victory in the Ia Drang: Triumph of A Concept," p. 85.

61. After Action Report, 1st Cavalry, 23 Oct-26 Nov 1965, Forward.

62. Lt Col Lloyd J. Picou, "Airmobile Artillery in Combat," *Artillery Trends*, Aug 1967, p. 20. *Artillery Trends* was a small journal published by the Artillery and Guided Missile School during the late 1950s, 1960s, and early 1970s. During those years the journal went by several different names: *The Artillery Quarterly, Trends in Artillery for Instruction*, and The *Field Artilleryman*. Basically, the journal was designed for in-house use by instructors at Fort Sill and not for wide distribution.

63. Picou, "Artillery Support for the Airmobile Division," *Artillery Trends*, Oct 1968, p. 7.

64. *Ibid.*, p. 9.

65. After Action Report, 1st Cavalry, 23 Oct-26 Nov 1965, p. 127; Report, US Army, Vietnam, subj: Battlefield Report: A Summary of Lessons Learned, undated, pp. 52, 55, in Morris Swett Library.

In their efforts to justify airmobile operations, Kinnard and other officers overlooked an important weakness. During the short but intensive battles on 1 and 3 November between small forces, tube artillery failed to furnish any support because it was out of range of the fights whereas aerial artillery rushed quickly forward to hit enemy units. Even though it was transported by helicopter, tube artillery lacked sufficient mobility to respond to fast-moving situations. This meant that the infantry and cavalry would have to fight alone on the enemy's terms unless they were under a protective umbrella of fire support. Likewise, firepower succeeded only because the North Vietnamese stood and fought. Although firepower was a decisive factor, it had limitations. Late in 1965, it could not be applied at will.

Because Ia Drang acquainted the enemy with American firepower and influenced it to avoid such encounters in the future, the Army had to inaugurate search-and-destroy operations in 1965-66 to ferret out the enemy.[66] For example, covered by 105-mm. and 155-mm. howitzer batteries positioned in the mountains bordering the Bong Son River, assaults by the 3rd Brigade, 1st Cavalry, landed south of the river on 28 January 1966 to deceive the enemy, attacked northward over the river with the Vietnamese Airborne Brigade, and destroyed two enemy battalions. On 6 February as a battalion of Marines sealed off the north end of the An Loa Valley to prevent the enemy from escaping, the division's 2nd Brigade air assaulted into An Lao Valley. As the 2nd Brigade opened a thrust south down the valley, the rest of the division pushed rapidly southwest of Bong Son.[67]

This rapid sweep taxed the 1st Cavalry's artillery's ability to support the maneuver elements. Even though field artillery officers tried to minimize displacements, the speed of the ground troops and the size of the area compelled them to make over 160 displacements, which strained the division's air resources. When the pieces were moved by helicopter, field artillerymen generally transported ammunition and guns separately. To economize and speed up displacements they devised a system of using one helicopter to carry both. They suspended the ammunition and the howitzer beneath the helicopter by means of a double-sling system to allow the transportation of a complete firing section. By doing this, field artillerymen reduced the time required to occupy a position and dispelled fears about the field artillery's inability to keep up with the other combat arms on a highly mobile battlefield.[68]

Even though 1st Cavalry field artillerymen could maneuver their 105-mm. howitzers around, they wanted still more firepower. Without suitable roads 155-mm. howitzers could not occupy positions within range of the objective. To resolve that shortcoming field artillerymen airlifted the howitzers. Using CH-54 Flying Cranes and CH-47 Chinook helicopters and reducing the weight of the 155-mm. howitzer by eliminating unnecessary equipment, the 1st Cavalry flew a four-gun battery a distance of fifteen miles in approximately two hours to provide fire for the ground forces. This movement set an important precedent as it indicated that medium guns could be airlifted and therefore possess the same mobility as lighter pieces had.[69]

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66. Report on the War in Vietnam, 30 Jun 1968, p. I14.

67. Lt Col Lloyd J. Picou, "The Day the Artillery Sprouted Wings," *Army Information Digest*, Nov 1966, pp. 24-25; Ott, *Field Artillery*, pp. 100-01; Rpt, 1st Air Cavalry Artillery, subj: Operation Masher and White Wing (Eagle Claw), 14 Mar 1966, pp. 46 in Morris Swett Library; 1st Air Cavalry: Memoirs of the First Team, Vietnam, August 1965-December 1966 (Tokyo: Dia Nippon Printing Company, Ltd, n.d.), pp. 30-32.

68. Ott, *Field Artillery*, pp. 105-06; After Action Report, 1st Air Cavalry Division Artillery, 16 May 1966, p. 10, in Morris Swett Library.

69. Picou, "Artillery Support for the Airmobile Division," *Military Review*, Oct 1968, pp. 9-10.

During those early days of 1966, field artillerymen in the 1st Cavalry also developed new tactics for aerial artillery. While tube artillery was adjusted on a target, aerial artillery orbited as near as possible. If any enemy tried to escape, aerial gunners fired on them. Whenever possible or appropriate, the pilots adjusted tube artillery to flush personnel into the open and then attacked. The ability to airlift towed 105-mm. and 155-mm. howitzers and the rapid response of aerial artillery signified important changes in tactics. The 1st Cavalry had the capability to maneuver their artillery aggressively on the battlefield to destroy the enemy and refused to allow difficult terrain to hinder delivering huge amounts of firepower upon enemy positions.[70]

The war concurrently forced the field artillery to refine certain gunnery techniques. In past wars field artillerymen could predict the enemy's moves because they were primarily confined to a sector and could be plotted on a map with some degree of accuracy. Vietnam changed this. Because of the North Vietnamese and Viet Cong practice of hitting from any direction at any time, gun crews had to respond quickly and deliver fire in a full circle.[71] Realizing that existing procedures were inadequate, gun crews improvised their own to furnish fire in a complete circle. This created varying ways. To eliminate confusion The Artillery and Missile School devised a method to fire in a complete circle in 1966 and disseminated it throughout the Army.[72] Moreover, the school increased its instruction time on firing in a complete circle (6400-mils) to prepare graduates better for combat in Vietnam.[73]

As important as technique was, suitable field pieces facilitated firing in a complete circle. The M108, M109, and M102 howitzers had the capability of traversing 360 degrees with ease, offset the limited traverses of other field guns, such as the 8-inch howitzer and 175-mm. gun, and complemented the revised 6400-mil firing chart.[74]

Although search-and-destroy operations of late 1965 and early 1966 were successful, the Army still had difficulties protecting the countryside. To ensure that the maximum area was defended by available troops, the Army assigned an area of operations to each unit from the highest to the lowest. This dispersed the Army throughout the countryside. Because of the size of the brigade's area and range limitation, the division artillery commander attached a battery to a particular battalion to provide the maximum coverage. Consequently, an artillery battalion no longer supported an entire brigade as it had done in previous wars. This habitual association decentralized fire direction from the battalion to the battery and frequently isolated the battery from the rest of its battalion. Addressing this development, Brigadier General James G. Kalergis, Commander, I Field Force Vietnam Artillery, explained in 1967 that field artillery batteries normally performed

70. Picou, "Artillery Support for the Airmobile Division," p. 11; Report, 1st Air Cavalry Artillery, subj: Operation Masher/White Wing (Eagle Claw), 14 Mar 1966, p. 5.

71. *Ibid.*

72. Ltr, 3rd Bn, 18th Artillery, to US Army Artillery and Missile School, subj: Artillery Employment, 8 Aug 1966, in Lessons Learned, 18th Artillery File, in Morris Swett Library; Report, US Army, Vietnam, subj: A Summary of Lessons Learned, 30 Aug 1965, p. II-1, in Morris Swett Library; Report, US Army, Vietnam, subj: A Summary of Lessons Learned, undated, p. 55, in Morris Swett Library.

73. "Simple Solution to 6400-mil Charts," *Artillery Trends*, Jan 1967, p. 11.

74. Report, Maj Gen Charles P. Brown, Cmdt, The Artillery and Missile School, 11-24 Sep 67, in Morris Swett Library; "Field Artillery Equipment," *Artillery Trends*, Jul 1966, pp. 3-11.

as if they were battalions and that battalions acted as if they were division artillery or group headquarters. This transferred the authority to make key decisions from the battalion commander or higher to the battery commander. For example, Operation Fitchburg of late 1966 and early 1967 in Tay Ninh Province gave the battery commander "an excellent opportunity to exercise command and control independent of the artillery battalion" because one 105-mm. howitzer battery was placed in direct support of each maneuver element.[75]

Commanders permitted batteries to operate independently because the war was basically a small unit conflict and was being fought over a large area. Although commanders preferred to keep fire direction under the battalion's control, batteries had to be able to direct their own fire since they were often employed piecemeal into battle. In some cases, batteries fragmented operations even more by assigning part of their guns for base camp defense and the other for tactical employment.[76]

Because of operations over vast areas, numerous displacements, short, violent actions, and an undefinable front and rear in 1965-66, the field artillery found the battery-battalion arrangement to be logical and to provide fast, accurate fire. As a result, the enemy feared American field artillery and made batteries prime targets for infiltration or full-scale attacks. Unable to perform their missions and protect themselves simultaneously, field artillerymen created fire support bases by positioning their pieces with the command post of a maneuver battalion. From these positions located so that any point in the area of operations could be reached by at least one battery and usually two or more, the maneuver commander conducted offensive operations, while field artillery, ranging from 105-mm. howitzers to 175-mm. guns, furnished fire support and helped defend other fire bases as required. This arrangement guaranteed a rapid response by the artillery when called upon, simplified furnishing fire support in guerrilla warfare, and saved lives. The base along with the availability of naval gunfire and tactical air gave the Army the capacity to rain deadly fire and reinforced the growing trend of relying upon firepower rather than maneuver for defeating the enemy.[77]

Most commanders concluded that the overriding lesson of 1965-66 was the importance of firepower. As the battles indicated, American ground forces were vulnerable when they lacked fire support. Because of that, many commanders reluctantly operated beyond their artillery or tactical air support and refused to fight on equal terms with the enemy.[78] Commenting on this, Brigadier General Willard Pearson, Commander, 1st Brigade, 101st Airborne Division, wrote in December 1966 that his unit's motto was "Save Lives, Not Ammunition."[79] Given this, he wrote

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75. After Action Report, 196th Light Infantry Brigade, 25 Nov 1966-8 Apr 1967, p. 3, in Morris Swett Library; Piccu, "Airmobile Artillery in Combat," pp. 12-14; Memorandum for CG, I FFORCEV Artillery, 5 Dec 1967, in Ltr, HQ I FFORCEV, to Brig Gen John J. Kenney, Asst Cmdt, Artillery and Missile School, 4 Jan 1968, in Morris Swett Library.

76. Memorandum for CG, FFORCEV Artillery, 5 Dec 1967; DF, subj: Observations of Artillery Operations in Vietnam, 14 May 1968, Tab A, in Morris Swett Library.

77. Bruce R. Palmer, Jr., *The 25-Year War: America's Military Role in Vietnam* (Lexington, KY: The University Press of Kentucky, 1984), p. 158; Report on the War in Vietnam, 30 Jun 1968, p. 120; Ltr, HQ 3rd Bn, 319th Artillery, to Cmdt, US Army Artillery and Missile School, 15 Jan 1966, in Correspondence Received from Vietnam File, in Morris Swett Library; Ott, *Field Artillery*, pp. 42-45; Piccu, "Airmobile Artillery in Combat," pp. 12-18; Cpt F.H. Hemphill, Jr., "Defense of the Artillery Battery," *Artillery Trends*, Jan 1967, pp. 27-32; Col R.E. Cavazos, et al., *Analysis of Fire and Maneuver in Vietnam, Jun 1966-Jun 1968* (Carlisle Barracks, Pa: US Army War College, 1969), pp. II-16-25; Capt Gary J. Pieringer, "Countering the Sappers," *Field Artillery*, Aug 1988, p. 6; Ott, *Field Artillery*, pp. 55-58, 238.

78. Doughty, *The Evolution of US Army Tactical Doctrine, 1946-1976*, pp. 36-38.

79. Pearson, "Find 'em, Fix 'em, Finish 'em," *Army Information Digest*, Dec 1966, p. 19.

in December 1966 that the ground forces' main task involved finding the enemy. Artillery and air power had the responsibility of defeating, routing, or destroying the enemy. In December 1966 he admitted, "Our airmobile operations and fire support then become the mainstay of our offensive."[80] Along with other commanders, Pearson insisted that massive artillery and air fire were the most effective ways to crumble enemy resistance. Although some officers opposed such a tactic, most commanders valued firepower because it preserved lives. A memorandum for General Kalergis pointed out "There is not [a] price tag in [on] the life of a US soldier; massive use of artillery, air and naval support will save US lives. . . ."[81]

The war in 1965-66, therefore, forced the field artillery to modify tactics and organization. Without a front line gun crews did not have the luxury of establishing positions in the rear areas, had to fire in a complete circle, had to defend themselves from infiltrators, had to airlift their pieces into remote areas, and had to decentralize their batteries through habitual association to provide support in many cases. Even though habitual association created fierce loyalties between the infantry and field artillery, it made massing battalion and division fire difficult and elevated the importance of the battery fire direction center. Despite these adaptations during the heat of combat, the field artillery gave prompt, reliable support. Along with the pressure from public opinion to preserve lives, by 1966 the Army made field artillery, naval, and air firepower more important than maneuver since infantry, armor, and cavalry units would not conduct operations unless they were under the protective umbrella of fire support.

Battles in 1967 and 1968 also reflected this preoccupation with firepower. Despite the success of the search-and-destroy operations in 1966, hostile bastions still dotted South Vietnam. Carefully situated in hard-to-reach areas—jungles, mountains, and swamps—and provided with escape routes, the bastions furnished the enemy excellent bases from which they assaulted South Vietnam. Since the Iron Triangle was a formidable arrow tip pointing straight at Saigon, the Army decided late in 1966 to destroy that preserve even though previous attempts had failed. Early in January 1967, the 1st Infantry Division, the 25th Infantry Division, the 173rd Airborne Brigade, the 11th Armored Cavalry Regiment, and separate battalions of the Army of the Republic of Vietnam opened Operation Cedar Falls. The units moved into pre-arranged positions around the Triangle to seal it off and attacked.[82] As expected, main force Viet Cong units dispersed as the Americans and South Vietnamese pushed into the bastion. Although enemy resistance was light, the field artillery fired missions from bases ringing the area of operations to seal off escape routes or reduce small points of resistance and fiercely shelled landing zones. Nevertheless, division artillery commanders had difficulty locating moving units and coordinating supporting fires. Because of this, the 1st Division's artillery commander delegated fire control to commanders of direct support battalions, who helped convert the Iron Triangle from a haven into a no man's land by the end of January.[83]

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80. *Ibid.*

81. Memorandum for CG, I FFORCEV, 5 Dec 1967; Scales, "Firepower and Maneuver in the Second Indochina War," p. 53.

82. Ott, *Field Artillery*, p. 110; David R. Palmer, *Summons of the Trumpet: US-Vietnam in Perspective* (San Francisco: Presido Press, 1978), pp. 134-37; LTG Bernard W. Rogers, Cedar *Falls-Junction City: A Turning Point* (Washington: Department of the Army, 1974), pp. 16-17.

83. After Action Report, 173rd Airborne Brigade, 25 Feb 1967, pp. 3-4, in Morris Swett Library; After Action Report, 1st Division, 13 Mar 1967, Annex F, in Morris Swett Library; Rogers, pp. 24-43, 75-76.

Shortly thereafter, the Army launched another multi-division operation called Junction City. For years the insurgents had a major stronghold along the Cambodian border from which they had hit the South Vietnamese. Late in February, the Americans surrounded the area with eighteen battalions and thirteen mutually supporting fire bases and conducted search-and-destroy operations over the next three weeks.[84]

Junction City culminated with the battles of Ap Bau Bang II, Suoi Tre, and Ap Gu. In each case Viet Cong forces attacked American fire bases with mortar rounds, rifle grenades, rockets, and recoilless rifle fire. To fight off the assaults the Americans employed small arms fire, field artillery, and air strikes. According to Brigadier General David E. Ott, Commander, 25th Division's artillery, the most significant artillery action occurred around Fire Support Base Gold during the Battle of Suoi Tre. As infantry patrols swept around the base on 21 March, they bumped into a Viet Cong force that was preparing to assail the base. The accidental confrontation prematurely triggered a violent enemy attack. To defend themselves American gun crews levelled their tubes and spewed beehive rounds (canister rounds filled with hundreds of metal darts) into the Viet Cong. At point-blank range round after round hit the assaulting force as batteries from other bases threw up a continuous wall of shells around the perimeter and as air strikes pounded the attackers. This demonstration of firepower along with small arms fire compelled the Viet Cong to withdraw.[85]

As Lieutenant General Bernard W. Rogers, who was the assistant division commander of the 1st Infantry Division in 1967, recalled in 1974, Cedar Falls/Junction City operations confirmed the importance of field artillery and air power. They verified the need to get as much firepower on the enemy as quickly as possible and to use artillery and air strikes simultaneously. Equally important, these operations reemphasized the value of 105-mm. howitzers because of their rapid-fire capabilities and strengthened the requirement for mutually supporting bases.[86]

In *Summons of the Trumpet: US-Vietnam Perspective* (1978), David R. Palmer, an advisor to the Vietnamese Military Academy and Vietnamese armor units during the Vietnam War, caught the essence of the transformation of Army tactics caused by the drive for fire support. By 1967 only a foolhardy or a desperate commander would ever engage the enemy by any means other than firepower. Early drifts towards this mentality started in Ia Drang and culminated in 1967. Even though Army doctrine still called for fire and maneuver, practice in Vietnam differed considerably. Commanders located the enemy with infantry and then attacked with field artillery and air strikes. After leaving Vietnam General Westmoreland criticized this routine vigorously when he admitted that artillery and air power had produced a firebase psychosis.[87]

In 1968 the North Vietnamese abandoned their strategy of a protracted war. Within twenty-four hours after the beginning of Tet, on 30 January 1968 Hanoi launched a series of attacks from the demilitarized zone to the southern tip of Vietnam. The Viet Cong and North Vietnamese struck six major cities, sixty-four district capitals, and fifty hamlets and caught the Americans and

84. Rogers, *Cedar Falls-Junction City*, pp. 83, 103, 107, 110.

85. Rogers, *Cedar Falls-Junction City*, pp. 129-40; Ott, *Field Artillery*, pp. 113-18.

86. Rogers, *Cedar Falls-Junction City*, p. 156.

87. Palmer, *Summons of the Trumpet*, pp. 140-46.

South Vietnamese off guard. In Saigon the Americans and South Vietnamese repulsed the initial assaults and cleared the city within several days. A similar pattern emerged in other places with the exception of Hue. After three weeks of heavy bombing and intensive artillery fire, the Americans and South Vietnamese finally liberated the city.[88]

Generally, post-Tet operations reflected past counter-guerrilla operations. Enemy tactics compelled the resumption of small unit actions, ranging from squad- to company-size. As the other combat arms scoured the countryside, gun crews supplied close support by shelling enemy positions. As a means to extend offensive operations, the Army conducted artillery raids from fire bases into remote areas by displacing artillery to supplementary positions and quickly withdrawing. Normally, a raid included one 105-mm. howitzer battery, one understrength 155-mm. howitzer battery (three howitzers), one rifle company for security, aerial observers from division artillery, and air cavalry for target acquisition and damage assessment when it was available. Equally important, American field artillerymen created a fourth firing battery in direct support battalions because of the clamor for more firepower and because of a surplus of guns and ammunition and increased the use of FADAC that had been introduced in Vietnam in 1966-67. In fact, FADAC had become the primary means of computing fire data by 1969.[89]

Although FADAC did not eliminate the need for manual computation for backup capability, it greatly altered the field artillery's performance in Vietnam. It reduced fatigue and the resulting errors of fire direction center personnel. By doing this FADAC greatly increased accuracy, decreased response time, and allowed gun crews to fire longer missions and hit more targets with less ammunition. For the field artillery these capabilities were critical because the North Vietnamese and Viet Cong were elusive, used hit-and-run tactics, and engaged the Americans and their allies at close distance with the idea of negating their superiority in artillery, helicopter, and tactical air support.[90]

The war assumed a new dimension following Tet. Even though the North Vietnamese did not achieve their objective, their ability to initiate such an offensive stimulated a great debate in the United States. For many Americans the offensive symbolized the senseless destruction of the war. For the military Tet presented a golden opportunity to crush the Viet Cong and North Vietnamese because they were weakened by that great effort. Seeking to take advantage of the enemy's condition, Westmoreland proposed a two-fisted offensive, a ground attack against sanctuaries in Laos and Cambodia and an intensive bombing campaign. In contrast, Pentagon civilians urged shifting from search-and destroy operations to population security by deploying the bulk of the military forces along the demographic frontier, a line just north of the major population centers. From here the military would defend against a major North Vietnamese thrust and engage in limited offensive operations to keep the enemy off balance. Pentagon civilians

88. Herring, *America's Longest War: The United States and Vietnam, 1950-1975*, pp. 185-87.

89. Ott, *Field Artillery*, pp. 157-69, 184-88; Maj Robert E. Gilbert, "FADAC," *Artillery Trends*, May 1968, p. 45; Maj Martell D. Fritz, "Revised Programs for FADAC, *Artillery Trends*, Apr 1969, p. 36; Lt Gen Richard G. Stilwell, "Evolution in Tactics: The Vietnam Experience," *Army*, Feb 1970, p. 21; Lt Gen Frank T. Mildren, "From Mekong to DMZ: A Fighting Year for the US Army's Best," *Army*, Nov 1968, p. 88.

90. Lt Col Matthew J. Ringer and Maj Martell D. Fritz, "FADAC Computations versus Manual Computations," *Artillery Trends*, Apr 1969, p. 40; Mildren, "From Mekong to DMZ," p. 88.

also wanted the South Vietnamese to assume more responsibility for their own defense and hoped to end the war through negotiation rather than a resounding military victory. Even though the military bitterly denounced this position and warned that it would produce certain disaster, President Lyndon B. Johnson's administration accepted it in March 1968, an election year. Because of his opposition to expanding the war, President Johnson cut back bombing, informed the South Vietnamese that they had to shoulder more of the burden for defending themselves, and launched a peace initiative to create an independent, non-communist South Vietnam.[91]

Although the Army continued fighting into 1973, Vietnamization changed the field artillery's primary mission. Beginning early in 1969, the Americans upgraded assistance programs to improve South Vietnamese artillery operations, allowed the South Vietnamese to function independently, and launched equipment modernization and training programs. Despite these efforts and those that strengthened the South Vietnamese army as a whole, South Vietnam finally collapsed in 1975 in the face of a determined North Vietnamese onslaught.[92]

Even though the Vietnam War demonstrated the Army's flexibility to move from its preoccupation with nuclear war to unconventional war, it also revealed the Army's growing reliance upon firepower. Exploiting new field pieces coming off production lines and FADAC and dusting off forgotten techniques, field artillerymen delivered unprecedented accurate fire to shatter enemy attacks and seal off the battlefield and showed their ability to furnish huge quantities of fire. Ironically, the Army's past conditioned soldiers to see firepower—artillery, naval guns, and tactical air—as the preferable solution.

Additionally, the Vietnam War highlighted the inherent shortcomings of consolidating the field and coast artillery. Following the closing of the Seacoast Artillery School in 1950 and disbanding of coast artillery units or converting them to field or antiaircraft artillery that same year, only field and antiaircraft artillery (called air defense artillery after 1957) existed as part of the Army's artillery. Because of the growing divergence of techniques, tactics, doctrine, equipment, and materiel for the two artilleries, the Continental Army Command outlined a plan in 1955 to develop basic courses in field artillery and antiaircraft artillery for new officers. Integrated basic and advanced officer courses, which had been initiated in 1947, had failed to provide officers with adequate preparation to serve effectively in either artillery.[93] With support from the Army's Assistant Chief of Staff for Training, the Continental Army Command created basic courses for the two artilleries in 1957 but reintegrated basic officer training in 1958 through 1961 because of the lack of officers and money.[94] In the meantime, the Continental Army Command retained the integrated artillery advanced course for officers with five to eight years of experience because

91. Herring, *America's Longest War: The United States and Vietnam, 1950-1975*, pp. 189-97, 204-05.

92. *Ibid.*, pp. 227-52.

93. Ltr, HQ Continental Army Command to Assistant Chief of Staff, G3, 9 Feb 1955, in The Artillery Center, Integration of the Artillery Schools, in Morris Swett Library, Fort Sill; "The Artillery Branch Study," pp. 35, 36, 41, in Morris Swett Library; Disposition Form with Enclosures, subj: Integration of the Artillery, undated, in US Artillery Center, "Consolidation of the Artillery School;" "Army Reorganization," *Antiaircraft Journal*, Jul-Aug 1950, p. 27.

94. "The Artillery Branch Study," p. 61.

of pressure to maintain flexibility in officer assignments.[95]

The pressure to end integrated training and form field artillery and air defense artillery as two distinct combat arms branches mounted. Based upon the report of the Army Officer Education and Review Board of 1958, the Continental Army Command reintroduced separate basic officer courses in 1962 because of the need for specialized training for new officers. Because the Army wanted flexibility to shift experienced artillery officers easily between field and air defense artillery units, the command retained the integrated advanced course. As a part of the advanced course, student officers received instruction at the Artillery and Guided Missile School and the Air Defense School at Fort Bliss, Texas. In a student thesis at the Army War College in 1963, Colonel William F. Brand pointed out that integrated training provided an inadequate amount of time for detailed instruction on all artillery weapons, which meant that officers left the advanced course without mastering any of the weapons. As a result, Colonel Brand urged separate training for field artillery and air defense artillery. At the direction of the Commanding General, Continental Army Command, the Artillery and Guided Missile School and the Air Defense School explored the desirability of dividing the artillery into two branches. In 1963 the schools recommended separation because of the difficulty of cross training and the growing difference between the two artilleries. In line with this, the authors of "The Artillery Branch Study" of 1966 wrote that integrated training "spawned mediocrity."[96]

In 1965-1967 the demand for field artillery officers with highly professional skills in the Vietnam War finally caused the Army and the Continental Army Command to reorganize the artillery. Because of the one-year tour that left little time for on the-job training, combat in Vietnam required the officer to arrive as a proficient field artilleryman and not a hybrid field and air defense artilleryman. Army commanders in Vietnam simply did not have the time to train an air defense artilleryman to be competent in field artillery and upgrade the skills of a field artilleryman, who had had insufficient training in the basic techniques.[97] Viewing the past years of integration and its detrimental impact on field and air defense artillery and the need for qualified officers in both artilleries, authors of "The Artillery Branch Study" urged ceasing the practice of cross training and forming two separate branches of artillery.[98]

The Army concurred with the recommendations and split the field artillery and air defense artillery into two distinct combat arms with their own training programs in 1968. This freed field artillerymen to concentrate on field artillery subjects. Yet, separating the two artilleries had little impact upon the Artillery and Guided Missile School, which was renamed the Field Artillery School, because it was already focusing its energies on field artillery

95. "Artillery Branch Study," p. 4l; Ltr, Acting Assistant Chief of Staff, G3, to CG, Continental Army Command, subj: Training and Assignment of Artillery Officers, 11 Jun 1955, in The Artillery Center, Integration of the Artillery School; Ltr, de Shazo to CG, Continental Army Command, subj: Integration of the Artillery, 16 May 1956, in US Army Artillery Center, Integration of the Artillery Schools, in Morris Swett Library.

96. "The Artillery Branch Study," pp. 45, 46, 93; William F. Brand, "A Re-examination of the Integration of the Artilleries," Thesis, US Army War College, 1963, pp. 31-32.

97. "The Artillery Branch Study," pp. 46, 93, 95, 96, 99.

98. *Ibid*, pp. 118-19.

matters and not air defense artillery.[99]

As such, the Vietnam War had a profound impact on the field artillery. After years of debate over the validity of consolidating field and air defense artillery, the war prompted the Army to recognize the existence of two artilleries and to make them independent of each other. Also, the war compelled the field artillery to adapt to fight a small-unit war, but it never abandoned its faith in massing fire.

Back to Europe

As involvement in the Vietnam War diminished, the Army shifted its attention back to Europe and saw shocking changes there. During the 1960s, the Warsaw Pact fielded new armaments and strengthened its forces. By the beginning of the 1970s, it possessed the capability of generating massive combat power beyond that encountered by the United States in any previous war and dramatically outnumbered the forces of the North Atlantic Treaty Organization (NATO).

Prodded by the threat's strength in Europe and the recent Yom Kippur War of October 1973, the field artillery initiated an ambitious modernization program. Seeking to reduce the time between a request for fire and the first round on target and to cut the time required to complete fire planning calculation from hours to seconds, the field artillery's interest in computerized gunnery heightened. Even though the Tactical Fire Direction System (TACFIRE) was first developed in the 1960s to replace FADAC, it assumed a greater importance in the mid-1970s.[100] As part of an integrated system that could perform a variety of field artillery functions and that would extend from the forward observer to the corps, TACFIRE represented the third generation of automatic data processing systems for the field artillery. It offered secure communications and a degree of surprise never achieved before.[101] To operate the system the forward observer communicated directly with the computer at the fire direction center with a message entry device. The computer verified the message, entered in all relevant data, and decided which battery in the battalion was in the best position to shell the target. If the target was beyond the battalion's capability, the computer automatically requested action from a higher headquarters. TACFIRE promised to revolutionize fire direction even more than FADAC had done because it could be tied to other computers to give the field artillery unparalleled sophisticated command and control and because it could keep track of the gun and ammunition status. Displaying confidence in TACFIRE even before it had been fully tested, the Commandant of the US Army Field Artillery School, Major General General David E. Ott (1973-1976), wrote in the *Field Artillery Journal* in mid-1975, "This command and control system will be our primary means for tactical fire control, target analysis, fire planning and target intelligence in the future. . . .What has been

99. "Two Career Fields Formed for Artillery," *The Journal of the Armed Forces*, 15 Jun 1968, p. 29; "Air, Ground Artillery Split," *Army Times*, 19 Jun 1968, p. 1; Brand, "A Re-examination of the Integration of the Artilleries," p. 24; "The Artillery Branch Study," pp. 52-53.

100. Maj Raymond Spigarelli and Maj Martell Fritz, "Here Comes TACFIRE," *The Field Artilleryman*, Nov 1969, p. 67; Maj Gen Charles P. Brown, "TACFIRE," *Artillery Trends*, May 1968, pp. 1920; Eric C. Ludvigsen, "Lifting the Fog of War," Army, Jul 1972, p. 31.

101. Ludvigsen, "Lifting the Fog of War," p. 32, Ltr, Ott to Maj Gen Albert B. Crawford, Jr., Project Manager, Army Tactical Data System, Fort Monmouth, NJ, undated, in author's possession.

our dream for almost a decade is close to reality."[102]

An article in the *Field Artillery Journal* boasted in 1979 that TACFIRE represented a quantum leap over FADAC.TACFIRE added numbers 18.6 times faster than its predecessor and had a memory capacity that was 65.5 times larger than FADAC's. Unlike FADAC, TACFIRE had computer-to-computer interaction capabilities to allow its computers to exchange digital traffic to complement, control, and back up each other and link counterfire radars, the battery computer system, rangefinders, the meteorological system, and other equipment together. Because of this ability, some field artillery officers envisioned that TACFIRE would be a multi-computer array of fire control.[103] This led the Commandant of the US Army Field Artillery School, Major General Jack Merritt (1977-1980), to describe TACFIRE as "the key to the next generation FA [field artillery] system" when he briefed students at the Army War College in 1979.[104]

Ironically, the field artillery had little doctrine for TACFIRE as it began deploying the system late in the 1970s. Few maneuver personnel had any knowledge of TACFIRE, while even fewer understood how it could enhance operations. Moreover, field artillerymen were equally unaware of TACFIRE's potential because only the 1st Cavalry Division and 1st Battalion, 17th Field Artillery, were equipped with it and because virtually no published material outside of two articles in the *Field Artillery Journal* existed. As such, acquiring TACFIRE reflected the old pattern in the Army of adopting technology before knowing how to exploit its capabilities. Although some field artillery officers knew about TACFIRE's capabilities, the Field Artillery School had not yet developed those principles in 1979-80 to unleash the system's full potential.[105]

As a part of the modernization effort, the field artillery adopted new counterbattery and target acquisition systems and new munitions. To help counter the Warsaw Pact's massive rolling barrages, the field artillery introduced the AN/TPQ-36 countermortar radar and the AN/TPQ-37 counterbattery radar. These systems enhanced counterbattery operations because they had greater range than their predecessors had, possessed the ability to track multiple firings, furnished input for TACFIRE, and helped offset the enemy's numerical superiority in artillery and mortars. In fact, the AN/TPQ-36 was so effective that gun crews could shell an enemy mortar battery before its first rounds landed on friendly positions. [106]

Simultaneously, the field artillery tested an experimental remotely piloted vehicle (RPV) for target acquisition. Equipped with television and laser designator systems to identify targets for precision-guided munitions that were steered to the target by lasers and operated from the ground,

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102. Ott, "Forward Observations," *Field Artillery Journal*, Jul-Aug 1975, p. 6; Col Leland A. Wilson and Col Kenneth S. Heitzke, "ARTADS: The Computer on Future Battlefields," *Army*, Jun 1974, p. 16; Ludvigsen, "Lifting the Fog of War," p. 33; US Army Field Artillery School, TACFIRE: The Tactical Fire Direction System, Reference Note, Apr 1975, pp. 1-2.

103. Edward D. Ray, "TACFIRE: A Quantum Leap in FA Data Processing," *Field Artillery* Journal, May-Jun 1979, pp. 54-57.

104. Briefing, Merritt, subj: Field Artillery Update, 18 Apr 1979, in possession of author; Maj John E. Martin, "TACFIRE: Where Do We Go From Here?" *Field Artillery Journal*, Jan-Feb 1979, p. 13.

105. Capt Forrest G. Clark, "TACFIRE and the Maneuver Commander," *Field Artillery Journal*, Jan-Feb 1981, p. 15.

106. Briefing, Merritt, subj: Field Artillery Update, 18 Apr 1979, p. 3; Patrick F. Rogers, "The New Artillery," *Army*, Jul 1980, p. 31.

the RPV could detect enemy infantry and armor movements and gun positions. Even though further refinements in the RPV were necessary before deploying it, the aerial vehicle promised to give the field artillery "a tremendous boost" by allowing the guns to engage targets that were not in the line-of-sight and conduct post-attack surveillance.[107]

To counterbalance the enemy's large numbers of tanks and armored personnel carriers, the Army outlined two options. Developers could increase the number of weapons or make qualitative enhancements by developing artillery munitions that were more deadly than existing high-explosive fragmentation munitions. The former would be expensive and would not resolve the field artillery's one great handicap of being inherently inaccurate. Even when field pieces were aimed correctly, they scattered rounds in a broad dispersion pattern. Because of this, gun crews had to use vast amounts of ordnance to destroy targets. Moreover, only a direct hit would stop a tank. For example, the Fire Support Mission Area Study of 1974 indicated that an average of fifty conventional 155-mm. howitzer high-explosive rounds were required to hit a stalled tank at eight kilometers and that even a greater number of rounds would be needed to kill a moving tank. Consequently, field artillery was an ineffective tank destroyer. "If the field artillery is to have an indirect fire anti-tank capability, it must have weapon systems that are relatively insensitive to error contributed by target motion and to small target location errors," the study concluded.[108]

Prompted by this study, the field artillery picked the second option by introducing precision-guided artillery projectiles (smart munitions).[109] The Copperhead that would be fired by the 155-mm. howitzer and the Sense-and-Destroy Armor (SADARM) munition that would be shot by the 8-inch howitzer promised to achieve first round accuracy and decrease the number of rounds required to neutralize armor. Discussing the potential impact of precision-guided munitions, in March 1976 Brigadier General Albert B. Akers, Assistant Commandant, US Army Field Artillery School, described the Copperhead projectile's capability to hit a moving target by using a ground- or air observer-operated laser designator or an RPV-mounted laser to direct the munition.[110] Subsequent tests of prototype SADARM munitions in 1979 substantiated General Akers' claims of 1976.[111]

Even though both munitions were still in the developmental stage in 1979-80 and represented the first generation of precision-guided projectiles, field artillery officers understood their implications. These munitions would give the field artillery pinpoint accuracy for the first time and the capacity of stopping enemy armor without excessive ammunition expenditures and tube wear. Precision-guided projectiles along with the family of scatterable mines complemented improved conventional munitions, high-explosive, beehive, white phosphorous, colored smoke, illuminating, gas (persistent and non-persistent), and nuclear rounds and

107. Briefing, Merritt, subj: Field Artillery Update, 18 Apr 1979, p. 3.

108. Fire Support Mission Area Study, Aug 1974, p. 95.

109. Capt Joseph C. Antoniotti and William J. Krondak, "Development of Precision Guided Munitions: A Field Artillery Point of View," *Field Artillery Journal*, Sep-Oct 1978, pp. 24-25; Col John T. Burke, "Smart Weapons: A Coming Revolution in Tactics," *Army*, Feb 1973, p. 16.

110. Akers, Speech, *Field Artillery Journal*, May-Jun 1976, p. 19.

111. Maj Michael W. Hustead, "Fire Support Mission Area Analysis: Impact of Precision Guided Munitions," *Field Artillery Journal*, May-Jun 1981, pp. 20-21.

increased the field artillery's lethality.[112]

Improving lethality also involved modernizing field pieces and adding new missiles to the inventory. Disturbed by the Soviet Union's and Warsaw Pact's field artillery with greater ranges than the Army's, field artillery officers projected replacing the Ml14Al towed 155-mm. howitzer with the helicopter transportable M198 155-mm. howitzer early in the 1980s. Using rocket-assisted projectiles, the M198 would have a range of thirty kilometers and more than double that of the Ml14Al. Yet, the Army Chief of Staff approved the M198 as the direct support weapon for light divisions in 1980 and left the Ml14Al for heavy divisions.[113] Work on extending the range of the M109 155-mm. howitzer paralleled that of the towed 155-mm. howitzer. By using more sophisticated propellants and longer tubes, field artillery officers ultimately wanted a thirty-kilometer range that would be a twenty to twenty-five percent improvement over the existing 155-mm. self-propelled howitzer's.[114] Likewise, they planned boosting the 8-inch howitzer's range to almost twenty kilometers and projected a twenty-six kilometer range with rocket-assisted projectiles.[115]

As they labored feverishly to improve tube artillery, they adopted new missiles and phased out older ones. They replaced the Honest John rocket and Sergeant missile with the Lance missile that was more mobile than its predecessors and could carry a nuclear or high-explosive warhead, fielded the nuclear Pershing IA, started work on Pershing II, and commenced developing the general support rocket system, later known as the Multiple Launch Rocket System (MLRS).[116]

Of the new missile systems MLRS represented the most dramatic development. Although the Army had multiple rocket launchers during the 1950s and 1960s, more glamorous rockets and guided missiles with their nuclear warheads and the drive to improve tube artillery attracted most of the attention. As a result, interest in multiple rocket launchers declined. Studies late in the 1960s and early in the 1970s described a NATO battlefield where the Warsaw Pact had far more tanks, aircraft, artillery, and modernized multiple rocket launchers than NATO. Pressed to neutralize the Pact's firepower superiority, the Army decided in 1975 to develop a multiple rocket launcher for counterbattery work and suppression of enemy air defenses. Over the next several years, the Army tested various prototypes of the general support rocket system with the idea of placing it under the control of the corps artillery commander, who could attach the system to the division. Organized into a battalion of three firing batteries, the general support rocket system

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112. Briefing, Merritt, subj: Field Artillery Update, 18 Apr 1979, p. 13; James F. Hall, "Precision Guided Artillery: First and Second Generation Projectiles," Field Artillery Journal, May-Jun 1981, pp. 9-12; Hustead, "Fire Support Mission Area Analysis," pp. 19-20; Report, HQ TRADOC Combined Arms Test Activity, subj: Restructuring of the Heavy Division, Phase I, Aug 1978, p. I-l; US Army Field Artillery School, Field Artillery Reference Data, Jan 1980, p. IV-2.

113. Maj William Whelihan, "The M198," *Field Artillery Journal*, Jan-Feb 1978, p. l; "FA Test and Development," *Field Artillery Journal*, Sep-Oct 1978, p. 15; Maj Walter B. Brown II, "The M198: New Howitzer for Light Divisions," *Field Artillery Journal*, Jul-Aug 1982, pp. 26-29.

114. "FA Test and Development," *Field Artillery Journal*, Nov-Dec 1978, p. 39; Whelihan, "Rockets and Missiles: An Obituary for Cannon?" *Field Artillery Journal*, Jul-Aug 1980, p. 14; Briefing, Merritt, subj: Field Artillery Update, 18 Apr 1979, p. 11.

115. Briefing, Merritt, subj: Field Artillery Update, 18 Apr 1979, p. 11; Truman R. Strobridge and Bernard C. Nalty, "The Roar of the 8-Incher," *Field Artillery Journal*, Mar-Apr 1980, p. 36.

116. Briefing, Merritt, subj: Field Artillery Update, 18 Apr 1979, pp. 11-12.

would maximize fire support by rapidly delivering its twelve rockets and then moving to avoid counterbattery fire. As General Merritt explained in 1979, this rocket system would give the Army an "area fire weapon which should accomplish the Lion's share of our counterbattery and suppression of enemy air defense requirements" sometime in the 1980s.[117]

The future appearance of TACFIRE, precision-guided munitions, more lethal conventional and nuclear missiles, the general support rocket system, and tube artillery presented the Army and its European allies with two clear cut alternatives for fighting the next war. Through the 1970s nuclear retaliation offered the only plausible means of stopping an invasion of Western Europe and drove the Army to organize itself and write doctrine centered around nuclear weapons. Technological developments during the 1970s permitted the Army to abandon dependence on nuclear weapons and envision defending Western Europe with conventional weapons. Thus, the Army had an option that was more politically acceptable. Even though the Army could resort to conventional weapons and feel confident about stopping the Warsaw Pact juggernaut, its weapons still cast a pale over a war in Europe. After all, the Yom Kippur War had already proven conventional weapons, especially precision-guided munitions, to be highly effective against armor and devastatingly destructive.

Field artillery officers fully understood that harnessing the longer ranges and greater lethality meant restructuring the field artillery. During the summer of 1975, General Ott wrote General William E. DePuy, Commander, US Army Training and Doctrine Command (TRADOC). In a perceptive letter General Ott pointed out the need for upgrading forward observation. Because of the expansion in the size of the battlefield, the forward observer team simply could not supply observed fire support throughout its company's sector. Moreover, the Army required the capability of shifting and massing fire from mortars, field artillery, attack helicopters, and tactical aircraft rapidly on the battlefield. With this objective in mind, General Ott proposed reorganizing the forward observer team to take better advantage of the new technology that was appearing and scheduled to be in the Army's inventory in the 1980s.[118]

Agreeing with Ott, DePuy formed the Close Support Study Group to investigate the best way to improve forward observation.[119] After a series of meetings and briefings between August and November 1975, the group drew the same conclusion that Generals Ott and DePuy had already reached. To accomplish the objective of enhancing forward observation, the group urged creating a Fire Support Team (FIST) at company level to replace the forward observer team. The FIST was critical because the artillery had fewer pieces than the enemy, because the forward observer had a major role in registrations and the use of smoke and illuminations that the fire direction center had previously coordinated, because the envisioned battlefield would be larger than in the past, because new equipment and new munitions were being introduced, and because airborne forward

117. Bruce Gudmundsson, "The Multiple Launch Rocket System: On Time and Under Budget," Case Program, Kennedy School of Government, Harvard University, 1987, pp. 1-5, 7, 10, in author's possession; TRADOC System Manager, Fort Sill, Multiple Launch Rocket System Information Brochure, Mar 1982, pp. 5, 33; Ltr with enclosures, US Army Field Artillery Board to See Distribution, subj: Draft Test Design Plan for Force Development Testing and Experimentation of the MLRS, 13 Apr 1982, in Morris Swett Library.

118. Ltr, Ott to DePuy, 25 Jun 1975, in Close Support Study Group Report, Executive Summary, 21 Nov 1975, in Morris Swett Library; Fact Sheet, subj: Close Support Study, 30 Mar 1976, in possession of author.

119. Ltr, DePuy to Ott, 17 Jun 1975, in Close Support Study Group, Executive Summary, 21 Nov 1975.

tactical air controllers would probably be absent because of Soviet-bloc air defenses. A fire support coordinator, also called the FIST chief, would handle the fire support tasks for the company. The FIST chief would have to understand how to employ the various indirect fire systems to coordinate them properly and would command, train, and supervise all observers, including 81-mm. and 4.2-inch mortar observers, within the FIST. The study group saw additional benefits because the team as well as battalion and brigade fire support sections would also be permanently assigned to the maneuver units. Such an arrangement would ensure that fire support experts would train with the maneuver unit, provide experienced fire support personnel at all times, increase the flexibility of the field artillery battalion, and coordinate tactical air strikes.[120]

The FIST concept and the recommendation of assigning fire support sections to the maneuver elements provoked an immediate response throughout the field artillery. Although Colonel Thomas H. Spence, Director, Combat Support Test Directorate, Headquarters, Modern Army Selected Systems Test Evaluation and Review, Fort Hood, Texas, agreed with the concept of revitalizing fire support coordination, he opposed attaching a fire support team permanently to every level of command. In a lengthy letter on 20 October 1975, he disagreed with this action because it would place fire support officers under infantry and armor commanders, who knew little about fire support. This would be disastrous because the eyes of fire support assets would serve under a separate chain of command and would no longer react as part of the fire support team. Even though Colonel Spence had other criticisms of the Close Support Study Group's conclusions, provided alternatives to the group's suggestions, and recognized that the group's report represented new thinking, he warned that the FIST concept and attaching fire support sections permanently to maneuver units would split responsibility for fire support between the maneuver and artillery commander. It would simply fragment command and control.[121]

Shortly afterwards, Lieutenant Colonel William F. Muhlenfeld, Commander, 1st Battalion, 38th Field Artillery, wrote General Ott. In Colonel Muhlenfeld's view the forward observer required personal knowledge of the capabilities, internal operating procedures, and personalities in his battery. Assigning the individual permanently to a maneuver unit would destroy this and seriously reduce the quality of fire support. Moreover, fire support officers should be under the command of the field artillery and not infantry or armor because maneuver officers lacked the understanding of indirect fire. The need for improving forward observation existed. However, "the cure [the FIST concept] is worse than the disease" according the Muhlenfeld.[122]

In a memorandum for the Commandant of the Field Artillery School, Colonel (later brigadier general) Paul F. Pearson, Director, Gunnery Department, US Army Field Artillery School, captured the essence of Spence's, Muhlenfeld's, and other officers' opposition to the FIST concept and the related proposal of attaching fire support personnel permanently to maneuver organizations. From Pearson's perspective opponents simply approached the problem of fire support from

120. Final Report, Close Support Study Group, 21 Nov 1975, pp. 4-13; Brig Gen Paul F. Pearson, "FIST," *Field Artillery Journal*, May-Jun 1976, pp. 7-12.

121. Ltr, Spence to Cmdt, Field Artillery School, subj: Coordination of Close Support Study (Draft Report - 12 Sep 75), 20 Oct 1975, in possession of author.

122. Ltr, Muhlenfeld to Ott, 26 Nov 1975, in possession of author.

the point of view of the field artillery and refused to broaden it.[123] Artillery commanders would lose some control, but permanently assigning fire support officers to a maneuver company would be one more step towards combined arms warfare and would force maneuver commanders to become more informed about fire support. Likewise, field artillery officers would have to become more familiar with maneuver tactics because they would be part of a maneuver company.[124]

Equally important, opponents feared that implementing the fire support team would adversely influence massing fire. Because of the FIST, each battery would become an entity unto itself and receive little direction from the division artillery commander. This would disperse firepower and destroy a system of massing fire that had been evolving since the advent of indirect fire at the beginning of the 1900s. In effect, they discounted improvements in communications that were appearing and would connect the FIST and other fire support personnel to the division's artillery commander.

The FIST concept also received support. In a brief letter to General Ott, Major General C.J. Le Van, Commandant, US Army Air Defense School, Fort Bliss, Texas, commented that the need for more observers at the lower maneuver levels had been recognized for a long time and that the fire support team appeared to solve that problem. In the meantime, other service schools within TRADOC voiced their endorsement.[125] In a short article in the *Field Artillery Journal* in July 1976, General Ott reported about the enthusiastic reception of the FIST concept by commanders in Europe and the United States.[126] Defending FIST, Brigadier General Pearson wrote in mid-1976 that it permitted the maximum indirect fire support because the FIST chief directed all fire support activities under the supervision of the company commander. The chief could select the best weapon for the job and make the combined arms team more potent than before.[127] From General Pearson's vantage point the FIST provided the necessary command link at the maneuver battalions to allow the field artillery to take over the mortars and furnish the maneuver commander full-time fire support expertise. In short, FIST would revolutionize fire support.[128]

General Pearson correctly assessed the FIST's impact. If it were properly implemented, the FIST would coordinate all fire support assets at the company for the first time and do for the company what the fire support coordination center had already done for the division. Equally important, the FIST would integrate the combat arms at a lower level of organization and make combined arms warfare more of a reality.

Although the Army approved the FIST in 1977 for implementation, the concept still required additional refining.[129] The Field Artillery School's Close Support Study Group II of 1979 examined

123. Memo for Cmdt, subj: Recent Comments on Close Support Study, 8 Dec 1975, in possession of author.

124. *Ibid.*

125. Ltr, Le Van to Ott, 12 Dec 1975; in possession of author; Ltr, Brig Gen Albert B. Akers, Asst Cmdt, Field Artillery School, to Maj Gen Vernon B. Lewis, Jr., Dir of Requirements, ODCSOPS, 28 Oct 1975, in possession of author; Memo for Cmdt, subj: Leavenworth Reactions to Close Support Study, 22 Sep 1975, in possession of author; Msg, Cmdt, US Army Armor School, to Cmdt, USAFAS, subj: Close Support Study, 261502Z Mar 1976, in possession of author.

126. Ott, "Forward Observations, " p.6.

127. Pearson, "FIST"," p.7.

128. Memo, Asst Cmdt, USAFAS, 3 Jan 1977, in FA Reorganization File, Morris Swett Library Archives.

129. Combat Development Study, USAFAS, Dec 1979, p.1-2, in Morris Swett Library Archives.

the FIST to determine its limitations and capabilities. After carefully scrutinizing the organization the group recommended reducing the number of team members in armor and armored cavalry units and increasing the number in infantry and mechanized infantry units. Aware that air cavalry and attack helicopter units needed fire support, the group also urged establishing fire support teams for them. Because technology was critical for the FIST to succeed, the group then recommended adopting the latest computers, laser systems for target acquisition and designation, and precision-guided munitions and considered the appropriate vehicle for the fire support team.[130]

Implementing the FIST late in the 1970s revolutionized fire support. Although personnel and equipment shortages and other problems frustrated many commanders as they adopted the fire support team, the FIST gave the combat arms coordinated fire support for the first time. Ever since they had been first assigned to maneuver units during World War II, forward observers had performed their duties admirably, but doctrine and organization prohibited cooperation among them. For example, observer parties with a mechanized infantry company in the 1970s included a single 81-mm. mortar forward observer for each platoon, a two-man 107-mm. mortar forward observer party, and a three-man field artillery observer party. Each observer only knew his particular weapon and did not coordinate his activities with the others. The FIST would abolish this practice. Once it was fully operational and manned, the FIST would assure teamwork because the chief would direct the activities of all of the company's observers. As the Field Artillery School claimed, the FIST would optimize fire support by integrating all fire support assets into a coherent team and help compensate for the inferior number of fire support weapons in relation to those fielded by the Warsaw Pact.[131]

The same considerations that influenced developing FIST prompted the Army to create a heavy division, tank or mechanized, for Europe.[132] Under the Army's direction TRADOC initiated the Division Restructuring Study in May 1976 to design a division for the 1980s with the capability of integrating and optimizing new weapons and doctrine to replace the Reorganization Objectives Army Division (ROAD) organized in the 1960s. To preclude repeating past actions the command conducted a detailed study of historical experiences, the Active Defense that was being introduced, and new weapons being fielded. After noting the increase in firepower lethality and the growth in the size of frontages during the past one hundred years, TRADOC recommended abandoning the traditional approach to structuring divisions. Rather than integrating new weapon systems into existing units, it urged developing combat and support organizations around weapons systems.[133] In addition, the study suggested integrating combined arms at the battalion and not company since the latter lacked a staff and had other significant problems, developing

130. Report, Close Support Study Group II, Executive Summary, 1 Feb 1980, pp. i-12, in Morris Swett Library Archives.

131. Report, Close Support Study Group II, 21 Nov 1975, pp. 4-6, in Morris Swett Library; Lt Col Joseph R. Simino, "Don't Forget Your FIST," *Field Artillery Journal*, Mar-Apr 1981, p. 58; Final Draft, Close Support Study Group, Executive Summary, 12 Sep 1975, History of the Forward Observer, in possession of author.

132. Division Restructuring Evaluation, US Army Combined Arms Combat Development Activity, Executive Summary, Sep 1978, p. iv, in Morris Swett Library Archives; Msg, Cdr, TRADOC, to Cdr, Combined Arms Center, *et al.*, subj: Reorganization Proposals, 081613Z May 1976, in possession of author.

133. Division Restructuring Study, TRADOC, 1 Mar 1977, p. v, 6, in Morris Swett Library; Lt Col Homer J. Gibbs, "A Report on DRS," *Field Artillery Journal*, May-Jun 1978, p. 36.

smaller companies and battalions, increasing the number of battalions and fire support in the division, creating separate antitank companies, and improving mobility, among other things.[134]

As part of the restructuring of the division, TRADOC proposed expanding division artillery to reduce the numerical superiority of Warsaw Pact artillery. In 1976 the command suggested that the heavy division should have a target acquisition battery, eight-gun batteries, three direct support battalions of four batteries each, one general support battalion of four batteries, be augmented by corps artillery, and use the FIST concept. This organization would dramatically increase the number of direct support artillery by increasing the number of self-propelled 155-mm. howitzers from 54 to 96 and fire direction networks and would facilitate multiple, simultaneous engagements of diverse targets. In comparison, the general support battalion would have sixteen self-propelled 8-inch howitzers, a fire direction element, and headquarters and provide counterfire (counterbattery) and air defense suppression missions. When required, the general support battalion would augment the direct support battalions. Ultimately, the new field artillery organization and the proposed introduction of precision-guided munitions, field artillery scatterable mines, tactical smoke, and laser observer/designators to guide the new precision munitions to the target would furnish more responsive, survivable, and flexible fire support for the division.[135]

Even though testing substantiated the desirability of three direct support battalions, one general support battalion, and eight-gun batteries, TRADOC and the Field Artillery School continued examining various ways to organize the field artillery as a part of the Division 86 Study mandated by the commander of TRADOC in October 1978.[136] Early in 1979 the school outlined four different options for division artillery. Each had a different mix of self-propelled 155-mm. howitzers, 8-inch howitzers, and the general support rocket system.[137] Later in 1979 after further study and with support from the Field Artillery School, TRADOC gave the division the counterfire mission because of extended communication requirements and the expected density of targets. As a result, TRADOC enlarged the target acquisition battery to a battalion and allotted thirty-six general support rocket systems to relieve the stress on tube artillery. Those modifications, along with others, would give division artillery three 155-mm. howitzer direct support battalions (seventy-two), two batteries of 8-inch howitzers (sixteen), one general support system rocket battalion, and a counterfire mission.[138]

Influenced by manpower and funding restrictions, TRADOC further revised division artillery late in 1979. It provided for seventy-two 155-mm. howitzers, sixteen 8-inch howitzers, and nine general support rocket systems in the division. All 155-mm. howitzers would be self-propelled, and

134. Division Restructuring Study, TRADOC, 1 Mar 1977, pp. 6-9; John L. Romjue, *A History of Army 86* (Fort Monroe, Va: TRADOC Historical Monograph Series, 1982), pp. 4-6; Ltr, TRADOC to See Distribution, subj: Division Restructuring Study Concept Paper, 21 Sep 1976, in possession of author.

135. Phase I Report, TRADOC, subj: Division Restructuring Study, Vol I, 1 Mar 1977, pp. 13, 14, A-6, A-9, A-11, A-12; Phase I Report, TRADOC, subj: Division Restructuring Study, Vol 2, pp. 82, 87, 89; Col John W. Foss, Col Donald S. Pihl, Lt Col Thomas G. Fitzgerald, "The Heavy Division," *Military Review*, Mar 1977, pp. 15-16.

136. Report, TRADOC, subj: Division Restructuring Study, Vol 3, 1 Mar 1977, pp. 20-30.

137. Report, Ad Hoc Committee on Field Artillery Reorganization Proposals, 27 May 1976, extract, in possession of author; Msg, Ott to Maj Gen Vinson, DCSCD, USATRADOC, undated, in possession of author; Field Artillery Division 86: Historical Report, Vol 2, 1 Oct 78-1 Oct 79, pp. 3-10, 3-22, 3-34.

138. Romjue, *A History of Army 86*, pp. 43, 78-79; Field Manual 100-5, 1977, p. 2-16.

each direct support battalion would be composed of three eight-gun 155-mm. howitzer batteries (twenty-four howitzers). The general support battalion would have two eight-gun batteries of self-propelled 8-inch howitzers and one battery of nine general support rocket system launchers. As planned, this reorganization substantially enhanced the heavy division's firepower over that of the old infantry, mechanized infantry, or armored division. It dropped the 105-mm. howitzer, added more 155-mm. howitzers and 8-inch howitzers, and introduced the general support rocket system as a division artillery weapon. Approved by the Army Chief of Staff in August 1980, the heavy division had six tank and four mechanized battalions or five tank and five mechanized battalions along with combat support, combat service support, and division artillery.[139]

Understanding that the heavy division's artillery could not adequately meet the massive counterfire and interdiction missions alone, the field artillery and TRADOC simultaneously restructured the relation between corps and division artillery. They changed corps artillery headquarters into a small corps field artillery staff section and deleted the target acquisition battalion since the division already had one. Because of the necessity of providing the division with additional firepower beyond that furnished by division artillery and because of the greater fronts, TRADOC and the field artillery restructured the artillery group. Rather than allowing the group to act independently as it had done, they gave it the mission of reinforcing division artillery, alternate division artillery, or direct support artillery and habitually attached it to a division. To eliminate any misconceptions about the new role of corps artillery, they changed the artillery group's name to the field artillery brigade but still allowed the brigade to control a varying number of battalions. This new organization tied corps and division artillery more closely together and made corps artillery more responsive to the needs of the division but did not diminish the corps commander's fire support assets.[140]

Concurrently, the Army searched for a better way to fight. Because of the projected appearance of new and more lethal weapons in the 1980s, the Yom Kippur War, and the task of preparing for combat against the deadly threat in Europe, the Army emphasized conventional and nuclear warfare again. Pointing out that its primary mission was to win land battles and that the enemy would possess weapons as effective as the Americans' had, the Army wrote in the 1976 field manual, *Operations* (FM 100-5), "Battle in Central Europe against forces of the Warsaw Pact is the most demanding mission the US Army could be assigned."[141] Because of highly destructive weapons, war in Europe would bring high losses in a short time. In fact, entire forces would be quickly destroyed if they were improperly deployed.[142]

To meet the demands of war in Europe and limit casualty rates and equipment losses, the Army accepted the active defense as official doctrine in 1976. With this type of defense, the

139. Romjue, *A History of Army 86*, pp. 42-43, 78-79, 111-20; Division 86 Final Report, Oct 1981, pp. I-13, 3-1 - 3-11, in Morris Swett Library; Division Restructuring Concept, Department of the Army Staff/US Army War College Review Group, 19 Jan 1977, p. B-16, B-18, in Morris Swett Library.

140. Ltr, Cmdt, USAFAS, to Cdr, TRADOC, subj: Recommended Changes to TOE 6-401H, Artillery Group, 3 May 1977, in possession of author; Ltr (draft), Ott to Maj Gen John H. Cushman, Cmdt, US Army Command and General Staff College, undated, in possession of author; Col Edward R. Coleman, "Field Artillery Brigade," *Field Artillery Journal*, May-Jun 1977, pp. 40, 51; FM 6-22, Division Artillery, Field Artillery Brigade, and Field Artillery Assigned to Corps (Draft), extract, May 1977, pp. 4-1, 4-2, in possession of author.

141. Field Manual 100-5, 1977, p. 1-2.

142. Field Manual 100-5, 1977, p. 1-1; Maj Richard H. Sinnereich, "Tactical Doctrine Dogma," *Army*, Sep 1979, p. 16.

commander organized his forces into three areas—the covering force, the main battle area, and the rear area. The covering force gained time by inflicting heavy casualties and deceiving the enemy about the location of the main defensive positions and attempted to compel the enemy to reveal the strength and direction of the main attack. After the opponent entered the main battle area, the commander conducted economy-of-force operations and counterattacked. In other words, the defense had elasticity, allowed the offense to penetrate so far without breaking, and then concentrated at the critical time and places. Employing direct and indirect fire support weapons, the Army counterattacked.[143]

Confronted by a numerically larger threat in Europe, the Army devised tactical doctrine in the 1970s with an emphasis upon defensive actions and huge quantities of firepower rather than offensive thrusts. The destructiveness of the weapons of the 1970s and those of the near future guaranteed superiority of the defense over the offense and enabled the defender to conduct successful operations against the attacker, which required a ratio of at least six to one to win.[144] Concerned about the lethality of the modern and future battlefield, the Army formulated a cautious doctrine. The United States could not sustain high casualties in the first battle of the next war and win. Surviving the first attack was the key, and many Army officers contended that the active defense increased the ability to prevent destruction and to turn to the offense.[145]

As rearmament suggested, the Army saw high technology and better organization as a means to fight a larger enemy. Computers, precision-guided munitions, and radars improved the field artillery's lethality, while revamping the field artillery's force structure facilitated exploiting the new weapon systems. Working together, high technology and reorganization encouraged the Army and field artillery to abandon their historical reliance upon crushing the enemy with numerical superiority for fighting more intelligently and resourcefully than they had ever done. Taking note of the Yom Kippur War, they planned to concentrate at critical places, deliver huge volumes of fire to blunt enemy drives, and then turn to the offense as quickly as possible by using highly sophisticated weapons, munitions, and computers.

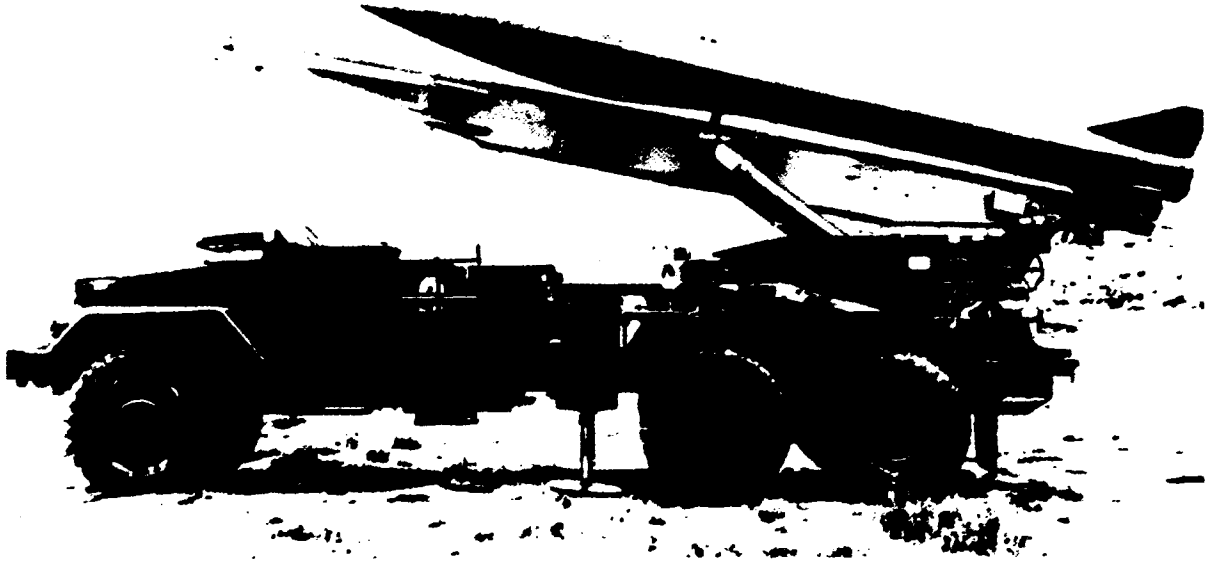
As the Army moved into the 1980s, its field artillery had come a long way since 1775. In the 1770s the field artillery began as a humble organization that grew into a complex one. During the next two centuries, the field artillery overcame periods of slow growth with times of rapid progress and abandoned its dependence upon the Europeans as a source for tactics, organization, equipment, and weapons. In doing so, the field artillery shed its image of being a follower by the 1940s for being an innovator and retained that position as it entered the 1980s by defining future advances in equipment, weapons, organization, and tactics that promised to revolutionize fire support.

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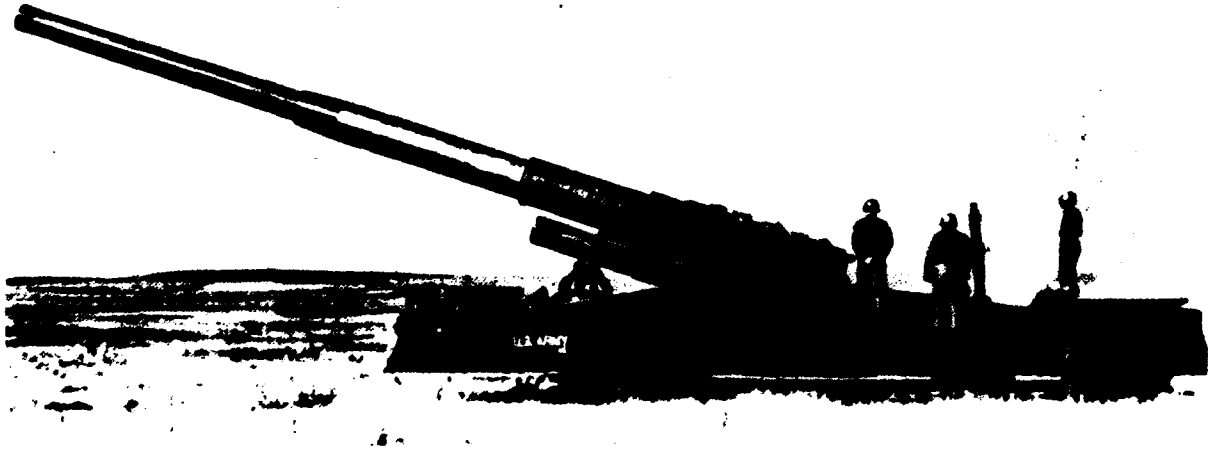
143. Field Manual 100-5, 1977, pp. 3-6, 3-7; Doughty, *The Evolution of US Army Tactical Doctrine, 1946-1976*, pp. 44-46; John Romjue, *From Active Defense to AirLand Battle: The Development of Army Doctrine, 1973-1982* (Fort Monroe, Va: Historical Office, TRADOC, 1984), pp. 6-8, 18.

144. Doughty, *The Evolution of US Army Tactical Doctrine, 1946-1976*, p. 44.

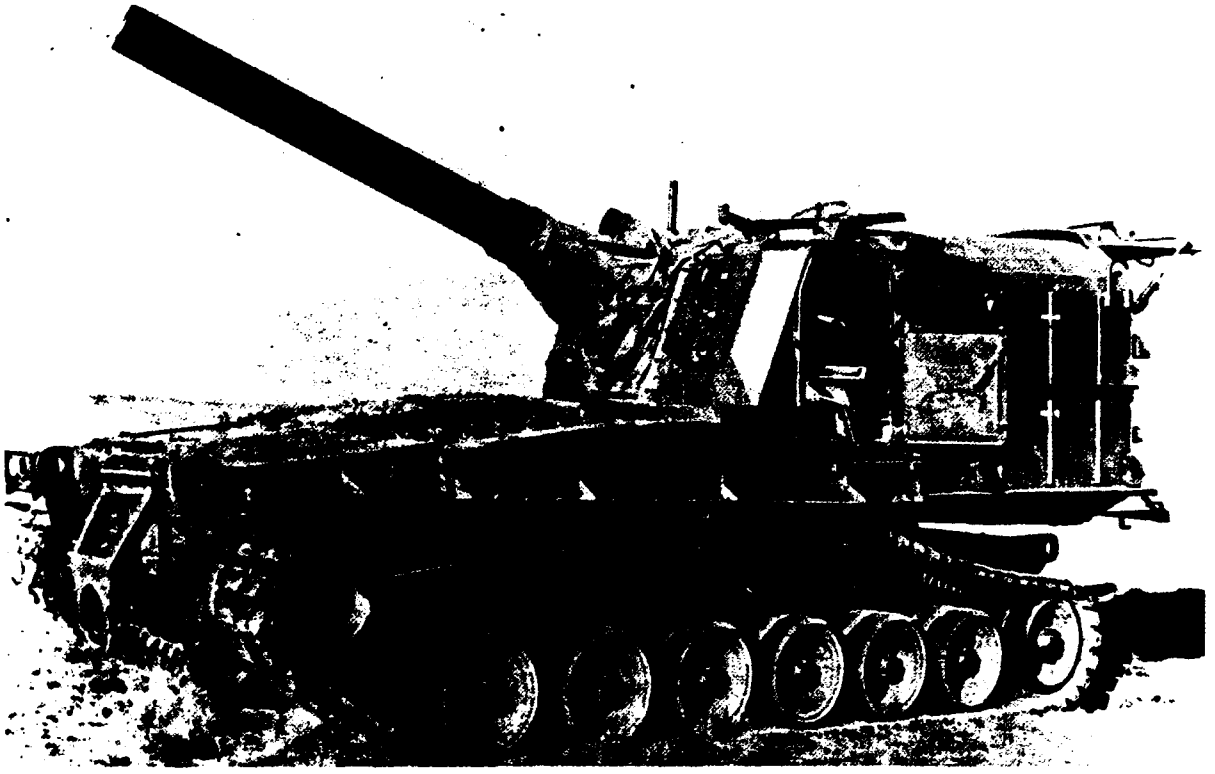
145. See Maj Paul H. Herbert, *Deciding What Has to Be Done: General William E. DePuy and the 1976 Edition of FM 100-5, Operations* (Fort Leavenworth, Ks: Leavenworth Paper No. 16, Combat Studies Institute, US Army Command and General Staff College, 1988) for the full debate over Active Defense. Because of the requirement to defeat echeloned Warsaw Pact forces, General Donn Starry, Commanding General, TRADOC, directed his staff to design new doctrine for defeating such forces. After going through several revisions, the doctrine evolved into AirLand Battle and was officially incorporated into FM 100-5, 1982. For a complete discussion of the development of AirLand Battle doctrine see John L. Romjue *From Active Defense to AirLand Battle: The Development of Army Doctrine, 1973-1982* (Fort Monroe, Va: TRADOC Historical Office, 1984).



Honest John rocket, ca. 1960.



280-mm. gun, "Atomic Annie," ca. 1960.



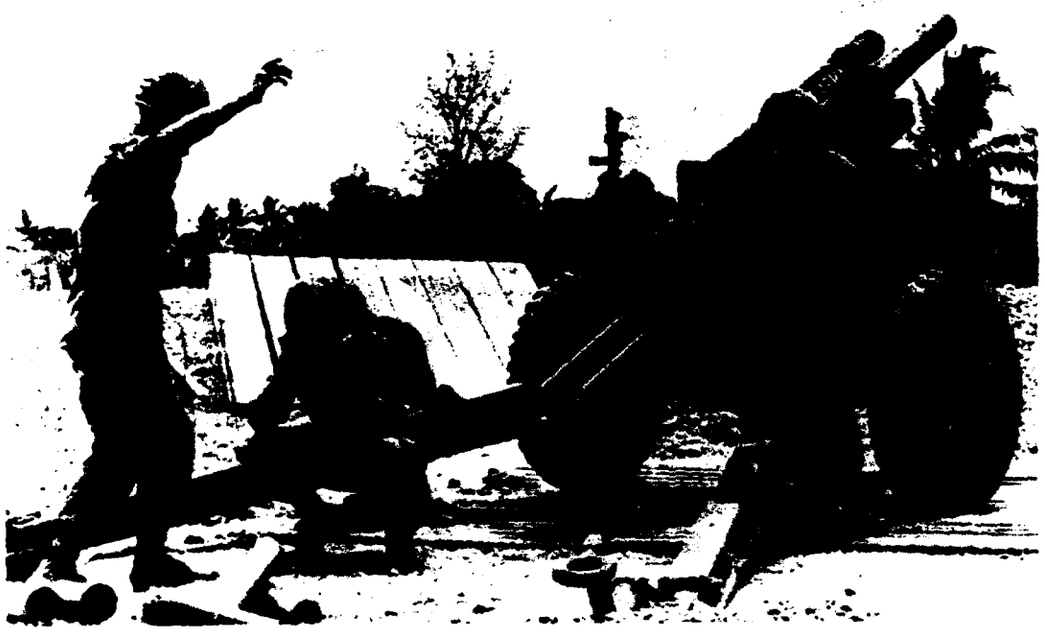
M55 8-inch self-propelled howitzer, ca. 1960.



M102 105-mm. howitzer being transported by CH-47 helicopter.



Gunners of C Battery, 1st Battalion, 83rd Field Artillery firing M107 175-mm. gun, Vietnam.



A M101 105-mm. howitzer ready to fire near Tan An twenty two miles southwest of Saigon, 1968.



M110 8-inch self-propelled howitzer in act of firing, Lie-Ky Base Camp, Vietnam, 1969.



The Pershing I-A being readied for test firing.

(All photographs courtesy Field Artillery and Fort Sill Museum).

Epilogue

FIELD ARTILLERY OF THE 1980s

The field artillery entered a new era in the 1980s. Because of deficiencies with existing weapons and equipment and the Soviet army that was modernizing its fire support at an alarmingly fast pace and echeloned its forces, the US Army revised its doctrine and initiated an aggressive program to introduce new field artillery systems by the 1990s.

Late in the 1970s, the Army launched a concerted effort to write doctrine to defeat echeloned forces better than the Active Defense could. Based upon his experience as commander of V Corps in Germany in the mid-1970s, General Donn Starry, Commanding General, US Army Training and Doctrine Command (TRADOC), expressed concern in 1977-78 that the Army had to do more than just defeat the Warsaw Pact's first echelon to win. The Army had to disrupt or delay the second echelon before it could join the first to overwhelm the defense. Using all available surveillance systems, the Army had to track the enemy's movements and and detect its command, control, and communication centers and employ tactical air and long-range artillery weapons to attack the second echelon before it reached the battlefield.[1]

For the Army's field artillery this emerging tactical concept had critical implications. The field artillery had to support units already fighting (the close-in battle) and simultaneously attack second echelon units (the deep battle) to reduce the impact that they might have. Addressing the importance of the latter mission, the Field Artillery School explained in 1979 that advancing second echelon forces would overpower the defense at some point even though the first echelon had been defeated. To prevent this the Field Artillery School and other TRADOC branch schools and centers began working on interdicting the second echelon. In the process the Field Artillery School developed a new concept of interdiction late in 1979. Interdiction meant more than interrupting the enemy's sustaining forces by hitting lines of communication, logistics, and replacements. Rather, it involved canalizing, creating gaps in formations, and delaying reserves to blunt the force of the attack. This would allow the United States and its allies to neutralize the enemy's numerical and firepower superiority. Yet, fighting echeloned forces required more effective target acquisition, command and control, and long-range weapon systems than the field artillery had at the end of the 1970s.[2]

While TRADOC writers developed AirLand Battle doctrine to defeat echeloned forces through combined arms action, the field artillery bolstered its capabilities to fight the close-in battle and the deep battle. As the 1980s opened, the Army had the AN/TPQ-36 and AN/TPQ-37 radars.[3] Aware that these radars were too large and heavy for a battlefield that was becoming

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1. John Romjue, *From Active Defense to AirLand Battle: The Development of Army Doctrine, 1973-1982* (Fort Monroe, Va: Historical Office, US Army Training and Doctrine Command, 1984), pp. 15, 24-26.

2. Romjue, *From Active Defense to AirLand Battle*, pp. 32-37, 46

3. Ltr, Office of the Deputy Chief of Staff for Research, Development, and Acquisition, to See Distribution, subj: Guidance Ltr, AN/TPQ-37, undated, Doc III-80, 1986 US Army Field Artillery Center and Fort Sill (USAFACFS) Annual Historical Review (AHR).

increasingly more mobile and lethal, in 1984 the Army directed the TRADOC and Field Artillery School to improve the AN/TPQ-36 so that it could replace the Q-36 and Q-37 radars in the 1990s. A developmental project, entitled Firefinder II, outlined combining the capabilities of the two radars into one advanced radar. Planned improvements included better target detection, mobility, and survivability and faster emplacement and displacement. Besides being able to locate enemy fires up to thirty-six kilometers away, the radar could pass target and command control data while moving.[4]

Meanwhile, the Army began acquiring another target acquisition system. In October 1979 the Advanced Scout Helicopter Special Study Group concluded that commanders required a real-time information, reconnaissance, security, aerial observation, and target acquisition/designation system that could operate day and night in all kinds of weather. Based upon those needs, obtaining the Advanced Scout Helicopter was mandatory.The following month, the Army System Acquisition Review Council concurred with obtaining the helicopter. Yet, knowing that the helicopter was unaffordable, the Army directed using the Advanced Helicopter Improvement Program (AHIP) OH-58D as a near-term program to produce a scout helicopter to support attack helicopters and the field artillery. Subsequently, the Army awarded the contract to Bell Helicopter in September 1981 and established a fielding date of December 1986. OH-58D helicopters would carry a laser range-finder-designator to calculate eight-digit grid coordinates that were sufficiently accurate for first-round fire-for-effect and would give Hellfire, Copperhead, and other laser-guided munitions pinpoint accuracy. Although the Army intended to have 578 AHIP OH-58D helicopters, the Army's divisions would receive only 30 for the field artillery because attack and air cavalry units had a higher priority.[5]

Following operational testing in 1984-85, the Defense Systems Acquisition Review Council recommended reversing the fielding priority. Late in 1985, the council noted that test results did not support full production of the OH-58D for aeroscout and air cavalry missions. Nevertheless, the helicopter demonstrated that it was satisfactory for field artillery missions. As a result, the Army opted to employ the helicopter in its field artillery role and go into full-scale production. This decision gave the field artillery first priority and forced the Field Artillery School to accelerate the development of training for aerial observers from 1992 to 1987 so that trained observers would be ready when the 2nd Armored Division received AHIPs late in the 1980s.[6]

These new target acquisition systems promised to improve the field artillery's ability to detect targets and support the deep battle. As the field artillery approached the end of the 1980s, it had the Firefinder radar, the elevated target acquisition system, the Aquila remotely piloted vehicle (RPV), and AHIP OH-58D in varying degrees of development to complement the Q-36 and Q-37 radars and the fire support vehicle.[7]

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4. "Major Field Artillery Weapons and Support Systems," *Field Artillery*, Dec 1987, p. 61; Fact Sheet, subj: Firefinder II Radars, 12 Nov 87, Doc III-59, 1987 USAFACFS AHR.

5. DF, subj: Trip Report, AHIP ILSMT Meeting, 7 Sep 82, Doc II-54, 1986 USAFACFS AHR.

6. Fact Sheet, subj: History of the Aerial Fire Support Division, 18 Feb 1988, Doc II-62, 1988 USAFACFS AHR; Fact Sheet, subj: OH-58D/AFSO Field Status, 19 Dec 88, Doc II-63, 1988 USAFACFS AHR; Fact Sheet, subj: History of AFSC/Proponency for Aerial Fire Support Coordinator Training, 23 Dec 1986, Doc II-65, 1988 USAFACFS AHR.

7. "Major Field Artillery Weapons and Support Systems," *Field Artillery*, Dec 1987, pp. 61-62.

Although the field artillery envisioned a bright future for the Aquila, Congress restructured the military services' RPV programs late in 1987. To eliminate redundancy and reduce costs Congress directed that RPV programs be consolidated and simultaneously deleted the services' separate research, development, test, and evaluation accounts. The Field Artillery School fought hard to keep the Aquila, which was scheduled to be operational in 1992, as a part of the Department of Defense's new program of unmanned aerial vehicles, but other TRADOC service schools did not think that the Aquila was sufficiently responsive and could be produced in sufficient numbers to serve the target acquisition needs of the brigade and division. Because of this, the TRADOC abandoned the Aquila in 1988 in favor of a family of unmanned aerial vehicles that would be part of the joint service effort to develop unmanned aerial vehicles for the 1990s and beyond.[8]

The elevated target acquisition system suffered a similar fate. Early in 1988, the commander. of the US Army Communications and Electronics Command informed the Field Artillery School that work on the system was being terminated because of budget restrictions and changes in user priority. Even though the system would not be built, portions of it might be relevant to other systems and could be adopted.[9]

As the field artillery pursued new target acquisition systems, it also identified the need to introduce new weapons. In 1981 the Corps Support Weapon System Special Task Force evaluated the ability of the corps to provide indirect fire support. After a year of study, the task force concluded that the Army required new systems to furnish the corps with deep attack capabilities, to complement offensive air support, to provide credible nuclear and chemical deterrence, to improve the manpower and missile ratio, to supply all-weather capabilities, and to replace or improve the aging Lance missile.[10] Other studies concurred. In April 1981 the Mission Element Need Statement pointed out that the Army needed an all-weather, extended-range artillery system by the 1990s, while the Fire Support Mission Area Analysis of 1981 identified three major shortcomings in corps artillery. It had insufficient range, inadequate responsiveness, and poor terminal effectiveness. Because of these problems, introducing a new system to attack the enemy beyond existing artillery ranges was paramount.[11]

Over the next several years, the Army implemented the recommendations of the studies by creating the corps weapon system program. To eliminate a duplication of effort, the Department of Defense, however, merged the Army's corps weapon system program with the Air Force's conventional standoff weapon system program in 1982. Nevertheless, the Army and Air Force could not reconcile their divergent requirements for a common missile. The Army wanted a missile with sufficient propulsion for ground launch, and the Air Force desired a missile that could be carried

8. 1987 USAFACFS AHR, p. I22; Directorate of Combat Developments (DCD) Newsletter, 23 Jun 1988, Doc III-2, 1988 USAFACFS AHR; Msg, Cdr, CACDA, to Cdr, US Army Intelligence Center, *et al*, subj: Non-lethal UAV Requirements, 231501z Dec 87, Doc III-26, 1987 USAFACFS AHR; Michael A. Dornheim, "Delay in Appointment Hampers Consolidation of RPV Programs," *Aviation Week and Space Technology*, 7 Mar 1988, pp. 17-18.

9. Msg, CECOM to Cmdt, USAFAS, et al, subj: ETAS Program, 291730Z Jan 88, Doc III-43, 1987 USAFACFS AHR.

10. Department of the Army, Corps Support Weapon System, Executive Summary, 1 Sep 82, Extract (S), p. E1, material used is unclassified, Doc III-48, 1986 USAFACFS AHR.

11. Proposed ROC for the JTACMS, Army 1985, Extract (S), p. I, material used unclassified, Doc III-49, 1986 USAFACFS AHR; Department of the Army, Corps Support Weapon System Executive, 1 Sep 82, p. E15.

by a B-52. After investigating possible missile systems, the two services finally agreed in May 1984 to pursue separate but complementary Joint Tactical Missile System programs. The Army would develop a short-range, ground-launched missile to strike at enemy forces that were not yet engaged and destroy enemy capabilities that would have an immediate impact on the close-in battle. The Air Force would build a long-range, air-launched missile.[12]

Following this decision, the Army designated the Multiple Launch Rocket System (MLRS) launcher as the Joint Tactical Missile System launcher and decided that the system, renamed the Army Tactical Missile System in 1985, would be a ballistic missile. Because of the need to hit the second echelon, the new missile would have to be able to attack enemy forces beyond the range of current field artillery systems. In 1985 the Army announced that the Army Tactical Missile System would replace the conventional Lance missile in the 1990s because it had a bigger payload and a better guidance system.[13]

Initially, the Army hoped to use the Army Tactical Missile System as a corps artillery weapon to deliver conventional or nuclear warheads. Congressional legislation late in 1983, however, limited the missile system to carrying conventional munitions. Because of this, the Army devised the service life extension plan for the Lance to lengthen the missile's life through the mid-1990s. Although prolonging the life of the missile was possible, the costs of maintaining the system would be prohibitive. As a result, the Army chose to replace the Lance with a missile system with better accuracy and a greater range. Equally important, the new missile, which was designated the Follow-on To Lance, had to use less manpower and have conventional and nuclear capabilities.[14]

Backed by the Vice Chief of Staff's guidance, the Field Artillery School began developing plans for the Follow-on To Lance late in the 1980s for fielding in the 1990s. The missile would be a corps weapon, provide long-range nuclear fires, be launched from a MLRS-type launcher, and furnish the corps commander with a nuclear capability to hit high priority targets. Specifically, the missile's primary targets would be deep, sophisticated targets in static positions, such as maneuver battalions, artillery batteries and battalions, and support units, while its secondary targets included airfields, rail yards, and storage sites.[15]

Concurrently, the Army conducted the Enhanced Self-Propelled Artillery Weapon System Study in 1979 to find ways to offset the numerical superiority of Soviet field artillery. The study determined that cannon systems had to be capable of continuous operations and have high rates of

12. 1986 USAFACFS AHR, pp. 76, 78; Briefing, subj: ATACMS, 1987; Interview, Dastrup with Maj Gregg Hutton, Chief, TRADOC SYSTEM MANAGER, (TSM) Rockets and Missiles Systems (RAM), DCD, 11 Mar 1988, Doc III-45, 1988 USAFACFS AHR; Glenn W. Goodman, Jr., "Jockeying with JTACMS," *Field Artillery Journal*, Jan-Feb 1986, p. 26; Ltr, JTACMS System Manager to Cdr, TRADOC, subj: TRADOC System Manager JTACMS Fourth Quarter FY 85 Report, 23 Sep 85, Doc III-52, 1986 USAFACFS AHR; Army TACMS Required Operational Capability (S), 17 Jan 88, p. 1, material used is unclassified, Doc III-73, 1988 USAFACFS Annual Historical Review.

13. Briefing, subj: ATACMS, 1987, Doc III-45, 1986 USAFACFS AHR.

14. Interview, Dastrup with Capt James Pearson, TSM RAM, DCD, 3 Mar 89, Doc III-79, 1988 USAFACFS AHR; Briefing, subj: FOTL, 1988, Doc III-71, 1988 USAFACFS AHR.

15. USAFAS and DCD, Program and Project Summary Sheets, 6 Jan 89; Interview, Dastrup with Pearson, 2 Mar 89, Briefing, subj: FOTL, 1988.

fire. Although modifications to the self-propelled M109 155-mm. howitzer since the weapon had been introduced early in the 1960s had improved the weapon, the Army required an entirely new cannon system of howitzers, ammunition vehicles, and command and control vehicles. Because developing a totally new system was too expensive, the Army chose to upgrade the M109 further through the Howitzer Extended Life Program (HELP).[16]

Even though HELP corrected some of the M109's deficiencies, the Mission Element Need Statement of December 1980 found shortcomings in responsiveness, survivability, terminal effects, and reliability, availability, and maintainability. To eliminate these problems and others the TRADOC signed a letter with the US Army Materiel Development and Readiness Command in February 1984 to initiate the Howitzer Improvement Program (HIP). This program outlined upgrading the M109 by including improvements identified by HELP and addressing weaknesses pointed out by the Mission Element Need Statement. Because HELP and HIP represented ongoing M109 projects, the Army Chief of Staff combined the two so that only a single howitzer would be fielded in 1989. Comprised of the latest technology, the HIP howitzer would have the ability to make small moves, quickly emplace, fire a number of missions, and then rapidly displace to avoid counterbattery fire. During times of intense counterbattery work, the HIP howitzer could use this tactic, if the terrain permitted, to increase survivability and still mass fire.[17]

Aware that the HIP howitzer stretched the upper limits of M109 performance for close support and lacked the growth potential to provide indirect fire support in the twenty-first century, the Field Artillery School concluded that the field artillery required a totally new cannon. After exploring various ways of meeting the challenge, combat developers in the school envisioned in 1986-88 that the Advanced Field Artillery System (AFAS) would replace the HIP sometime in the 1990s and satisfy the Vice Chief of Staff's direction of 1984 to develop a next-generation, self-propelled howitzer.[18]

Although the concept of the AFAS had appeared as early as 1984, the school solidified it in 1988. Because of the HIP's deficiencies in stand off range, survivability, and susceptibility to counterbattery fire and enemy target acquisition, the Advanced Field Artillery System had to be able to fire within fifteen seconds from the move and ten seconds while emplaced after receipt of a fire mission and fire four rounds within thirty seconds for time-on-target missions. The system would also have artificial intelligence to aid maintenance, resupply, local security, and navigation. In addition, the howitzer would be manned by four to six personnel that would be assisted by automation in technical fire control and ammunition handling, while the cannon would have a range of forty kilometers.[19]

16. Briefing, subj: 155mm Self-propelled Howitzer Improvement Program, undated, Doc III-68, USAFACFS AHR; Anthony G. Pokorny, "Take The Tech," *Field Artillery Journal*, Sep-Oct 1984, p. 21.

17. 1986 USAFACFS AHR, pp. 82-85; Capt James F. Janda, "Getting HELP and HIP," *Field Artillery Journal*, Sep-Oct 1985, p. 20; Ltr of Agreement for the 155mm Self-Propelled Howitzer Improvement Program, 6 Feb 84, Doc III-71, 1986 USAFACFS AHR; Fact Sheet, subj: HIP, 10 May 1988, Doc III-42, 1988 USAFACFS AHR; Briefing, subj: HIP, 2 Feb 1989, Doc III-41, 1988 USAFACFS AHR.

18. Fact Sheet, subj: AFAS-C, 12 Sep 1988, Doc III-48, 1988 USAFACFS AHR; Fact Sheet, subj: AFAS, 15 Jul 1988, Doc III49, 1988 USAFACFS AHR.

19. Briefing, subj: FA Test Bed Program, undated, Doc III-50, 1988 USAFACFS AHR; Fact Sheet, subj: AFAS, 15 July 1988.

As combat developers in the Field Artillery School explained, the Advanced Field Artillery System incorporated state of-the-art technologies and also built upon proven HIP technology. As a result, the weapon system would furnish substantial increases in lethality, responsiveness, survivability, mobility, sustainability, and availability and reduce manpower, operational and maintenance costs, and the logistical burden. Such capabilities would permit the howitzer to defeat moving and stationary enemy artillery and armor of the leading and follow-on echelons and a variety of high value targets, such as air defense systems and engineer vehicles, and to operate as individual firing units, platoons, or batteries because dispersion was critical to protect the weapon from enemy counterfire.[20]

Even though new missiles and cannons with greater power and ranges were being developed to engage echeloned forces, the field artillery also required effective command and control systems to orchestrate their employment. The Fire Support Mission Area Analysis of 1980 pointed out that the Tactical Fire Direction System (TACFIRE) needed to be replaced with a state-of-the-art command, control, and communication system. In 1981 the Army and Department of Defense approved a plan to obtain the Advanced Field Artillery Tactical Data System (AFATDS) during the 1990s to give field artillery personnel the necessary automation to perform fire support functions. This system would integrate all types of fire support into the maneuver plan and attack the highest payoff targets with the most effective munition at the critical time. Ultimately, the AFATDS would be incorporated into the Army Command and Control System and provide a new dimension in processing capabilities.[21]

Concurrently, the Field Artillery School pursued force structure initiatives because new weapon, command and control, and target acquisition systems were insufficient to readdress the enemy's numerical and firepower superiority and fight the deep battle. Supported by the Legal Mix V Study of 1978, the school sought to improve firepower, survivability, and man-to-equipment ratio by abandoning the six-gun battery in 155-mm. howitzer and 8-inch howitzer battalions for an eight-gun battery. This action, called the 3x8 conversion, would give a battalion three, eight gun batteries rather than three, six-gun batteries and expand the number of tubes in a battalion from eighteen to twenty-four. At the same time the new organization would allow creating two, four-gun platoons in each battery and dividing them into separate, semi-independent units to enhance survivability. In June 1985 the first units began changing to the eight-gun battery with the last scheduled for fiscal year 1993. By that time all 155-mm. howitzer units, including National Guard, and 8-inch howitzer units, except for the 9th Motorized Division's 155-mm. howitzer batteries that had unique roles, would have been converted.[22]

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20. Briefing, subj: FA Test Bed Program, undated; Appendix 12 AFAS-C, to Annex D of the Operational and Organizational Plan for AFV, 18 Aug 1988, p. D-12-1 - D-12-3, Doc III-51, 1988 USAFACFS AHR; Fact Sheet, subj: AFAS, 15 Jul 1988.

21. Army Modified AFATDS Program Plan, 30 Aug 1985, Executive Summary, and p. 1, Doc III-1, 1985 USAFACFS AHR; Ltr, FATDS System Manager, USAFAS, to Cmdt, USAFAS, subj: TSM-FATDS Quarterly Report, 4 Apr 1986, Doc III-2, 1985 USAFACFS AHR; Ltr, General Maxwell R. Thurman, to Honorable Joseph P. Addabbo, Chairman, Subcommittee on Defense, House of Representatives, undated, Doc III-3, 1985 USAFACFS AHR.

22. 1987 USAFACFS AHR, p. 86; Interview, Dastrup with Chris Klein, Organization and Personnel Division, DCD, USAFAS, 9 Feb 1989, Doc III-15, 1988 USAFACFS AHR; Mark P. Gay, "The Field Artillery in Support of Deep Offensive Missions," unpublished Master of Military Art and Science Degree, US Army Command and General Staff College, 1984, p. 173.

At the same time the Field Artillery School developed an Echelon Above Division Transition Plan to increase the number of MLRS units to improve the division's firepower. The plan directed decreasing the number of 8-inch howitzers and Lance missile units and using personnel saved by these actions to man new MLRS units. The Army wanted to reduce the number of 8-inch units because the howitzer had a low-rate of fire and low survivability. Because the Army still required the 8-inch howitzer to perform nuclear missions, it would become a corps weapon, while all active component and National Guard heavy divisions would have MLRS batteries as general support weapons. The reduction of Lance missiles, known as Lance compression, would cut back the number of Lance battalions from eight in fiscal year 1988 to four by fiscal year 1993. However, the size of each battalion would double from three batteries of two launchers each to three batteries of four launchers each. Thus, the number of missiles would be kept constant. Upon completion of this action, the Lance would serve exclusively as a nuclear delivery system because the Army Tactical Missile System would pick up the conventional mission.[23]

With the signing of the Intermediate-range Nuclear Forces Treaty in 1988, the school had to change its Echelon Above Division Plan. The treaty put the plan on hold until a sufficient amount of conventional artillery could be fielded in Europe and until Pershing II personnel could be transferred to MLRS military occupational specialties or reclassified into other field artillery specialties.[24]

Because laser-guided munitions and aircraft were the most effective way to kill armor, the Field Artillery School also took steps to increase the number of Combat Observation Lasing Teams in the heavy division as part of the effort restructure the force. In 1984 the Close Support Study Group III urged expanding the number of teams from three to eighteen to provide more high technology observation teams for lasing targets. Although TRADOC approved increasing the number of teams, the Army disapproved the action in December 1986 until further justification could be provided.[25]

After two years of extensive work, the Field Artillery School completed the rationale for adding more combat observation lasing teams. It explained that the team would maximize the use of smart munitions. Even though the team was initially conceived to be employed with the Copperhead, it could be used with any munitions that required laser energy for ballistic guidance. Moreover, the team could lase for Air Force and Army air smart munitions and increase the probability of first-round hits.[26]

In 1988 the school elucidated why first round hits were so critical. Because the United States and NATO faced a numerically superior adversary, they had to achieve as close to a first round fire for effect capability as possible. Employing combat observation lasing teams would conserve munitions and allow delivery systems to attack more targets and survive because fire support systems could hit a target on the first round. Because of the criticality of achieving first round hits, three teams were simply insufficient. Only eighteen teams would provide the coverage needed on

23. 1987 USAFACFS AHR, p. 86.

24. Interview, Dastrup with Klein, 9 Feb 1989.

25. Fact Sheet, subj: COLT Doctrine, 27 Jan 1987, Doc III17, 1988 USAFACFS AHR.

26. *Ibid.*, Tab B.

the future battlefield. Based upon this line of thought and the need to neutralize the numerical superiority of Warsaw Pact armies, in 1988 the Army approved expanding the number of teams in the heavy division.[27]

As such, during the 1980s the field artillery inaugurated far-reaching reforms to prepare for the future battlefield. With support from the Army and TRADOC, the Field Artillery School devised plans to introduce totally new tube and missile artillery systems with greater power, mobility, and ranges than existing weapons to fight on a highly mobile battlefield, designed organizations to exploit current and future weapons, and took steps to acquire new target acquisition and command and control systems. When completely introduced, these reforms of the 1980s would revolutionize the field artillery. With the new organizations the field artillery would have the capability to exploit its firepower more effectively than ever before, while the new weapon systems would furnish the field artillery with a quantum leap in lethality, mobility, and responsiveness. These new high technology target acquisition, command and control, and weapon systems would allow the field artillery to engage the enemy's lead echelon and simultaneously disrupt and destroy the follow-on forces and prevent defeat by killing the enemy's field artillery and upsetting its battle tempo.

27. *Ibid.*, Tab D, pp. 6-9.

Appendix A

MAJOR FIELD ARTILLERY WEAPONS IN 1988

System	Range	Prime Mover
M101A1 105-mm. howitzer	11,500 with conventional projectiles	truck
M102 105-mm. howitzer	11,500 meters with conventional projectiles 15,100 meters with rocket assisted projectiles	truck
M109 HIP howitzer	NA	self-propelled
M110A2 8-inch howitzer	22,900 meters with rocket-assisted projectiles	self-propelled
M114A1/A2 8-inch howitzer	14,600 meters with conventional projectiles 19,300 meters with rocket-assisted projectiles	truck
M119 105-mm. howitzer	14,300 meters with conventional projectiles 19,500 meters with rocket-assisted projectiles	truck
M198 155-mm. howitzer	30 kilometers with rocket-assisted projectiles	truck
Multiple-Launch Rocket System	30 kilometers	NA
Lance Missile	91 kilometers	NA
Pershing II	1,800 kilometers	NA

Source: "Major Field Artillery Weapons and Support Systems," *Field Artillery*, Dec 1987, pp. 57-60.

Appendix B
LIST OF PAST COMMANDANTS

Capt. Dan T. Moore ..... 19 Jul 1911—15 Sep 1914
Lt. Col. Edward F. McGlachlin, Jr. ..... 15 Sep 1914—26 Jun 1916
Col. William J. Snow ..... 27 Jul 1917—26 Sep 1917
Brig. Gen. Adrian S. Fleming ..... 26 Sep 1917—11 May 1918
Brig. Gen. Laurin L. Lawson ..... 11 May 1918—18 Dec 1918
Brig. Gen. Dennis H. Currie ..... 24 Dec 1918—10 Jun 1919
Brig. Gen. Edward T. Donnelly ..... 30 Jun 1919—9 Jul 1919
Col. Richard H. McMasters ..... 26 Jul 1919—24 Oct 1919
Maj. Gen. Ernest Hinds ..... 25 Oct 1919—1 Jul 1923
Maj. Gen. George LeR. Irwin ..... 1 Jul 1923—1 Apr 1928
Brig. Gen. Dwight E. Aultman ..... 6 Apr 1928—12 Dec 1929
Brig. Gen. William Cruikshank ..... 8 Feb 1930—31 Jul 1934
Brig. Gen. Henry W. Butner ..... 17 Sep 1934—10 May 1936
Brig. Gen. Augustine McIntyre ..... 29 Jun 1936—31 Jul 1940
Brig. Gen. Donald C. Cubbison ..... 1 Aug 1940—22 Dec 1940
Brig. Gen. George R. Allin ..... 20 Jan 1941—31 Jun 1942
Brig. Gen. Jesmond D. Balmer ..... 1 Jul 1942—11 Jan 1944
Maj. Gen. Orlando Ward ..... 12 Jan 1944—30 Oct 1944
Maj. Gen. Ralph McT. Pennell ..... 31 Oct 1944—30 Aug 1945
Maj. Gen. Louis E. Hibbs ..... 30 Aug 1945—4 Jun 1946
Maj. Gen. Clift Andrus ..... 20 Jun 1946—9 Apr 1949
Maj. Gen. Joseph M. Swing ..... 8 Apr 1949—31 Mar 1950
Maj. Gen. Arthur M. Harper ..... 2 Apr 1950—16 Nov 1953
Maj. Gen. Charles E. Hart ..... 4 Jan 1954—28 May 1954
Maj. Gen. Edward T. Williams ..... 8 Jun 1954—24 Feb 1956
Maj. Gen. Thomas E. de Shazo ..... 12 Mar 1956—31 Jan 1959
Brig. Gen. Philip C. Wehle ..... 31 Jan 1959—15 Feb 1959
Maj. Gen. Verdi B. Barnes ..... 15 Feb 1959—25 Mar 1961
Maj. Gen. Lewis S. Griffing ..... 6 Apr 1961—31 Mar 1964
Maj. Gen. Harry H. Critz ..... 1 Apr 1964—15 May 1967
Maj. Gen. Charles P. Brown ..... 5 Jul 1967—20 Feb 1970
Maj. Gen. Roderick Wetherill ..... 24 Feb 1970—31 May 1973
Maj. Gen. David E. Ott ..... 1 Jun 1973—24 Sep 1976
Maj. Gen. Donald R. Keith ..... 9 Oct 1976—21 Oct 1977
Maj. Gen. Jack N. Merritt ..... 22 Oct 1977—26 Jun 1980
Maj. Gen. Edward A. Dinges ..... 27 Jun 1980—27 Sep 1982
Maj. Gen. John S. Crosby ..... 28 Sep 1982—3 Jun 1985
Maj. Gen. Eugene S. Korpal ..... 4 Jun 1985—20 Aug 1987
Maj. Gen. Raphael J. Hallada ..... 20 Aug 1987—18 Jul 1991
Maj. Gen. Fred F. Marty ..... 19 Jul 1991—present

Previous Names of the US Army Field Artillery School

School of Fire.....1911—1919
Field Artillery School .....1919—1946
The Artillery School .....1946—1955
The Artillery and Guided Missile School .....1955—1957
US Army Artillery and Guided Missile School.....1957—1969
US. Army Field Artillery School .....1969—Present

GLOSSARY

Adjust: Correcting the aim of the fire of the guns.

Bag Charge: A propelling charge for a gun or howitzer that is contained in a cloth bag.

Ballistics: The science that deals with projectiles in motion. Interior ballistics involves the forces that propel the projectile down the cannon tube. Exterior ballistics deals with the forces that act on the projectile in flight, such as wind, temperature, and air pressure.

Barrage: A system of artillery fire that delivers a line of bursting shells in front of advancing infantry.

Breech: The rear part of the cannon behind the bore.

Breechblock: The movable piece that closes the breech end of the cannon for firing.

Bore: The interior cylindrical cavity of the cannon.

Caisson: An ammunition wagon for field artillery.

Caliber: The diameter of the cannon bore.

Canister or Case Shot: A can filled with small projectiles, often small balls, which scatter after being fired from the gun.

Cannon: A generic or family name for all tube artillery pieces. Cannon is further divided into mortars, howitzers, or guns according to trajectory of their projectiles.

Carriage: The support with wheels for the cannons.

Cartridge: A bag or case holding the complete powder charge and in some cases the projectile and powder charge.

Chamber: That part of the bore of a cannon that holds the propelling charge, especially when the chamber is a different size from the rest of the bore.

Close Support: The action of the artillery against targets that are sufficiently close to the supported maneuver arm to require detailed integration into the plan of movement of the maneuver arm.

Concentration: Artillery fire that delivers rounds on a particular target for maximum effect.

Counterbattery work/fire: Artillery fire against hostile artillery.

Defilade: To shield from enemy fire or observation by use of natural or artificial obstacles.

Direct Fire: Artillery fire that requires seeing the target to hit it.

Elevation: The angle between the axis of the cannon bore and the horizontal.

Enfilade fire: Fire striking the flank of the target, usually from a defilade position.

Equilibrator: A spring or hydro-pneumatic device that balances the weight of the gun so that elevating the gun is easier.

Fuse: A device to set off the powder charge of a shell.

Grapeshot: A cluster of small iron balls grouped around a wooden spindle and covered by a heavy cloth netting.

Gun: An artillery piece with a long tube, high muzzle velocity, and flat trajectory.

Gunnery: The science of delivering artillery fire to the desired target.

Howitzer: An artillery piece with a trajectory between that of the gun and mortar.

Indirect Fire: Artillery fire on an unseen target.

Lay: To aim or point a cannon in elevation and direction.

Limber: A two-wheeled vehicle to which the carriage is attached for support when being transported.

Mil: 1/6400th part of a circle used for aiming and survey.

Mortar: An artillery piece designed to be fired at a high angle so that the projectile plunges down sharply onto the target.

Obturation: Sealing of the breech to prevent gases from escaping.

Range: The distance from the gun to the target.

Recuperator: A mechanism that returns the gun tube back into the firing position after recoil.

Shell: A long, hollow projectile filled with powder and fitted with a fuse to cause detonation.

Shrapnel: An artillery shell filled with steel balls that is bursted by a powder charge in flight.

Time on Target: Artillery fire from various sources that is synchronized to fall on a particular target at a particular time.

Trajectory: The projectile's flight path.

Traverse: Horizontal movement of the cannon.

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Many journals, magazines, and newspapers were used extensively over the course of this research to include *Army, Army and Navy Journal, Army Information Digest, Artillery Quarterly, Artillery Trends, Cavalry Journal, Chronicles of Oklahoma, Combat Forces Journal, Field Artillery, Field Artillery Journal, Field Artilleryman, Journal of the Military Service Institution, Journal of the United States Artillery, McClures Magazine, Military Affairs, Military Collector and Historian, Military Review, Niles Register, Parameters, Scribner's Magazine, Tactical and Technical Trends in Artillery for Instruction,* and *Trends in Artillery for Instruction.*

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  - Operational and After Action Reports
  - Organizational Reports
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  - Fact Sheets
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Boyd L. Dastrup

Boyd Lawrence Dastrup, a native of Ogden, Utah, received his B.S. from Weber State College, M.A. from Utah State University, and Ph. D. from Kansas State University. Dr. Dastrup has served as Center Historian for the Sheppard Technical Training Center, Sheppard AFB, Texas, and is currently the Army's Field Artillery Branch Historian at the US Army Field Artillery Center and Fort Sill, Fort Sill, Oklahoma. He has written *The US Army Command and General Staff College: A Centennial History* (1982) and *Crusade in Nuremberg: US Military Occupation, 1945-1949* (1985).

