

IS THE U.S. ARMY FIELD ARTILLERY PREPARED TO SUPPORT THE NEXT MAJOR COMBAT OPERATION?

A Monograph

by

MAJ James T. Cobb
United States Army



School of Advanced Military Studies
United States Army Command and General Staff College
Fort Leavenworth, Kansas

2013-01

Approved for public release; distribution is unlimited.

REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.					
1. REPORT DATE (DD-MM-YYYY) 17-06-2013		2. REPORT TYPE Master's Thesis		3. DATES COVERED (From - To)	
4. TITLE AND SUBTITLE IS THE U.S. ARMY FIELD ARTILLERY PREPARED TO SUPPORT THE NEXT MAJOR COMBAT OPERATION?				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) MAJ James Cobb				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Command and General Staff College ATTN: ATZL-SWD-GD 100 Stimson Ave. Ft. Leavenworth, KS 66027-2301				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT In 2007, three former brigade combat team commanders authored a white paper and sent it to the Army Chief of Staff entitled <i>The King and I: The Impending Crisis in the Field Artillery's Ability to Provide Fire Support to Maneuver Commanders</i> . The paper details the authors' concerns as maneuver commanders with the ability of the field artillery to support maneuver operations. This monograph examines Operation COBRA to determine how the corps commanders employed field artillery when conducting offensive operations and identifies key concepts that were used to ensure success. The three areas that were seen as crucial to the success of offensive operations were the ability to mass artillery fires, integrate close air support into the ground maneuver plan, and how logistics supported artillery units. For the future of the field artillery, those three areas must be maintained in order to prevail in the next major combat operation.					
15. SUBJECT TERMS Field Artillery, Operation COBRA, Massing, Logistics, Close Air Support.					
16. SECURITY CLASSIFICATION OF: UNCLASSIFIED			17. LIMITATION OF ABSTRACT UU	18. NUMBER OF PAGES 52	19a. NAME OF RESPONSIBLE PERSON
a. REPORT Unclassified	b. ABSTRACT Unclassified	c. THIS PAGE Unclassified			19b. TELEPHONE NUMBER (include area code)

MONOGRAPH APPROVAL PAGE

Name of Candidate: MAJ James T. Cobb

Monograph Title: Is the U.S. Army Field Artillery Prepared to Support the Next Major
Combat Operation?

Approved by:

_____, Monograph Director
Daniel G. Cox

_____, Seminar Leader
James D. Sisemore, COL

_____, Director, School of Advanced Military Studies
Thomas C. Graves, COL

Accepted this 23rd day of May 2013 by:

_____, Director, Graduate Degree Programs
Robert F. Baumann, Ph.D.

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

ABSTRACT

IS THE U.S. ARMY FIELD ARTILLERY PREPARED TO SUPPORT THE NEXT MAJOR COMBAT OPERATION? by MAJ James T. Cobb, 45 pages.

In 2007, three former brigade combat team commanders authored a white paper and sent it to the Army Chief of Staff entitled *The King and I: The Impending Crisis in the Field Artillery's Ability to Provide Fire Support to Maneuver Commanders*. The paper details the authors' concerns as maneuver commanders with the ability of the field artillery to support maneuver operations. This monograph examines Operation COBRA to determine how the corps commanders employed field artillery when conducting offensive operations and identifies key concepts that were used to ensure success.

The three areas that were seen as crucial to the success of offensive operations were the ability to mass artillery fires, integrate close air support into the ground maneuver plan, and how logistics supported artillery units. For the future of the field artillery, those three areas must be maintained in order to prevail in the next major combat operation.

TABLE OF CONTENTS

ACRONYMS	v
CHARTS	vi
INTRODUCTION.....	1
MASSING	8
CLOSE AIR SUPPORT	17
LOGISTICS.....	27
CONCLUSION AND RECOMMENDATIONS	34
BIBLIOGRAPHY	42

ACRONYMS

FSO	Fire Support Officer
LTC	Lieutenant Colonel
USMC	United States Marine Corps
FDC	Fire Direction Center

CHARTS

	Page
Chart 1. Command and Support relationship responsibilities	11
Chart 2. Artillery ammunition lots drawn by 1 ST Army, September 27-30, 1944.....	33

INTRODUCTION

In November 2004 a combined force of United States Marine and Army personnel along with elements of the Iraqi Army assaulted into the insurgent held city of Fallujah, as part of Operation PHANTOM FURY. One of the two United States Army units that assaulted into the city was Task Force 2-2 Infantry (Mechanized), 3rd Brigade, 1st Infantry Division, commanded by Lieutenant Colonel (LTC) Peter Newell.¹ As part of the operation, Newell's unit was tasked with firing white phosphorous smoke rounds as a cover for breaching efforts while his organic mortar teams fired high explosive rounds on insurgent fighting positions in the city. To accomplish these tasks, LTC Newell used an internal howitzer platoon, consisting of two M109A-6 PALADINs and one mortar platoon. With this direct support, the intent was for the artillery to suppress the enemy's defenses enabling the rest of the assault force to move across the obstacles and into the city.² The 1st Marine Division's plan, on the other hand, was to conduct a two regimental team (six battalion) assault with a deliberate breach of insurgent defensive obstacles using a doctrinal suppress, obscure, secure, reduce, and assault battle drill. During this operation, Regimental Combat Team 7 (USMC) acted as the higher headquarters for Task Force 2-2.³ Unlike LTC Newell's Infantry unit, the Marines did not possess the full complement of direct support artillery for the operation. In fact, the traditional ratio of artillery to maneuver forces is one artillery

¹The task force consisted of two mechanized infantry companies, one armor company, one cavalry troop, one engineer platoon, and two M109A6 PALADIN howitzers with fire direction center. For further discussion on Task Force 2-2 Infantry and their force composition, see Dick Camp, *Operation PHANTOM FURY; The Assault and Capture of Fallujah, Iraq* (Minneapolis: Zenith Press, 2009), 124.

²Combat Studies Institute interview with Lieutenant Colonel Peter A. Newell (Fort Leavenworth KS: Combined Arms Research Library, 2006), 9.

³Regimental Combat Team 7 was comprised of its habitual organic units; two infantry battalions, a battalion sized engineer element, a battalion sized scout reconnaissance element and a Marine field artillery battery.

battalion per brigade or one battery per maneuver battalion. In the case of the Marines, the assault into Fallujah included only of one reinforced battery falling well short of the recommended level of support.

As commonly seen in warfare, planned operations did not run smoothly. In fact, shortly after the PALADINs began firing their smoke rounds, the Fire Direction Center (FDC) Chief notified the Captain directing the fires – known as the Fire Support Officer (FSO) – that the center’s ballistic computer had crashed and the guns would be out of action until the computer could be re-started. The FSO, understanding the lengthy process of this recovery sequence, found himself in a precarious situation as the loss of the guns meant that the breaching force would be in the open and exposed to enemy fire. There was no other artillery available to replace the idle guns as five other battalions were attacking Fallujah at the same time, and depended on their own direct artillery support. Furthermore, LTC Newell’s battalion did not have priority of fire and could not rely on receiving fire support from an adjacent unit. This situation coupled with insufficient indirect fire units assigned from the start led Newell’s unit to experience a lack of general support or general support reinforcing fires during the course of the operation. More importantly, the infantry assault could not be delayed as the obstacle reducing force was already moving to the breach site, and the remainder of the task force was in its assault position. The already bad situation was made worse by a simple computer software problem that now placed American soldiers in the position of enduring unnecessary casualties. Fortunately, the Fire Direction Center’s senior sergeant took charge and managed to get the back-up computer operating in time to allow the fire mission to continue with only a short delay and with little effect on the breaching operation.⁴

⁴The author was the fire support officer for Task Force 2-2 Infantry. This incident is from his recollection and experiences in the battle. For further reading on this topic see Combat Studies Institute interview with Lieutenant Christopher LaCour (Fort Leavenworth KS: Combined Arms

Army combat units have not always had a problem with shortages of artillery support on the battlefield. For instance, field artillery operations in the European Theater during World War II represent one of the high points in indirect fire support to ground forces. One of the best examples of this artillery support during WWII was witnessed during Operation COBRA where extensive artillery assets allowed commanders to have flexible fire support plans, as well as redundant firing units available to make up identified shortfalls. This capability essentially enabled Allied units to develop and maintain the initiative throughout the war. To better understand this connection, however, a broader explanation of the various forces and how they integrated into overall operations is required.

Looking at the initial landing, Operation OVERLORD was the Allied plan for the invasion of France on June 6, 1944. During this operation, Allies would end up placing nearly 160,000 soldiers on French soil to include three airborne divisions that landed beyond the five main beach landing sites on D-Day. Over the next month, these units expanded the beachhead and attempted to secure deep-water ports. British General Sir Bernard Montgomery was the Commander of all Allied Ground forces in Western Europe that included the Second British Army on the eastern flank, commanded by Lieutenant General Miles Dempsey, and the First United States Army on the western flank, commanded by Lieutenant General Omar Bradley.⁵ As part of the operation, Bradley successfully secured the Cotentin peninsula and the city of Cherbourg effectively controlling the surrounding ports. In July, Montgomery directed Bradley to turn his attention south to capture the Breton ports and penetrate the southern flank of the German

Research Library, 2006).

⁵Martin Blumenson, *United States Army in World War II: The European Theater of Operations Breakout and Pursuit* (Washington, D.C.: Center of Military History United States Army, 1961), 9.

defenses in an effort to wheel his army east.⁶ The terrain that the Americans were operating in contained numerous marshes that hindered cross country movement and bocage that channelized forces onto the few roads through the area.⁷ Although Bradley's army experienced early successes, Dempsey's army labored well into July to secure the initial D-Day objective of Caen. Unlike the channelized terrain in the American sector, the Caen-Falaise plains were gently rolling open areas of dry firm ground that presented a more conducive environment for mechanized warfare. The Germans, consequently, were defending Caen more aggressively subsequently stalling Dempsey's advance.⁸ This unforeseen hold on Caen eventually prompted Dempsey to launch Operation GOODWOOD as a secondary plan to break the German lines.

Operation GOODWOOD was launched as a ground attack consisting of three corps following an extensive bombardment from both heavy bombers and fighter-bombers.⁹ On the morning of July 18, 1944, nearly 1,700 heavy bombers from both the Royal Air Force Bomber command and the United States Eighth Air Force dropped more than 8,000 tons of bombs in order to blast an opening in the German defense for the ground force to exploit.¹⁰ The initial attack succeeded in penetrating almost three miles into German territory before Allied forces were halted by effective anti-tank fire from the Germans who capitalized on the limited number of paths through the various minefields. After four days of heavy fighting, the British secured an

⁶Ibid., 37.

⁷A bocage or hedgerow is a series of small fields surrounded by earthen banks that are three to six feet high and overgrown with thick shrubbery or trees. The trees and earthen banks limited observation from one field to the next and were used by the Germans to form the basis for heavily defended strong points that halted the American advance.

⁸Blumenson, *Breakout and Pursuit*, 11.

⁹Anthony Beevor, *D-Day: The Battle For Normandy* (New York: The Penguin Group, 2009), 305-306.

¹⁰Blumenson, *Breakout and Pursuit*, 191.

additional thirty-four square miles of battlefield capturing Caen, however, they were not able to continue the attack and exploit deeper into France. Montgomery claimed that he had never intended to penetrate any further than he did. Rather he stated the he was setting the conditions for Operation COBRA being planned by Omar Bradley.¹¹ At the higher command level, General Eisenhower was disappointed that Operation GOODWOOD did not achieve the spectacular breakthrough that he was expecting. Eisenhower pinned his hopes on a break out of the beachhead during Operation COBRA.¹²

As early as July 13, 1944, Bradley was planning on a break-through of the German lines near Saint Lô.¹³ According to the operations order, Bradley's concept was to conduct an air bombardment, similar to the one that supported Operation GOODWOOD. This plan, however, dictated that his ground forces would immediately follow bombing operations in order to penetrate the German defenses as a means to prevent the enemy from having time to recover. Another difference between GOODWOOD and COBRA was that Bradley would concentrate his ground forces and attack on a narrow front.¹⁴ In essence, Bradley's force would integrate armor, infantry, field artillery and close air support in a combined arms maneuver as a means to effectively execute Operation COBRA.¹⁵ Bradley's intention for Operation COBRA was to penetrate the German defenses using an armored thrust into Coutances after an intense bombardment of the area. If successful, COBRA would break through the main German

¹¹Ibid., 195.

¹²Ibid., 195.

¹³ First U.S. Army "Outline Plan COBRA," July 13, 1944, 1.

¹⁴Ibid., 187.

¹⁵Beevor, *D-Day*, 342-343.

defensive lines allowing the Americans to drive deep into the enemy's rear area.¹⁶

The firepower that Bradley unleashed on the German defenses was staggering. Eighth and Ninth Air Force would allocate 1,800 heavy bombers, 396 medium bombers, and over 350 fighter-bombers from IX Tactical Air Command. In addition to the air support, Bradley also supported VII Corps with over 1000 pieces of field artillery.¹⁷ Extensive artillery support before the assault along with Air Corps bombing raids, served to both demoralize the enemy and destroy defensive positions and communication lines leading from various headquarters to the forward line units.¹⁸ In fact, the attack went so well that less than twenty-four hours after the assault commenced, VII Corps Commander, Lieutenant General Collins, decided to commit two of his three mobile columns to exploit the penetration.¹⁹ Within four days, the Germans were breaking away and attempting to retreat to more defensible positions further east.²⁰

Modern warfare has become more reliant on firepower in the past one hundred years. In fact, artillery in World War I led to seventy-five percent of all combat casualties.²¹ Interestingly, after World War II, General George Patton was credited with saying, "I do not need to tell you who won the war. You know, the Artillery did."²² American commanders fighting in World War

¹⁶Blumenson, *Breakout and Pursuit*, 197.

¹⁷Russell F. Weigley, *Eisenhower's Lieutenants: The Campaign for France and Germany 1944-1945* (Bloomington: Indiana University Press, 1981), 151. Also see Department of the Army, The General Board: Report on Study of Field Artillery Operations, November 1945, 16. First U.S. Army "Outline Plan COBRA," July 13, 1944.

¹⁸Blumenson, *Breakout and Pursuit*, 240.

¹⁹Weigley, *Eisenhower's Lieutenants*, 155.

²⁰*Ibid.*, 160-161.

²¹James F. Dunnigan. *How to Make War: A Comprehensive Guide to Modern Warfare in the 21st Century* (New York: Harper Collins Publishers, 1982), 101.

²²The Patton quote is on a plaque that hangs in Knox Hall at Fort Sill OK; the actual

II understood that firepower enabled maneuver. The common thought held by commanders was that they would rather hit the enemy with artillery than send waves of fighting men into the teeth of a determined enemy defense. For this reason, the United States Army developed a tactical doctrine during the 1930s that called for fire and maneuver.²³ This research examines examples of how artillery supported successful offensive operations during World War II and compares these historical capacities to current artillery manning, equipping, and training operations for combat. The primary question put forth by this research is intended to answer how the United States Army Corps Commanders during World War II employed field artillery when conducting offensive operations? Accordingly, these insights will benefit United States Army efforts in guiding how the organization prepares its artillery for the next major combat operation.

From a doctrinal standpoint, both current and period manuals identify similar tasks for field artillery. For instance, the current Army Doctrine Reference Publication ADRP 3-0 (Unified Land Operations) outlines responsibility for the delivery of fires, the integration of all forms of Army, joint, and multinational fires, as well as the targeting of fires for the war fighting function.²⁴ Furthermore, the 1941 edition of Field Manual 100-5 (Operations) lists the specific missions that the field artillery was to accomplish: support infantry units with indirect fire, provide both counter battery fire, and deep interdiction fires against the enemy. The 1941 field manual also lists several capabilities that the field artillery must have in order to be effective. These capabilities include the flexibility of fire across the breadth and width of the operating

quote cannot be found in his autobiography, *War As I Knew It*.

²³Weigley, *Eisenhower's Lieutenants*., 5.

²⁴Army Doctrine Reference Publication ADRP 3-0 *Unified Land Operations* May 2012 (Washington, D.C.; Create Space Independent Publishing Platform, 2012), 3-4.

environment and the ability to possess the power to destroy or neutralize enemy forces.²⁵ More importantly, characteristics of the United States Army's usage of field artillery in the offense during World War II included the massing of fires, the use of close air support, and the integration of logistics. By themselves, these three capabilities are adequate to support the primary mission of the field artillery – to support the maneuver forces. However, when combined through a commander's vision and guidance they can become greater than the sum of their parts. Hence, this research looks at these three areas for future training consideration as the Army draws down in Afghanistan and returns its focus to combined arms training. By using historical case studies derived from the United States Army World War II offensive operations, the following research considers the massing of fires, the use of close air support, and the integration of logistics as primary opportunities for future training consideration in a constrained resource environment.

MASSING

Operation COBRA represents one of the best examples of the use of artillery to support an offensive operation through the massing of firepower.²⁶ To mass artillery fires requires several conditions to be met. The first condition is effective command and control of the artillery units. The second condition centers on multiple artillery units engaging the targets simultaneously. The third condition is the integration of effective procedures to ensure that the rounds accurately hit their targets. The term "massing fires" was commonly used during World War II despite not being defined by the United States Army until the 1983 edition of FM 101-1-5. In this 1983

²⁵United States Army, Field Manual 100-5, *Operations* (Washington D.C., USA: War Department, 1941), 8-9.

²⁶The General Board "Report on Study of Field Artillery Operations," November 1945, 14.

manual “massing fires” was defined as the combining of fire from two or more weapons directed at a single point or target.²⁷ For the purposes of this research, that definition will be expanded to include two or more artillery units firing at a target. For instance, massing fires is more than just aiming all of the artillery pieces at a specific target and then firing. As noted by Carl von Clausewitz, this concept emphasizes the concentration of forces in space to be strong at the point of attack.²⁸ Hence, artillery fires in this example are an extension of this concept.

Commanders, for example, tend to group their artillery units together in order to concentrate their fire and provide greater firepower at the decisive points.²⁹ The concentration and massing of artillery fires, in turn, can have a devastating psychological effect on the enemy while also demoralizing the force as a whole. The authors of past wartime doctrine clearly understood this concept by indicating that the massing of artillery fires was a force multiplier on the battlefield.³⁰ More importantly, in order to mass fires on a target, a shift from a decentralized control process – common in the interwar years – to a centralized control process of fire direction had to occur.³¹

One of the many tools available to a commander for massing fires is the establishment of command and support relationships. These arrangements, published in the operations order, are

²⁷Period doctrinal manuals do not specifically define “Massing.” This definition is from FM 101-1-5, *Operational Terms and Graphics* (Washington, DC: Government Printing Office ,1983).

²⁸Carl von Clausewitz, *On War*, ed. Michael Howard and Peter Paret (Princeton, New Jersey: Princeton University Press, 1984), 204.

²⁹United States Army, Field Manual 6-20, *Field Artillery Tactical Employment* (Washington, DC: Government Printing Office, 1944), 1.

³⁰FM 100-5, *Operations*, 1941, 8-9.

³¹Boyd Dastrup, *The Field Artillery History and Sourcebook* (Westport, CT: Greenwood Press, 1994), 60.

fundamental to establishing clear responsibilities between supported and supporting units. The order identifies the type and amount of indirect fire support that units can expect to receive or provide. Since World War II, there have been three categories of artillery support: direct, general, and reinforcing. An artillery unit that is in direct support of a specific maneuver unit will answer the requests for fire from its supported unit to the exclusion of all other units. A direct support artillery unit, however, is not attached to its supported unit and remains under the control of a higher artillery commander.³² An example of a direct support artillery unit would be an artillery battalion that is in direct support of an infantry brigade.

The commander can also place an artillery unit in a general support. In this role, the artillery unit provides additional firepower for the force commander to influence the fight. An example of a general support artillery unit would be a field artillery battalion that is supporting an infantry division. The third support role is reinforcing. A unit with this mission will answer calls for fire directly from the unit whose fires it is to reinforce.³³ Usually an artillery unit that is in a reinforcing role will also be in a general support role as well. For instance, an artillery battalion providing general support for an infantry division may also be providing reinforcing fires for the division's main effort. A commander, however, can designate an artillery unit to provide reinforcing fires for additional support to his main effort in an attack as a means to create overwhelming artillery fire.

³²FM 6-20 *Field Artillery Tactical Employment* (1944), 8-9.

³³*Ibid.*, 8-9.

	Answers calls for fire from	Has its zone of fire	Is positioned by	Required to provide liaison to	Fires planned by
Direct Support	Supported maneuver unit	Zone of action of supported maneuver unit	To best support maneuver unit	No requirement	Develops own fire plans
General Support	Force field artillery HQ	Zone of action of supported artillery unit	Force field artillery HQ	No requirement	Force field artillery HQ
Reinforcing	Reinforced artillery unit	Zone of fire of reinforced artillery unit	Reinforced artillery unit HQ	Reinforced artillery unit HQ	Reinforced artillery unit HQ

Source: Data adapted from Department of the Army, *The General Board: Report on Study of Field Artillery Operations*, NOV 1945, 2.

The innovation of fire direction centers during the interwar years resulted in a greater ability to mass fires subsequently requiring significant change in how artillery units were trained and equipped. In the 1930s, the American Army developed a fire direction center to centralize the command and control of an artillery battalion's firing batteries into one network. By taking advantage of the fire direction center, 1930s era battalion could fire all of its twelve howitzers on a single target in approximately twelve minutes. By 1941, an American Army division could mass four battalions of artillery (forty-eight howitzers) within five minutes after the request for fires was received from the forward observer.³⁴ This massing of fires from all available artillery effectively caused the maximum amount of damage to the enemy with a minimum expenditure of ammunition. This technique also limited the lethal exposure of friendly troops to enemy fires. By massing fires, the enemy also experienced less time to react and seek protection from the attacks leading to more casualties and damage to equipment. When used correctly, these advances in

³⁴Dastrup, *The Field Artillery History*, 60.

techniques and doctrine gave commanders an effective tool to devastate the enemy using minimal manpower.

The actual technique of massing of fires requires more than just assembling a number of artillery units. It requires all of the units to be on a common survey to ensure they are pointed in the same direction, and can shift from target to target with accuracy.³⁵ The observers must have a secure and reliable means of communicating with the Fire Direction Centers in order to send them the proper target location. More importantly, the Fire Direction Centers must be able to accurately calculate firing data for widely dispersed artillery units as a means to have all of their fires impact on a specified point (the target) some distance beyond their line of sight.

One aspect of mass is simply the number of artillery tubes available to a unit. In World War II, United States Army units incorporated this massing concept into operational planning by equipping units with significant amounts of artillery. Commanders also had the authority to change the task organization of units to increase support for their main effort if needed. This flexibility enabled the commander to weight the main effort with more fires to tilt the odds in their favor. For instance, the usual task organization for an infantry division in 1944 included one light artillery battalion (75-mm. howitzers) in support of each infantry regiment. For Operation COBRA, First Army increased the artillery support to its main effort by a significant amount. VII Corps received support from nine heavy battalions (8-inch guns), five medium battalions (155-mm. howitzers), and seven light battalions (105-mm. howitzers) in addition to their organic artillery battalions. VII Corps also controlled the fires of 1st Infantry Division, as well as 2nd and

³⁵War Department, *Digest of Field Artillery Developments* (Fort Sill: Field Artillery School Printing Plant, 1935), 26-27. Common survey can be as simple as all of the artillery units using the same map data as the forward observers that are requesting the fire missions. The First Army Operations Plan COBRA specified that the corps supporting VII Corps would adjust their survey control to agree with VII Corps.

3rd Armored Divisions who were waiting in reserve to exploit the breakthrough.³⁶ Both VIII Corps and XIX Corps received similar additional artillery support, however, to ensure that VII Corps had priority in the resupply of ammunition, these units were not allowed to fire except for emergency purposes until they were committed to the fight.³⁷ At the point of attack, VII Corps had an artillery density of one firing piece for every fourteen yards of front.³⁸ To support VII Corps' attack, Omar Bradley directed that V, VIII, and XIX Corps provide both general support and reinforcing fires to allow VII Corps artillery to focus on the point of attack. V Corps artillery was directed to fire smoke rounds to mask the observation from the enemy held high ground near St. Jean Des Baisants, and to interdict the communication center near Vire if enemy reserves were seen there. VIII Corps artillery was prepared to fire smoke rounds on the high ground near Mothuchon and Camprond when VII Corps requested it. XIX Corps artillery received a similar smoke mission targeted near La Calange and Le Mensnil Herman.³⁹ Bradley provided an additional 252 artillery pieces from the corps artillery units to directly support his main effort, VII Corps.⁴⁰

Bradley's intention was to "blast a hole" in the German defensive lines in order to break through the German defenses and allow his exploitation force to seize Coutances and cross the

³⁶The General Board, "Artillery Operations," 15-16. For further discussion see Peter R. Mansoor, *The GI Offensive in Europe: The Triumph of American Infantry Divisions, 1941-1945* (Lawrence, KS: University Press of Kansas, 1999), 166.

³⁷*Ibid.*, 17-18.

³⁸*Ibid.*, 19.

³⁹First Army "Operations Plan COBRA", July 18, 1944, Field Artillery and Tank Destroyer Plan, 2.

⁴⁰The General Board, "Artillery Operations," 16-17.

Sienna River to the southwest.⁴¹ Between the artillery bombardment and the air attacks, the point of attack turned into a scene of devastation for the defenders.⁴² For instance, Major General Fritz Bayerlein, Commander of the Panzer Lehr and responsible for the area that VII Corps was attacking, completely lost control of his units in the first twenty-four hours of the attack after the intense American fire cut his communications lines. Forty-eight hours after the attack, Bayerlein effectively lost control of most of his division enabling the breakthrough to expand quickly.⁴³ In retrospect, Operation COBRA was a clear example of a well thought out and prepared operation with an abundance of pre-planned artillery support. The Allied response to the German counterattack – Operation LUTTICH – would rely just as heavily on the effects of massed artillery fire.

Operation LUTTICH, which began on August 7, 1944, was the German response to Operation COBRA. The German plan called for three armored divisions (116th Panzer Division, 2nd Panzer Division, and 17th SS Panzer Division) to attack two United States Army divisions (3rd Armored and 30th Infantry).⁴⁴ The Germans commenced the attack around midnight without an artillery preparation initially making good progress against the unarmored American forces. One exception in the German advance, however, was Second Battalion, 120th Infantry which was defending Hill 317 just outside Mortain. Hill 317 provided excellent observation of the entire area for the Americans and allowed the forward observers to direct massed artillery fire against the

⁴¹First U.S. Army “Operations Plan COBRA,” July 13, 1944, 2.

⁴²Martin Blumenson, *United States Army in World War II: The European Theater of Operations Breakout and Pursuit* (Washington, D.C: Center of Military History United States Army, 1961), 240.

⁴³Thomas A. Hughes, *Overlord; General Pete Quesada and the Triumph of Tactical Air Power in World War II* (New York: The Free Press, 1995), 214-218.

⁴⁴Blumenson, *Breakout and Pursuit*, 460-461.

attacking German forces. Major General Collins ordered his corps artillery battalions into a direct support role to provide further artillery fires for the defenders of Hill 317.⁴⁵ With this additional artillery support, Second Battalion 120th Infantry was able to defend the hill and to disrupt enemy movement in the area effectively slowing the German advance. After nearly four days of desperate fighting, Second Battalion 120th Infantry was able to halt the German advance despite suffering almost 300 killed or wounded.⁴⁶ More importantly, Collins was able to stop the armored penetration and send two of his divisions to encircle the Germans because of his ability to mass his artillery fire against the German main effort. To accomplish this, Collins used seven divisions against four severely mauled German divisions that could only muster two hundred tanks after days of enduring regular attacks from close air support and artillery fire.⁴⁷ It is arguable that without the additional artillery support, Hill 317 would have fallen and Operation LUTTICH would have broken through the lines resulting in the loss of all of the ground that VII Corps had spent the last two weeks fighting to capture.

In the end, the Allies defeated the German counterattack by massing artillery fires on German formations and using air attacks on stalled armored columns. This operational tactic provided time for American armored divisions to reach attack positions. The ability of the American commanders to mass artillery fire by adjusting task organizations, as well as the resulting command and support relationships provided additional support for the ground forces against Panzer formations. These command decisions, in turn, were crucial to the successful

⁴⁵Ralph A. Kerley, MAJ USA, "Personal Experiences of a Company Commander: an Isolated Infantry Battalion Defending a Key Terrain Feature" (monograph written for Advanced Infantry Officer's Class #1, 1949-1950), 10, <http://www.30thinfantry.org/Mortain-Operations.doc> (accessed April 2, 2013).

⁴⁶J. Lawton Collins, *Lightning Joe—An Autobiography* (Baton Rouge: Louisiana State University Press, 1979), 255.

⁴⁷Blumenson, *Breakout and Pursuit*, 487-489.

defense and later counterattack that very nearly destroyed the German Army. The *General Board: Report on Study of Field Artillery Operations* from November 1945 studied the tactical organization for combat and employment of United States field artillery used in the European Theater of Operations and confirmed the importance of mass.⁴⁸ Supporting this argument, the board reached the following conclusions regarding massed artillery fire:

- A. That there was no substitute for massed artillery fires.
- B. That these fires played a major role in the advance of our troops and in breaking up and disorganizing enemy counterattacks.
- C. That these fires were carefully controlled and readily shifted to the desired location.
- D. That these fires were available, on short notice, during all hours of the day and night and in all kinds of weather.⁴⁹

Massing fires is a crucial element when conducting offensive operations. If the overall commander has the resources to do so, massed fires used effectively can make the difference between a successful and failed attack. For massing to be effective, the unit must have centralized control of its artillery units in order to focus the fires on priority targets while also ensuring that multiple units are not firing at the same targets. There is also a very specialized technical fire control aspect to massing fires. This aspect requires that Fire Direction Centers compute firing solutions for widely scattered units to fire at targets across the breadth and depth of the operating environment. Commanders must also recognize that they may have to be very flexible with the command and support relationships between the artillery and maneuver units. To provide increased support for the main effort in an offensive operation, a commander may designate additional artillery units to provide direct support artillery units to fire targets supporting the

⁴⁸The General Board: "Field Artillery Operations", 106.

⁴⁹Ibid.,106.

attack. Accordingly, artillery units must be flexible enough to shift its fires from supporting one unit to another if the main effort changes due to culmination. Hence, massed artillery fire is devastating against a target and can break up a counter attack quickly by inflicting significant casualties against the enemy while maintaining responsiveness to the commander.

CLOSE AIR SUPPORT

July 25, 1944 was an unusually clear and bright day on the European mainland allowing the full weight and power of the Allied air forces to support Operation COBRA. At precisely 0938 hours, the first flights of fighter-bombers began to strike German defensive positions along the Saint Lô road. For the next twenty minutes, in four-minute intervals, 350 fighter-bombers dove in to attack German positions. At 1000 hours, the first of three waves of Allied medium bombers arrived to continue the attack. After two hours of air bombardment, the ground forces stepped out of their fighting positions and began to move towards the German lines.⁵⁰ The Panzer Lehr Division received the full weight of the American artillery and air attacks. General Lieutenant Fritz Bayerlein stated after the war that it was “like hell on earth” and that “his front lines looked like the landscape on the moon due to the craters caused by the bombs and artillery rounds.”⁵¹ He estimated that he lost at least seventy percent of his personnel and all of his front line tanks.⁵² The day after the initial attacks, Bayerlein was ordered to hold the Saint Lô -Periers road at all cost. This order, however, came too late. The road was already in American hands.⁵³ The success of this Allied action primarily lay in the highly effective air and ground integration developed from a close personal relationship between the supporting and supported commanders.

⁵⁰Hughes, *Overlord*, 210-212.

⁵¹Carlo D’Estes, *Decision in Normandy* (New York: E.P. Dutton, Inc., 1983), 402

⁵²D’Estes, *Decision in Normandy*, 402

⁵³*Ibid.*, 402.

This relationship also helped improve techniques for communication between the air and ground forces by deconflicting the types of ordinance that the airplanes utilized.

During the early days of World War II, there was significant debate within the Allied headquarters as to the best use of airpower. These debates, which were remnants of the inter-war years, had yet to be resolved by the time the war started. Furthermore, a doctrine that specified how the Army would use the Air Corps in a supporting role to the ground forces was not formalized until just before the American invasion of North Africa.⁵⁴ Regardless of the argument, the main sticking points were how the air power would be utilized and who would control it.⁵⁵ In fact, many officers advocated the preponderance of air power be dedicated to strategic bombing of the German industrial complex. By late 1942, however, the debate was partially solved when the War Department assigned the Air Corps the mission of providing close air support to ground forces.⁵⁶ This pre-war doctrine emphasized the bombing of strategic targets of an economic or industrial nature. Interestingly, the North African desert had none of these targets. The barren terrain only held enemy combat troops and their support structure. To content with this situational issue, the air forces focused on targeting enemy airfields, gaining air superiority, and interdicting the German ground support.⁵⁷

To help solve this issue, General Eisenhower created the Mediterranean Air Command

⁵⁴Scott A. Hasken, MAJ, USA, “A Historical Look At Close Air Support” (master’s thesis, United States Army Command and General Staff College, 2003), 2.

⁵⁵Michael R. Matheny, *Carrying the War to the Enemy: American Operational Art to 1945* (Norman, University of Oklahoma Press, 2011), 119.

⁵⁶Daniel R. Mortensen, *A Pattern For Joint Operations: World War II Close Air Support North Africa* (Washington D.C.: Office of Air Force History and U.S. Center of Military History, 1987), 28.

⁵⁷Wesley F. Craven and James L. Cate, eds., *The Army Air Forces in World War I; Europe: TORCH to POINTBLANK*, (Chicago: The University of Chicago Press, 1956), 86. For further discussion see Mortensen, *A Pattern for Joint Operations*, 62.

with subordinate elements that included divisions for strategic, tactical, and coastal air forces.⁵⁸ The identification of a new headquarters to plan and coordinate the air efforts was certainly a move in the right direction, but there was still a deep history of mistrust between the ground and air forces. Even Eisenhower was not immune to his distrust of the air forces. He admitted as much after the German victory at the Kasserine Pass when he complained that the pilots were not able to strike German strongpoints.⁵⁹ Eisenhower was justifiably frustrated at the fighting ability of his force as a whole subsequently lashing out at all his components at one point or another. This was the environment that air and ground force commanders operated in. In other words, fighting the Germans while fighting the other services for support contradicted their pre-war doctrines that did not account for true combined arms operations. Accordingly, General Eisenhower would take the lessons learned in North Africa to heart, and better prepare his air to ground integration for the invasion of France.

Field Manual 100-20, *Command and Employment of Airpower* (1943), declared the air force would be equal to the ground force and that control of airpower must be centralized and that command of the airpower must be exercised through the air force commander.⁶⁰ This field manual also set the airpower priorities as “achieve air superiority, interdict the movement of hostile troops and supplies and to participate in a combined effort in the battle area on the immediate front of friendly forces.”⁶¹ This meant that Eisenhower would have to designate a

⁵⁸Matheny, *Carrying the War to the Enemy*, 89.

⁵⁹Diary of Harry Butcher, January 4, 1943, Eisenhower Papers, Eisenhower Library.

⁶⁰ War Department Field Manual 100-20, *Command and Employment of Airpower* (Washington, DC: Government Printing Office, 1943), 1.

⁶¹US War Department, Army Air Force Field Manual 100-20, *Command and Employment of Airpower*, in *Airpower and Ground Armies: Essays on the Evolution of Anglo-American Air Doctrine, 1940-1943*, ed. Daniel R. Mortensen (Maxwell AFB, AL: Air University Press, 1998), 178-179.

strategic air commander, as well a tactical air commander to ensure that the strategic and operational objectives were met. Strategic airpower, in turn, was designed to attack all targets beyond the land battle. Tactical air command would control and plan all of the air operations affecting the land campaign including interdiction against Luftwaffe airfields and the transportation network in Europe.⁶² This was the setting for First Army and the IX Tactical Air Command when they began operations in France.

Lieutenant General Pete Quesada commanded the IX Tactical Air Command that supported Bradley's First Army with fighter-bomber support. These two commanders forged a relationship based on trust that despite a fierce rivalry between the air and ground forces, found common ground in fighting the enemy instead of each other. For instance, Quesada set the IX Tactical Air Command command post as close as possible to Bradley's First Army command post to ensure that there was cooperation between the two staffs. The co-location of command posts was a simple and uncommon solution to how the ground and air could coordinate their efforts at the higher levels. In a letter to General Carl Spaatz, the Commanding General of the United States Strategic Air Forces, Bradley stated, "that joint planning at the appropriate command level is essential and has been obtained here by first the close physical association of headquarters and second by the operational linking up of ground and staff personnel in your various air headquarters. The latter is original within this theater and has thoroughly justified itself."⁶³

The approved air support plan for Operation COBRA, included attacks by approximately

⁶²Philip W. Wielhouwer, MAJ, USAF, "Trial by Fire: Forging American Close Air Support Doctrine, World War I Through September 1944" (master's thesis, United States Army Command and General Staff College, 2004), 65.

⁶³Letter from General Omar Bradley to General Carl Spaatz, May 17, 1945 (*The Effectiveness of the Third Phase Tactical Air Operations in the European Theater 5 May 1944-8 May 1945*, The Army Air Forces Evaluation Board, August 1945), 218.

1,586 heavy and medium bombers, as well as almost 800 fighter-bombers.⁶⁴ There were negotiations in the planning phase, however, that compromised on the relative size of the safety buffer provided between the front line of friendly troops and the bomb line. These negotiations also resolved the direction that the heavy bombers should approach to attack. The buffer agreed upon was 1,250 yards from the front line of troops, however, there remained a misunderstanding on the direction of flight for the bombers.⁶⁵ This misunderstanding on the size of the safety buffer resulted in two tragic fratricide incidents involving the heavy bombers, with Allied planes dropping bombs that fell behind American lines causing casualties.⁶⁶ Whether it was due to the inaccurate nature of carpet-bombing or dust obscuring the target area, one entire formation dropped its bomb load short on American positions.⁶⁷

Despite various missteps, a shining success in air support during the war was the fighter-bombers. By flying at a lower altitude and having better coordination with the maneuver commanders, they were able to strike German targets without causing friendly casualties. Chester Hansen noted, “the dive bombers were perfect, hitting their targets with incredible accuracy in wave after wave with none falling behind our lines.”⁶⁸ Clearly, there was enormous power in using the heavy bombers to break the enemy defensive positions, but the cost was very high. After learning of the fratricide incidents, General Eisenhower commented that he did not really believe in the use of the heavy bombers in tactical situations and that he saw them as a better weapon against strategic targets rather than in support of ground troops. He went on to state,

⁶⁴Hughes, *Overlord*, 200.

⁶⁵*Ibid.*, 199.

⁶⁶Blumenson, *Breakout and Pursuit*, 206.

⁶⁷Hughes, *Overlord*, 214.

⁶⁸Hansen diary, July 25, 1944.

“that’s a job for the artillery.”⁶⁹ The fighter-bombers flying at a lower altitude, however, were much more successful. This success was due to two reasons. The first reason was the close integration of the air support plan with the ground plans enabling commanders at different command levels to communicate across the battlefield. The second reason was the natural abilities of the pilots flying closer to the ground possessing the capability to positively identify their targets before engaging them. Learning from these mistakes, more importantly, helped the air force in its efforts to continue to develop innovative techniques to overcome the fog and friction of war.

One of the largest and most pressing problems that plagued operations was the lack of effective coordination between the ground forces and the air support. For instance, at the beginning of the Normandy campaign in June 1944, all requests for air support were sent from the requesting unit to a tactical air command via a rear area signals junction and then to a fighter group located in England to send support. When the aircraft left the airfield, the only mission information they had was from the ground unit sent hours earlier. In fact, there was no technique at the time designed for the pilots to get updates after they arrived at the target area as the ground forces did not have the same radio systems located inside the aircraft.⁷⁰ In the early phases of the campaign, this simple communication effort was inconvenient but generally effective because the front was slow moving and generally stable.⁷¹ The only technique to mark friendly forces and prevent fratricide was by ground marker panels that could be seen from the air. This process, however, was time consuming and resulted in air support that often arrived at least an hour after it

⁶⁹Hansen diary, July 25, 1944.

⁷⁰*The Effectiveness of the Third Phase Tactical Air Operations in the European Theater 5 May 1944-8 May 1945* (The Army Air Forces Evaluation Board, August 1945), 28.

⁷¹Hughes, *Overlord*, 183.

was requested. To help solve the problem, Quesada installed a common radio system in tanks and airplanes so that the pilots and the ground forces could talk to each other. This novel concept, however, also had a problem because pilots and tankers have different points of view of the battlefield. For instance, what can appear as a very distinguishable landmark to a tanker can be nearly invisible to a pilot flying at a high altitude or at hundreds of miles an hour. The simple solution was to place a pilot in tanks equipped with high frequency radios.⁷² The tank commander lost a trained crewmember but gained the ability to communicate with his air support. Quesada also moved fighter groups to operate from airfields in France effectively cutting the flying time from the airfield to the battlefield. This also allowed the pilots to fly more sorties per day because they did not have to fly back to England to refuel or re-arm.

Another example of air to ground cooperation was the incorporation of “counter-flak” artillery missions to suppress German anti-aircraft guns before an air strike. Radio communication was established between the aircraft and the supporting artillery units to ensure proper timing for the artillery fires. Counter-flak targets for the artillery included all heavy anti-aircraft guns within 5000 meters of the line of flight when heavy and medium bombers were flying to the target area. Fighter-bombers, in turn, were allocated a smaller area of 2500 meters to either side of the line of flight and 5000 meters short of the target.⁷³ By using this technique, low and medium altitude attacks were safer for the pilots while increasing accuracy rates. It is interesting that both air and ground forces understood that in order to fully integrate they would have to work together despite inter-service rivalries. Furthermore, the air corps would have to become more responsive to the ground attack plan and establish effective communication while

⁷²Ibid., 184.

⁷³General Courtney H. Hodges, *Combat Operations Data: First Army Europe 1944-1945* (General Hodges personal papers, Eisenhower Library), 34.

the ground force would have to take measures to try to protect the aircraft from ground fire.

An additional problem that plagued early air and ground integration was the lack of specialized munitions to support the ground forces. Up to this point, the ordinance used by the tactical air forces was the same that was used for the strategic bomber force. The bombs best suited to be dropped from 20,000 feet into a city were not always the best option for low flying aircraft attempting to destroy armored columns or entrenched enemy positions. Fortunately, the United States Navy reported that they had success using airborne rockets in the Pacific theater. In July 1944, Quesada requested to have these rockets supplied to the IX Tactical Air Command as well. On July 17, 1944 the rockets were used in combat for the first time by the 406th Fighter Group targeting a railroad-marshaling yard. The effect was that the pilots were able to attack at a lower altitude and at a higher rate of speed. They launched forty-eight rockets with thirty-eight of striking twenty-five locomotive engines. This incredibly accurate attack impressed Quesada enough to wire the Chief of the Air Corps, General Hap Arnold, in Washington D.C. with the report. General Arnold, in turn, reported the excellent results to both the Secretary of War, Henry Stimson, and General Marshall.⁷⁴ Another weapon that was successful was napalm.⁷⁵ Napalm proved particularly effective against targets that were hidden in wooded areas and that were difficult to observe from either the air or the ground. Furthermore, the delivery of the napalm did not have to be very accurate as the fire would spread and burn the enemy's facilities. Logistical issues would prevent the widespread use of napalm until later in the year, but its use proved that it had the potential to be a very effective weapon.⁷⁶

⁷⁴Hughes, *Overlord*, 190.

⁷⁵Napalm is jellied gasoline that has been packaged into an air deliverable container with a fuse device.

⁷⁶Memo from Bradley to Eisenhower, July 28, 1944, Eisenhower Pre-Presidential Papers.

To support Operation COBRA, and the subsequent breakout, a technique was developed to provide near continuous air coverage to each of the columns advancing. Operations Order Number 90 from IX TAC dated July 20, 1944 stated, “aircraft will maintain close armed recce (sic) in advance of rapidly moving column. They may attack any target which is identified as enemy...The Combat Command commander may also request this flight to attack targets immediately in front of him.”⁷⁷ Harold Holt’s mission brief to the 366th Fighter Group on July 26, 1944 was simple and to the point, “[y]our mission is column cover for Combat Commands A and B of the Second Armored Division. Assist them in any way that you can.”⁷⁸ This broad mission guidance allowed for considerable flexibility to both the pilots and the ground forces. Once the aircraft arrived over the column, they established radio contact with the ground forces and requested target information and guidance. When a column encountered enemy resistance, they could rapidly describe the target and identify the location to the pilots who could then quickly destroy it. Quickly overcoming localized enemy resistance allowed the ground forces to continue to advance and maintain pressure on the enemy. After over a month of struggling in the bocage, the Americans were on the verge of breaking through the German defenses and routing them out of France. This was partially due to the effectiveness of close coordination of air support. Hodges wrote that this technique was “enthusiastically endorsed” by the ground units that were supported and called it “splendid cooperation.”⁷⁹

The Air Forces developed many innovations for better air to ground integration in the summer of 1944. When most of the Air Corps saw ground support as a diversion of critical

⁷⁷Hodges, *Combat Operations Data*, 49.

⁷⁸Harold Holt, “Column Cover,” *American Aviation Historical Society*, (Fall/Winter 1983).

⁷⁹Hodges, *Combat Operations Data*, 49.

resources from the decisive fight of strategic bombing, the tactical air commands saw it as a new side of air power that should be developed into an effective method of supporting either the tactical or operational fight. Collins and Bradley would rely on this new form of combined arms operation to penetrate the German defenses in support of Operation COBRA and the ensuing breakthrough. The air and ground forces ultimately reached a level of trust and cooperation that resulted in a highly effective combination of lethal fire and maneuver. It was the first time that close air support was truly responsive and effective in battle and has been argued that it is still the best example of close air support in major combat operations.⁸⁰ This close cooperation resulted from forward thinking leaders that learned from previous mistakes subsequently setting conditions for the development of creative solutions. For instance, the solution for the lack of communication between the pilots and ground forces was simply to issue common radios to both parties enabling them to talk to each other. Subsequently assigning a trained pilot to talk to the aircraft with a common technical language furthered this communication advancement.

Another example of learning from past mistakes involved the use of specialized munitions for close air support as a solution for fighter-bombers previously using bombs that were originally designed for strategic bombing. For instance, strategic bombing usually calls for large bombs that have fuses set to detonate after they penetrate a building. Tactical close air support, on the other hand, requires ordinance to be effective despite being used in close proximity to friendly forces. Most of the bombing targets include vehicles, command posts, or troop formations that require accurate strikes while flying from low altitudes and high speeds. As noted earlier, rockets and napalm were also very effective against similar targets. All of these technical improvements, however, were useless without trust and respect between the air and

⁸⁰Scott A. Hasken, "A Historical Look At Close Air Support" (master's thesis, Fort Leavenworth: US Army Command and General Staff College, 2003), 21.

ground forces trust. Unfortunately, early in the war the level of competition, and lack of doctrine identifying close air support, lead to an almost universal mistrust between the air and ground forces. Still, leaders such as Quesada, Bradley, and Collins understood that they must work together and maximize the efforts of their forces to become more effective and cause more damage to the enemy than they received.

LOGISTICS

Logistics plays a significant role in combat. The availability of fuel and ammunition has a direct impact on the modern fighting force. In fact, several planned offensive operations in September 1944 against the German defenders of the Siegfried line were postponed due to a lack of war material to support them.⁸¹ Tank and field artillery units also require large amounts of dangerous and bulky supply items to be effective. For instance, a lack of fuel can limit the depth and the speed that an offensive can operate. More importantly, without artillery rounds, maneuver forces will not get the support that they need to break through defensive positions in order to attack enemy reinforcements. From this aspect, the American Army was presented with a significant logistics challenge after Allied forces came ashore in Normandy, France. The Allies planned to put over 160,000 troops across the beaches on June 7, 1944 with nearly three million men by the end of August. To accomplish this feat, the Allies developed a plan to keep the troops fed, fueled, and supplied with ammunition after they established a beachhead. The following research, however, will only encompass the operational level of supply after they were delivered to the continent. The focus will be on the use and resupply of artillery ammunition, innovations in logistical techniques, and new artillery equipment for the battle.

A limiting factor for supplying ammunition in the early phases of the battle was the

⁸¹Lieutenant General Hodges' war diary as kept by MAJ William Sigbram, September 10, 1944 and September 17, 1944.

ability to ship the bulky and dangerous cargo from England and then safely unload it in France. Initially, the Allies relied on temporary harbors that were susceptible to bad weather and did not have the capacity of a permanent dock with unloading capabilities.⁸² Another limiting factor was the lack of sealift capability to move the huge amounts of cargo from England to France. In fact, estimates indicate that by D+90 (the ninetieth day after the initial assault) there would only be 490,000 long tons of lift available.⁸³ The European Theater of Operations headquarters, however, assured First Army Group that there would be enough ammunition in theater to meet all requirements up to D+70.⁸⁴ Even with all of the assurances of the higher headquarters, rationing of artillery ammunition began in First Army on June 15, 1944. Fortunately for the purposes of the General Board, rationing and allocation of rounds were interchangeable. To use current terminology to define rationing one should consider required supply rate verses controlled supply rate. For instance, a required supply rate is what the end user requests that the logistics system supplies. The controlled supply rate, in turn, is what the logistics system can actually provide to the consumer.⁸⁵

At the tactical level, the amount and type of artillery ammunition that is available has significant implications to the fire plan in support of the scheme of maneuver. In the case of Operation OVERLORD, there were several reasons for the rationing, but the one with the most

⁸²R.W. Crawford, Major General USA, “Mulberry B, D+4 – D+147 1944 10 June to 31 October”, (Supreme Headquarters Allied Expeditionary Force, 1944), 1. <http://www.ibiblio.org/hyperwar/ETO/Overlord/MulberryB/> (accessed on April 5, 2013).

⁸³The General Board, United States Forces, European Theater: Report on Ammunition Supply for Field Artillery, 1945, 10. A long ton is a British ton and weighs 2240 pounds. The United States uses short tons which weigh 2000 pounds.

⁸⁴Ibid., 10-11.

⁸⁵United States Army Field Manual 1-02 *Operational Terms and Graphics* (Washington D.C.: Headquarters Department of the Army, 2004), 1-45 and 1-161.

impact was a period of bad weather in the English Channel that stopped delivery to the continent for three days.⁸⁶ To ensure that he had enough artillery ammunition in support of Operation COBRA, Bradley restricted artillery units from firing except for emergencies in the days leading up to the start of the operation. Units were limited to one unit of fire for attacks and a third of a unit of fire for normal operations in the period of July 4-15, 1944.⁸⁷ The logisticians in the formation enthusiastically embraced this rationing because it allowed them to better control the amount of ammunition in the ammunition supply points that was available to issue. This rationing order, however, was detested by the artillerymen. In fact, in a report from the XIX Corps, the Division Artillery Executive Officer complained that his unit “caught hell” for using excessive ammunition in support of two divisional river crossings. He also added that to repel a large counter attack on Anzio beach the artillery fired up to 60,000 rounds in one day. According to that officer, it was cheaper to fire the rounds than have soldiers killed in battle.⁸⁸ The crisis of supplying artillery rounds continued for the remainder of the war.

The 6th Army Group was planning a large offensive operation in November 1944. To prepare for the attack, the usage of artillery was restricted and transportation capacity increased to build up the estimated amount needed. Not surprisingly, the delivery rate of ammunition to the forward areas determined the actual date of the attack.⁸⁹ Clearly, corps commanders understood

⁸⁶First Army Report of Operations: “Comments of the Artillery Section,” 1945, Annex 8.

⁸⁷A unit of fire was an estimate of what a combat element would expend in two and half days of combat. A unit of fire was determined from historical ammunition expenditures in North Africa, Sicily and Italy. A unit of fire was the amount of “ammunition that would be expected to be expended [sic] in two and half days of average combat.” The General Board, United States Forces, European Theater: “Report on Ammunition Supply for Field Artillery,” 2.

⁸⁸The General Board , “Report on Ammunition Supply,” 17.

⁸⁹Headquarters 6th Army Group. “The Effect of Ammunition Supply on Operations of 6th Army Group – World War II, D-Day to May 7, 1945.”

the importance of artillery fire supporting offensive operations and took pains to ensure that they had the crucial capability available when they needed it. Rationing was necessary but was not the only method used to ensure the artillery rounds were available.

By August 1944, the American Army was starting to understand that fast-paced maneuver warfare relied on effective logistics. To reduce the amount of time needed to resupply a unit on the move, the VIII Corps Ordnance Officer organized rolling ammunition supply points to follow the lead elements on the attack. The officer further organized a resupply element that consisted of ten tank transporters loaded with fifty tons of ammunition each.⁹⁰ This allowed the issue of 500 tons of ammunition directly from the trucks to the armored columns they followed.⁹¹ The rolling ammunition supply points were the first example of “push” logistics where the supplies were pushed as far forward as possible to reduce the time needed to replenish the war fighters.

The “pull” system, where units send a request for supplies back to a depot where the request is processed for delivery, was still in effect for most units across the theater. From a logistical aspect, a pull logistics system is very efficient because it allows the logisticians to accurately account for all of the supplies in their depot. Furthermore, this system enables logistical planners to forecast, with some degree of certainty, what will be requested in the future. This system’s effectiveness is limited when combat operations forces units to expend more resources than anticipated resulting in emergency re-supply efforts. A push system, on the other hand, is more effective because the supplies are readily available when needed. However, the

⁹⁰A tank transporter was a flatbed trailer attached to a semi-truck that was primarily used to load and haul heavy tracked vehicles.

⁹¹Lida Mayo, *United States Army in World War II: The Ordnance Department: On the Beachhead and Battlefront* (Washington, D.C.: Center of Military History United States Army, 1991), 262.

need for re-supply may not follow the estimates from before the battle resulting in valuable resources being out of position and not available for use by other units across the theater.⁹²

Another innovation that the ordnance service used with great effect was the radio. A radio network was established while the force was training for the invasion back in England. Once the different fronts in Europe became widely separated it became time consuming to send written requests for supplies back to a central location and then send the supplies out to the units. The transmittal of supply requests via radio saved days in the delivery time to units that stretched across France. The radio network also allowed ordnance planners to balance the push/pull supply systems by sending ammunition units as far forward as possible without tying down valuable resources.⁹³ Responsive logistics was becoming the norm rather than the exception. This applied to commodities, such as fuel and ammunition, as well as to material items like new weapon systems.

The 1919 United States Army Caliber Board recommended the development of long-range artillery systems to extend the range of artillery fire beyond the range of the standard 105-mm. howitzer. They settled on an 8-inch gun and a 240-mm. howitzer.⁹⁴ In 1940, the Chief of the Field Artillery asked the Chief of Ordnance to procure prototypes of each for possible procurement. The interest in long-range artillery, however, waned as the German's successful use of aircraft for close support to infantry and armor forces became known during the German

⁹²John J. Coyle, C. John Langley Jr., Brian J. Gibson, Robert A. Novack, Edward J. Bardi, *Supply Chain Management; A Logistics Perspective* (Mason, OH: South-Western Cengage Learning, 2008), 346.

⁹³Mayo, *Beachhead and Battle front*, 274.

⁹⁴“The Ordnance Department maintained a policy of pairing a gun (a long barreled cannon with a high muzzle velocity) with a howitzer (a short barreled cannon firing shells in a relatively high trajectory) of approximately the same caliber.” Mayo, *On the Beachhead and Battlefront*, 202.

attacks in France, North Africa, and Russia.⁹⁵ Long range artillery duels with Axis forces in Italy also resulted in the increased use of 155mm artillery that resulted in accelerated barrel wear. In response to this situation, a call went out to ship some of the 8-inch/240mm systems into theater as a means to counter the increased wear on the 155mm howitzers. These systems proved very successful and were soon considered a necessary addition to the arsenal.⁹⁶ By the time the First Army executed Operation COBRA, forty-eight of the first self-propelled 155mm guns were sent overseas to include eighteen 240mm howitzers and six 8-inch guns.⁹⁷ At the conclusion of the war, a General Board found that the 8-inch and 204mm howitzer were universally praised for their mobility, accuracy, and effectiveness of its projectile. Interestingly, another innovation that emerged from the development of better artillery guns was the planned lot segregation of artillery ammunition.

Since the development of modern artillery, Fire Direction Centers have attempted to adjust the fall of the first few rounds on the target and then mathematically compute a firing solution so that the rest of the rounds will fall on the same target. A very large assumption in that equation is that all of the rounds have the same ballistic characteristics. Due to mass production methods, however, this is not possible. Consequently, artillery rounds are segregated into lots that have the same characteristics in order to make the rounds perform in a similar manner during various fire missions. The problem arises when different lots of ammunition are mixed together during transportation from the factory to the front. The goal is to have the fewest number of lots while maximizing the number of rounds in each lot. Using this concept, First Army Group

⁹⁵Walter J. Boyne, ed., *Air Warfare: An International Encyclopedia* (Santa Barbara, CA: ABC-CLIO Inc., 2002), 139.

⁹⁶Mayo, *On the Beachhead and Battlefront*, 202.

⁹⁷Mayo, *On the Beachhead and Battlefront*, 255.

established a requirement to have a minimum of 500 rounds of the same lot delivered to a single battalion. The following table illustrates an example of what a common shipment of ammunition was composed of on September 27-30, 1944.⁹⁸

FA Battalion	Total rounds drawn	Number of lots drawn	Average number of rounds per lot
26 FA BN	594	29	20.5
26 FA BN	792	45	18.0
26 FA BN	742	57	14.5
84 FA BN	262	32	8.2
60 FA BN	1076	36	29.9

Source: This data was adapted from The General Board, “Report on Ammunition Supply for Field Artillery,” 76-77.

It is evident from the above chart that the ordnance branch did not successfully meet First Army Group’s requirement. In response to this problem, the solution put forth was that the sealift ships should be loaded with as few lots as possible forcing the factory to provide as many rounds per lot in each shipment. More importantly, ordnance personnel supervised the loading of the ships to ensure that lot integrity was maintained. The ammunition from a single ship was sent to a single depot to reduce the cross contamination of lots as much as possible. The depots would then send single lots to individual ammunition supply points. This method required an intense amount of work and diligence and subsequently provided some improvement, however, the process was not completely successful.⁹⁹ Just as there is fog and friction in war there is also fog and friction in

⁹⁸The General Board, “Report on Ammunition Supply,” 76-77.

⁹⁹Ibid., 77.

logistics. Nevertheless, it was an innovative plan that laid the groundwork for future ammunition management.

The task of supplying an army on the march is incredibly complex and difficult. The effects of a lack of planning for logistical support can have catastrophic results on the battle. In fact, the General Board conducted after World War II attributed faulty logistical planning as one of the various reasons for the lengthening of the war and increase in casualties.¹⁰⁰ This bold statement does not take into account enemy action or the complexity of the task of supplying a theater with the materials of war. From the artillery branch's point of view, the logisticians could not, or would not, supply them with the ammunition needed to complete the mission. However, it is acceptable to expect a robust planning effort to accurately forecast ammunition expenditure and anticipate future requirements. Army logistical planners attempted to be more responsive by using innovative techniques to meet the changing demands of the battle with rolling ammunition supply points and a radio network to become more responsive. They also recommended that ammunition rationing occur until the supply distribution network was robust enough to meet the demands of the end users. Rationing was not a popular technique but it was effective to ensure that every major operation had an adequate supply of ammunition. One of the successes was the ability to request and receive new weapon systems and ammunition for those systems. For instance, the War Department was able to respond to the request from the field for larger field artillery systems with longer range as well as self-propelled howitzers.

CONCLUSION AND RECOMMENDATIONS

In 2007, three former Brigade Combat Team commanders authored a white paper entitled *The King and I: The Impending Crisis in the Field Artillery's Ability to Provide Fire Support to*

¹⁰⁰Ibid., 79.

Maneuver Commanders.¹⁰¹ The paper detailed the author's concerns as maneuver commanders with the ability of the field artillery to support maneuver operations. It contained information from combat training centers trends and personal experiences that reflected a growing feeling that the field artillery is in crisis due to transformation, counter-insurgency operations, and the non-standard mission demands of supporting Operation Iraqi Freedom and Operation Enduring Freedom. These commanders were concerned that field artillery was becoming a "dead branch walking" and was suffering from an identity crisis.¹⁰² They feared that the branch would not be able to support another counter-insurgency or high intensity conflict in the future.¹⁰³

The current state of the United States Army field artillery is one characterized by units deployed to support Operation Enduring Freedom in Afghanistan. The trend over the past five years was that brigade commanders elected to task only a portion of their artillery units with traditional artillery missions. The smaller number of artillerymen and howitzers supporting a large non-contiguous operating environment results in artillery support that can only cover a limited area and that is not mutually supporting. When fewer artillerymen are training on artillery tasks and deploying to fulfill artillery missions, it only follows that as a force, fewer artillerymen will be as experienced in all facets of field artillery employment. To keep effective artillerymen in the force, they have to be trained and used as artillerymen.¹⁰⁴ As operations in Afghanistan are

¹⁰¹Colonels Sean MacFarland, Michael Shields, and Jeffery Snow, *The King and I: The Impending Crisis in the Field Artillery's Ability to Provide Fire Support to Maneuver Commanders*, <www.npr.org/documents/2008/may/artillerywhitepaper.pdf>, accessed 30 NOV 2012.

¹⁰²*Ibid.*

¹⁰³*Ibid.*

¹⁰⁴As an example, during fiscal year 2012 no artillery unit that conducted a training rotation at the Joint Readiness Training Center was able to get first round accuracy within eighty meters. JRTC Trends 3rd and 4th Quarter FY 2012; <https://call2.army.mil/HotTopicsView_dev.aspx?ids=160> accessed March 26, 2013.

winding down and other conventional threats increase, the Army must prepare for the next fight.

To regain a high level of expertise in artillery related skills requires the Army to expend the time and effort to reach proficiency. Historically, governments reduce the budgets of their military forces at the conclusion of hostilities. There is nothing to suggest that the United States will do anything differently in this current operational environment. With that in mind, the Army must come up with a plan to re-build and re-train the force in an era of limited resources. To accomplish this retaining a focused effort to expend the limited training resources on the proper tasks and skills is imperative. Major General David Ralston, the former Commanding General of the U.S. Army Field Artillery Center, wrote a memo to the Vice Chief of Staff of the Army stating that “leaders at all levels have experienced the atrophy of field artillery specific skills.” He further stated that the “ability to perform core tasks was questionable after executing non-standard missions and being away from traditional field artillery missions.”¹⁰⁵

Command Sergeant Major William High, the former senior field artillery non-commissioned officer of the U.S. Army Field Artillery Center, proposed a plan to retrain field artillery units that have spent eighteen or more months performing non-standard missions either through mobile training teams or to bring the entire unit to Fort Sill for training.¹⁰⁶ General Richard Cody, former Vice Chief of Staff of the Army, also testified before the United States Senate Armed Forces Service Committee that soldiers were training for counterinsurgency operations and not training on full spectrum operations.¹⁰⁷

¹⁰⁵Memorandum thru TRADOC CAC Cdr and TRADOC Cdr for VCSA, subj: Response to VCSA Tasker to Assess FA Lieutenant Training, 7 Aug 2006, HRDC; Briefing, subj: Field Artillery Reset, 3 Oct 2008, HRDC; Briefing, subj: Field Artillery Reset, 3 Oct 2008 and HQ TRADOC Tasking Order, subj: TRADOC Task # IN 000564, 29 Aug 2006, HRDC.

¹⁰⁶Command Sergeant Major William E. High, “The FA Master Gunner and Reset of the Redeployed FA Battalion,” *Field Artillery Magazine*, (Jan-Feb 2007), 1-3.

¹⁰⁷Command Sergeant Major Dean J. Keveles, “NCOES: Restoring NCO Core

It can be argued in the current operational environment that most units cannot mass field artillery due to units deploying with less than a full complement of organic artillery systems. It is also a common practice for deploying brigades to assign artillery units non-standard missions like route security or to assume control of a portion of the brigade's battle space, serving as a maneuver unit. To support these missions, commanders shift focus away from the manning of guns to other tasks. Another technique used in Iraq and Afghanistan is for units to disperse on widely separated isolated patrol bases. These small units are not able to support each other with interlocking or reinforcing fires. For example, in Afghanistan forward operating bases are geographically separated and usually only have 120mm mortars or a two gun section of howitzers for local defense. Clearly, two modern howitzers cannot equal the available firepower of a multiple artillery battalion time on target mission. Vincent Bielinski authored an article in the *Field Artillery Journal* stating that the need for massed artillery fires may have passed. His argument is that modern precision munitions make concentrating a large number of artillery rounds on the target a moot point. Bielinski states that there would be no need for expending large amounts of artillery if one precise round will deliver the desired effect. Of course, that argument is only valid if there are a limited number of targets to service with artillery and you know precisely where they are located. One can only imagine the response from the forward observer on Hill 317 if he was told that he could only fire one round at a time to engage an armored column attacking his position. There are times when quantity has a quality all of its own just as there are times when application of a single high explosive round is all that a target requires. The Army must not forget the lessons it learned in the use of artillery just because it has been fighting a decentralized enemy in a low intensity conflict.

Bielinski also points out that due to the limited number of artillery units remaining in the Competency," *Fires Bulletin*, (Jul-Aug 2008), 20-21.

Army formation, massing of fires may not be achievable to the levels that previous conflicts have seen.¹⁰⁸ That may be a true statement, but it is a poor excuse not to train to execute the mission. The American Army is historically an army that swells its numbers during a time of crisis. To do that effectively the army must maintain a level of expertise in all of its basic skills. The delivery of massed artillery fires is a basic skill that will have to be relearned and then maintained for future use. Expanding the ranks of the army to face a new threat is the absolute wrong time to attempt to re-discover highly technical field artillery skills.

The military must support the soldiers in the field with arms and ammunition. The task of supplying the fighting force is more difficult during offensive operations due to the increased expenditure of fuel and ammunition, as well as the rapid movement of the maneuver forces away from the logistical hubs that they draw their supplies from. To overcome these difficulties requires detailed planning and input from commanders at all levels. Operation COBRA required that commanders, upon the advice of logisticians, institute limits on the amount of artillery rounds fired leading up to the operation to ensure that there would be enough ammunition for the duration of the battle. There were also limits on which units could fire and when they could fire.¹⁰⁹ Logistics also supplied new weapons that the commanders requested. For instance, self-propelled artillery systems and the long-range 8-inch howitzers were identified as an operational necessities from the field. The Ordnance Department, in turn, was able to field both systems and new ammunition for the 8-inch howitzers in time for operational use in the field.

It is difficult to imagine the current Department of Defense developing and fielding a new long range weapon system within a year as was done in World War II. The current operational

¹⁰⁸Vincent R. Bielinski, "Massed Precision Fires—A New Way of Thinking," *Field Artillery Journal* (March-April 2009), 13-14.

¹⁰⁹Blumenson, *Breakout and Pursuit*, 239.

environment in Afghanistan, and previously in Iraq, is less mobile than World War II and generally more developed. The current operational environment does not require the same logistical requirements that historical offensive operations required. As a result, logisticians have fallen out of practice in lieu of missions much like artillerymen. Likewise, they have had less practice performing their historical tasks of supplying offensive operations.

As noted earlier, the thesis for this research was how did the United States Army corps commanders during World War II employ field artillery when conducting offensive operations? Accordingly, the intention was to provide the reader with some examples of how the corps commanders used artillery to support their operations and then contrast these facts with how current brigade commanders are using artillery today. The mission of the United States Army is to fight and win our Nations wars. In order to accomplish this mission, the Army has to be prepared to execute both combined arms maneuver and wide area security. The definition of combined arms maneuver is compelling the enemy to respond to friendly action.¹¹⁰ In the offense, that means taking the fight to the enemy and not allowing him to recover. In the defense, that means to prevent him from achieving success and then counterattacking to seize the initiative.¹¹¹ Wide area security is retaining the initiative by improving the civil conditions and applying combat power to prevent the situation from deteriorating further.¹¹² The Army has been conducting wide area security for over a decade and will have to make a determined effort to be prepared to execute combined arms maneuver in the future. Some missions cannot fail, because the price for failure is too high.

¹¹⁰ Army Doctrinal Reference Publication 3-0; *Unified Land Operations*, (Washington D.C.: Headquarters, Department of the Army). 2-2.

¹¹¹ *Ibid.*, 2-2.

¹¹² *Ibid.*, 2-2.

RECOMMENDATIONS

The United States Army and the field artillery branch in particular, must retain the hard earned skill of massing artillery fires against the enemy as future conflicts may not focus solely on low intensity operations. For instance, there may be a need for massing artillery fires against large enemy formations in the future. History is replete with examples of artillery fire turning the tide of a battle or breaking the back of an enemy ground force. American combat training centers are now focusing on decisive action rotations for training units. That focus will drive the training of the units before the rotation. Part of that training needs to be how to mass the fires against the enemy, in either the offense or the defense.

Close air support is an integral part of any ground maneuver plan, however, the artillery fire plan must be fully integrated to be completely effective. Operation COBRA provides a clear historical example of effective close air support and how it was closely coordinated with the field artillery plan. The United States Army has been very effective in the integration of close air support and field artillery during the two counter insurgency conflicts, yet they must sustain that momentum in the future. The close cooperation of air forces and ground forces must be continued during training events to further develop the processes that have been tested in combat. An example of that close cooperation is the regular joint operations access exercises that the 82nd Airborne Division conducts with the U.S. Air Force. Following this concept, other army divisions should also coordinate for the same support for their brigades while conducting training at the combat training centers.

Directly related to the ability of the artillery to mass fires is the ability of the logistics support structure to keep artillery ammunition flowing to the units. Artillery rounds are heavy and bulky resulting in more transportation assets to keep an artillery force supplied relative to other classes of supply. It is self-evident that in order to fire large amounts of artillery a requirement

exists that needs large amounts of artillery rounds be delivered to the guns. The supply chain starts with the manufacturing capacity to ensure that enough rounds are in the inventory. The process then moves to the sealift capability to ship the rounds to the theater. Finally, the system relies on the organic Army haul assets to get these supplies to the units. With a future that will include reduced Department of Defense budgets, cheaper “dumb” artillery rounds will be more economical than more expensive “smart” rounds.

BIBLIOGRAPHY

Primary Sources

- Bradley, Omar, General USA. Letter to General Carl Spaatz, May 17, 1945. *The Effectiveness of the Third Phase Tactical Air Operations in the European Theater 5 May 1944-8 May 1945*. The Army Air Forces Evaluation Board, August 1945.
- Bradley, Omar, General USA. Memorandum to General Dwight Eisenhower, July 28, 1944. Abilene, KS: Dwight D. Eisenhower Library.
- Bradley, Omar, General USA. *The Collected Writings of General Omar Bradley, Volume V*. Fort Leavenworth, KS: Combined Arms Library, n.d.
- Butcher, Harry. Personal war diary. Abilene, KS: Dwight D. Eisenhower Library.
- Collins, J. Lawton. Personal Papers Collection. Abilene, KS: Dwight D. Eisenhower Library Collection, 1896-1975.
- Cook, Gilbert R. Major General. Personal Papers Collection. XII Corps Artillery in Combat. Abilene, KS: Eisenhower Presidential Library.
- Crawford, R.W. Major General USA. "Mulberry B, D+4 – D+147 1944 10 June to 31 October." Supreme Headquarters Allied Expeditionary Force, 1944.
<http://www.ibiblio.org/hyperwar/ETO/Overlord/MulberryB/> accessed on April 5, 2013).
- Hansen, Chester. Personal war diary. United States Military History Institute.
- History of the VII CORPS for the Period of 1-31 AUG 1944. Official After Action Report, 1944.
- Kerley, Ralph A, MAJ USA. "Personal Experiences of a Company Commander: an Isolated Infantry Battalion Defending a Key Terrain Feature."
<http://www.30thinfantry.org/Mortain-Operations.doc> (accessed April 2, 2013).
- LaCour, Christopher, Lieutenant USA. Interview with Combat Studies Institute. Fort Leavenworth KS: Combined Arms Research Library, 2006.
- Newell, Peter A., Lieutenant Colonel USA. Interview with Combat Studies Institute. Fort Leavenworth KS: Combined Arms Research Library, 2006.
- The Army Air Forces Evaluation Board. *The Effectiveness of the Third Phase Tactical Air Operations in the European Theater 5 May 1944-8 May 1945*, August 1945.
- US Army. 1st Army Operations Order COBRA, July 13, 1944.
- US Army. 1st Army Headquarters Papers. Abilene, KS: Eisenhower Presidential Library.
- US Army. 1st Army Headquarters Combat Operations Data. General Courtney H. Hodges papers. Abilene, KS: Eisenhower Presidential Library.
- US Army. 1st Army War Diary of Lieutenant General Hodges war diary as maintained by MAJ William Sigbram and CPT Francis Smith. Abilene, KS: Eisenhower Presidential Library.
- US Army. 1st Infantry Division Papers. Eisenhower Presidential Library, Abilene, KS.
- US Army. 4th Infantry Division Papers. Eisenhower Presidential Library, Abilene, KS.
- US Army. 6th Army Group. "The Effect of Ammunition Supply on Operations of 6th Army Group – World War II, D-Day to May 7, 1945."

- United States Forces. European Theater, Report on Ammunition for Field Artillery. US Army, 1945.
- United States Forces. European Theater, Report on Study of Field Artillery Operations. US Army, 1945.
- Wade, Gary Major. Conversations with General J. Lawton Collins. Fort Leavenworth, KS: Combat Studies Institute, 1986.

Secondary Sources

- Bailey, J.B.A. *Field Artillery and Firepower*. New York: Oxford Press, 1987.
- Bailey, Jonathon A. *Field Artillery and Firepower*. Annapolis: Naval Institute Press, 2004.
- Ballard, John R. *Fighting for Fallujah: A New Dawn for Iraq*. Westport, CT: Praeger Security International, 2006.
- Bielinski, Vincent R. "Massed Precision Fires—A New Way of Thinking." *Field Artillery Journal* (March-April 2009).
- Blumenson, Martin. *The Battle of the Generals: The Untold Story of the Falaise Pocket -- The Campaign That Should Have Won World War II*. New York: William Morrow, 1993.
- Blumenson, Martin. *United States Army in World War II: The European Theater of Operations Breakout and Pursuit*. Washington, D.C: Center of Military History United States Army, 1961.
- Boyne, Walter J., ed. *Air Warfare: An International Encyclopedia*. Santa Barbara, CA: ABC-CLIO Inc., 2002.
- Bradley, Omar N. *A General's Life*. New York: Simon and Schuster, 1983.
- Bradley, Omar N. *A Soldier's Story*. New York: Rand McNally, 1951.
- Camp, Dick. *Operation PHANTOM FURY: The Assault and Capture of Fallujah, Iraq*. Minneapolis: Zenith Press, 2009.
- Von Clausewitz, Carl. *On War*. Edited by Michael Howard and Peter Paret. Princeton, New Jersey: Princeton University Press, 1984.
- Collins, J. Lawton. *Lightning Joe: An Autobiography*. Baton Rouge, LA: Louisiana State Press, 1979.
- Coyle, John J., C. John Langley Jr., Brian J. Gibson, Robert A. Novack, Edward J. Bardi. *Supply Chain Management; A Logistics Perspective*. Mason, OH: South-Western Cengage Learning, 2008.
- Dastrup, Boyd. *The Field Artillery History and Sourcebook*. Westport, CT: Greenwood Press, 1994.
- D'Estes, Carlo. *Decision in Normandy*. New York: E.P. Dutton, Inc., 1983.
- Doubler, Michael D. Captain. *Busting the Bocage: American Combined Arms Operations in France, 6 June-31 July 1944*. Fort Leavenworth, KS: Combat Studies Institute, 1988.
- Dunnigan, James F. *How to Make War: A Comprehensive Guide to Modern Warfare in the 21st Century*. New York: Harper Collins Publishers, 1982.

- Eisenhower, Dwight D. *Crusade in Europe*. Garden City, NY: Doubleday, 1948.
- Fisher, Ernest F.Jr. *United States Army in World War II; Cassino to the Alps*. Washington D.C.: Center of Military History, 1993.
- Greenfield, Kent R., Robert R. Palmer and Bell I. Wiley. *United States Army in World War II: The Army Ground Forces The Organization of Ground Combat Troops*. Washington D.C.: Center of Military History, 1987.
- Gudmundson, Bruce I. *On Artillery*. Westport: Praeger Publishers, 1993.
- Harrison, Richard W. *Architect of Soviet Victory in World War II: The Life and Theories of G.S. Isserson*. Jefferson, NC: McFarland & Company, Inc., 2010.
- Hasken, Scott A., MAJ USA. "A Historical Look At Close Air Support." Masters monograph United States Army Command and General Staff College, 2003.
- Hastings, Max. *Inferno: The World at War 1939-1945*. New York: Alfred A. Knopf, 2011.
- Hartig, Michael J. COL United States Army. *The Future of the Field Artillery*. Masters thesis United States Army War College, 2010.
- Helmer, Daniel, Captain, USA. "Not Quite Counterinsurgency: A Cautionary Tale for US Forces Based on Israel's Operation Change of Direction." *Armor* (January–February 2007).
- High, William E., Command Sergeant Major, USA. "The FA Master Gunner and Reset of the Redeployed FA Battalion." *Field Artillery Magazine* (Jan-Feb 2007).
- Holt, Harold. "Column Cover." *American Aviation Historical Society* (Fall/Winter 1983).
- Hughes, Thomas A. *Overlord: General Pete Quesada and the Triumph of Tactical Air Power in World War II*. New York: The Free Press, 1995.
- Joint Readiness Training Center Trends 3rd and 4th Quarter FY 2012.
https://call2.army.mil/HotTopicsView_dev.aspx?ids=160 (accessed March 26, 2013).
- Keveles, Dean J., Command Sergeant Major, USA. "NCOES: Restoring NCO Core Competency." *Fires Bulletin* (Jul-Aug 2008).
- MacDonald, Charles B. *The Operations of VII CORPS in September 1944*. Washington D.C.: Office of the Chief of Military History, 1963.
- Colonels MacFarland, Sean, Michael Shields and Jeffery Snow, *The King and I: The Impending Crisis in the Field Artillery's Ability to Provide Fire Support to Maneuver Commanders*.
www.npr.org/documents/2008/may/artillerywhitepaper.pdf (accessed November 30, 2012).
- Mansoor, Peter R. *The GI Offensive in Europe The Triumph of American Infantry Divisions, 1941-1945*. Lawrence, KS: University Press of Kansas, 1999.
- Matheny, Michael R. *Carrying the War to the Enemy: American Operational Art to 1945*. Norman: University of Oklahoma Press, 2011.
- Matthews, Matt M. *We Were Caught Unprepared. The 2006 Hezbollah-Israeli War*. Fort Leavenworth, KS: Combat Studies Institute Press, 2008.
- Mayo, Lida. *United States Army in World War II: The Ordnance Department: On the Beachhead and Battlefield*. Washington, D.C.: Center of Military History United States Army, 1991.

- Miller, John Jr. *Guadalcanal: The First Offensive*. Washington D.C.: Government Printing Office, 1949.
- Miller, Robert A. *August 1944: The Campaign For France*. Novato, CA: Presidio Press, 1988.
- Mortensen, Daniel R., ed. "Command and Employment of Airpower." *Airpower and Ground Armies: Essays on the Evolution of Anglo-American Air Doctrine, 1940-1943*. Maxwell AFB, AL: Air University Press, 1998.
- Mortensen, Daniel R. *A Pattern for Joint Operations: World War II Close Air Support in North Africa*. Washington D.C.: Office of Air Force History and U.S. Center of Military History, 1987.
- Mosier, John. *The Myth of the Great War*. New York: Harper Collins Publishers Inc., 2001.
- Patton, George S., General. *War As I Knew It*. New York: Bantam Books, 1947.
- Penrose, Jane, ed. *The D-Day Companion*. New York: Osprey Publishing, LTD., 2004.
- Raines, Edgar F. Jr. *Eyes of the Artillery; The Origins of Modern U.S. Army Aviation in World War II*. Washington D.C.: Center of Military History, 2000.
- Sayen, John J. *US Army Infantry Divisions 1944-45*. New York: Osprey Publishing, LTD., 2007.
- Schifferle, Peter J. *America's School for War: Fort Leavenworth Officer Education, and Victory in World War II*. Lawrence, KS: University Press of Kansas, 2010.
- US Army Infantry Divisions 1942-43*. New York: Osprey Publishing, LTD, 2006.
- Garland, Albert N., Lieutenant Colonel and Lieutenant Colonel Howard M. Smyth, *United States Army in World War II: Sicily and the Surrender of Italy*. Washington D.C.: Center of Military History, 1993.
- Triandafillov, V. K. *The Nature of the Operations of Modern Armies*. Edited by Jacob W. Kipp. Translated by William A. Burhans. Newbury Park: Frank Cass & Co. LTD., 1994.
- War Department, *Digest of Field Artillery Developments*, Fort Sill: Field Artillery School Printing Plant, 1935.
- Weidner, William. *Eisenhower and Montgomery at the Falaise Gap*. Bloomington: Xlibris Corporation, 2010.
- Weigley, Russell F. *Eisenhower's Lieutenants: The Campaign for France and Germany 1944-1945*. Bloomington: University Press, 1981.
- Wielhouwer, Philip W., MAJ USAF. "Trial by Fire: Forging American Close Air Support Doctrine, World War I Through September 1944." Masters thesis. United States Army Command and General Staff College, 2004.
- West, Bing. *No True Glory: A Frontline Account of the Battle for Fallujah*. New York: Bantam Dell, 2005.
- Wilson, David S. *Evolution of Artillery Tactics in General J. Lawton Collins' US VII Corps in World War II*. Masters thesis. United States Army Command and General Staff College, 1996.
- Yenne, Bill. *Operation Cobra and the Great Offensive: Sixty Days that Changed the Course of World War II*. New York: Pocket Books, 2004.

Government Documents

- Air Corps Field Manual 1-10, *Tactics and Technique of Air Attack*. Washington, D.C.: Government Printing Office, November 1940.
- United States Department of the Army. Field Manual 100-5, *Operations*. Washington, D.C.: Government Printing Office, May 1941.
- United States Department of the Army. Field Manual 6-20, *Field Artillery Tactical Employment*. Washington, D.C.: Government Printing Office, FEB 1944.
- United States Department of the Army. Field Manual 1-02, *Operational Terms and Graphics*. Washington, D.C.: Headquarters, Department of the Army, 2004.
- United States Department of the Army. Army Doctrinal Reference Publication 3-0, *Unified Land Operations*. Washington, DC: Headquarters, Department of the Army, May 2012.
- Memorandum thru TRADOC CAC Cdr and TRADOC Cdr for VCSA. Subject: Response to VCSA Tasker to Assess FA Lieutenant Training, 7 Aug 2006, HRDC; Briefing, Subject: Field Artillery Reset, 3 Oct 2008, HRDC; Briefing, subj: Field Artillery Reset, 3 Oct 2008 and HQ TRADOC Tasking Order. Subject: TRADOC Task # IN 000564, 29 Aug 2006, HRDC.