

AD-A258 249



2

OBSTACLE "THEORY":
DO WE NEED IT ?

A Monograph
by
Major John E. Sterling

SD
DTIC
ELECTE
DEC 21 1992
A D



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

First Term AY 91-92

Approved for Public Release; Distribution is Unlimited

59
92-32416



92 12 18 106

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

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 the data needed, and completing and reviewing the 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 Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. REPORT DATE 12/16/91		3. REPORT TYPE AND DATES COVERED MONOGRAPH	
2. REPORT TYPE AND DATES COVERED MONOGRAPH		5. FUNDING NUMBERS	
4. AUTHOR(S) JOHN E. STERLING, USA		6. PERFORMING ORGANIZATION REPORT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) SCHOOL OF ADVANCED MILITARY STUDIES ATTN: ATZL-SWV FORT LEAVENWORTH, KANSAS 66027-6900 TEL (913) 684-3437 AUTOVON 552-3437		8. SPONSORING/MONITORING AGENCY REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES			
12. DISTRIBUTION/AVAILABILITY STATEMENT APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.		13. DISTRIBUTION CODE	
14. ABSTRACT (Maximum 200 words) UNCLASSIFIED.			
15. SUBJECT TERMS TACTICS MINE WARFARE STRATEGY BYPASSING OBSTACLES ES		16. NUMBER OF PAGES 53	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED		18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	
19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED		20. LIMITATION OF ABSTRACT UNLIMITED	

540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. Z39-18
298-102

SCHOOL OF ADVANCED MILITARY STUDIES

MONOGRAPH APPROVAL

Major John E. Sterling

Title of Monograph: Obstacle "Theory": Do We Need It?

Approved by:

Dennis W. Tighe
COL Dennis W. Tighe, MS

Monograph Director

James R. McDonough
COL James R. McDonough, MS

Director, School of
Advanced Military
Studies

Philip J. Brookes
Philip J. Brookes, Ph.D.

Director, Graduate
Degree Program

Accepted this 31st day of December 1991.

ABSTRACT

OBSTACLE "THEORY": DO WE NEED IT? by Major John E. Sterling, USA, 53 pages.

This monograph discusses the usefulness of a theory concerning only a small sector of ground combat. Using obstacles as a point of discussion, it seeks to determine how far down the benefits of theory apply.

The paper begins by examining the benefits of theory in analyzing the complex phenomenon of war. These benefits include help in (1) understanding history, (2) identifying issues that might otherwise go overlooked, and (3) ensuring consistency in doctrine. The monograph then examines one small segment of ground combat--the use of obstacles--to see if these same benefits apply to an extent that justifies the effort in developing and maintaining a theory on such a constrained subject. Alternatively, the doctrine writer might develop satisfactory doctrine using only a "lessons learned" approach.

In exploring the need for theory on the use of obstacles, this monograph looks for variation in the history of the use of obstacles since World War I. It examines the intentional construction of bypasses in obstacles as an overlooked issue in our obstacle doctrine. Finally, the paper examines Field Manual 5-100, Engineer Combat Operations for inconsistencies.

This monograph concludes that the history of obstacles exhibits considerable variation. Furthermore, our doctrine has long overlooked at least one significant issue, and our doctrine is inconsistent. For these reasons, this monograph concludes that even a narrow portion of ground combat such as obstacles would benefit from theory. The doctrine writer who relies solely on the experiences of combat veterans, or other "lessons learned," risks developing incomplete or inconsistent doctrine. Finally, this paper argues that if theory would be useful in the case of obstacles, it would probably also apply in many other small portions of ground combat; and that the TRADOC schools are the logical places for the development of such theories.

Accession For	
NTIS GRA&I	☒
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	

Table of Contents

TITLE PAGE	1
APPROVAL SHEET	.11
ABSTRACT	111
TABLE OF CONTENTS.	.iv
LIST OF ILLUSTRATIONS.	v
INTRODUCTION	1
THE VALUE OF THEORY.	3
OBSTACLE HISTORY	9
-OBSTACLE HISTORY OBSCURED BY	
LACK OF DETAIL	9
-THE PURPOSE OF OBSTACLES	.13
-OBSTACLES AS BARRIERS.	.17
-CHANGING NATURE OF OBSTACLES	.22
OVERLOOKED ISSUES.	.29
DOCTRINAL INCONSISTENCY.	.36
CONCLUSIONS AND IMPLICATIONS	.39
ENDNOTES	.44
BIBLIOGRAPHY	.50

LIST OF ILLUSTRATIONS

Figure	Page
1. Ground Combat Doctrine Development (Without Theory)	6
2. Ground Combat Doctrine Development (With Theory)	7
3. Using Obstacle Bypasses to Separate Attacking Enemy Units	35

Introduction

In his monograph "The U.S. Army and Ground Combat Theory," Lieutenant Colonel Ricky M. Rowlett argues that theory has value in the development of war-fighting doctrine. Theory helps us understand the past, identify issues that might otherwise go unnoticed, and ensures consistency of concepts and doctrine. He concludes that we need an overarching theory of war to help the U.S. military prepare for war in a totally integrated fashion.'

While such an overarching theory of ground combat may be useful in developing the Army's basic warfighting doctrine, its scope might be too large to help resolve issues involving only a small portion of ground combat. Issues such as the proper use of obstacles involve components of ground combat that are probably too small to address in a national theory of war. If that is the case, would a theory on just one aspect of ground combat be useful? How far down do the benefits of theory extend?

This paper examines whether the reasoning that justifies the development of a national theory of war extends down to the development of a theory on just one small part of ground combat. It examines whether a theory on the use of obstacles would be useful to the doctrine writer. It seeks to determine if such a theory would assist the doctrine writer in

understanding history, in identifying issues that might otherwise go overlooked, or in ensuring consistency in doctrine.

At a quick glance, a theory on such a limited subject seems trivial. It would apply to only a small portion of the Army. One might reasonably expect doctrine writers to develop a satisfactory doctrine from lessons learned or from the experiences of combat veterans. The effort in developing a theory on such a constrained topic might not be worth the effort.

On the other hand, if even in a narrow field such as the use of obstacles there are (1) a widely varied history, (2) important issues that have gone overlooked in our doctrine, or (3) inconsistencies in our doctrine, then I maintain that a doctrine writer would benefit from such an "obstacle theory."

Before examining the use of obstacles to see if the benefits of theory may apply, a review of just what these benefits are is in order. Then I will analyze the possible advantages of an "obstacle theory" through an examination of the history of obstacle use, the existence of issues that may have been overlooked, and the consistency of our obstacle doctrine. Finally, from the conclusions of my analysis, I will draw any implications for doctrine development.

The Value of Theory

War is one of the most complex of human endeavors. According to Julian Corbett, the factors governing the conduct of war are "so varied, so intangible, so dependent upon unstable moral and physical conditions, that it seems incapable of being reduced to anything like true scientific analysis."² Carl von Clausewitz spoke of the endless complexities of war, and stated that the intellectual difficulty posed by war is "among the most extreme to which the mind can be subjected."³

In such a complex and uncertain phenomenon, with the fate of lives--if not entire nations--in the balance, military leaders have naturally sought to better their understanding of war and how to fight it. According to Clausewitz, this understanding of war was first sought out from the memoirs and reminiscences of those who had experienced combat first hand.⁴ Unfortunately, in his view, these sources proved unsatisfactory.

Clausewitz described many reasons why the personal experiences of combat veterans are such unreliable sources for guiding principles in the conduct of war. First of all, even those who took part in the battle may not have understood the reasoning behind the plan of the operation in which they participated. As Clausewitz says, "Most of the arguments and clashes of

opinion that precede a major operation are deliberately concealed."⁵

The battle of Königgrätz provides an example of just such a lack of understanding of the concept of operation--even among the highest ranks. According to historian Martin van Creveld, not even Moltke's staff understood Moltke's plan to use widely separated routes to concentrate his three armies at the decisive point and time. Repeatedly, Moltke had to interject himself and correct moves made by his army commanders. These moves, according to van Creveld, stemmed from the failure of the army commanders to understand Moltke's plan.⁶ It would appear, then, that one must be suspect of "lessons learned" from the battle on the part of the Prussian army commanders, given their lack of understanding of the plan.

A second reason why the personal experience of a single combat veteran is an unreliable source for guiding principles of war is that a single observer or participant in a battle never gets the full story. According to Clausewitz, all action in war takes place in a kind of twilight, or fog, that distorts reality to the observer. As a result, all information coming from the participants in a battle is unreliable.⁷

Yet another problem exists with using the memoirs or reminiscences of first-hand observers to guide action in war. Even if these participants had complete

knowledge of the operation plan and perfect information from the battlefield, they can each interpret their observations differently and arrive at different conclusions. According to Clausewitz, early "theorists" who based their premises on their own personal experiences failed to take "adequate account of the endless complexities involved."⁸ Clausewitz went on to say that these experiences could be misleading, with the result that different observers could use the same examples to support conflicting views. Or, they may select only those examples from their experience which "prove" the point they are trying to make.⁹

Clausewitz did not think highly of these early attempts at theory, referring to them as "one-sided points of view."¹⁰ As a result of the lack of understanding of the operational plan, the unreliability of battlefield information, and the differing interpretations of the same events, these memoirs of combat veterans often conflicted with themselves or with reality. The result was a continuing debate among early theorists over this "maelstrom of opinions."¹¹

Perhaps LTC Rowlett provides the clearest explanation of why the views of individual observers, unaided by theory, are often so inconsistent. In his monograph, he explains that when each of us looks at

the complex combination of events that make up "absolute military reality," we each do so through a different filter. According to LTC Rowlett, these filters comprise "our values and beliefs, military experience, depth of reading and research, and other variables."¹² The effect of these filters is to distort the "absolute military reality" into our own "perceived military reality." His model of the effect of these filters is shown at Figure 1.¹³

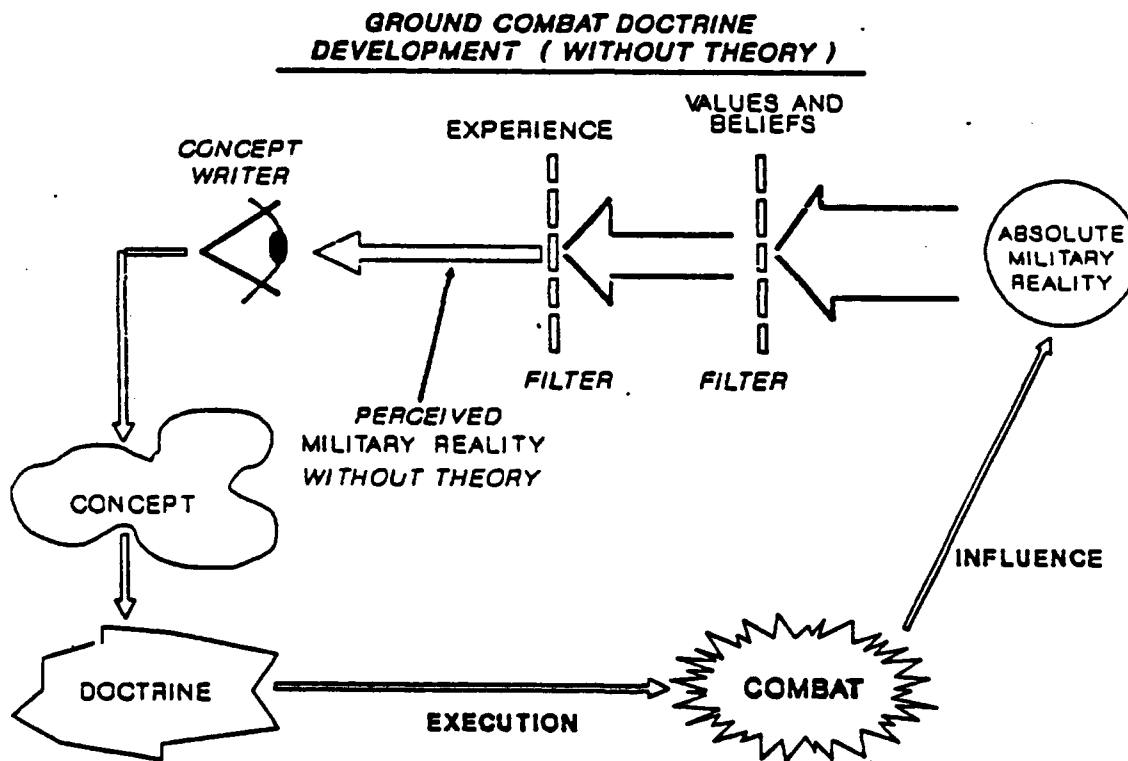


FIGURE 1

According to LTC Rowlett, theory serves to reduce the distorting effects of the filters of our own values and experiences. This lens, which contains "the various theoretical principles which help explain the

processes and phenomena related to war and the battlefield," clarifies the view of "absolute military reality." His model of the effects of this "theory lens" is shown at Figure 2.¹⁴

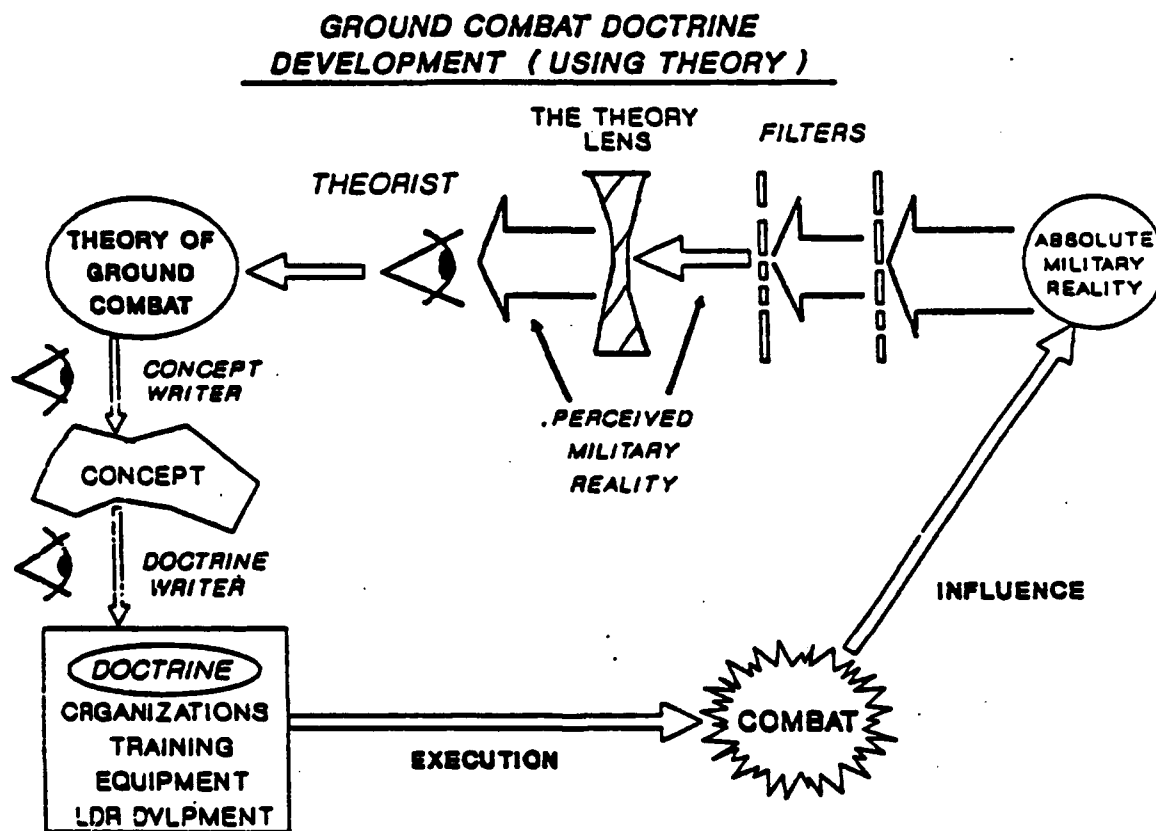


FIGURE 2

Because of the clarifying effect of the "theory lens," theory has several benefits for the doctrine writer. According to LTC Rowlett, a sound theory will (1) help us analyze and understand history, (2) help identify issues which might otherwise go unnoticed, and (3) help insure consistency of doctrine.¹⁵ Because of these benefits, he concludes that a national theory of war is needed to help develop an overarching joint operational concept for conducting war.¹⁶

This is a convincing argument. Surely anyone trying to analyze and understand something as complex as war would benefit from the advantages of theory described by LTC Rowlett. The question this paper seeks to answer, though, is how far down these benefits of theory extend. Are the same complexities present in one small part of ground combat as they are in a comprehensive theory on the nature of war? Do our "filters" distort our perceptions of small portions of military reality the same way they alter our view of the reality of war in the larger sense?

To answer my research question, I will examine one small part of ground warfare--the use of obstacles--to see if the benefits of theory would apply. Assuming that the benefits described by LTC Rowlett are correct, I will look to see if I can show that even in such a narrow field as the use of obstacles there are (1) a widely varied history, (2) important issues that may have gone overlooked, and (3) inconsistencies in our obstacle doctrine. If I can, then the doctrine writer should benefit from an obstacle theory.

To conduct this examination, I will first examine the history of obstacles in war from the time of World War I. I will next examine the writings on obstacles to see if I can identify any important issues which have gone overlooked in our doctrine. Finally, I will examine our current doctrine for internal consistency.

Obstacle History

Does the doctrine writer need an obstacle theory to assist in analyzing and understanding the history of the use of obstacles? In other words, does the history of the employment of obstacles in this century exhibit clear and stable principles? If so, then the obstacle doctrine writer could probably base doctrine on "lessons learned" from the experiences of combat veterans. However, if the history of the use of obstacles is obscure or varying over time, then I maintain that an obstacle theory should help the doctrine writer to analyze and understand that history.

I believe the history of the use of obstacles is obscure and has varied over time. It is obscure because of the lack of detailed information on the use of obstacles and their effects. The variation in the history of obstacles is evident in the changing views on the overall purpose of obstacles; in the diverse historical views on using obstacles as barriers, in particular; and in the changing characteristics of obstacles themselves.

-Obstacle History Obscured by Lack of Detail

The first difficulty the doctrine writer encounters in analyzing and understanding the history of the use of obstacles is the lack of detailed

information on their use. The experience of the Historical Evaluation and Research Organization, also known as HERO, is an example of the difficulty faced by the student of obstacle usage. Commissioned to study obstacle effectiveness in World War II, HERO reviewed a number of operations in which the combatants made extensive use of obstacles.¹⁷

Among the operations of World War II examined by HERO was the German defense of northern Italy along the Gothic, or Green Line, particularly in the region of Il Giogo pass. The Green Line extended roughly from Pisa, on the Italian west coast, to Rimini, on the east coast, passing just north of Florence in the center. The Germans fought a delay from the Gustav line to the Green line after the Allied breakout from the Anzio beachhead on May 30, 1944.¹⁸ This defensive line was a large undertaking, with the original plans formulated by Field Marshal Albert Kesselring in September of 1943. The line was some 170 kilometers long, and construction of the defenses extended from September of 1943 until the Allied attack on August 25, 1944. The Germans employed some 28,000 workers in the construction. In the Il Giogo pass area, some 506 field positions were constructed in a 19.5 kilometer front.¹⁹ Yet, despite the massive size and long period of this defensive construction, HERO could find

no descriptions of the actual defenses or their associated obstacles in the German records.²⁰

HERO experienced similar difficulties in obtaining detailed obstacle information in its examination of the Soviet defense at Kursk in July of 1943. This defense was also a massive undertaking, with two army groups defending a front of 550 kilometers. The troops of the two army groups, numbering over 1.3 million men, worked steadily from April to July 1943 to prepare the defenses. They were assisted by hundreds of thousands of mobilized local inhabitants.²¹ Yet, despite the massive size of the preparations and the 3-month construction period, HERO reported that the details of the siting of the obstacles were rare.²²

American soldiers in World War II were apparently no better in reporting the details of their obstacle use. In fact, prior to the Battle of the Bulge, the Americans had little experience in or seldom considered the use of obstacles.²³ General George Patton's orders concerning obstacles were typical of American commanders prior to December 1944. When troops halted due to lack of fuel or other operational reasons, he ordered them not to dig in or emplace obstacles, so as not to alert the Germans that they were on the defensive.²⁴ As a result of this lack of experience in obstacle use and the unexpected nature of the German counterattack, the American employment of

obstacles in the Ardennes is best described as hasty in comparison to the previous two examples.²⁵ Once more, details on the siting and appearance of obstacles were rare.²⁶

In fact, HERO's analyses of U.S. and German official combat records, as well as analyses of Russian postwar studies, indicated that none of these documents contained the amount of information they desired for their study.²⁷ In their words, there was a "paucity of detailed descriptions of obstacles and barriers in the reports."²⁸

Unfortunately, this dearth of detailed records on the use of obstacles is not limited to just World War II. The American experience in Korea is an example of how the reporting of obstacle usage did not improve. In a five-month period in that war, from June to November 1950, U.S. troops emplaced over 180,000 mines. The Army Engineer received minefield reports accounting for only about 23,000 mines, leaving over 85 per cent of the mines unaccounted for.²⁹ This lack of detailed information on obstacle siting makes analysis of how commanders used obstacles in conjunction with the scheme of maneuver much more difficult.

The lack of detailed information on the siting of obstacles during some of the largest defensive operations obscures the history of obstacle usage. It makes analysis and understanding of obstacle usage

difficult for the doctrine writer. Because the history of obstacle usage is not clear and straightforward, an understanding of history based on personal experience would be suspect. This is one indication that an "obstacle theory" might be of value in helping to understand this incomplete history.

Besides being obscure, the history of obstacle usage has not been consistent over time. Its variety has been evident in the views on the overall purpose of obstacles, especially in the varying ideas on the use of obstacles as barriers and in the changing characteristics of obstacles themselves.

-The Purpose of Obstacles

The purpose of obstacles, as stated in doctrine, is a good vehicle for examining how the history of the use of obstacles has changed over time. By the stated purpose of obstacles, I mean the desired effect the obstacles should have in support of the commander's tactical plan. Our doctrine, as it has developed from World War I, has continually provided a description of the intended purpose for obstacles; consequently, the doctrine provides good insight on how this view has repeatedly changed.

Immediately after World War I, LTC P. S. Bond, a prolific writer of practical guides for the military officer, set about to describe the science of field

fortifications as learned in the war.³⁰ In his treatise, he described the purposes of obstacles in the defense as (1) guarding a defensive position against surprise, (2) checking the momentum of an attack, (3) delaying the enemy's progress, and (4) holding him under the fire of the defenders.³¹ He later codified these into his "General Principles of Field Fortification." The principle on obstacles stated that they were to "interfere with the movements of the attacker and to hold him under the fire of the defender's weapons."³²

This view of the purpose of obstacles apparently changed little during the interwar period. The 1941 version of FM 100-5 Operations states that the creation of a zone of obstacles serves to "impede the advance of the enemy."³³ The versions of FM 20-32 on land mine operations, published from the nineteen-fifties to the nineteen-seventies, also indicate only minor changes in this view.

However, beginning in the mid nineteen-eighties, the stated purpose in our doctrine for our obstacles began to undergo a series of changes. In the 1984 version of FM 5-100, Engineer Combat Operations, a new purpose for obstacles had emerged. According to the field manual, "obstacles are used by maneuver commanders to reinforce terrain. . . . Reinforcing obstacles are constructed to reinforce and tie together

existing obstacles."³⁴ Although this may seem like a subtle change, it is interesting to note that the focus of obstacle effort had changed from effects on the enemy (impeding movement, holding him in defensive fires) to effects on terrain (reinforcing terrain, tying together obstacles). This had an interesting impact on obstacle doctrine development, which will be discussed later. In any event, this was a change in emphasis, since neither LTC Bond writing in 1923 nor the 1941 FM 100-5 emphasized the necessity to "reinforce terrain."

The following year saw a return to more "traditional" purposes for obstacles with the publication in 1985 of FM 5-102, Countermobility. It describes three primary purposes for obstacles: (1) enhance the effectiveness of friendly fires, (2) delay the enemy's advance, upset his timing, disrupt and channelize his movement, and (3) enhance friendly economy of force measures.³⁵ It has not completely abandoned "reinforcing terrain," however, as it goes on to say that "reinforcing obstacles tie together to strengthen and extend existing obstacles."³⁶ This apparent discrepancy was seemingly resolved with the publication in 1986 of our current capstone manual, FM 100-5, Operations, which states that "natural obstacles . . . must be reinforced with man-made obstacles."³⁷

However, FM 100-5 did not have the final say on the purpose of obstacles. The latest version of FM 5-100, Engineer Combat Operations, introduces yet another intent. Published in 1988, it states that the primary purpose of obstacles is "to attack the enemy's ability to execute his plan."³⁰ It also provides a secondary intent--"to destroy or disable his vehicles."³⁰

From this brief review of doctrinal publications, we have seen the stated overall purpose of obstacles experience a number of changes. From a start of interfering with the enemy's movement and holding him under our fire, the purpose of obstacles changed to that of reinforcing terrain and tying together existing obstacles. Our current doctrine calls for obstacles to attack the enemy's ability to execute his plan, with a secondary intent to destroy or disable his vehicles. These different purposes are not necessarily mutually exclusive; yet, as we shall see later, they are sufficiently different to cause the doctrine writer to come to different conclusions on how to best employ obstacles. In any event, we can say that the stated purpose for obstacles in our doctrine has not been consistent over time. This inconsistency is an indication of the changes in the history of the use of obstacles.

-Obstacles as Barriers

Besides the overall purpose of obstacles, the variation in the history of obstacles is evident in the diversity of opinions throughout history on one particular use of obstacles: the use of obstacles as barriers. Although the phrase "Maginot Line mentality" has been used derisively, defensive planners throughout this century have fluctuated in their appreciation for the effectiveness of barrier-based defenses.

Certainly in World War I, war planners learned to appreciate the effectiveness of barriers. After the French successfully repositioned troops to halt the German drive to fulfill the Schlieffen plan, both sides poured in troops to try to outflank the other. The result was the "Race to the Sea," ending in a deadlocked front of some 450 miles from the North Sea to the Swiss frontier. This front would change little for four years, yet claim millions of lives.⁴⁰ In this stalemated front, Jean de Bloch's prediction of a thousand-meter interval complete with obstacles, through which no living thing could pass, was vindicated.⁴¹ Permanent, fixed defenses also proved valuable. According to historian Larry Addington, General Henri Pétain of France "made his reputation on his unconquerable defense of Verdun."⁴²

Military leaders apparently suffered no loss of respect for barriers between the world wars. Pétain,

the hero of Verdun, campaigned for the construction of a line of fixed fortifications across the hundred-mile-wide Lorraine Gap. Pétain ultimately succeeded in his campaign, and the French constructed the Maginot Line.⁴³

The French were not the only ones to demonstrate faith in the effectiveness of barriers. Various armies constructed "lines" before and during World War II. Besides the Maginot Line, these included the Siegfried Line in Germany, the Jitra Line in Malaya, the Mareth Line in Tunisia, the Mius and Winter Lines in Russia, and the Gothic (later Green) Line in Italy.⁴⁴

However, World War II also saw a number of military writers begin to speak out against the use of barriers in the defense. Following the rapid success of the German advances in Poland, Belgium, and France, F. O. Micksche, an "eminent and imaginative"⁴⁵ military writer, published his 1941 book Attack: A Study of Blitzkrieg Tactics. His purpose was to help the rest of the world understand the success of the Nazi armies in 1939 and 1940.⁴⁶ In his book, he stated that the old ideas on defense of "lines" were no longer valid. His new concept for defense was one which used depth by actually allowing the enemy to go through some parts of the line, then closing on the attacking force "like a net."⁴⁷

German Field Marshal Ritter von Leeb, writing in 1943, expressed the same sentiment. In his opinion, the war to that point had "disproved completely the impregnability of fortresses. The most formidable barrier . . . can always be coped with."⁴⁸

Despite the lessons provided by writers like Miksche and von Leeb, as well as those provided by the German successes, defensive planners continued to put their faith in static defense based on the defense of lines. This use of barriers was evident through the remainder of World War II and continued to modern conflicts.

Even the Germans themselves continued to use barrier-based defenses. At the defense of their bridgehead near Nikopol on the Dneiper River in 1944, they established the 120-kilometer-long Nikopol line.⁴⁹ Just as the Germans had attacked the weak portion of the Maginot Line in the marginally trafficable Ardennes Forest, the Russians attacked the weak point of the Nikopol defense in the difficult terrain of the Beloserka Gorge.⁵⁰ The Germans fell back to subsequent lines (the Sigrid and Brunhilde lines), and had to abandon the bridgehead altogether when outflanked by the Russians.⁵¹

Following World War II, many authors concluded that positional defense based on the assumed strength provided by barriers was simply not effective. Echoing

the observations of Miksche and von Leeb, Field Marshal Kesselring wrote of the failure of the defense of lines in World War II. Writing in 1949, he criticized Adolf Hitler for refusing to consider a defense in depth. Even the massive works of the Atlantic Wall, he wrote, gave "clear evidence" that a linear defense along a barrier was a "basically wrong idea."⁵² Otto Heilbrunn, in his 1965 Conventional Warfare in the Nuclear Age, summed up these views by stating that the Blitzkrieg period had shown the ineffectiveness of purely static defenses, such as those along the Maginot and Siegfried lines.⁵³

Our own doctrine gradually reflected this aversion to barriers. Although the 1955, 1959, and 1971 versions of FM 20-32, Mine/Countermine Operations, still listed "barrier minefields" as one of the classifications of minefields, the 1976 version had removed all references to barriers. This attitude continued into the 1980's in the new manuals FM 5-100, Engineer Combat Operations, and FM 5-102, Countermobility, which do not contain any references to barriers.

Despite the apparent evidence of the Second World War, and the subsequent commentary by military history analysts, some military planners continued to use barriers in their defensive plans. Following the 1967 Arab-Israeli War, the Israeli Defense Force (IDF)

constructed the 165-kilometer-long Bar-Lev line. This was a formidable project, costing some \$268 million. The obstacles along the line, besides the Suez Canal itself, included a three- to six-foot-high concrete wall along the canal, backed by a steep, 10- to 25-meter-high sand embankment. Behind this embankment were two more sand embankments. Some 750,000 anti-tank and anti-personnel mines were used along the line; moreover, in some places, up to 15 rows of concertina barbed wire were emplaced.⁵⁴ Clearly, the IDF had not been convinced of the futility in constructing barriers. The Israelis were not the only ones to still display faith in barriers; the Egyptians built a similar barrier on the other side of the Suez.⁵⁵ The Iran-Iraq war also saw extensive use of barrier-oriented defenses.⁵⁶ Perhaps these armies would have chosen other methods of defense if they had the benefit of theory to help them understand the history of the use of barriers.

I am not attempting through all of this discussion on the use of barriers to determine which side of the argument is correct. The point is that the opinions in this century on the use of obstacles as barriers have been far from unanimous or consistent. Starting with the First World War, we have seen a varying history of the appreciation for and the use of barriers. In World War I, Marshal Pétain built a reputation on his ability

to defend a static position, and he dedicated the interwar period to building the French frontier fortifications. By the end of the next war, the concept of defending along a fortified line, in the eyes of many military writers, had become fully discredited. Yet, the use of barriers in defensive plans persists up to the most recent conflicts.

Like the diverse history on the views of the overall purpose of obstacles, the changing appreciation for the value of obstacles as barriers further indicates variation in the history of obstacles. The doctrine writer who depends on "lessons learned" as a basis for doctrine might get widely varying viewpoints, depending on which combat observer he queried about barriers. This plus the obscure nature of much of the details of past obstacle usage indicate that the doctrine writer would benefit from theory's ability to assist in the analysis and understanding of history.

-Changing Characteristics of Obstacles

We have seen how the stated overall purpose of obstacles, and in particular the views on the effectiveness of obstacles as barriers, have both varied considerably over time. Another area in which the history of obstacles seems to have changed is the characteristics of obstacles. The technological

advances in the materials and munitions used in obstacles have not only made the obstacles more effective, but they have also changed the very characteristics of obstacles, as I will show below. This change in characteristics further complicates the understanding of the history of obstacles and their use.

Perhaps the best illustration of the changing characteristics of obstacles is found in the development of mine warfare. Although mines are just one type of obstacle, they are often the most used. According to FM 5-100, Engineer Combat Operations, "the best [emphasis added] means of achieving countermobility is reinforcing terrain with mines."⁵⁷

As with most munitions and weapon systems, mines have undergone a number of technological changes since their introduction. In World War I, anti-vehicular and anti-tank mines were first developed to counter the increased use of motorized vehicles. These early mines consisted mainly of modified artillery shells or other expedient materials, and were used in small numbers.⁵⁸

Following World War I, little development occurred in the technology of mines. Brigadier General B. K. Young, reporting on the development of land mine warfare in the British publication The Army Quarterly in 1945, stated there was no money to spend on mines in England in the interwar period. In 1937, in preparation for a training event, he could locate only

two mines in all of England.⁵⁹ The situation in the United States was not much better before the outbreak of World War II. In fact, no country had more than two models of mines at the beginning of World War II.⁶⁰

However, with the onset of hostilities, a virtual explosion in the technology of mine warfare occurred. By the end of the war, many nations had developed many different types of mines and fuzes. The Germans alone developed over 38 different types of mines.⁶¹ Mines also became one of the dominant forms of obstacles. The Germans were again one of the leaders in mine warfare, emplacing some 5 million mines in France alone. The Russians eventually emplaced over 10 million mines in World War II; moreover, both the British and Germans made heavy use of mines in North Africa.⁶²

By the end of the war, high explosive mines, capable of destroying or stopping a tank, were standard. These mines had different types of fuzes: pressure, magnetic influence, seismic, and frequency-induction (for anti-mine detector use).⁶³ These types of mines and fuzes have continued to be the mainstay of the U.S. inventory in the long duration since World War II.⁶⁴ In addition, they form the bulk of the mines used by many other countries today. The Iraqis, for example, employed similar mines in the recent Gulf War.⁶⁵

These mines comprised the majority of obstacles emplaced in World War II, and have since been the basis for much of our obstacle planning. What are the characteristics of these obstacles, and how have they changed with technology?

One characteristic of these World War II types of mines is that they take a long time to emplace. The doctrine writer and defensive planner must account for the requirement for large amounts of time and manpower to create obstacles with these types of mines. For example, the planning guides in FM 20-32, Mine/Countermine Operations at the Company Level, indicate that one 300 meter long section of standard-pattern minefield would take an engineer platoon about 10 hours to emplace.⁶⁶

Other characteristics of these types of obstacles result from the fact that once emplaced, they obstruct both sides for a long period of time. As one writer, discussing the difficulty of synchronizing obstacles with maneuver, explains:

One of the most serious challenges to coordination of maneuver and obstacle operations at the execution level is the relentless neutrality of the combat obstacle. . . . [Obstacles] that magnificently frustrate an enemy drive can have an equally devastating effect on a friendly counterattack. This lack of loyalty is exacerbated by an obstacle's persistence. Unlike the instantaneous, transient effects of direct or indirect fires, an obstacle's effect persists until it is negated through a significant expenditure of breaching or by-pass effort. Real obstacles cannot be turned "on" and "off" with impunity ⁶⁷

The doctrine writer, for the majority of the period since World War II, has thus had to concern himself with obstacles whose characteristics are that they (1) require considerable time and resources to emplace, (2) are neutral (that is, the effects are the same on both friendly and enemy troops), and (3) are persistent. Recently, however, technological changes in mine warfare have affected all three of these characteristics.

One such technological change came with the introduction of the field artillery-delivered scatterable mines in the 1970s. No longer do minefields require lengthy periods to install, nor is their persistence indefinite. Artillery can now emplace a 400-meter-wide low-density minefield in the time required to fire as few as 48 artillery rounds.⁶⁹ With the self-destruct feature of the mines, the obstacle effect disappears after the 4- or 48-hour period programmed into the mine.⁶⁹

Even more dramatic changes in mine warfare are on the horizon. As advanced as the field artillery-delivered mines are, not enough exist to replace the more conventional mines. The bulk of our mines are still of the conventional type, and our stock of scatterable mines was insufficient to meet even our needs in Desert Storm.⁷⁰ However, with the fielding of the Volcano scatterable mine system, each engineer

company will have a significant capability to rapidly emplace minefields. The truck or track-mounted Volcano's mine emplacement capability will be limited only by the cross-country speed of the vehicle. The Volcano mine will also have preset self-destruction times.⁷¹

Moreover, the Army is developing a new Wide Area Mine, or WAM, which will completely change the characteristics of future obstacles. The Volcano system can rapidly employ it, and its unique fuzing system eliminates the problems of minefield neutrality and persistence. The WAM will have a remote on/off arming capability, as well as a command destruct feature.⁷² This means that emplaced mines in a lane can be left unarmed for the safe passage of a covering force and other friendly troops. Upon passage of the friendly forces, the mines could be remotely armed, closing the lane as the enemy approached. The mines could again be remotely disarmed or destroyed to permit counterattacking forces to rapidly pass through the minefield.

In summary, the nature of obstacles using minefields has changed dramatically within this century. From a collection of only a few expedient mines in World War I, mines have become one of the major types of obstacles employed. The doctrine writer for a long time had to consider three major

characteristics when discussing the employment of mines: the heavy time and resource requirement to emplace mines, the neutrality of their effects, and their persistence. With recent developments, however, each of these characteristics changed. Mines now feature rapid emplacement, remote on/off arming to negate the mines' effects on friendly troops, and preset or command destruction to remove the obstacle entirely.

These changing obstacle characteristics are further evidence of the variation in obstacle history. When I add that to my earlier observation about the lack of detail on obstacle use and the diversity of historical views concerning the purposes of obstacles, I must conclude that the analysis and understanding of the history of obstacles are far from trivial tasks. Certainly, the doctrine writer who depends on "lessons learned" from combat participants would obtain a variety of lessons, depending on what war the veteran providing them had experienced. For these reasons, the potential of theory to aid in the analysis and understanding of history is applicable in the case of obstacles. Theory would thus provide a framework for studying the history of obstacles and help guide the student in his self-education.⁷³

Overlooked Issues

In addition to aiding in the analysis and understanding of history, LTC Rowlett states that theory has value in helping to identify overlooked issues. Having seen how theory should help with respect to the history of obstacles, I will now examine our doctrine for overlooked issues. If any major ideas have gone undeveloped in our doctrine, then perhaps a theory of obstacles would assist the doctrine writer. As Clausewitz suggests, theory would protect the doctrine writer from the necessity of "sorting out the material and plowing through it," as though he were the first to conduct an analysis of this historical evidence. Instead, capitalizing on the work of previous scholars, theory could provide the benefit of a framework for analyzing history.⁷⁴ With such a framework, it would seem that the doctrine writer would be less likely to miss a major historical point.

One recurring idea on the use of obstacles involves the concept of allowing the enemy to easily bypass obstacles. This concept seeks to direct the enemy into the defender's engagement area, as opposed to blocking him well forward by constructing a wall of obstacles across the enemy's avenue of approach. This concept was perhaps best articulated by British Lieutenant Colonel C. E. E. Sloan in his analysis of

mine warfare. In his 1973 book, Mine Warfare on Land, he stated that "minefields are best viewed as baffles, as opposed to constraining dams."⁷⁵ Minefields should shepherd the enemy into pre-selected fire pockets where he can be destroyed.⁷⁶

This idea is not unique to Sloan. In his report on the lessons of the 1973 Yom Kippur war, van Creveld concluded that in future wars, minefields, anti-tank ditches, and other artificial obstacles will be used "not so much to stop movement as to channel it into pre-selected 'killing grounds.'"⁷⁷ More recently, this idea has appeared in a variety of military-related publications. In Engineer magazine, Thomas MacIver and Andrew Hough reported that the armored cavalry regiment (ACR) they support wanted obstacles to "get the enemy into an engagement box" so they could focus combat power against him.⁷⁸ As a result, obstacles on the flanks of the enemy avenue of approach, designed to turn the enemy into the desired engagement area, are the highest priority for emplacement for that ACR. Conversely, the ACR commander designated those obstacles across the avenue of approach, designed to slow the enemy in the engagement area, as the lowest priority and last to be accomplished.⁷⁹

This idea is echoed in Major David Ozolek's article in Armor magazine, in which he states that obstacles complement the concept of operation by

channelizing the enemy into selected engagement areas.^{e0} He illustrates that obstacles which completely block an avenue of approach are less effective than ones that allow a bypass that permits the defender to focus combat power on a portion of the advancing enemy.^{e1}

This concept of using deliberate bypasses to channelize the enemy is consistent with the historical effects of obstacles on an attacking enemy. Obstacles have been more effective at diverting the enemy than stopping him. Ozolek states as a "fundamental truth" that obstacles cannot realistically be employed to stop an enemy.^{e2} In his analysis of mines, Sloan concludes that "a minefield required to halt an advance might be almost unachievable."^{e3} A first-hand testimony came from the German Army High Command immediately after World War II. The General of Engineers for the Oberkommando des Heeres (OKH) published guidelines on obstacle construction in 1945, stating that "field anti-tank obstacles will not hold against medium or heavy tanks."^{e4}

However, as I will show below, the defender can expect to effectively divert an attacking enemy with obstacles by leaving a bypass that leads into the direction desired. Most attackers will bypass the obstacle rather than attempt to breach it, if they follow current doctrine. Our own doctrine tells us to

bypass identified obstacles "whenever possible."⁶⁶ Soviet General V. G. Reznichenko echoed the same idea on the Russian side in his doctrinal work, Tactics.⁶⁶ In addition, the authors of The Geography of Warfare have likened the advance of an attacking army to "water flowing over the surface of military opportunity," where units "gush along open channels . . . flowing around resistant obstacles."⁶⁷

The Germans in World War II again provide an example of this concept. In establishing their defense along the "Green Line" in Northern Italy, they quickly discovered their inability to stop the advancing Allies with obstacles. The commander of the German Fourteenth Army published "Urgent Measures After Occupying the Green Line," in which he described the Allies' ability to mass fires on a selected portion of the line and make a penetration. He drew the conclusion that obstacles must be placed behind the first line of defense, with defenders firing from protected positions on the flanks.⁶⁸ Placing the obstacles behind the first line of defense, in effect, drew the enemy into the Germans' pre-selected "kill zones," the effectiveness of which was shown by the following American experience at Il Giogo pass.

After an initial penetration of the German lines of some 700 meters, the Americans found themselves pinned down in a "kill zone" by flanking fire from both

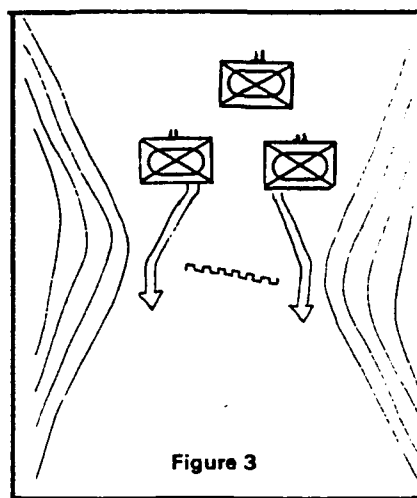
sides. The U.S. troops were unable to penetrate a belt of obstacles deep in the avenue of approach, a belt which the Germans had reinforced with mines at night following the initial attack. For three days the Americans were subjected to devastating fire whenever they attempted to advance. Only when the Germans exhausted their supplies and abandoned their positions were the Americans able to continue to move.²⁹

From this discussion, I can say that the concept of allowing the enemy easy bypass of an obstacle to draw him into an engagement area has not gone untested by other armies. How well has our doctrine incorporated and developed it? Unfortunately, it has not been included well at all. As shown below, our obstacle doctrine has consistently favored creating a linear wall of obstacles over establishing bypass avenues to divert the enemy into our engagement areas.

The theme of tying obstacles together to prevent bypass has been particularly evident in our doctrine since the early 1980s, when, as discussed earlier, "reinforcing terrain" became a primary focus. The 1984 version of FM 5-100, Engineer Combat Operations, states that "obstacles must reinforce other obstacles. They must be placed to make bypassing difficult."³⁰ FM 71-2, The Tank and Mechanized Infantry Battalion Task Force, advises that obstacles "must overlap on each side with the existing obstacle it will complete."³¹

Our current FM 5-102, Countermobility, is the most emphatic against the idea of permitting bypass of obstacles. In numerous places it tells us to locate obstacles to "strengthen and extend existing obstacles," or to "close the gaps between existing obstacles." The "critical design width" for an obstacle is the distance from existing obstacle to existing obstacle, indicating a requirement to tie the two existing obstacles together.²² Finally, as a point of emphasis, the author of FM 5-102 concludes that "any obstacle that can be bypassed immediately is worthless."²³

Other evidence against the concept of permitting bypass exists in the illustrations provided in our manuals of mine warfare. In every version since 1959 of FM 20-32, Mine/Countermine Operations, under the section "Emplacing Procedure," an illustration of a "wall-to-wall" minefield, extending from one piece of restrictive terrain to another, appears. This same illustration is in FM 5-102, Countermobility. No manual depicts a bypass, as Ozolek does in his Armor magazine article. He provides the following illustration of how to use obstacles to separate enemy units from mutual support, so they may be defeated individually:²⁴



Perhaps the most telling evidence of our failure to incorporate this concept lies in how we execute our own doctrine. According to LTC Robert Greenwalt, writing in Infantry magazine, "all too often at the NTC [National Training Center], a task force's countermobility plan is not integrated into the scheme of maneuver."⁹⁵ Repeatedly at the NTC, task forces emplace a wall of obstacles where they actually prevent the enemy from entering the engagement area. Following his doctrine, the OPFOR bypasses the obstacle and never enters the area where the task force planned to concentrate his combat power.⁹⁶ It was not until the publication of the 1988 version of FM 5-100, Engineer Combat Operations, that our doctrine admitted that units should not plan obstacles simply because the terrain allows construction of "a really good obstacle."⁹⁷ This manual does introduce the concept of "turning" obstacles to alter the course of the enemy's advance. However, it still does not clearly

state that one of the major purposes of obstacles is to get the enemy into the defender's engagement area, as Sloan, van Creveld, Ozolek, and Greenwalt all seem to suggest. Perhaps if the U.S. Army had an obstacle theory, this concept would have been developed earlier and more completely.

In summary, the concept of employing obstacles with intentional bypasses designed to divert the enemy into pre-selected engagement areas is one which has repeatedly appeared in military writings. It has been demonstrated in historical experience. Yet, for a long period, our doctrine has overlooked this idea. The concept of permitting a bypass has been an anathema to our doctrine writers, who repeatedly focused on "reinforcing terrain" by tying into existing obstacles on each side. Although this is only one example of an overlooked issue, its absence from our doctrine shows that others may be missing as well. If a benefit of theory is identifying issues which might otherwise go overlooked, then that benefit would apply in the case of obstacle employment.

Doctrinal Consistency

Having seen how theory might aid in the understanding of history and in the identification of issues that may otherwise go overlooked, it is time to

examine the third benefit of theory described by LTC Rowlett--that theory also helps insure consistency in doctrine. One can hardly expect that a doctrine with as many manuals as ours could be free from inconsistencies. Still, several examples exist within individual manuals that indicate a lack of consistent thinking. In such cases, the doctrine writer may benefit from an obstacle theory.

The first such example involves our obstacle breaching doctrine. The 1984 version of FM 5-100, Engineer Combat Operations, describes the Soviet doctrine of using mines and other obstacles to channelize enemy forces into open kill zones, where concentrated fires can be brought to bear against him.⁹⁸ However, only a few chapters later, the manual states that identified obstacles and mined areas "should be bypassed, if possible."⁹⁹ However, no caution is provided that doing so may lead the unit into the strength of the Soviet defense. Unfortunately, the 1988 version of FM 5-100 provides the same advice. Perhaps a more consistent approach to breaching would be to first template the enemy's kill zones, based on the layout of his obstacles, and then concentrate your breaching and combat power on an obstacle on the enemy's flank. This approach would overwhelm the defending unit located there, while avoiding his strength.

Another apparent inconsistency involves the continuing problem of counterattacking through your own obstacles. FM 5-100 states in one place to leave counterattack routes open in our obstacles.¹⁰⁰ A few chapters later it advises to "insure that all lanes and gaps can be closed quickly when enemy action is expected."¹⁰¹ The doctrine writer may not have developed this inconsistency had he been exposed to a theory which considers obstacles as channelizing baffles (with bypasses available to the counterattack force) instead of constraining dams.

A final example of internal inconsistency in our doctrine again comes from FM 5-100, which in one place states that the scheme of maneuver governs the engineer plan. In another place, however, it states that the engineer sites obstacles.¹⁰² A more consistent approach would have the engineer recommend obstacle locations for approval by the maneuver commander, as earlier versions of our doctrine specified.¹⁰³

Although no doctrine as comprehensive as ours can be expected to be fully consistent, the above examples indicate that our obstacle doctrine has experienced several instances of inconsistent thinking within a single document. If a benefit of theory is ensuring consistency in doctrine, then it would apply in the case of the use of obstacles.

Conclusions and Implications

Without theory the doctrine writer is dependent on his own experiences or "lessons learned," as gleaned from combat veterans. In such instances, the doctrine writer is without the benefit of the "theory lens," as LTC Rowlett describes it. His view of military reality, or that of the veteran upon whom he depends, is distorted by the filters of his own values, beliefs, and experience. If LTC Rowlett is correct, no comprehensive theory of a complex subject like war can be developed without the benefit of theory to help correct the distortions of the observer's filters. Theory should help the doctrine writer analyze and understand history, identify issues that might otherwise go overlooked, and insure consistency in doctrine.

In this paper, I have examined the use of obstacles to determine if the same benefits of theory extend all the way down to just a single part of ground combat. I have sought to determine if the observer's view of reality concerning obstacles is sufficiently "filtered," or distorted, to require the corrective action of the theory "lens."

In analyzing the historical use of obstacles, I have shown that history is not easily analyzed or understood. Many of the details of actual obstacle

siting with respect to the defender are simply not available. Other major ideas, such as the overall purpose of obstacles, and more particularly their use as barriers, have varied considerably over time. Moreover, the changing technology of obstacles has in some cases changed their very characteristics.

Furthermore, I have determined that at least one major issue has been overlooked in our doctrine. Despite recurring appearances in military literature and historical examples of its effectiveness, our doctrine has consistently discounted the idea of constructing obstacles with bypasses. Only recently has our doctrine begun to acknowledge that we might better use obstacles in a mode other than tying together existing obstacles.

Finally, I have shown that our obstacle doctrine does contain internal inconsistencies. Several contradictory statements within a single manual indicate the lack of an understanding of the nature of obstacles--an understanding that would help insure consistency.

As a result, I believe that our doctrine writers could benefit from an "obstacle theory." Such a theory, while not prescribing specific techniques or procedures in the use of obstacles, could help the doctrine writer understand the complex history of the use of obstacles, help identify overlooked issues, and

help him insure doctrinal consistency. Theory could help the doctrine writer understand the variations in the history of obstacles by providing a framework for self-education. With theory--to paraphrase Clausewitz--the doctrine writer would not have to start afresh each time he began to "plow through" the mountains of new material. Theory could help guide the doctrine writer through the study of this material, capitalizing on the work of previous scholars--thus making it much less likely that he would overlook major issues. Finally, by providing a common framework for the understanding and discussion of obstacles, theory would help insure consistency in our doctrine.

I have not attempted in this paper to describe an obstacle theory, but rather to show that the characteristics of theory described by LTC Rowlett indicate that theory would be useful--even for one small part of ground combat theory. I have shown that for a narrow subject such as obstacles, the doctrine writer is at peril if he depends solely on lessons learned or individual combat experiences. Even on this small scale, the observer's "filter" sufficiently distorts his perception of military reality to require the clarifying effect of the theory "lens."

If this is true, other limited doctrinal issues might also benefit from theoretical analysis. Placing tanks in reconnaissance units, for example, is an issue

which may benefit from theory. What do we expect of our reconnaissance units? Should they be only "lookers", not to engage in combat? Or has history shown that reconnaissance units must fight to get intelligence? The proper mix of infantry and armor in a heavy division is another narrow issue which may benefit from theory. If my analysis of obstacle doctrine is valid, resolution of these issues based on personal combat experience, lessons learned, or "gut feel" should not be satisfactory.

I believe that the branch schools are the logical places to develop and maintain theories on such narrow issues. There, the subject matter experts and the analytic rigor of the academic environment can provide the spark for the development and updating of theory. The theorist and doctrine writer would also benefit from a closer association.

In his analysis of the impact of the publication of the 1976 version of FM 100-5, Operations, in "Deciding What Has to be Done: General William E. DePuy and the 1976 Edition of FM 100-5," author Paul Herbert described how that capstone manual generated a resurgence of doctrinal thought in the U.S. Army.¹⁰⁴ Perhaps, now, this resurgence should extend to many other, more narrowly defined issues in our doctrine. It is, after all, according to Michael Howard, our job as military leaders "to prevent the doctrines from

being too badly wrong." 105

ENDNOTES

- ¹ Ricky M. Rowlett, The U.S. Army and Ground Combat Theory, (Fort Leavenworth: USACGSC, 1990), 5.
- ² Julian S. Corbett, Some Principles of Maritime Strategy (Annapolis, Maryland: Naval Institute Press, 1988), 3.
- ³ Carl von Clausewitz, On War, ed. and trans. Michael Howard and Peter Paret (Princeton, New Jersey: Princeton University Press, 1976), 146.
- ⁴ Ibid., 134.
- ⁵ Ibid., 112.
- ⁶ The ideas in this paragraph concerning the lack of understanding of Moltke's plan came from Martin L. van Creveld, Command in War (Cambridge, Massachusetts: Harvard University Press, 1985), 119-120.
- ⁷ Clausewitz's views on the unreliability of information in war comes from On War, 140.
- ⁸ Ibid., 134.
- ⁹ Ibid., 172.
- ¹⁰ Ibid., 136.
- ¹¹ The idea concerning how combat veterans differ over their recollections of their experiences came from Clausewitz, 134.
- ¹² Rowlett, 7.
- ¹³ The discussion in this paragraph on the effects of individual filters, and the follow-on figure, come from Rowlett, 6-7.
- ¹⁴ The effects of the "theory lens" in offsetting distortions of perceived reality, and Figure 2, come from Rowlett, 8-9.
- ¹⁵ Ibid., 5.
- ¹⁶ Ibid., 36.
- ¹⁷ Historical Evaluation and Research Organization, Historical Evaluation of Barrier Effectiveness (Dunn Loring, Virginia: HERO, September 1984), 1-2.

- ¹⁸ The information in these two sentences on the location of the Green Line came from Thomas E. Griess ed., Atlas of the Second World War: Europe and the Mediterranean (Wayne, New Jersey: Avery Publishing Group, Inc.), 50-51.
- ¹⁹ The details of the description of the Green Line preparations came from HERO, 61-64.
- ²⁰ Ibid., 67.
- ²¹ The description of the size and preparations of the Kursk defense came from HERO, 16-24.
- ²² Ibid., 15-16.
- ²³ Ibid.
- ²⁴ General Patton's instructions, and the fact that they were typical of American commanders in Europe, came from HERO, 79.
- ²⁵ Ibid., 79.
- ²⁶ Ibid., 15-16.
- ²⁷ Ibid., 2.
- ²⁸ Ibid.
- ²⁹ David A. Fastabend and Ralph H. Graves, "Maneuver, Synchronization, and Obstacle Operations," Military Review LXVI no. 2, February 1986, 40.
- ³⁰ P. S. Bond, Field Engineering: A Practical Exposition of the Organization of the Ground for Defense. (Baltimore: The New Military Library, 1923), preface (unnumbered).
- ³¹ Ibid., 23.
- ³² Ibid., 7.
- ³³ Department of the Army, Field Manual 100-5, Operations (Washington, D.C.: U.S. Department of the Army, 1941), 149.
- ³⁴ Department of the Army, Field Manual 5-100, Engineer Combat Operations (Washington, D.C.: U.S. Department of the Army, 1984), 7-4.
- ³⁵ Department of the Army, Field Manual 5-102, Countermobility (Washington, D.C.: U.S. Department of the Army, 1985), 37.

36 Ibid., 27.

37 Department of the Army, Field Manual 100-5, Operations (Washington, D.C.: U.S. Department of the Army, 1986), 143.

38 Department of the Army, Field Manual 5-100, Engineer Combat Operations (Washington, D.C.: U.S. Department of the Army, 1988), 55.

39 Ibid.

40 The description in this paragraph of the creation of the western front in World War I came from Larry H. Addington, The Patterns of War Since the Eighteenth Century (Bloomington, Indiana: Indiana University Press, 1984), 129.

41 Jean de Bloch, The Future of War (Boston: The World Peace Foundation, 1914), xxix.

42 Addington, 163.

43 The information in this paragraph about Pétain's involvement in the construction of the Maginot Line came from Addington, 163.

44 Otto Heilbrunn, Conventional Warfare in the Nuclear Age (London: George Allen & Unwin, Ltd., 1965), 65.

45 Chris Bellamy, The Future of Land Warfare (New York: St. Martin's Press, 1987), 79.

46 F. O. Miksche, Attack: A Study of Blitzkrieg Tactics (New York: Random House, 1942), v.

47 Ibid., 197.

48 Ritter von Leeb, Defense, trans. Stefan T. Posnoy and Daniel Vilfroy (Harrisburg: The Military Service Publishing Company, 1943), 137.

49 HERO, 47.

50 Ibid., 50.

51 Ibid., 55-61.

52 Field Marshal Albert Kesselring, quoted in HERO, A-1.

53 Heilbrunn, 65.

⁵⁴ The description of the Bar-Lev line in this paragraph came from Anthony H. Cordesman and Abraham R. Wagner, The Lessons of Modern War, Volume I: The Arab-Israeli Conflicts, 1973-1989 (Boulder, Colorado: Westview Press, 1990), 39-40.

⁵⁵ Ibid., 42.

⁵⁶ Anthony H. Cordesman and Abraham R. Wagner, The Lessons of Modern War, Volume II: The Iran-Iraq War (Boulder, Colorado: Westview Press, 1990), 448.

⁵⁷ FM 100-5, 7-9.

⁵⁸ FM 20-32 (1976), 133.

⁵⁹ B. K. Young, "The Development of Land Mine Warfare," The Army Quarterly, January and April 1945, 190.

⁶⁰ FM 20-32 (1976), 133.

⁶¹ Ibid., 134.

⁶² Ibid., 136.

⁶³ Ibid., 135.

⁶⁴ Vernon Lowrey, "Initial Observations by Engineers in the Gulf War," Engineer 21, October 1991, 44.

⁶⁵ Ibid.

⁶⁶ FM 20-32 (1976), 204.

⁶⁷ Fastabend and Graves, 38.

⁶⁸ Department of the Army, Field Manual 5-34, Engineer Field Data (Washington, D.C.: U.S. Department of the Army, 1987), 3-36.

⁶⁹ U.S. Army Engineer School, Combat Engineer Systems Handbook (Fort Leonard Wood, Missouri: U.S. Army Engineer School, April 1991), 44.

⁷⁰ Lowrey, 48.

⁷¹ The information on the Volcano mine system in these three sentences came from U.S. Army Engineer School, 54.

⁷² Ibid., 55.

⁷³ Clausewitz, 141.

- 74 Ibid.
- 75 C. E. E. Sloan, Mine Warfare on Land (London: Brassey's Defence Publishers, 1986), 13.
- 76 Ibid, 15.
- 77 Martin van Creveld, "Military Lessons of the Yom Kippur War: Historical Perspectives," The Washington Papers III no. 24, (London: Sage Publications, 1975), 36.
- 78 Thomas D. MacIver and Andrew H. Hough, "Whose Side Are Those !*@%& Engineers On, Anyway?," Engineer 20, October 1990, 5.
- 79 Ibid., 7.
- 80 David J. Ozolek, "Barrier Planning," Armor XCIV no. 6, November-December 1985, 14.
- 81 Ibid., 15-16.
- 82 Ibid., 14.
- 83 Sloan, 114.
- 84 HERO, 12.
- 85 FM 5-100 (1988), 46.
- 86 V. G. Reznichenko, ed. Trans. Department of State, Canada, Tactics (Published by U.S. Air Force, 1987), 101.
- 87 Patrick O'Sullivan and Jesse W. Miller, Jr, The Geography of Warfare (New York: St. Martin's Press, 1983), 56.
- 88 The Germans' experience in northern Italy comes from HERO, 70-71.
- 89 The American experience at Il Giogo pass comes from HERO, 72-73.
- 90 FM 5-100 (1984), 7-5.
- 91 Department of the Army, Field Manual 71-2, The Tank and Mechanized Infantry Battalion Task Force (Washington, D.C.: U.S. Department of the Army, 1988), 4-17.
- 92 FM 5-102, 40.

93 Ibid.

94 Ozolek, 15-16. Note that the attacking regiment could be further restricted to an avenue only one battalion wide by providing just one bypass instead of two. The defender could then take on the regiment one battalion at a time.

95 Robert J. Greenwalt, "NTC: Winning in the Engagement Area," Infantry 79 no. 6, November-December 1989, 24.

96 The problems with obstacle location at the NTC came from the executive officer of the 177th Armor Brigade, Major Craig A. Gephart, interview by author, 9 September 1991, Fort Irwin, California.

97 FM 5-100 (1988), 56.

98 FM 5-100 (1984), 1-6.

99 Ibid., 6-6.

100 Ibid., 4-4.

101 Ibid., 7-6.

102 FM 5-100 (1988), 53.

103 FM 20-32 (1971), 2-12.

104 Paul H. Herbert, "Deciding What Has to be Done: General William E. DePuy and the 1976 Edition of FM 100-5, Operations," Leavenworth Papers 16, July 1988, 105.

105 Michael Howard, "Military Science in an Age of Peace," Journal of the Royal United Services Institute for Defence Studies 119 (March 1974): 7.

BIBLIOGRAPHY

BOOKS

- Addington, Larry H. The Patterns of War Since the Eighteenth Century. Bloomington, Indiana: Indiana University Press, 1984.
- Bellamy, Chris. The Future of Land Warfare. New York: St. Martin's Press, 1987.
- Bloch, Jean de. The Future of War. Boston: The World Peace Foundation, 1914.
- Bond, Paul S. Field Engineering: A Practical Exposition of the Organization of the Ground For Defense. Baltimore: The New Military Library, 1923.
- Cordesman, Anthony H. and Abraham R. Wagner. The Lessons of Modern War. Vol. 1, The Arab-Israeli Conflicts, 1973-1989. Vol. 2, The Iran-Iraq War. Vol. 3, The Afghan and Falkland Conflicts. Boulder, Colorado: Westview Press, 1990.
- Griess, Thomas E., ed. Atlas of the Second World War: Europe and the Mediterranean. Wayne, New Jersey: Avery Publishing Group, Inc.
- Heilbronn, Otto. Conventional Warfare in the Nuclear Age. London: George Allen & Unwin, Ltd., 1965.
- Miksche, F.O. Attack: A Study of Blitzkrieg Tactics. New York: Random House, 1942.
- O'Sullivan, Patrick and Jesse W. Miller, Jr. The Geography of Warfare. New York: St. Martin's Press, 1983.
- Reznichenko, V.G., ed. Tactics. Translated by the State Department of Canada. Published by U.S. Air Force, 1984.
- Sloan, C.E.E. Mine Warfare on Land. London: Brassey's Defence Publishers, 1986.
- von Leeb, Field Marshall General. Defense. Translated by Stefan T. Posnoy and Daniel Vilfroy. Harrisburg: The Military Service Publishing Company, 1943.

REPORTS, MONOGRAPHS, AND STUDIES

Herbert, Paul H. Deciding What Has To Be Done: General William E. DePuy and the 1976 Edition of FM 100-5, Operations. Fort Leavenworth, Kansas: U.S. Army Command and General Staff College, Leavenworth Papers 16, 1988.

Historical Evaluation and Research Organization. Historical Evaluation of Barrier Effectiveness. Dunn Loring, Virginia: Historical Evaluation and Research Organization, 1984.

Rowlett, Ricky M. The U.S. Army and Ground Combat Theory. Fort Leavenworth, Kansas: U.S. Army Command and General Staff College, 1990.

Van Creveld, Martin. "Military Lessons of the Yom Kippur War: Historical Perspectives", The Washington Papers III no. 24. London: Sage Publications, 1975.

ARTICLES

Campbell, James L. "Obstacles." Infantry 66 (May-June 1976): 12-13.

Fastabend, David A. and Ralph H. Graves. "Maneuver, Synchronization, and Obstacle Operations." Military Review 66 (February 1986): 36-48.

Greenwalt, Robert J. "NTC: Winning in the Engagement Area." Infantry 79 (November-December 1989): 24-26.

Howard, Michael. "Military Science in an Age of Peace." Journal of the Royal United Services Institute for Defence Studies 119 (March 1974): 3-9.

Lowrey, Vernon. "Initial Observations by Engineers in the Gulf War." Engineer 21 (October 1991): 42-48.

MacIver, Thomas D., and Andrew H. Hough. "Whose Side Are Those !*% Engineers On, Anyway?." Engineer 20 (October 90): 4-8.

Ozolek, David J. "Barrier Planning." Armor 94 (November-December 1985): 14-18.

Watson, Bryan G. "Obstacle Integration: A Matter of Intent." Infantry 80 (May-June 1990): 42-46.

Young, B. K. "The Development of Land Mine Warfare." The Army Quarterly, January-April 1945, 118-122.

Army Publications

Department of the Army. Field Manual 5-71-100, Regimental Engineer Combat Operations. Washington, D.C.: U.S. Department of the Army, 1991.

Department of the Army. Field Manual 5-100, Engineer Combat Operations. Washington, D.C.: U.S. Department of the Army, 1988.

Department of the Army. Field Manual 5-100, Engineer Combat Operations. Washington, D.C.: U.S. Department of the Army, 1984.

Department of the Army. Field Manual 5-102, Countermobility. Washington, D.C.: U.S. Department of the Army, 1985.

Department of the Army. Field Manual 20-32, Mine/Countermining Operations. Washington, D.C.: U.S. Department of the Army, 1985.

Department of the Army. Field Manual 20-32 Mine/Countermining Operations at the Company Level. Washington, D.C.: U.S. Department of the Army, 1976.

Department of the Army. Field Manual 20-32, Landmine Warfare. Washington, D.C.: U.S. Department of the Army, 1971.

Department of the Army. Field Manual 20-32, Landmine Warfare. Washington, D.C.: U.S. Department of the Army, 1959.

Department of the Army. Field Manual 20-32 Employment of Land Mines. Washington, D.C.: U.S. Department of the Army, 1955.

Department of the Army. Field Manual 71-1, Tank and Mechanized Infantry Company Team. Washington, D.C.: U.S. Department of the Army, 1988.

Department of the Army. Field Manual 71-2, The Tank and Mechanized Infantry Battalion Task Force. Washington, D.C.: U.S. Department of the Army, 1988.

Department of the Army. Field Manual 100-2-1, The Soviet Army: Operations and Tactics. Washington, D.C.: U.S. Department of the Army, 1984.

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

U.S. Army Engineer School. Combat Engineer Systems Handbook. Fort Leonard Wood, Missouri: U.S. Army Engineer School, 1991.

War Department. Field Manual 100-5, Field Service Regulations: Operations. Washington, D.C.: U.S. War Department, 1941.