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HISTORICAL EVALUATION OF BARRIER EFFECTIVENESS

Study Report

March 1974

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Contract Number DAAG39-74-C-0033

For

US ARMY CONCEPTS ANALYSIS AGENCY
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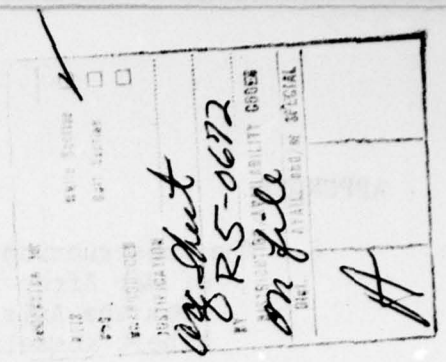

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I. INTRODUCTION

HERO has undertaken a study of the uses and effects of obstacles in modern and future combat in Europe as a preliminary but substantive effort which it was expected would (a) provide sufficient specific data to permit tentative development of quantitative inputs for combat models with respect to efforts to create or improve obstacles and barriers, and to their effectiveness under varying circumstances of combat, as well as planning factors for preparation or improvement of obstacles and for obstacle effects both individually and in barriers, and (b) provide a basis for refinement of such inputs and factors through subsequent development of an expanded data base. The character and form of the report have necessarily been determined by the time available and the actual availability of primary research material.

The general basis of the study is the analysis of four combat engagements in World War II, involving US, German and Soviet forces. The material derived from these analyses provides the data for further examination of the role of obstacles and barriers as operating elements in a battle. Emphasis in principle has properly been given to barrier systems, and to consideration of obstacles, or obstacle types, as components of such systems. In the one example in which a planned barrier system did not exist, there is evidence that a series of obstacles, not actually related in any conceptual sense, tended to grow into barriers in terms of effects.

Chapter II is an examination of some of the most important features of the barrier doctrine of the United States, Germany, and the Soviet Union. In some cases the contemporary material on doctrine was directly available; in others it was necessary to infer the governing principles from actual performance or--particularly in the Russian case--from the observation of others. This approach, although less specific in terms of direct evidence, has the offsetting advantage of "real world" conditions under the pressures of combat.

In order to discuss the experience of fighting forces with barriers in actual combat it is necessary to describe the combat which took place in the barrier area. Consequently Chapter III contains brief historical accounts of four engagements:

1. The attack of the XLVIII Panzer Corps on the Sixth Guard Army sector of the Voronezh Army Group at Kursk, 5-12 July 1943;

2. The German 335th Division in the Nikopol bridgehead, 13 January-8 February 1944;

3. The US 85th Division at Il Giogo Pass, 12-17 September 1944;

4. The US 4th Division in the Battle of the Bulge, 16-24 December 1944. (In addition, a general survey of the obstacle-barrier effort of the US First Army in that battle is included.)

Each narrative, while describing the progress of combat, focusses on the barriers and obstacles involved--their organization, construction, and function in battle.

The engagements selected proved to depict a very wide variety of barrier activity, ranging from hasty preparations in the face of a sudden and unexpected counterattack to the elaborate building of a defensive system in depth with significant expenditure of time and resources. This range of activity supports some judgments about construction priorities and obstacle effectiveness in a variety of settings.

Although the case studies all focus on the experience of combat units with barriers, they vary considerably in content and in presentation because of the variations in type and quality of source material. HERO researchers have used as their basic sources US and German official combat records and reports of the World War II operations, and Russian postwar studies and analyses of the operations on the Eastern Front. None of these proved to contain the ideal amount of information on obstacles and barriers, and time did not permit full exploration of each source. (In particular there was a paucity of detailed descriptions of obstacles and barriers in the reports.) Each source has different strengths and weaknesses, which are reflected in the narratives and necessarily in the analyses.

Chapter IV compares various features of the barrier experience described in Chapter III and analyses them qualitatively. Chapter V assembles quantitative data relating to each engagement in statistical form and analyses it, in large part by using techniques developed by HERO in the generation of its Quantified Judgment Method of Combat Analysis (QJMA). The results of the analysis are shown in tables and graphs that provide preliminary insights into valid model inputs for the preparation or improvement of obstacles, the utilization made of them, and their effects upon attacking forces in terms of delays imposed, or otherwise. These insights, while reasonable in the terms of the engagements studied here, must remain preliminary until a much larger base of data is assembled, derived from many more examples of barrier experience in combat.

HERO had not anticipated the need to rely so heavily on the QJMA in this analysis. However, in preparing Chapter V it soon became

evident that (regardless of the amount of detailed information that might or might not be available on barriers or obstacles) it would be impossible to consider quantitatively the effects of obstacles and barriers on the effectiveness and performance of attackers and defenders in the four case studies without a contextual capability for quantified analysis of historical combat. The statistics of construction efforts, construction materials used, and of engagement results would have been a mere collection of numbers, defying coherent analysis, had the QJMA not been available, to provide both a structure and a conceptual basis for the analysis.

While this study cannot be taken as definitive, it does develop a basis for a more detailed examination of historical barrier doctrine, and provides insights for elaboration of possibly modified doctrine. It describes the functions of barriers and obstacles in a setting that also considers the other elements that affect the outcome of battles. It suggests priorities for effort in both stabilized and fluid situations. There are some quantifications of barrier effects which are highly tentative, and even arbitrary, but which furnish an organized basis for proceeding further. Of particular interest is the concept of the barrier as "terrain enhancement" and the idea of a variable (time sensitive) factor to represent the role of the obstacle/barrier on the endurance of attacking forces in sustained and continuous combat. Unfortunately time was not available to explore this idea; its significance lies in the effects (noted in previous HERO studies) of prolonged combat upon the casualty-inflicting capability of a unit (Score Effectiveness) and upon the level of combat effort it can exert (Intensity of Combat).[1]

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[1]See Figure V-1, p. 133, for a definition of these terms.

II. BARRIER AND OBSTACLE DOCTRINE IN WORLD WAR II

Obstacles and Barriers as Defensive System Components

A barrier, according to the definition in AR 310-25, is "a coordinated series of obstacles designed or employed to canalize, direct, restrict, delay, or stop the movement of an opposing force, and to impose additional losses in personnel, time, and equipment upon the opposing force."[2] In the same publication an obstacle is defined as "any obstruction that stops, delays, or diverts movement." Obstacles are, and barriers may be, components of a defensive position, which is, broadly speaking, "any area occupied and more or less organized for defense."

A single obstacle, or a combination of hastily constructed obstacles, was considered in this study to have become a barrier to the extent that it accomplished one or more of a barrier's functions, of which six major ones may be readily identified:

a. Halting the attacker
and
b. Increasing his casualties } use of firepower advantage and coordinated fire

c. Slowing attacker's rate of advance
and
d. Destroying coordination - restricting movement, opening flanks

e. Diverting the attacker to less favorable ground; canalization; (barriers in denial operations)

f. Exhausting the attacker's capacity for sustained combat before he can reach objectives.

These barrier functions also have significant influence on the rate and volume of expenditure of the "store of combat energy" of the combat units that come up against them. This attribute, which determines the unit's ability to sustain effective combat, derives from the physical and moral state of the troops, the inevitability of exhaustion, the logistics adequacy and endurance of the force, and its firepower in absolute and comparative terms.

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[2]A glossary of terms is included in Appendix C.

It is therefore clear that the use of obstacles, and their incorporation into a barrier system, is a major aspect of the preparation of a defensive system, and the work involved on the one is integrally related to the other In this regard, the preparation of a defensive system involves four major kinds of effort, all related directly or indirectly to obstacles, as follows:

1. The construction of entrenchments and other forms of field fortifications, the primary purpose of which is not to be obstacles, but which do, in fact, become a part of a barrier system;

2. The preparation of demolitions to block passages of roads, bridges, or other defiles;

3. The preparation of various forms of artificial, or constructed, obstacles for the purpose of blocking limited or broad potential avenues of hostile movement; and

4. The emplacement of mines or other explosive charges, also to impede hostile progress across otherwise favorable, generally broad, avenues of movement.

To the extent the records consulted will permit, this study devotes major consideration to these four kinds of effort, and the results they achieve in terms of the six functions listed above.

Comparison of Concepts

Since an in-depth discussion of barrier and obstacle doctrine of Germany, the Soviet Union and the United States in World War II is clearly beyond the scope of this study, this chapter deals only with the most significant points which have emerged from a review of the available literature of the three nations from that time period and the demonstration of doctrine in action in the records of the four engagements. The review has revealed considerably more similarities than differences.

The Germans, as a continental European power, thought of fortification of their national boundaries and other preparations for war as an integrated whole. For example, in comparing the West Wall to the preparations of the French, Russians, and other European countries, they described their concept as involving a main defensive area which was fortified throughout with concentration and deepening at predominant sites but without the express formation of strongpoints. In contrast, they saw the Maginot Line, the Stalin Line, and Czech and Greek border fortifications as based on the strongpoint system, with intermediate areas between them less heavily defended. The

Germans were, naturally enough, critical of other systems and at one point said, " . . . it develops that the fortification in its entire course must be equally strong . . . every position is only as strong as its weakest part."[3]

The Germans saw their national system as having influence on the actions of others beyond that of defensive power. For example, they said that the strength of the West Wall frightened off the British and French when Germany entered Czech territory in 1939 and covered their own strategic rear when they invaded Poland. The West Wall also provided a secure starting position and base of maneuver when they launched the attack on France on 10 May 1940. The German philosophy was transferred downward to operating levels and is demonstrated in the large number of reports and instructions they produced and the meticulous attention to detail in their technical publications.

It is interesting to compare General Eisenhower's later view of the West Wall with that of the Germans. In describing the setting for the Ardennes fighting in 1944, he said:

> The strong artificial defenses of the Siegfried Line assisted the enemy to achieve strength in the attack. The obstacles, pillboxes, and fixed guns of the line so greatly multiplied the defensive power of the garrison that the German could afford to weaken long stretches of his front in order to gather forces for a counter-blow.[4]

At the actual time of the battle, however, there was another aspect of the role of fortifications. General Bradley expressed gratification that the enemy was leaving the shelter of his fortifications and coming out to where he could be "got at." In his Order of the Day on 22 December 1944, General Eisenhower said: "By rushing out from his fixed defenses the enemy may give us the chance to turn his great gamble into his worst defeat."[5] It is evident that the German high command was sensitive to the role of barriers and obstacles and integrated appropriate considerations into their plans. The reactions of Generals Eisenhower and Bradley, cited above, were correct insofar as application in the instant situation was involved.

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[3]OKH General Staff of the Army, General of Engineers and Fortresses H21/294 Manual on Experiences Gained in Construction of Land Fortifications During WW II, 30 April 1943.

[4]Dwight D. Eisenhower Crusade in Europe (Doubleday and Co., Inc., Garden City, New York, 1948), p. 346.

[5]Ibid., p. 354.

They do not, however, address the carefully thought out and specified German concepts of the role of physical barriers in the defense.

The doctrine of the Soviet Union was probably as well formulated in higher level analysis and projection as the German, but it is not subject to equal postwar open analysis. However, during the war, the Germans had (typically) undertaken a considerable analysis of Soviet barrier doctrine based upon intelligence data and operational observation. They claim that the best defense of Russia would have exploited her vast and exhausting spaces, and that her major national barrier, the Stalin Line, should have had more depth and solidity inside the country. Other fortifications placed close to the border were declared by the Germans to show that Russia had adventure beyond her borders to the westward in mind all the time. Whatever philosophical validity this claim might hold, German evaluation of its intended role in action demonstrated keen awareness of the total role of barriers in combat.

At the time of the beginning of the Battle of the Ardennes in mid-December, 1944, the US forces in Europe were not conspicuously concerned with the preparation of elaborate barriers in depth. The First Army, in the north, had already begun its attack on the Roer River line. South of the First, the Third Army was preparing to resume the attack eastward on 19 December. The campaign in Europe to this point had required principally that US forces protect themselves in local and temporary defense positions. Deliberate and elaborate preparation for defense against massive attack had not been a necessary undertaking. The order issued by General Patton (see Chapter III, p.79) is a fair statement of the prevailing thinking of the American high command at the time of the attack, even allowing for the author's style of discourse. General Eisenhower was later to say:

> At any moment from November 1 onward I could have passed to the defensive along the whole front and made our lines absolutely secure from attack while we waited reinforcements. My basic decision was to continue the offensive to the extreme limit of our ability, and it was this decision that was responsible for the startling successes of the first week of the German December attack.[6]

More directly, the First Army Engineer said:

> The German counter offensive in the Ardennes resulted in the establishment of barrier defenses in much larger scale than at any previous time. Barriers were planned and developed at Army level. The division covering obstacles were breached

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[6] Ibid., p. 340.

> by the initial thrust of the Germans and with the American forces falling back, the engineers of divisions, corps and Army were committed to the installation of obstacles to cover the withdrawal and eventually to the establishment of the final defensive barrier. Many obstacles such as road blocks, abatis, and destroyed bridges were created at advantageous positions.[7]

The American doctrine in existence on 16 December 1944 was straightforward and practical. The place of barriers and obstacles in US thought is implied in an excerpt from a statement about field fortifications in a publication current at the time:

> Field fortifications increase the combat efficiency of troops. They must be used skillfully to further the mission of a unit and must not be allowed to lead to a passive or static defense.[8]

It must be remembered that from D-Day onward the US Army had been engaged primarily in offensive actions. US forces in the Ardennes were largely without actual experience in the preparation and use of complex barrier systems. Their experience had been almost entirely limited to the protective measures taken by troops at a temporary halt, or the preparation of obstacles to deal with local counterthrusts. It may be said that the US did not have a strategic barrier philosophy of the type held by the German Army; as events were to prove, this was not a significant factor, but only because resources available to the Germans in late 1944 were inadequate to permit them to accomplish their operational concept.

Levels of Command

In all cases the initiating order for the establishment of a major barrier system, as part of a deliberate defense, emanates from the highest command actually involved with the current or prospective fighting. In general, this would be Army or Army Group. In the US case studied the barrier plan manifested itself only in piecemeal fashion, but it is nevertheless true that the designation of lines to be prepared and the allocation of engineer troops and material were actions taken by First Army Headquarters, in accordance with procedures prescribed.

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[7]Annex III to After Action Report, December 44, S-3 Office of the Engineer, First US Army.

[8]Field Manual 5-15, Field Fortifications, 14 February 1944.

In all cases it would appear that the general trace and tactical location of a barrier was established by the initiating authority, with the details of actual siting and cooperation left to those who were to build the positions. The highest authority did control fortification material and mines and thus did have strong negative control over progress and priorities. In the test of actual battle the command and control function is of course exercised over barriers as integral parts of the force. US doctrine made the division commander responsible for operational details, including the firing of demolitions.[9]

The Strategic Roles of Barriers

German military authorities articulated very clearly the role that fortifications and barriers have in national strategy. In a continental power it was necessary to protect the people and structure of the production base. An attacker had to be halted at some specific point. This produced ideas about depth as well as strength in forward positions. In Italy Kesselring complained that Hitler's attachment to the idea of the heroic stand in place subverted the operational concept of defenses in depth.[10] The Soviet Union also held views about integrity of territory, but the comparative vastness of the Russian nation made Soviet leaders more willing to accept some penetration. The ground on which they chose to make a stand was, however, thoroughly organized and--witness Stalingrad--stubbornly defended. In both countries there was a rational flow of thought from the attitudes induced by history and national strategy to the policies and practices of battlefield preparation. US forces, lacking similar background, apparently had a simpler view, but there was recognition of the general part that barrier systems play in military strategy. The limited number of case studies reported here demonstrate the great strategic purposes of barriers: to assist in the denial of vital territory; to withstand and exhaust the combat power of an attacker who might have local superiority of resources; to protect a secure point from which to start a counterattack; or, finally, to achieve a decisive victory at the scene of the defenses.

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[9]Field Manual 5-30, Engineer Field Manual, Obstacle Technique, 30 June 1943.

[10]General Field Marshal Albert Kesselring, The Construction of Positions in the Italian Theater of War After the Withdrawal of Royalist Italy from the Axis Alliance, MS #C-031; Historical Division, European Command, August 1949. Included as Appendix A to this study.

Systems Concepts

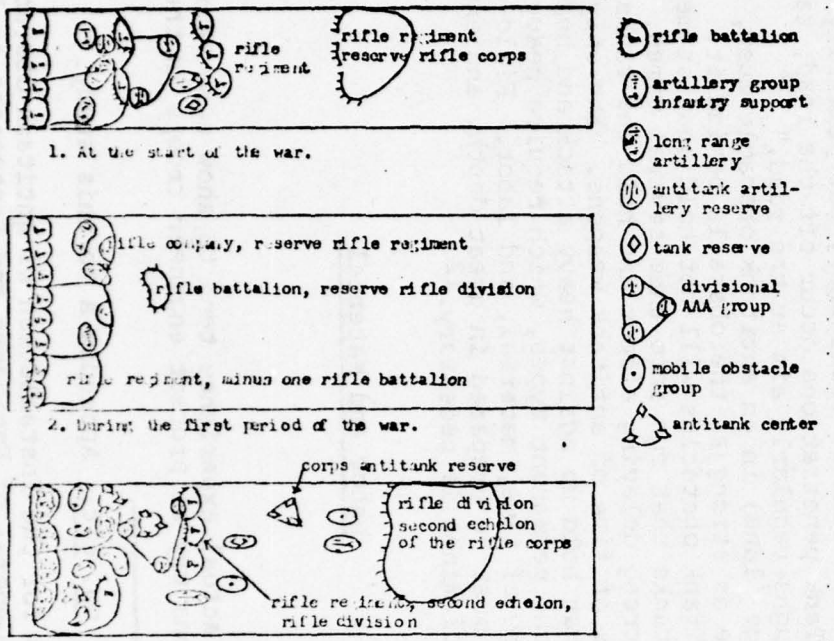
Despite the forced application of some of Hitler's concepts, German doctrine emphasized the importance of depth in a barrier system. The underlying idea is clear and simple. An enemy force, having penetrated the front of a barrier, was not to be allowed time or space in which to regain his balance and security or reorganize to continue the attack. Barrier elements in depth inhibit significant progress and simultaneously shelter the counterattacking force, which was a basic tenet of German defensive doctrine. Russian doctrine was also designed to wear out the attacker. The schematic diagrams (Figure II-1) taken from Soviet analytical studies portray layouts for large unit systems in three periods of World War II. It is particularly to be noted that the overall depth of a corps zone was such as to deny the attacker the ability to continue a major attack without forward displacement of his artillery. It is also interesting to observe the manner in which doctrine adapted to resources, as shown by the lighter density of defenses in the middle period of the war. American thought, at least in the field of theory, recognized the same principles concerning depth and the way it should be measured. The decision as to the actual distribution of positions and the location of the elements of a barrier was necessarily made in light of local circumstances and not according to some rigid doctrinal prescription.

There were no significant differences in views of the three nations about the composition of barriers. All doctrines emphasize certain factors: the essential role of mines in defense against armor; the mixture of elements including camouflage needed to provide against combined arms attacks; the necessity for all-around protection and for obstacle strength realistically designed to cope with heavy attack; the importance of coordination of natural and artificial obstacles and system integrity; the importance of preliminary reconnaissance and of continuous surveillance; the essentiality of adequate manpower and weapons coverage of a barrier.

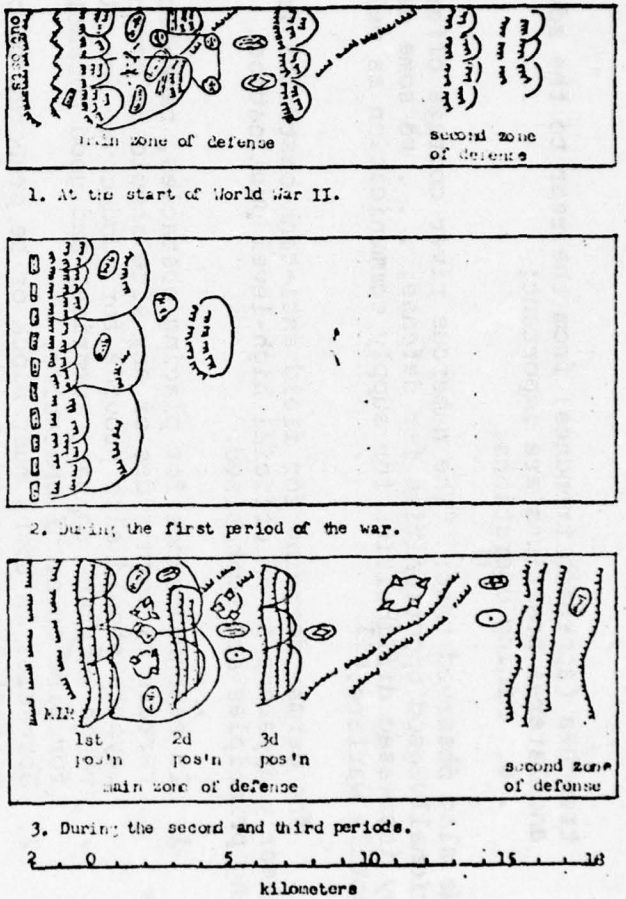
In a general account of the command view of the preparation of defenses in Italy, Field Marshal Kesselring included several statements that exemplified the principles of barrier doctrine as seen at the highest German command levels:

> a. Maximum use of camouflage and a field of fire from flanking installations is of decisive importance;
> b. Natural anti-tank obstacles, supplemented by artificial obstacles (emphasis added) (AT ditches, steep walls, swamping, etc.) should be constructed throughout the depth of the fortified zone;
> c. Building separately protected shelters and firing positions with the exception of "galleries" in the Alps;
> d. Camouflaged and if possible covered communication

SOVIET BATTLE FORMATIONS OF INFANTRY UNITS IN DEFENSE, WORLD WAR II



SOVIET ENGINEER CONSTRUCTION OF THE TACTICAL ZONE OF DEFENSE



Adapted from illustrations accompanying article by Col. Ivan Sazonov, "Development of Tactical Defense in World War II," Voyenno-Istoricheskiy Zhurnal, September 1968.

Figure II-1

trenches (approach trenches) from the rear to the advanced and lateral positions are important;

e. Mining operations.

He also observed that: "The numerous river courses offered exceptionally good opportunities for defense, . . . to some degree offset by increased difficulties for supply communication as well as for mobile warfare."[11]

The German doctrine for field anti-tank obstacles is even more clearly apparent in an official high-level publication. The following principles are emphasized:

1. In reconnaissance for placing obstacles, tank-secure terrain on both sides of any site should be sought. Layouts should also provide for good cover for close-range antitank combat, surprise, and good potential for fire cover of obstacles.
2. Obstacles in towns must block or be prepared to block most of the entrances to the town. They must be integrated with the town security plan.
3. Barriers for roads and paths must be prepared not only along the main line of resistance, but primarily in depth. "Tank penetrations occur off the road; tank breakthroughs regularly aim at the road."
4. The passage (lane) in an antitank obstacle must, when closed, be as strong as the obstacle behind it.
5. Field antitank obstacles will not hold against medium or heavy tanks that run into them several times. They do have strong delaying effect and hold the tanks in the fields of fire of antitank weapons. The only obstacles that hold up against heavy attack and heavy fire are the permanent types, which require heavy expenditure of time, material, and labor. Field-type obstacles must be prepared in great depth, and extensive use of mines is necessary.[12]

Labor and Material

Manpower

Doctrine and actual experience tend to show some variance. All formal prescriptions try to protect engineer troops in their special

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[11]Kesselring, op. cit. Appendix A to this study.

[12]"Guidelines for the Installation of Antitank Obstacles" published by the OKH General of Engineers and Fortresses on 30 January 1945.

role. Their duties as instructors and supervisors, as well as in performance of technical tasks requiring their unique skills, are stressed by all. Doctrine also uniformly requires major troop labor inputs. The Soviet and German principles also sanctioned the extensive use of civilian labor. In the German case there was also the formally established Organization Todt, which made a significant contribution to the construction of more deliberate fortified positions. It may be deduced from recorded experience that only actual fighting tasks took precedence over barrier construction, and all troops had to participate. Both Germans and Russians published manuals illustrating in some detail the labor factors to be used in calculating construction requirements. American authorities were true to their stereotype image. They issued large quantities of work data, work formulae, material requirements, and technical instructions for making obstacles and positions. The technical function of engineer troops was stressed at every opportunity.[13]

Material

In the doctrinal sense there is little variation in prescriptions for the material requirements of barriers. The use of local material is urged. Adequate strength for each obstacle is a prime requirement, and this general statement is supplemented by detailed technical engineer material that prescribes the dimensions, construction methods, and material to be used for every type of barrier. If any doctrinal exceptions existed, they may be inferred as the products of the national resource situation and national construction practices. On that basis it may be said that the Germans showed more inclination toward the use of concrete and steel than did the Russians. US forces placed emphasis on simple local actions--craters, abatis, blown bridges. On the other hand, they were quick to use large numbers of mines and quantities of prepared material such as concertina wire. The types of obstacle construction actually employed were the products not so much of formal doctrine as of the circumstances of the ongoing situation. Doctrine in itself contemplated and tolerated a variety of responses to that situation.

Summary and Projections

General

Comparison reveals considerable agreement in principle among the doctrines of the US, Soviet Union, and Germany in World War II.

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[13]For good examples of these qualities, see Field Manual 5-35, Reference Data, 15 February 1941 and Field Manual 5-6, Operations of Engineer Field Units, 23 April 1943.

Their views of the functions of command, the fitting of barriers into their surroundings, the need for integrity of systems, the role of barriers in the scheme of defense, and the operational priorities of construction do not vary in any substantial degree. The types of barriers did not differ very much, although designs were not identical. There were differences of execution, not so much because of doctrinal differences as because of the differences of the situations and purposes for which barriers were constructed.

The Applications of History

The doctrines obtaining at the time of World War II enunciate and agree on matters of principle and, in principle, have validity today. Any attempt to translate doctrine forward from its original context faces one major task: that of recognizing the problems generated by changes in physical capacities of machines, weapons, and men.

There are differences of scale. The vehicles of today have cross-country and water-crossing capabilities that make earlier defenses against similar equipment inadequate. The advent of the troop-carrying helicopter gives the problem of all-around integrity of barriers a new level of importance. The prospect of tactical nuclear environment has profound effect on battlefield densities and hence on the location and nature of barriers.

New technology requires reconsideration of the role of air support, particularly the case of the "pop-up" helicopter as a preferred means of fire coverage of a barrier. New sensors affect the style of the surveillance of barriers, offering opportunities for reduction of troop involvement in that role. Newer types of mines change time factors for minefield laying and also may have significant effect on logistics systems; the "one time" devices save time only at some cost in procurement in later resupply effort, since they are not reusable. More powerful explosives, including nuclear devices, change the calculations for bridge blowing, cratering, and slope destruction.

The basic nature of combat in NATO Europe, involving new postures and local political and social considerations, will limit and shape the preparation of defenses, probably placing great emphasis on obstacles and barriers that can be quickly placed and quickly removed, and offer minimal problems to inhabitants of an area after the combat phase is over. This clearly implies emphasis on mines and pre-fabricated material, careful consideration of the long-term implications of damage, and the recalculation of time factors for barrier construction. The new environment--human, technical, and political--does not affect the immutable principles of war, but it does impose the need to gauge with great care the application of long-term principles.

III. COMBAT EXPERIENCE WITH BARRIERS IN WORLD WAR II

Four very different types of barrier experience were selected for analysis in this study. The selection of operations was made on the basis of knowledge of the operations themselves and the variety of defense experience they represented. The selection of units to be studied was made on the basis of availability of primary source materials. The sources searched were of five types: (1) Combat records of US units in the National Records Center, specifically the contemporary reports of the various units of the 4th Division (G-1, G-2, G-3, G-4, Ordnance, Engineers, 12th Infantry Regiment), the pertinent records of the US First Army, and the records of the 85th Division. (2) Combat records of German units, on microfilm in the National Archives, incomplete, without adequate indexing and of varying degrees of legibility. (3) Soviet analyses of World War II experience, published in Russian military periodicals. (4) Secondary accounts of operations in official or semi-official publications. (5) Field manuals and publications on barrier doctrine, in English and German. It was patently impossible in a short study to search all records of all units involved in an operation of army size, as, for example, at Nikopol or the Ardennes. Although in both those cases some records of units more actively engaged than those selected may exist, time did not permit a wider search before concentrating on a single division.

The first operation, the attack on the Soviet Sixth Guard Army in the southern sector of the Kursk salient, involved a complex barrier system in great depth, carefully planned and executed. The second, the experience of the German 335th Infantry Division in the Nikopol bridgehead, involved a planned barrier system built under combat pressure in a very restricted area. At Il Giogo Pass the barrier was planned in principle nearly a year in advance in a mountainous area where natural obstacles made passage difficult. The experience in the Ardennes during the German counterattack in December 1944 was one of hastily constructed obstacles erected to halt an attack in progress. The narratives of the combat experience in each of these examples have been drafted largely from contemporary records of the participants.

All available information on the construction and function of obstacles and barriers in the areas has been included; where statistics or other data concerning barriers do not appear in the narratives it may be assumed that they could not be found in the records of the units concerned. Details of the appearance and siting of obstacles

are rare. Since Germans, Russians and Americans all had doctrine on how and where to install each kind of obstacle, in the absence of comments on construction it must be assumed that the doctrine was followed.

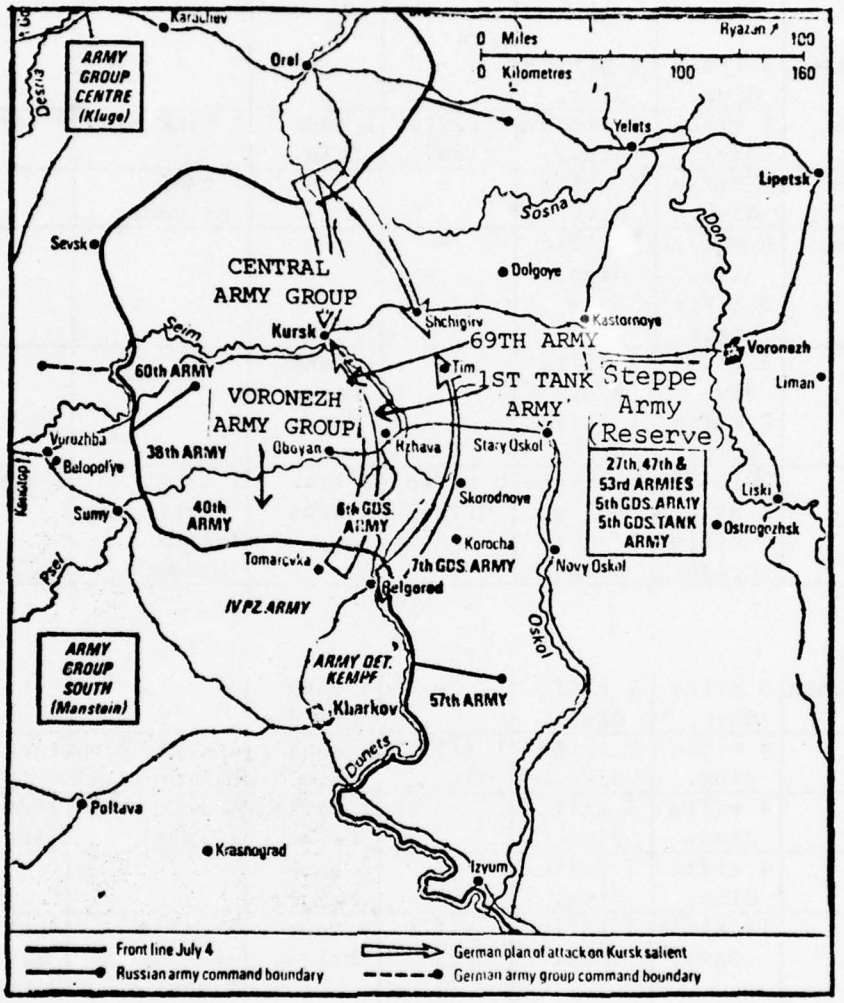
A. The Attack of the XLVIII Panzer Corps on the Sixth Guard Army of the Voronezh Army Group at Kursk, 5 - 12 July 1943

The Defenses

In the winter of 1943, Soviet troops pushed out a salient in the central region of the Eastern Front west of Kursk, a bulge that protruded from Orel to Belgorod (Map 1). As spring approached, the Soviet High Command, well aware that the existence of the salient would be temptation to the Germans to attempt to cut it off with a double operation from north and south at the base of the bulge, decided that the whole area must be fortified. The Germans could be expected to attack as early as possible in the summer, and on 12 April 1943 the order was given to commence construction of a barrier system. When the Germans struck, on 4 July, the defenses were ready.

Two Soviet army groups were assigned to defend the salient, the Central Army Group in the north, and the Voronezh Army Group in the south. Their strengths are shown in Tables III-1 to III-6, drawn from postwar Soviet sources. Together the two Army Groups covered a front of 550 kilometers, about 13% of the entire Soviet-German front. The defense system, including the Steppe Army Group, east of the bulge, which formed the strategic reserve, not only occupied the whole bulge area but stretched as much as 250-300 kilometers in depth, from west to east. The Voronezh Army Group defended 244 kilometers of the front, with five combined arms armies, one tank army, one separate rifle corps and two separate tank corps. In the southeast, where the main thrust of the German attack was expected, was the Sixth Guard Army, with seven rifle divisions covering 64 kilometers of frontage, four of them covering 28 kilometers, while the other three covered 36. All of the Sixth Guard Army's tank brigades, tank regiments, and antitank artillery brigades were deployed in the 28-kilometer sector. Beyond the Sixth, the Seventh Guard Army held the rest of the Voronezh Army Group's front.

The density of defending infantry, artillery and armor in both army groups in the whole Kursk salient on the average was one rifle division per 7 to 7.4 kilometers of frontage, 35 guns and mortars per kilometer, and five to seven tanks and self-propelled guns per kilometer. In the most vulnerable sectors, such as that held by the Sixth Guard Army, the density was increased to about one rifle



Map 1
PLAN OF GERMAN ATTACKS AT KURSK
July 1943

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*Adapted from Geoffrey Jukes, Kursk, Ballatines Illustrated History of World War II, Battle Book No. 7, New York: Ballantines, 1968, p. 21.

TABLE III-1

OPERATIONAL COMPOSITION OF THE CENTRAL AND VORONEZH ARMY GROUPS IN DEFENSE AS OF 1 JULY 1943

Armies	Army Group's 1st Echelon				Army Group's 2nd Echelon	Army Group Reserve
	Army's 1st Echelon	Army's 2nd Echelon	Army's 3rd Echelon	Army Reserve		
Central Army Group						
Forty-eighth	3 rifle divs.	4 rifle divs.	-	-		
Thirteenth	4 rifle divs.	3 rifle divs.	5 rifle divs.	1 tank brig.	1 tank army	2 tank corps
Seventieth	4 rifle divs.	4 rifle divs.	-	-	1 tank brigade	
Sixty-fifth	6 rifle divs. 3 rifle brigs.	3 rifle divs.	-	-		
Sixtieth	3 rifle divs. 2 rifle brigs.	2 rifle div.s 1 rifle brig.	-	1 tank brig.		
Total	20 rifle divs. 3 rifle brigs.	16 rifle divs. 1 rifle brig.	5 rifle divs.	2 tank brigs.	2 tank corps 1 tank brigade	2 tank corps
Voronezh Army Group						
Thirty-eighth	5 rifle divs.	1 rifle div.	-	2 tank brigs.		
Fortieth	4 rifle divs.	2 rifle divs.	1 rifle div.	1 tank brig.	1 field army (Sixty-ninth)	1 rifle corps (V Corps)
Sixth	4 rifle divs.	3 rifle divs.	-	1 rifle brig.	1 tank army (First)	2 tank corps (II & V)
Seventh	4 rifle divs.	3 rifle divs.	-	2 tank brigs.		
Total	17 rifle divs.	9 rifle divs.	1 rifle divs.	6 tank brigs.	5 rifle divisions 2 tank divisions 1 mechanized corps	3 rifle divisions 2 tank corps

*First Tank Army consisted of VI and XXXI Tank Corps and 31st Mechanized Corps.

TABLE III-2

COMPOSITION OF THE AIR FORCE AND NUMBER OF AIRCRAFT
IN THE CENTRAL AND VORONEZH ARMY GROUPS
AS OF 1 JULY 1943

	Central Army Group	Voronezh Army Group
Corps		
Fighter-interceptor	1	2
Ground Support	-	1
Bomber	1	1
Mixed	1	-
Corps Total	3	4
Divisions		
Fighter-interceptor	6	5
Ground Support	2	3
Bomber	4	3
Division Total	12	11
Aircraft		
Fighter-interceptor	455	389
Ground-support	241	276
Day Bombers	260	172
Night Bombers	74	34
Reconnaissance	4	10
Aircraft Total	1,034	881

TABLE III-3

COMPOSITION OF THE CENTRAL AND VORONEZH ARMY GROUPS
AS OF 1 JULY 1943

	Central Army Grp	Voronezh Army Grp
Field Armies	5	5
Tank Armies	1	1
Air Force Armies	1	1
Rifle Corps	11	11
Rifle Divisions*	41	35
Tank Destroyer Division	1	--
Rifle Brigades	4	--
Fortified Areas	3	--
Separate Tank Corps	2	2
Separate Tank Brigades	3	6
Separate Tank Regiments	15	7
Separate Self-Propelled Artillery Regiments	4	3
Artillery Corps	1	--
Artillery Divisions	3	--
Antiaircraft Artillery Divisions	5	4
Separate Artillery Brigades	1	4
Separate Tank Destroyer Artillery Brigades	3	7
Separate Mortar Brigades	1	1
Separate Artillery Regiments	3	9
Separate Tank Destroyer Artillery Regiments	8	26
Separate Antiaircraft Regiments	12	9
Separate Mortar Regiments	10	11
Truck-mounted Multiple Rocket Launcher Divsisions	1	--
Truck-mounted Multiple Rocket Launcher Regiments	10	11
Separate Armored Train Battalions	1	3
Separate Engineer Brigades	4	5
Separate Engineer Battalions	21	14

* Average strength of a rifle division, 7,400 men in the Central Army Group, 8,400 men in Voronezh Army Group.

TABLE III-4

TROOPS, WEAPONS AND EQUIPMENT IN THE CENTRAL AND VORONEZH ARMY GROUPS AS OF 1 JULY 1943

Personnel and Materiel	Central Army Group		Voronezh Army Group	
	Total	In Combat Units	Total	In Combat Units
Men	711,575	510,983	625,511	466,236
Rifles and Carbines	341,396	297,008	301,826	242,876
Submachine Guns	114,431	110,734	111,261	106,953
Light Machine Guns	15,872	14,411	15,642	14,548
Heavy Machine Guns	5,179	5,012	4,578	4,386
Antitank Rifles	11,561	11,216	13,224	12,897
Tanks				
Heavy	100	74	105	105
Medium	1,007	924	1,114	1,109
Light	587	518	443	443
Total	1,694	1,516	1,662	1,657
Self-Propelled Artillery				
Heavy	25	25	-	-
Medium	32	32	24	24
Light	34	34	18	18
Total	91	91	42	42
Artillery				
Antitank 45 and 57 mm	2,144	2,106	1,795	1,763
Field Guns 76 mm and up	3,140	3,107	2,327	2,279
Mortars 82 and 120 mm	5,792	5,512	4,596	4,539
Total	11,076	10,725	8,718	8,581
Antiaircraft Guns				
78-85 mm	447	446	311	310
20-37 mm	684	678	450	434
Total	1,131	1,124	761	744
Truck-mounted Multiple Rocket Launchers	246	246	272	272
Vehicles	29,311	15,849	26,331	14,156

TABLE III-5

OPERATIONAL DENSITY OF INFANTRY, ARMOR, AND ARTILLERY[1]
AS OF 1 JULY 1943

	Central Army Group	Veronezh Army Group
Frontage of Defensive Positions (km)		
Total length	306	244
Sector of most probable enemy attack	40	144
Percent of total length	13.0	46.7
Number of Rifle Divisions		
On whole front line	41	35
In sector of most probable enemy attack[2]	14	22
Percent of total number of divisions	34.0	63.0
Density of Rifle Divisions (km/div)		
On total front	7.4	7
On sector of most probable enemy attack	2.8	5
Number of Guns and Mortars[3]		
On whole front	10,725	8,581
In sector of most probable enemy attack	5,000	5,780
Percent of total number	46.6	66.2
Density of Artillery (per km)		
On whole front	35	35.2
In sector of most probable enemy attack	125	50.7
Number of Tanks and Self-propelled Artillery		
On whole front	1,607	1,699
In sector of most probable enemy attack	1,119	1,304
Percent of total number	70.0	77.0
Density of Tanks and Self-propelled Artillery (per km)		
On whole front	5.2	7.0
In sector of most probable enemy attack	27.8	11.4

[1]Combat troops only.

[2]In the Central Army Group this sector included Thirteenth Army, two rifle divisions from the Seventieth Army, Second Tank Army, IX and XIX Tank Corps; in the Voronezh Army Group this sector included Sixth Guard Army, Seventh Guard Army, Sixty-ninth Army, First Tank Army, II and V Tank Corps, and XXXV Rifle Corps.

[3]Excluding truck-mounted multiple rocket launchers, AA artillery and 50 mm mortars.

TABLE III-6

AMMUNITION SUPPLY VORONEZH ARMY GROUP
AS OF 1 JULY 1943

Type of Ammo * (in units of fire)	In Units	In Army Depots	Total in Armies	In Army Group Depot	Total in Army Group
Rifle	1.3	0.2	1.5	0.5	2.0
Antitank Rifle	1.3	0.3	1.6	0.3	1.9
50 mm Mortar	1.0	0.5	1.5	0.1	1.6
82 mm Mortar	1.5	1.7	3.2	0.7	3.9
120 mm Mortar	1.3	0.4	1.7	0.4	2.1
37 mm Antiaircraft	2.4	0.3	2.7	1.3	4.0
76 mm Antiaircraft	-	-	-	1.1	1.1
85 mm Antiaircraft	2.1	0.5	2.6	1.5	4.1
45 mm Artillery	1.6	0.8	2.4	0.2	2.6
76 mm Regimental Artillery	1.5	0.5	2.0	0.1	2.1
76 mm Divisional Artillery	2.2	0.4	2.6	0.4	3.0
122 mm Howitzer	1.3	0.3	1.6	0.4	2.0
152 mm Gun	2.6	1.8	4.4	1.3	5.7
152 mm Gun/Howitzer	1.6	0.5	2.1	0.8	2.9
203 mm Howitzer	-	-	-	2.8	2.8

*Units of fire, which it is understood are comparable to the US basic load.

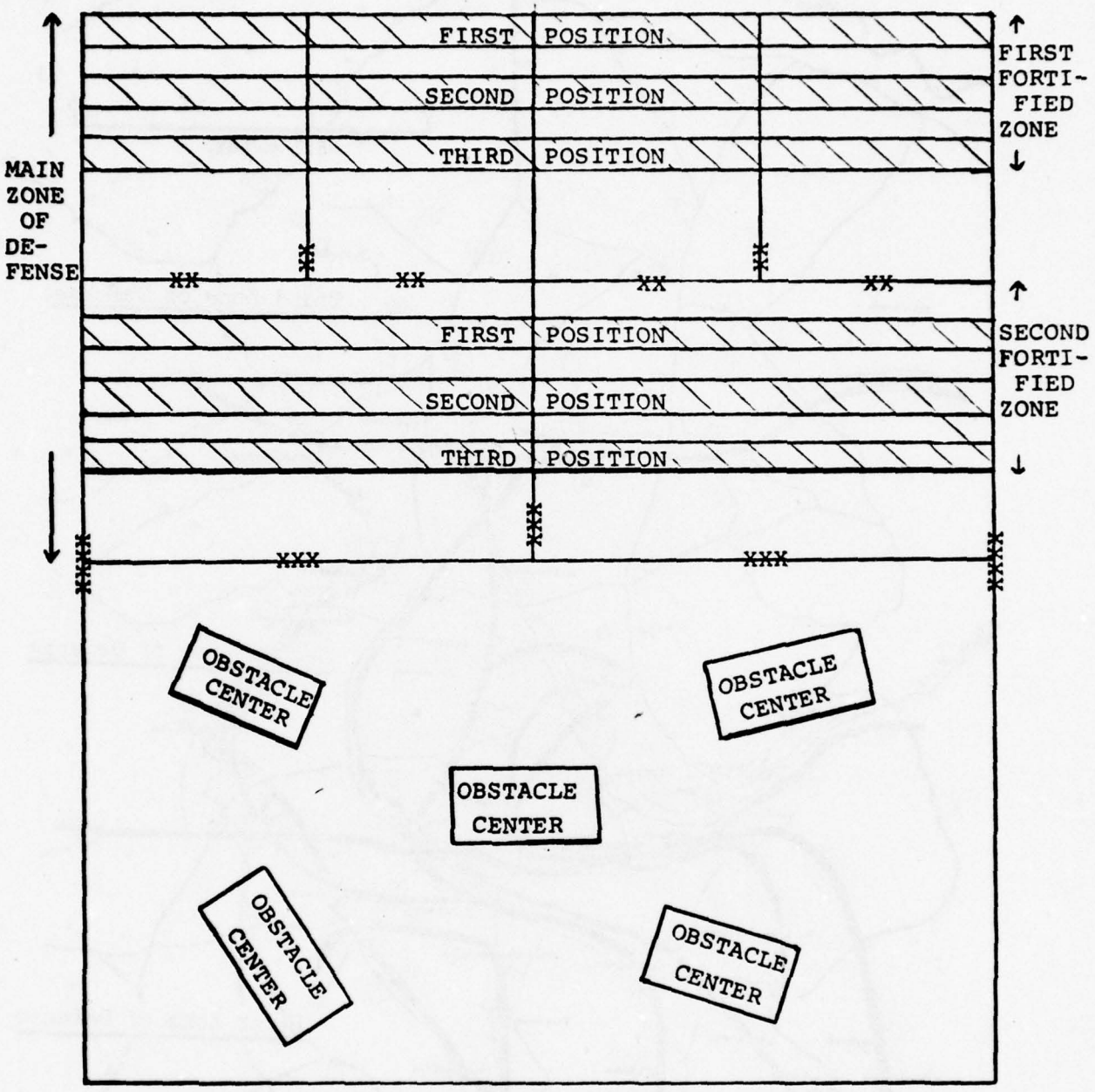
division per two to five kilometers, 50 to 125 guns and mortars per kilometer, and 11 to 17 tanks and self-propelled guns per kilometer. Each rifle regiment included 25 to 30 snipers, and most rifle companies had a machine gun platoon attached.

The troops of the two army groups, assisted by hundreds of thousands of mobilized local inhabitants, worked steadily from April to July to construct a formidable barrier system throughout the whole area of the Kursk bulge. The organization of the defenses of a section of the front is shown schematically in Figure III-1. The location of the three lines of defense on the Sixth Guard Army front is shown on Map 2. Also shown on this map are the places mentioned subsequently in the narrative of the defense experience.

Along the entire front, in a main zone of defense that was about twenty kilometers deep, the defenses were built in two successive fortified zones, about five kilometers apart. The first fortified zone, about five to seven kilometers in depth, had three successive positions, each separated by from one and a half to two and a half kilometers. Where the terrain favored it, combat outposts, well fortified, were set up one to two kilometers in front of the battle line, as defined by the first position of the first zone. Each division maintained two regiments in the first two positions, and one in the third, each regiment deploying two battalions in the first position and one in the second. About ten to twelve kilometers behind the battle line (four to six kilometers behind the third position) was the second fortified zone; its defenses also were constructed in three positions, to a depth of five or six kilometers. The mission of the divisions in the second fortified zone was to stop and destroy any German force which broke through the first zone, and to serve as a springboard for counterattacks. The distance between the two zones was so calculated as to make it necessary for the Germans to displace light and medium artillery and to regroup infantry and armor before attacking the second zone, while permitting the Russians to send prompt support forward if necessary.

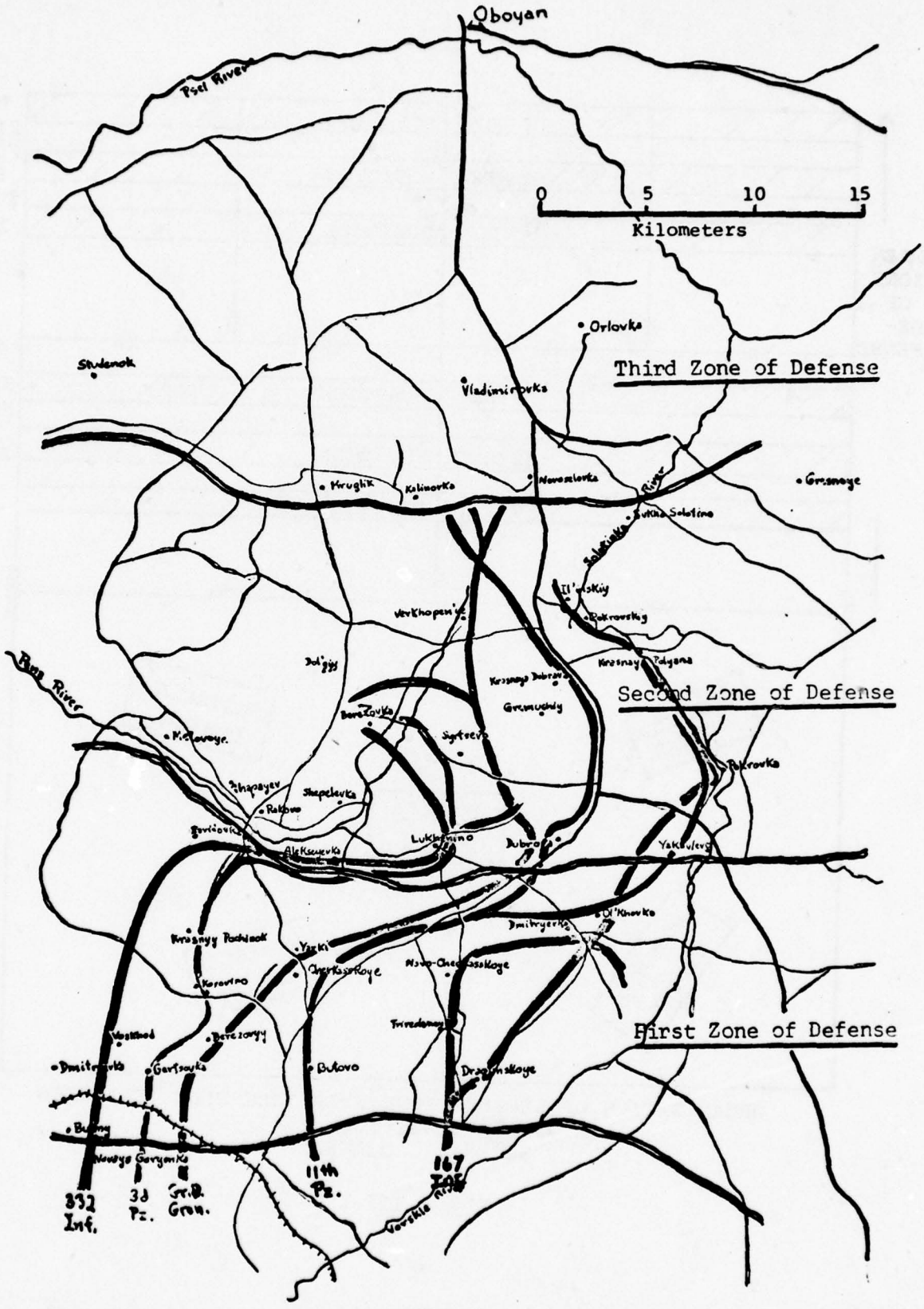
Behind the main zone of defense for a depth of 17 to 18 kilometers, obstacle centers were built, each covering an area of about two by five kilometers. They were tactically placed to cover the most vulnerable areas of potential penetration and elements assigned to them retained maximum mobility.

This fortified complex, about 35 to 38 kilometers deep, was occupied by the first echelon units of the Voronezh Army Group, including (right to left) four of the five combined armies (Thirty Eighth, Fortieth, Sixth Guard and Seventh Guard), 15 artillery brigades, 22 separate tank destroyer artillery regiments, and eight truck-mounted multiple rocket launcher regiments. The second echelon, behind the first, comprised the Sixty Ninth Combined Arms Army and the First Tank Army. Their area, which began 35 to 38 kilometers



ORGANIZATION OF DEFENSE ZONE, FIRST ECHELON OF ARMIES
KURSK SALIENT, JULY 1943
SCHEMATIC DIAGRAM

Figure III-1



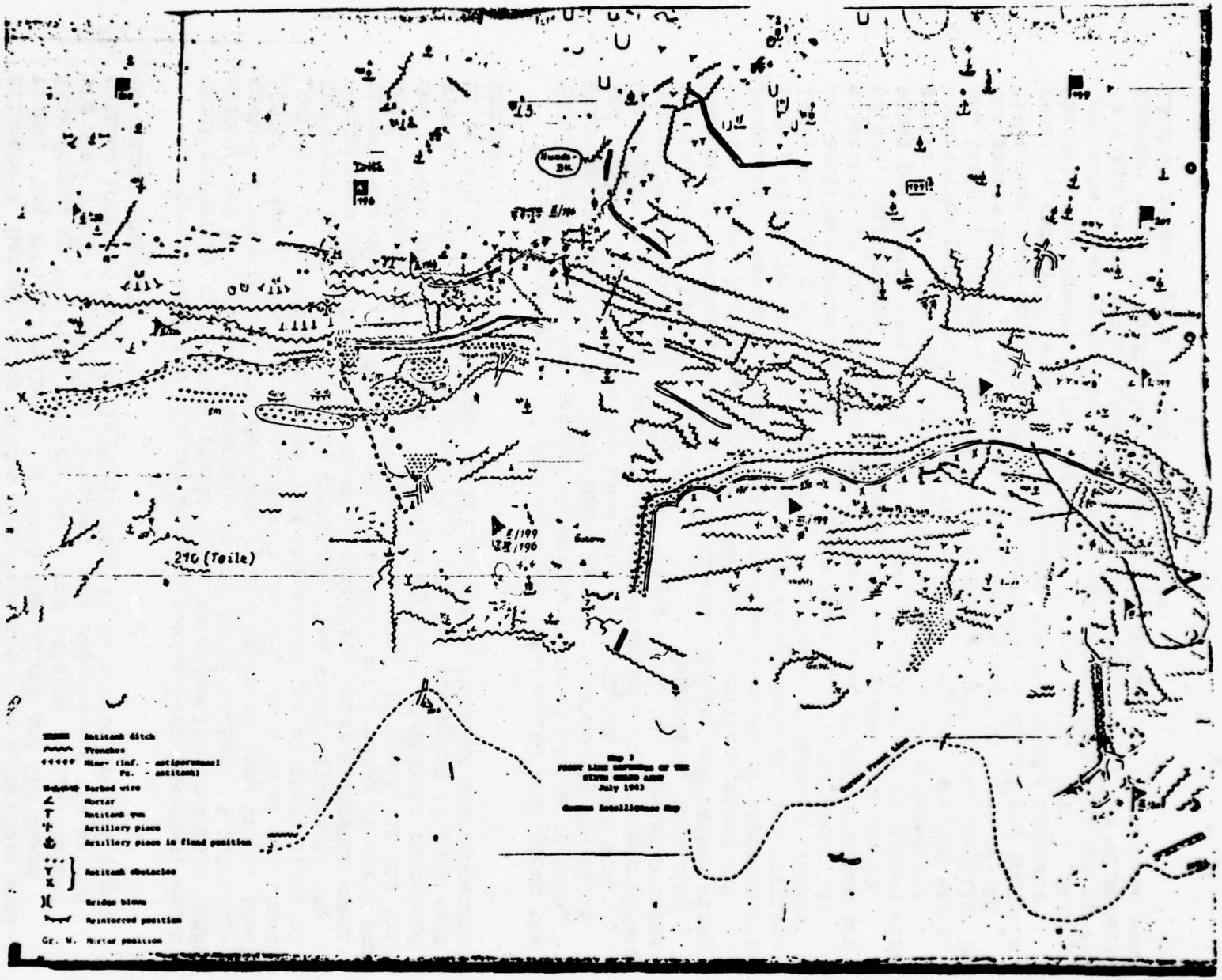
Map 2

SIXTH GUARD ARMY SECTOR
KURSK, JULY 1943

behind the front line and extended to a total depth of 50 to 70 kilometers, had obstacles placed to defend the most vulnerable positions. The 35th Rifle Corps, 2d Guard Tank Corps and 5th Guard Tank Corps, in the same area as the second echelon armies, formed the army group's operational reserve. The reserve and the second echelon included eight rifle divisions, 14 tank brigades and eight motorized brigades.

Integrated with the barrier defense system were trenches, which while primarily field fortifications are secondarily obstacles. There were 10,000 kilometers of trenches in the Kursk salient, 4,200 kilometers of them in the area defended by the Voronezh Army Group, about 500 of these in the Sixth Guard Army's sector. In each of the three positions of the first defense zone there were two or three lines of trenches, linked by connecting trenches. The trench system of the second zone was similar but somewhat simpler. Under favorable conditions a man could dig from a half to a whole cubic meter of earth per hour, depending on the type of shovel he used. At night, in the rain, and in hard ground the ratio decreased at least 20-25%; it decreased even more when done under enemy fire. By the beginning of July each rifle division had dug about 70 kilometers of trenches and connecting trenches.

An intricate system of obstacles was constructed throughout the bulge, improving on the natural defensive features of the terrain, which in the area of the Sixth Guard Army were primarily low hills and ravines. Map 3 shows the locations of obstacles on the Sixth Guard Army front, as drawn from aerial photographs on a very accurate German intelligence map of the 11th Panzer Division. Soviet sources distinguish two types of obstacles: (a) non-explosive, including trenches and antitank ditches, road blocks, abatis, and barbed wire; (b) explosive, including antipersonnel mines, antitank mines and fougasses. They were placed on all critical avenues of approach for tanks, along the front and in the depth of the defense, and particularly heavily in the approaches to the battalions' defense centers and artillery emplacements. The Sixth Guard Army built about 140 kilometers of non-explosive tank obstacles, laid 89,888 antitank and 63,843 antipersonnel mines (according to some Soviet sources 200 mines per German tank), and strung some 110 kilometers of barbed wire obstructions. The Army also constructed about 1,100 command and observation posts, nearly 4,000 shelters and dugouts, and 900 earth and timber pillboxes. Of the mines and other explosives installed by the armies of the first echelon, 40-50% were laid in front of the first fortified zone, 30-35% in the fortified zones and the obstacle centers, and 15-20% were kept in reserve for the Mobile Engineer Obstacle Detachments to lay during the course of the battle. Antitank minefields were usually at least 100 meters in depth, the mines laid six to ten meters apart in irregular rows, with 15 to 40 meters between rows. A continuous antipersonnel and antitank minefield was laid in front of the first fortified zone.


210 (Toile)
Antitank ditch
Trenches
Mines (inf. - antipersonnel
Pz. - antitank)
Barbed wire
Mortar
Antitank gun
Artillery piece
Artillery piece in fixed position
Antitank obstacles
Bridge blown
Reinforced position
Gr. W. Mortar position

The density of mines and other explosive obstacles in the whole defensive area of the Kursk salient reached 3,500 per kilometer of frontage. This was four times that at Moscow (1941) and two and a half times that at Stalingrad (1942).

In the Kursk battle a new concept of antitank defense came into being, the antitank fortified defense centers. They were constructed at tactically important points on the most vulnerable routes for tank attack, at various depths behind the front line. Such centers were usually equipped with four to eight antitank guns, nine to twelve antitank rifles, two to four mortars, a platoon of engineers with mines, and a squad of submachine gunners. Sometimes several tanks and/or self-propelled guns were added.

Map 4 shows the arrangement of obstacles in the main defense zone of the 81st Guard Rifle Division as portrayed in a Soviet postwar study of the Kursk defense. This division was part of the Seventh Guard Army, deployed at the boundary with the Sixth Guard Army where it also came under German attack in July 1943. According to Soviet sources the attackers were unable to break through there because of the well-constructed minefields throughout the zone. On each kilometer of front there were 2,133 antitank mines and 2,626 antipersonnel mines, and in the division area 34 kilometers of barbed wire.

An important element of the antitank defense system were the Mobile Engineer Obstacle Detachments. These were composed of: in rifle regiments, from a squad to a platoon of engineers, with a limited number of mines and horses and carts for transport; in rifle divisions, two or three engineer platoons, with 400 to 600 mines, mostly antitank, and two to five trucks; in corps, one or two engineer companies, with over 800 mines and four to six trucks; in armies, up to an engineer battalion, with over 1,000 mines and six to nine trucks. There were also special engineer groups for antitank warfare in each unit, deployed along approach roads or behind German lines, where they mined roads and bridges and attacked German tanks.

Mobile antitank artillery reserves were available to be moved as needed to the area of heaviest attack. They consisted of two platoons of 45mm to 75mm guns per rifle regiment and from a battery to a battalion in a rifle division. In some cases the Sixth Guard Army also had field, antiaircraft, and even heavy artillery, as well as tanks, attached to rifle battalions, forming part of its antitank defense system.

The Operations[14]

The area held by the Sixth Guard Army is cut by numerous ravines and gullies, many of them dry except after rain. Tnree rivers, the

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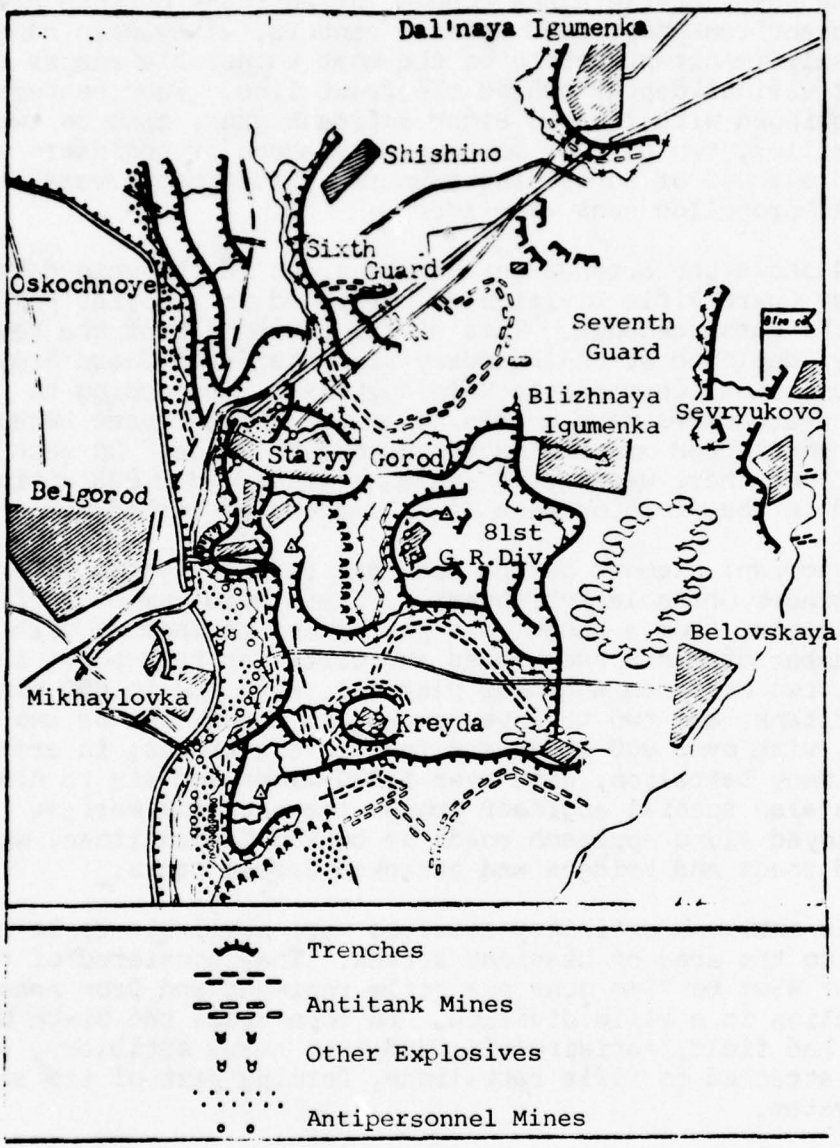
[14]This narrative is written from the contemporary records of the German XLVIII Corps, and from various Russian postwar studies.



Map 4

Deployment of Obstacles
81st Guard Rifle Division, Kursk 1943

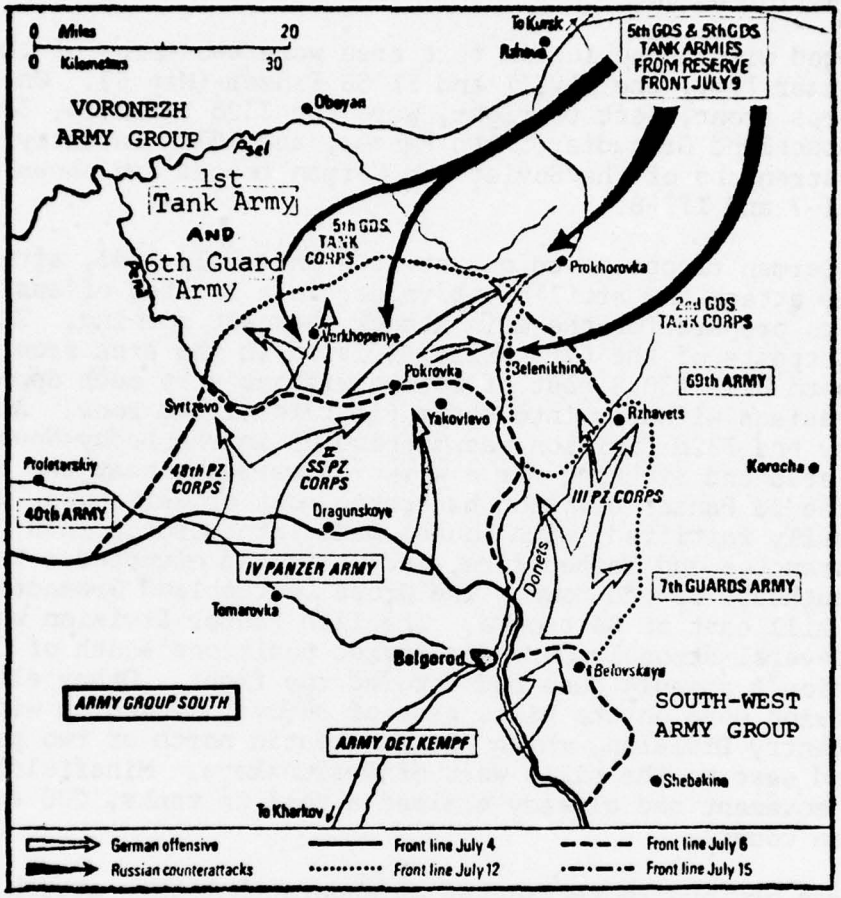
Vorskla, Pena, and Solotinka, cross the area, the first two flowing from northeast to southwest and the last flowing north. One main road, from Yakovlevo to Oboyan, runs from south to north, and lesser roads link the many hamlets that dot the landscape. A number of low hills and small patches of forest had been fortified as part of the defense barrier scheme.

Charged with attacking in this area were two corps of the German Fourth Panzer Army, the XLVIII and II SS Panzer (Map 5). On the XLVIII Corps front, left to right, were the 332d Infantry, 3d Panzer, Gross Deutschland Grenadier, 11th Panzer, and 167th Infantry Divisions. Relative strengths of the Soviet and German forces are shown on Tables III-7 and III-8.

The German troops moved out at 1500 on 4 July 1943, after a ten minute air attack and artillery barrage, in a limited offensive designed to prepare for the main attack the next morning. They overran the outposts of the 67th Rifle Division in the area from Gertsovka to Butovo to Hill 230.8 east of Butovo without very much opposition, as the Russians withdrew into their first fortified zone. At the end of the day the 332d Division was mopping up in the Budny-Novaya Goryanka area and fighting for a workers' barracks near the railroad tracks; the 3d Panzer Division had taken most of Gertsovka, which they found heavily fortified, with houses made into strongpoints, minefields, trenches and barbed wire, and units had occupied a trench system southeast of the town. The Gross Deutschland Grenadier Division was on a hill east of Gertsovka. The 11th Panzer Division was fighting against several strongly defended Soviet positions south of Butovo and the division's assault guns had entered the fight. Other elements of that division were on the hills east of Butovo, linked up with the 167th Infantry Division, which had penetrated north of two patches of forest and east to the hills west of Dragunskoye. Minefields had hindered movement and already claimed a toll in tanks, 200 according to Russian count.

It was obvious to the Soviet defenders that this attack was preliminary to a major attack on the first fortified zone. The Commanding General of the Voronezh Army Group, General N.F. Vatutin, ordered a counterbarrage fired at 2230. It lasted for five minutes and was aimed at 17 troop and tank concentration areas, the 12 most active artillery batteries, and 17 observation and command posts. When the German artillery opened up for 30 minutes at 0200 the Soviets responded again with a 30-minute counter barrage at 0300, which delayed the German attack.

The advance on 4 July had brought the Germans up to the Soviet main line of resistance. The attack the next day was fierce, as German infantry and panzer units tried to break through the heavily fortified and stubbornly defended line. In addition to constant artillery fire, the Germans were supported by the Luftwaffe, which was reported by the Russians to have flown 3,160 sorties in the Oboyan sector. Soviet



Map 5

GERMAN ATTACK IN THE SOUTH, KURSK
July 1943

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*Adapted from Geoffrey Jukes, Kursk, Ballantines Illustrated History of World War II, Battle Book No. 7, New York: Ballantines, 1968, p. 21.

TABLE III-7

RELATIVE STRENGTH OF GERMAN AND SOVIET FORCES AS OF 1 JULY 1943

	German	Soviet	Ratio
In Kursk Area			
Total Personnel	c.900,000[1]	1,300,000+	1:1.4
Combat Troops	c.570,000	c.977,000	1:1.7
Artillery and Mortars[2]	c.10,000	c.19,300	1:2
Tanks and Self-propelled Artillery	c. 2,700	c.3,300	1:1.2
Aircraft	c. 2,050	2,650	1:1.3
In Voronezh Army Group Sector of Main Effort, 114 km Frontage[3]			
Personnel	c.280,000	c.334,000	1:1.2
Artillery and Mortars	c.2,500	c.5,780	1:2.3
Tanks and Self-propelled Artillery	c.1,500	1,304	1.1:1

[1]Second, Ninth, and Fourth Tank Armies, Special Group "Kempf."

[2]Excluding truck-mounted multiple rocket launchers and 50 mm mortars.

[3]German forces include: striking forces of Fourth Panzer Army and of Special Group "Kempf"; total five infantry, eight panzer and one mechanized divisions. Soviet forces include: Sixth Guard, Seventh Guard, Sixty-ninth and First Tank Army, XXXV Guard Rifle Corps, II Guard Tank Corps, V Guard Tank Corps; total 22 rifle divisions, four tank corps and one mechanized corps.

TABLE III-8

TACTICAL DENSITY AND RELATIVE STRENGTH OF GERMAN AND SOVIET FORCES IN BREAKTHROUGH SECTOR (64 km frontage), 1 July 1943

	German[1]		Soviet[2]		
	Strength	Tactical Density per km	Strength	Tactical Density per km	Ratio
Personnel	62,000	968	98,000	1,531	1:1.6
Artillery and Mortars[3]	c.c.700	10.9	c.1,500	23.4	1:2.1
Tanks and Self-propelled Artillery	c.c.700	10.9	c.840	13.1	1:1.2

[1]Striking force of XLVIII Panzer Corps (infantry, panzer, mechanized divisions).

[2]Sixth Guard Army (seven rifle divisions); First Tank Army.

[3]Only 76 mm and over.

aircraft flew 1,400 sorties and claimed 127 German planes shot down and 34 destroyed on the ground.

During the night the remainder of the 3d Panzer Division, including the heavy weapons, had moved slowly along the heavily-mined road from Fastov to join the advance elements in Gertsovka. The division was not ready to attack until 0500, and even then all of its artillery was not in position. The panzer regiment did not reach Gertsovka until 0600. The 332d Division also was having problems bringing up its artillery and reserves because of the difficult road situation. At 0500 the two divisions attacked. A half hour later infantry and panzer units of the Gross Deutschland Grenadier Division had reached an antitank ditch and ravine east of Berezovyy that was full of water from the heavy rain that had fallen during the night, and strongly protected by barbed wire and minefields. This was to be the pattern during the operation, ravines, muddy when it rained, and with their natural defense capability strengthened by minefields and barbed wire.

The infantrymen managed to cross the ravine and entered Cherkasskoye from the southwest, but the tanks made slow progress through the minefields and the mud. At 0945 they were still bogged down. One tank had broken down in the ravine, moreover, and stopped all movement behind it. Engineer troops were working feverishly to build a crossing, but all the material they had prepared in advance for such construction sank into the deep mud. Trucks and tanks concentrated near the ravine were exposed to continuous air attacks, and many casualties had resulted, especially among the officers. By 1100 two crossings had finally been completed, and ten tanks had crossed the ravine. The infantry regiment and tanks that had already crossed were under counterattack from Soviet infantry. Hopes of bringing up all the tanks were dashed when another broke down and blocked the crossing. By 1300 only 15 tanks were across, none of them a Panther. Reconnoitering to the east in hopes of finding a way around, the division discovered that the area was heavily mined, and engineers were put to work to clear it. By around 1600 about 30 Panthers, 14 M-IV tanks, four infantry battalions and an antitank battalion had crossed the ravine and turned toward the northwest corner of Cherkasskoye, but the terrain ahead was heavily mined. The crossing was clogged again at 1620. The engineers completed a bridge, but it collapsed again before 1730. The units which had crossed were involved in heavy fighting.

At this point the Gross Deutschland Grenadier Division changed direction and headed toward the road from Butovo which led to the northwest part of Cherkasskoye. This move was more successful. The panzer regiment made its way to Yarki, north of Cherkasskoye, by 2030. Shortly thereafter elements of the Gross Deutschland Grenadier Division fought their way into Cherkasskoye from the west.

The 3d Panzer Division came up very slowly on the left of the Gross Deutschland Grenadier Division. The bridges across the river

had been destroyed, and heavy artillery fire poured in on the Germans trying to bridge it. While some units remained to secure Gertsovka, others crossed the river to the east and proceeded toward Berozovyy. West of that town they were pinned down by heavy artillery and mortar fire and were forced to regroup. German Fourth Panzer Army artillery poured a constant stream of artillery fire on Korovino, north of Berozovyy, and the hills in front of it. By 1100 the 3d Panzer Division had taken the western part of Berozovyy and was standing along the stream behind it, trying to make a crossing. Infantry units crossed and proceeded north, but the tanks and an APC battalion were held up until 1400. Two hours later some units were at Korovino, where the Russians put up a stubborn defense. By late afternoon there were signs that the Soviets were withdrawing heavy weapons, and by 2020 Korovino was in German hands. An hour later, after a fierce battle, a panzer unit took Krasnyy Pochinok and the bridge beyond it, which was only slightly damaged and quickly repaired.

The 332d Infantry Division, on the left of the German front, was held up by a fierce fight that went on all night of 4/5 July, for control of the workers' barracks near the railroad track north of Bubny. Soviet artillery from the area of Dmitryevka to the northwest poured heavy fire on the German positions. At 0715 on 5 July the Germans finally controlled the barracks, although Soviet counterattacks continued to pin down German troops there. Two hours later the 332d Division was advancing toward Voskhod. Its reconnaissance battalion made contact with units of the 676th Reserve Regiment of the 3d Panzer Division, southwest of Korovino. Voskhod was taken by 2100, and the reconnaissance battalion held the hill one kilometer west of Korovino. The division was transferred to the LII Corps at midday.

The attack of the 11th Panzer Division and the 167th Infantry Division on 5 July was ordered for 0730. The engineers of the 11th Panzer Division had been busily clearing mines from around Butovo during the night. Two battalions proceeded north from Butovo, and encountered antitank ditches near the gravel road south of the road fork south of Cherkasskoye. Only with great difficulty, by detouring around the ditches, close to some woods, did the tanks make their way across the antitank ditches, which backed up traffic well to the south. By 1130 the 2d Battalion, 111th Regiment, 11th Panzer Division, was close to Cherkasskoye, and encountering heavy Russian resistance. The division was ordered in midafternoon to attack Cherkasskoye from the east and south. Strong Russian counterattacks, with tank support, held the Germans outside the town, and there was prolonged, heavy fighting for a hill to the east. The Panzer Group of the division took the hill at 2100, and the 1st Battalion, 110th Regiment, having entered Cherkasskoye from the east, was engaged in heavy fighting for it. South of the town division units were clearing the extensive minefields.

The 167th Division, on the right flank of the German line, crossed the ravine west of Trirechnoye with its left wing and center at about

0900 and advanced north and northeast against stubborn resistance. In midafternoon the division turned toward the northeast, its right wing at the antitank ditch one kilometer south of the Manayki Brook, and its left wing close to the 11th Panzer Division, east of Cherkasskoye. At 1800 some 600 Russian troops, armed with machine and submachine guns, counterattacked on the left.

In view of the danger of a German breakthrough, General Vatutin at 1600 on 5 July ordered the First Tank Army,[15] commanded by General M.E. Katukov, to advance during the night with its VI Tank and III Mechanized Corps toward the second defense zone of the Sixth Guard Army, and take up defensive positions on the line Melovoye-Rakovo-Shepelevka-Alekseyevka-Yakovlevo to prevent a German breakthrough toward Oboyan. The XXXI Tank Corps was to take up defensive positions in the Army's second echelon, along the line Studenok-Novyy Poselok (Kruglik)-Vladimirovka-Orlovka.

At about 2300 the VI Tank and III Mechanized Corps took up their defensive positions, the VI Tank Corps with 13 kilometers of front and the III with 19. Since the positions had been prepared in advance, both were combat ready by early morning of 6 July.

Engineers of the German 11th Panzer Division worked on the road from Butovo to the northwest to remove mines, and engineers of the Gross Deutschland Grenadier Division cleared the area between Berezovyy and Cherkasskoye during the night of 5/6 July. The crossing near Berezovyy was completely engulfed in mud, and, in order for the tank units to advance, the mines in the other areas had to be removed. The process was complicated by the infiltration of Soviet troops into the forest southeast of Cherkasskoye, from which they could cover the road. The attack, which had been planned for 0600, was delayed until 0830 by the necessity to clear the mines and bring the tanks up. Army artillery had been moved up to Yamnoye, prepared to fire to the north and northeast. The 11th Panzer Division reported at 0715 that the road from Butovo to the northeast was cleared of mines, and tanks of the Grenadier Division were advancing on it. The 11th Panzer Division moved its engineer units forward, and the Corps took over the last of the mine-clearing operation.

The 3d Panzer, 11th Panzer, and Grenadier Divisions all attacked at 0830 on 6 July. The 3d had difficulty crossing the stream near Krasnyy Pochinok because the bridge had been destroyed and the engineers had to build a new one. Heavy flank fire from the area of Dmitryevka hit the forces as they advanced. At 0920 the first tanks

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[15]The First Tank Army was composed of the VI and XXXI Tank Corps, III Mechanized Corps, 8th AAA Division, 79th Guard Truck-mounted Multiple Rocket Launcher Regiment, 385th Air Signal Regiment, 83d Signal Regiment, 72d and 267th Motorized Engineer Battalions, 35th Transportation Regiment, and supporting services.

entered Zavidovka, where they found only a weak defense. Across the Pena River, however, the defense was very strong. The division was ordered to capture a crossing as soon as possible so that a bridge could be built during the night and the division could advance to Rakovo. But the advanced units had overextended and had to withdraw from Zavidovka. Reconnaissance units found defenses on both sides of Rakovo well prepared, with entrenched tanks and artillery as well as various constructed obstacles. Both banks of the river were marshy.

The 3d Panzer Division was ordered at 1415 to regroup and concentrate south of the Pena River, although, until the 332d could move up to protect its flank, the 3d Panzer Division would have to leave strong shielding forces in the area of Krasnyy Pochinok. By the end of the day the panzer group of the division was about two kilometers south of Zavidovka. The main portion of the division was north of the line Yarki-Krasnyy Pochinok. It was ordered to advance behind the Gross Deutschland Grenadier Division to Lukhanino.

The 11th Panzer Division made steady progress in the morning of 6 July. At 1000 word came from the Army Chief of Staff that the II SS Panzer Corps, on the right of the XLVIII, was making faster progress than it had the day before, and the Gross Deutschland Grenadier Division and the 11th Panzer Division should proceed as rapidly as possible to the road fork northeast of Dubrova, so that the II SS Panzer Corps would not advance unprotected on its left flank. When the Commanding General of the Fourth Panzer Army arrived a half hour later he ordered the Corps to direct the main effort east and northeast toward the area south of Dubrova to break the Soviet defenses there. Lukhanino was to be taken by the Gross Deutschland Grenadier Division, but for the time being Alekseyevka to the left should not be attacked.

At 1230 the 11th Panzer Division reached the crossroad southwest of Dubrova. The reconnaissance battalion was in the northern part of Novo Cherkasskoye and approaching Dmitryevka, where it encountered a deep complex of antitank ditches and minefields. Heavy combat developed in this strongly fortified area, with both the 11th Panzer and the Gross Deutschland Grenadier Division engaged. Under small arms and antitank fire the engineers cleared mines from in front of the ditches. By late afternoon Dmitryevka was surrounded by the Germans, and the main force of the 11th Panzer Division, after negotiating the minefields and other obstacles, was advancing northeast toward the forest south of Dubrova. The division was ordered to encircle the Izotova Woods from the south with its reconnaissance battalion in order to approach the Russian positions from the rear. Despite the problems the division had encountered, the commander reported that the Russian resistance had been less than anticipated. Many positions that appeared in aerial views to be well fortified had proved to be dummies.

The Gross Deutschland Grenadier Division on 6 July had advanced under heavy artillery fire from Alekseyevka, beating off Soviet counterattacks. By 1350 the Panzer Regiment had reached the Bolshoye Ravine. The 11th Panzer Division and elements of the Gross Deutschland Grenadier Division were engaged with strong Soviet forces of the 3d Mechanized Brigade southwest of Dubrova by midafternoon. The 2d Battalion of the Fusilier Regiment had advanced to a position south of Lukhanino, and the reconnaissance battalion was advancing toward Alekseyevka. By 1810 the division had overcome extremely heavily mined barbed wire obstacles and antitank ditches in the Ol'khovaya and Volshoye Ravines and was attacking Dubrova against extremely heavy resistance. Some 50 to 60 Soviet tanks were reported by air reconnaissance to be about one kilometer southwest of the town. South of Syrtsevo also heavy fighting was reported by the division, against strong antitank formations, and German casualties were heavy. Obstacles and the natural difficulty of the terrain made it impossible to encircle Syrtsevo from the west.

The two flanking divisions, the 332d on the west and the 167th on the east, had less heavy fighting. When the LII Army Corps advanced on the left, the 332d was relieved to move to Krasnyy Pochinok and relieve elements of the 3d Panzer Division near Korovino. Movements were slow because of the muddy roads.

The 167th, with a regiment of the 315th Infantry Division attached, moved out at midday, passed through Novo Cherkasskoye and advanced toward Ol'khovka-Dmitryevka, with the Russians withdrawing before it. The 315th Regiment mopped up the Dragunskoye area, and the division approached Ol'khovka by late afternoon. All of the key reserves of the Voronezh Army Group by this time were engaged in the defense of the second zone. General Vatutin decided to transfer units of the Thirty Eighth and Fortieth Armies as reinforcement from the Army Group right. Various other units[16] also moved to the area, but most of them did not arrive in time to help much on 7 July.

Remnants of the 52d and 67th Guard Rifle Divisions of the Sixth Guard Army, which had been fighting with the III Mechanized Corps, were withdrawn temporarily, and two tank brigades of the Thirty Eighth Army and other units were sent to reinforce the First Tank Army.

The German objective for 7 July was set at the Psel River. The 11th Panzer Division was to continue to try to break through near Dubrova, but to turn to Ol'khova to the south if that proved too difficult. The Gross Deutschland Grenadier Division, on the left of

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[16]Three tank brigades, four tank regiments, three tank destroyer artillery brigades, eight tank destroyer artillery regiments and two battalions of antitank rifles in addition to a tank destroyer artillery brigade and the 309th Rifle Division from the Fortieth Army and the 204th Rifle Division and an artillery regiment from the Thirty Eighth Army.

the 11th Panzer, was to exploit its progress near Dubrova and Lukhanino, and attack north and a little east of north through Syrtsevo and Verkhopen'ye, to Shipy on the Psel River. The 3d Panzer Division would advance behind the Gross Deutschland Grenadier Division near Lukhanino and then attack north toward Beresovka and Dolgyy, securing the corps's western flank.

The advance elements, infantry and panzer, of the Gross Deutschland Grenadier Division got across the antitank ditches near Dubrova during the night, and at day break found themselves under heavy attack from artillery, antitank artillery and rockets. Other elements of the division, to the west, proceeded toward Gremuchiy, where they encountered heavy Soviet resistance east of the town. In the area of Gremuchiy and Syrtsevo the division made little progress in the face of stubborn defense of a strongly fortified area.

The 11th Panzer Division had attacked at 0300. Held up by minefields which had to be cleared, it moved slowly toward the north and the hills east of Gremuchiy.

The 3d Panzer Division advanced toward Lukhanino and at 0600 was south of Alekseyevka. Its artillery moved up more slowly, and it prepared to attack Lukhanino at 1300.

At about noon word came that the Soviets (49th Tank Brigade) were attacking the left flank of the II SS Panzer Corps on the right of the XLVIII with strong tank formations, from Luchki to Pokrovka. Consequently the XLVIII was ordered to accelerate its attacks on both sides of Gremuchiy toward Verkhopyen'ye, to hit the flank of the Soviet attack. The Gross Deutschland Grenadier Division was to open a crossing of the branch of the Pena River at Lukhanino.

The 167th Division, meanwhile, had been moving from the Ol'khovka area through the Solowa Woods toward Pokrovka, in a largely mopping up operation. It reached the road north of the Markova Woods at 1530 and was ordered to halt and prepare to move to the east flank of the army.

Although in midafternoon it seemed to the Germans that the Soviets were withdrawing from the XLVIII front, by 1830 it was apparent that they were not. They were consolidating their positions in the second fortified zone. They had in fact thrown in the 192d Tank Brigade, two battalions of antitank rifles, and the 112th Tank Brigade. Both the 11th Panzer and the Gross Deutschland Grenadier Division reported stiffening resistance and Soviet tanks and assault guns arriving on the front. At 1900 the Panzer Regiment of the 11th Panzer Division was halted in front of antitank barriers, which ran along both sides of the road near Krasnaya Dubrava. Twelve Soviet tanks were in position behind the barriers. On the left the Gross Deutschland Grenadier Division was involved in combat with a total of fifty Soviet tanks. The 3d Panzer Division had managed to cross

the Pena River at Lukhanino. Crossing had been very difficult, however, because the area was heavily mined and covered by crossfire from the hills north of Lukhanino. Two battalions of the 394th Regiment were across by 2040, and the engineers were building a bridge so that tanks could follow. The Soviets had established their defense on the line Lukhanino--1.5 kilometers east of Syrtsevo--Krasnaya Dubrava--two hills to the east.

The XLVIII Panzer Corps was ordered to break through the Soviet defense positions around Syrtsevo the next morning (8 July) and advance to the north to head off Soviet forces attempting to withdraw to Oboyan. The SS Panzer Corps was to come in from the west and try to encircle the First Tank Army. General Vatutin, on the other hand, ordered a counterattack to drive out the penetrating German forces. The Soviet II and X Tank Corps, newly arrived from reserves of Soviet Supreme Headquarters, were to attack from the east, while the II Guard and V Guard Tank Corps and portions of the Fortieth Army struck from the west. To strengthen the First Tank Army, ordered to hold against an attempt to break through toward Oboyan, Vatutin attached the 86th Tank Brigade, 33d Artillery Brigade, two tank destroyer regiments and a mortar regiment, all taken from the Fortieth Army.

Shortly after midnight, 7/8 July, Soviet aircraft attacked the bridge under construction by the 3d Panzer Division at the Lukhanino crossing and destroyed it. With Russian resistance stiffening and causing many German casualties, the 3d Panzer Division asked for and received permission to move its tanks, heavy weapons and the rest of the Panzer Grenadier Regiment through Dubrova and around to the hill northeast of Lukhanino before trying again to build a bridge. The 11th Panzer Division moved into defensive positions along the line from Krasnaya Dubrava to the western part of Pokrovka. The Division occupied Gremuchiy, and was still fighting hard for Syrtsevo.

The following morning, the 11th Panzer Division mopped up Pokrovka, which was finally secure in German hands after having changed back and forth with the Soviet 49th Tank Brigade several times the day before. At noon the division was ordered to attack up the road toward Pokrovskiy and Il'inskiy. It proceeded north, with one regiment on each side of the road and the third echeloned to the right, heading toward Krasnaya Polyana. The attackers soon encountered heavy resistance, and by 1800 were at a standstill, under attack by about 40 Soviet tanks from Pokrovskiy. This was the belated Soviet counterattack, which temporarily eased the situation for the XXXI Tank Corps and III Mechanized Corps. Most of the German 11th Panzer Division was reported north of the Stanovaya Forest at 2130. The Panzer Group was west of Pokrovskiy.

On the left of the German XLVIII Panzer Corps on 8 July the 3d Panzer Division, with the 394th Grenadier Regiment from the Gross Deutschland Grenadier Division, was fighting to hold the hills north of Lukhanino from heavy attack. East of Syrtsevo other elements were

advancing toward the north. By noon the rest of the Gross Deutschland Grenadier Division was engaged south and southeast of Verkhopen'ye. Both the Gross Deutschland Grenadier Division and the 11th Panzer Division were involved in extraordinarily heavy fighting east of Verkhopen'ye all afternoon as the Soviet counterattacking units arrived. The Gross Deutschland Grenadier Division claimed destruction of 50 Soviet tanks, but took considerable losses from flanking fire from west of the Pena River.

The 3d Panzer Division attacked Syrtsevo and Lukhanino in early afternoon. At Lukhanino the attack bogged down. The 3d Rifle Regiment made very slow progress through the system of mines, barbed wire, and trenches. At the end of the afternoon, German troops broke into Syrtsevo, and house-to-house fighting followed, continuing into the night. The town was essentially cleared by 0900, but fighting in and around it was not halted until almost midnight on 9 July. The Russians had in fact counterattacked all along the front at midday, but under heavy air attack the First Tank Army was pushed back, and by nightfall was withdrawing across the Pena and Solotinka Rivers, abandoning Alekseyevka, Syrtsevo, Krasnaya Dubrava, Pokrovskiy, Il'inskiy, Krasnaya Polyana, Malyye Malachki, and Greznoye.

Once again General Vatutin called up additional forces. Toward morning of 9 July the X Tank Corps and 309th Infantry Division had taken up positions behind the III Mechanized and XXXI Tank Corps along the line Novyy Poselok-Kalinovka-Orlovka, to halt the German advance toward Oboyan.

At Lukhanino on 9 July, the Germans were faced with Russians dug in in the stream itself as well as on the hills around it, behind an extensive obstacle system. Construction of the bridge there made no progress, because of constant shelling. German aircraft, striking at the Soviet tanks and artillery across the Pena, reported that the Russians were withdrawing to the north. Minefields near the river continued to hold up the main body of the 3d Panzer Division, although the Reconnaissance Battalion headed for Verkhopen'ye. By 1600 the division had finally taken two hills north of Lukhanino, and one battalion had penetrated into the depression between Lukhanino and Syrtsevo. At least 450 Russian dead were counted in this area. But the western part of Lukhanino was still in Soviet hands, and about 40 Soviet tanks were still facing the division, which was taking heavy casualties, and had lost 14 tanks. Some division units had relieved the Gross Deutschland Grenadier Division around Verkhopen'ye by 2145, and the division was ordered to cross the Pena and attack northwest toward Berezovka.

The 11th Panzer Division on 9 July was advancing toward the Il'inskiy Hill by 0500, having been held up about an hour by mines and obstacles south of the road junction south of Il'inskiy. The 110th Regiment, advancing toward Pokrovskiy, met little resistance. The 339th advanced toward Krasnaya Polyana. The Il'inskiy Hill was

reached at 0645, but, although it was clear of Russians, covering fire from the hill to the north prevented the Germans from advancing beyond it. An hour or so later both Krasnaya Polyana and Beregovyy were taken by the 339th Regiment, and the 2d Battalion of the 110th took Pokrovskiy. The forward battalion of the Panzer Regiment bypassed the hill where Soviet tanks were emplaced and, with air support, surprised them from the rear, damaging many of them and driving the others off to the north. The 111th Panzer Grenadier Regiment reached the southwestern outskirts of Sukhoye Solotino in early afternoon and proceeded north toward the east-west road. While the Gross Deutschland Grenadier Division turned to the left the 11th Panzer Division was ordered to proceed north to cover their maneuver.

The Gross Deutschland Grenadier Division was engaged by Soviet tanks in the morning of 9 July, south of the east-west road that runs south of the town of Verkhopen'ye. By 0930 the division had worked its way into the town, but it could go no further because of the heavy flanking fire from the west. About 40 tanks were reported before noon to be covering the withdrawal of Soviet forces south of Novoselovka, but the reconnaissance battalion and assault guns of the Gross Deutschland Grenadier Division were advancing in that direction. Two hours later the Panzer Regiment reported having destroyed many Russian tanks there and taken the town. When a regiment of Russian troops, covered by tanks, was reported retreating west of Berezovka, the Gross Deutschland Grenadier Division was turned to the southwest to advance toward Dolgyy and cut off the retreating Russians. The Russians moved rapidly, however, and took up defensive positions on the line Novyy Poselok-Kalinovka-Orlovka. The 309th Infantry Division was already there, and the 204th Infantry Division and X Tank Corps were ordered to take up defensive positions there during the night. The direction of attack of the XLVIII Panzer Corps was changed on 10 July toward the west in an attempt to destroy the Russian Sixth Guard Tank Corps west of the Pena River.

In the early morning of 10 July units of the Gross Deutschland Grenadier Division penetrated the southern part of Kalinovka. The Russians still held the northern part. At 0700 the Grenadier Regiment struck out to the southwest along the Kubasovskiy Ravine. In a battle for a hill that developed a couple of hours later, over 20 Soviet tanks were destroyed. Flanking fire from Kalinovka and a hill to the east made it impossible to advance very far. The reconnaissance battalion was pinned down in the depression west of Novoselovka. The battle increased in intensity as Soviet tanks moved in from the north and northwest. It was reported at 1845 that 49 Russian tanks had been destroyed. The 67th Guard Rifle Division was reportedly smashed. The Gross Deutschland Grenadier Division, however, was down to six Panthers, three Tigers and about 11 M-III and M-IV tanks. Extremely heavy fire was coming from the Tolstoye Woods, where reportedly the Soviets had about 50 tanks.

The 3d Panzer Division observed at daybreak that Russian units on the northern bank of the Pena were withdrawing. The bridge at Verkhopen'ye was found to be intact, and the division sent its reconnaissance battalion to capture a bridgehead west of Verkhopen'ye. The rest of the division went through Dubrava with the purpose of crossing the river and advancing south along the hills overlooking the Pena toward the highlands east of Berezovka. Across the river in the afternoon division units became involved in a tank battle and accounted for five Russian tanks.

With the 3d Panzer and Gross Deutschland Grenadier Divisions pushing west, and the 332d Infantry Division breaking through near Rakovo to head north, the Soviet VI Tank Corps and 90th Guard Rifle Division were threatened with encirclement. They were ordered to retreat to the line Novoselovka-Novenkoye, where the 184th Rifle Division of the Fortieth Army and the X Tank Corps had been established.

The 11th Panzer Division encountered stiff Russian opposition on its left near the Malinovoye Woods on the 10th, but on the right units of the division had reached the south bank of the Solotinka River by 1000. The Russians were on the north. Widening its front, the 11th Panzer Division was in contact with the Gross Deutschland Grenadier Division near Kalinovka. The division made slight advances toward the north during the day and was ordered to proceed north the following day to the high land south of Orlovka, sending out strong elements to the east to the Psel River near Shipy and Il'inskiy (not the same one already passed). The highlands were known to be heavily fortified with many obstacles. About forty or fifty tanks were believed to be deployed there. They could not be bypassed, but must be taken with a frontal assault, and strong air support was needed.

Rain fell during the night of 10/11 July, making tank movements difficult on the muddy roads and air support impossible in the morning The 11th Panzer Division proposed to delay its attack on the highlands south of Orlovka and advance on both sides of the road. At 0700 a Russian force of battalion strength hit the left flank of the division northeast of Kalinovka and was beaten off. Tanks were slipping so much on the muddy roads that the division made no attempt to advance until 1100. Heavy clouds had made air support impossible, and artillery preparation was inadequate. The advance toward the strategic Hill 244.8 made no progress.

The Gross Deutschland Grenadier Division had better luck. At 0540 advance elements had occupied a hill south of the Tolstoye Woods. The main body of the division attacked at 0600, and advanced toward the south until about 0900, when the tanks came to a halt in front of a large minefield. After clearing it, the division's advance elements pushed a kilometer and a half west of Berezovka. Again thick minefields prevented a further advance toward Rakovo. Ravines in the whole area were held by stubborn, dug-in Russian troops.

The 3d Panzer Division also jumped off at 0600, encountering more resistance than the Gross Deutschland Grenadier Division did. The 394th Regiment crossed the Pena River near Syrtsevo at 0800 and advanced toward the west. The left wing, pushing toward Shepelevka, forced the Russians to withdraw. The western portion of Berezovka was taken at 0910 after heavy fighting, and tanks proceeded south toward Spitsin. The 3d Panzer Grenadier Regiment was ordered about noon to clear up Berezovka. Russian resistance in the Tolstoye Woods was increasing. All the bunkers south of Berezovka had to be attacked by Panthers and assault troops, and units of both divisions were engaged in mopping up the area until late afternoon.

The 332d Division, which had been transferred to the LII Army Corps, after finding it impossible to cross at Rakovo, crossed the river near Alekseyevka and made contact with advance panzer elements of the Gross Deutschland Grenadier Division during the afternoon.

On 12 July the Germans planned to turn all the attacking units toward the north, but the Russians counterattacked. The Voronezh Army Group, reinforced by the Fifth Guard Tank Army and the Fifth Guard Combined Arms Army, moved out from the line Novoselovka 2 - Novenkoye toward Yakovlevo, and struck at the German XLVIII Corps.

Early morning attacks on the 11th Panzer Division were driven off. The Gross Deutschland Grenadier and 3d Panzer Divisions proceeded with regrouping according to plan, preparatory to an attack. At 1100 a Soviet regiment struck in the 11th Panzer Division sector, advancing through the woods and along the Plotovoye Ravine. Although Corps Artillery was ordered to pound the troops with all it had, the Russian attack continued. At 1515 the 11th Panzer Division was ordered to assume a defensive posture and then was granted permission to withdraw. It attempted to set up a defense line and to lay a large minefield in front of it.

Pressure on the 3d Panzer and Gross Deutschland Grenadier Divisions built up during the morning. The 3d Panzer, advancing toward the northeast from Berezovka, came under Russian attack. One battalion of the 394th Regiment was overrun. Verkhopen'ye and the hills to the west were under fire from Russian tanks by early afternoon. The reconnaissance battalion of the Gross Deutschland Grenadier Division was forced to fall back. Relief of the regiment east of Kalinovka by the 3d Panzer Division was impossible. The 3d Panzer Division turned to the west and northwest to try to stop the Russians advancing toward the east.

At 1600 it was reported that Russians were advancing with tanks and infantry through Dolgyy toward Chapayev-Rakovo. Near Mikhaylovka they had broken through the German lines. The 332d Division took up defensive positions on the western edge of Cherkasskoye. Near Kalinovka other Russian tanks broke through, and the main force of the Panzer Brigade and assault guns of the Gross Deutschland Grenadier

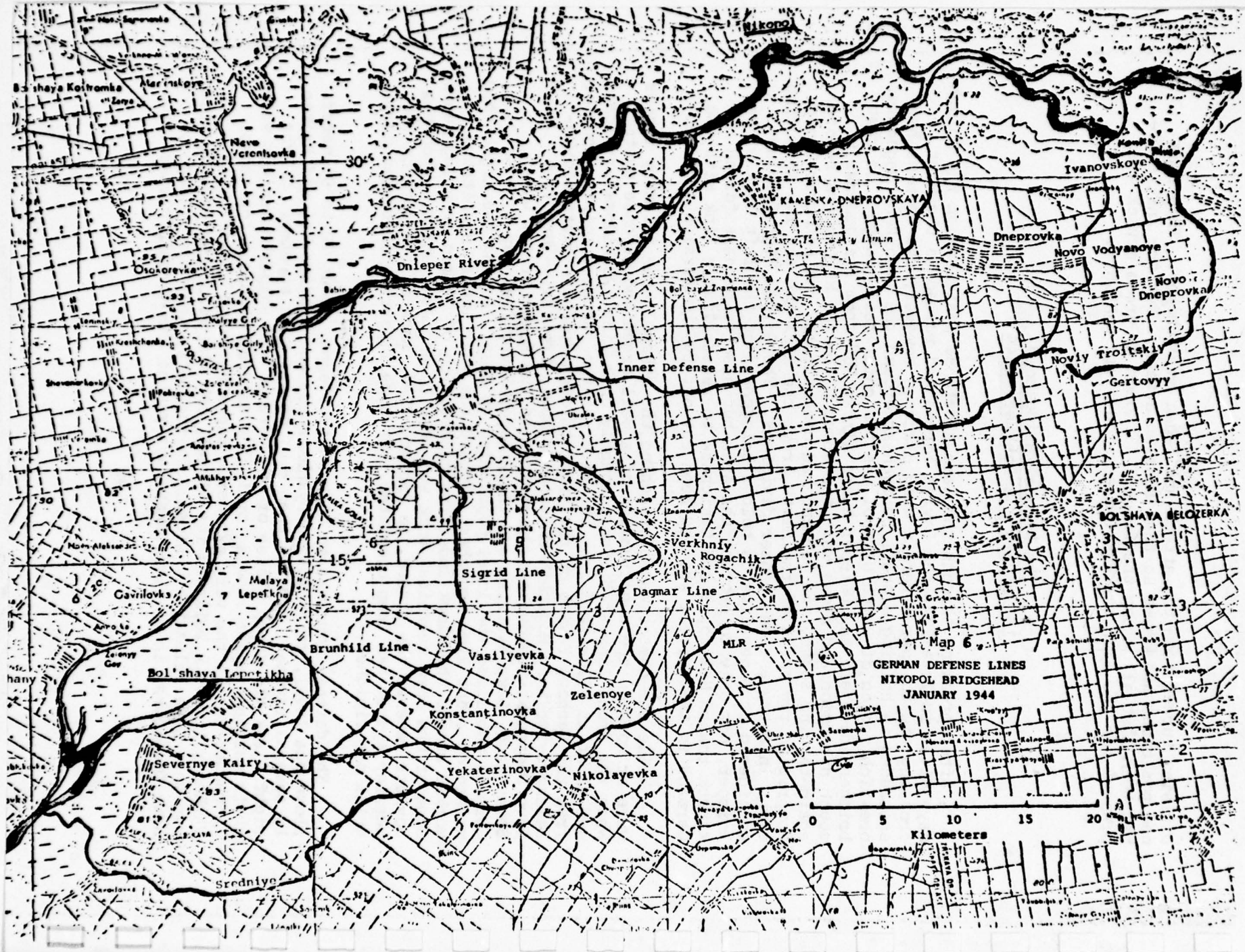
Division turned from the attack and began to withdraw. They took new positions and broke up that Russian attack. But the initiative had been lost all along the front. Although a German attack was planned for the 13th the Russian advance would continue.

B. The Nikopol Bridgehead 13 January - 8 February 1944

After breaking through the German defense positions on the Molochnaya River in late 1943 the Soviet forces had rushed to the west, crossing the Dnieper River in many places. However, the Germans had succeeded in holding a small bridgehead around the important magnesium ore-rich region of which Nikopol was the chief rail center. In that bridgehead, where the Dnieper turns almost 90° from its generally south direction and flows west for about 90 to 100 kilometers before again turning south, the Germans had concentrated the Schörner Group, comprising two corps of the Sixth Army, the XXIX and the IV, including eight infantry and one panzer divisions. The German High Command considered it imperative to hold a bridgehead on the left bank of the Dnieper, not only to protect the area but also to prepare for an attack toward Melitopol and Genichesk to reestablish a link with the Germans in the Crimea, who had been cut off by the Russian advance.

While the combat was approaching the Nikopol area infantry troops were at work on the construction of a well organized defense system. When the front line stabilized, roughly on a line 120 kilometers long and about 15 kilometers from the river at the farthest points, running from the Verbovo ravine on the right through Sredniy-Yekaterinovka-Zelanoye-Verkhniy Rogachik-Shevchenko-Noviy Troitskiy-Gurtovyy-Novo Dneprovka-Ivanovskoye-the marshes on the Konka River, Lake Shvaychano, Lake Bystrik, and the Dnieper River (see Map 6), the Germans mobilized the local population to help. During the night they worked on front line trenches. Toward the rear local inhabitants worked around the clock under the supervision of German army engineers. Some of the more technical work was done by engineer units. When the Soviets renewed the attack, in January 1944, much of the work on the barrier system had been completed, but some important obstacles were still not finished.

The defense zone was an open, flat steppe, about 70 to 80 meters above sea level, crisscrossed by dirt roads and windbreaks, and broken by several ravines, some of them dry, others with streams. On the right flank the steep slopes of the Verbovo and Bolgarka ravines with their multiple spurs made a formidable natural obstacle for tanks. In the center is the very extensive Sapozhnitskaya ravine, with Verkhniy Rogachik built on its slopes, and the Belozerka ravine, which ran into Lake Belozerskiy Liman. On the left, near the village of Novo Dneprovka, in the Ivanenkovskaya ravine the terrain slopes toward


Nikopol
Ivanovskoye
KAMENKA-DNEPROVSKAYA
Dneprovka
Novo Vodyanoye
Novo Dneprovka
Dnieper River
Inner Defense Line
Noviy Troitskiy
Gertovyy
BOLSHAYA BELOZERKA
Verkhniy Rogachik
Sigrid Line
Dagmar Line
MLR
Brunhild Line
Vasilyevka
Zelenoye
Konstantinovka
Yekaterinovka
Nikolayevka
Bol'shaya Lepetikha
Severnye Kairy
Srednye
Map 6
GERMAN DEFENSE LINES
NIKOPOL BRIDGEHEAD
JANUARY 1944
0 5 10 15 20
Kilometers

the Dnieper from 80 to 20 meters above sea level. The Dnieper River in this area meandered through a wide area of marsh and swamp (now covered by the water of a reservoir), making almost a right angle turn behind the German defense zone. On the right of the front line there were about two kilometers of marshy flood plain between the river and the higher ground of the defense zone.

There are few inhabited localities in the area, and they cluster around the sources of water. Most of them were surrounded by large orchards, where it was easy to hide and camouflage troops, heavy weapons and command posts. Many of the houses--adobe with tile or thatched roofs--were used as observation posts.

The network of dirt roads was of little help to the Germans during the rainy or snowy weather of the winter of 1943/44. Rain and melting snow made the clay and black dirt roads into boggy mud, impossible to traverse. A hardtopped road ran northeast from the river crossing at Bol'shaya Lepetikha, while three fanned out from the Nikopol crossing. The radial character of these improved roads leading from the crossings at Nikopol and Bol'shaya Lepetikha facilitated quick maneuver of troops and heavy weapons, for reinforcement, and for evacuation.

In the bridgehead the Germans organized a defense system based on a heavy concentration of all kinds of weapons, great density of fire, and large numbers of explosive and non-explosive obstacles. In the flat steppe it was necessary to deploy artillery, obstacles and antitank artillery with approximately equal density throughout the area along the entire front. The front line was so constructed that in almost all areas there was an open field of vision of three kilometers. Where it was occasionally necessary to construct positions on reverse slopes, with vision limited to 200 to 300 meters, the sectors were all so narrow that they could be covered by flanking fire from the neighboring sectors.

The first defense zone (HKL) was divided in four sectors, shown on Map 6:

The first, on the left, ran from the Dnieper River to Ivanovskoye, an area of marshes in which it was impossible to dig trenches. Since the Germans anticipated only reconnaissance activity in the area, the defending troops were deployed in separated positions.

The second sector extended from Ivanovskoye to the road from Dneprovka to Bol'shaya Belozerka about halfway between the two towns. Under constant attack from infantry and armored troops as the Soviets tried to improve their positions after their advance stopped at the end of December 1942, this was considered by the Germans to be the most vulnerable sector. It was fortified with a continuous line of trenches, strongpoints, minefields and antitank ditches. From Noviy Troitskiy to the Bol'shaya Belozerka-Dneprovka road, the area

considered most likely to be attacked, the Germans built three lines of trenches. From Noviy Troitskiy to Novo Dneprovka there was a single line of trenches with a line of machine gun emplacements behind it. From Novo Dneprovka to Ivanovskoye were two lines of trenches connected by communications trenches.

In the third sector, from the Bol'shaya Belozerka-Dneprovka road to Verkhniy Rogachik, no major attack was expected, because the large Belozerka ravine, with its many branches, and the absence of roads made any movement into the area extremely difficult.

The fourth sector, on the right from Verkhniy Rogachik to the Verbovo ravine, was considered by the Germans to be the second most likely to be attacked. In it they built a zone of trenches and machine gun emplacements up to 200 meters deep. The trenches were 50 to 150 meters apart, echeloned up to 150 meters deep, and for the most part not linked by communicating trenches. Machine gun emplacements were between the trenches and to the rear. In three places a continuous trench was dug along the front line: on the outskirts of Zelenoye 2d, in the area of Mogila Vysokaya, and near the Bol'shaya Lepetikha-Rubanovka road. On the right flank the depth of the defenses was increased considerably in order to secure an open field of fire along the Dnieper, in case the Soviets should attempt to attack from the river.

Behind the first defense zone the Germans constructed two inner lines of defenses in the area of Bol'shaya Lepetikha (Brunhild and Sigrid Lines) and a switch position from Noviy Troitskiy to Novo Vodyanoye, Novo Ukrainka, and the Konka River. The latter had one continuous trench with machine gun emplacements built in at intervals. The former was prepared by engineer units, with well-constructed explosive and non-explosive obstacles as well as artillery and machine gun emplacements. They were built on the outskirts of Bol'shaya Lepetikha on the main approach roads and the exits from ravines. Machine gun emplacements were built along the road leading southeast from the town for a distance of about two and a half kilometers.

As shown on Map 6, other lines were built, one west of Verkniy Rogachik (HKF) running roughly northwest, one connecting Brunhild with HKL (UTE), and complete inner lines closer to the vital crossings at Nikopol and Bol'shaya Lepetikha. The German map from which Map 6 was drawn gives some figures on the construction on these lines in January 1944:

	HKL	HKF	UTE	Brunhild	Sigrid	Inner Defense
Entrenchments	1,606	421	. .	. .	. .	471
Shelters	2,555	573	. .	. .	. .	288
Strongpoints	. .	. .	175	431	390	

On the Dagmar Line strongpoints were still under construction, as were 161 entrenchments and 176 shelters on the HKL. No other figures on obstacles planned or in place are available.

In constructing defenses around villages in the zone, the Germans built forward positions 1.2 to 2 kilometers from the village, linked to its outskirts by communicating trenches. Additional trenches for infantry, support elements, and observation posts were built on the outskirts of the village, and mortars and artillery were deployed within it.

The entrenchments from the Verbovo ravine to the Bol'shaya Belozerka-Dneprovka road were 60 to 150 meters apart. Each had one or two machine gun emplacements or general purpose platforms. Between the trenches were more machine gun emplacements. From the Verbovo ravine to Verkhniy Rogachik antitank artillery was positioned, up to 700 meters behind the front line. In places it was brought to the front or even moved 200 to 300 meters ahead of the front line to cover minefields. Antitank guns were commonly positioned on the reverse slopes of hills. Artillery was distributed equally throughout the zone. Heavy artillery was positioned near the roads, about three to five kilometers to the rear of the front line. Specially detailed machine gun units protected the artillery positions.

In sectors one and two, most of the weapons were deployed in the first line, with machine gun emplacements 50 to 80 meters apart. There were five or six emplacements for 37mm. or 75mm. guns in the first and second trenches, and 105mm. artillery between the second and third and behind the third, about 800 to 1,500 meters to the rear of the front line.

Heavy artillery was deployed where the land sloped to the Dnieper River, south of Dneprovka and Novo Vodyanoye, around Ivanovskoye, and in several villages. Each firing position had three strongpoints and was protected by a battery of 76mm. to 105mm. antitank guns. Infantry mortars were placed in general purpose platforms in the trenches. The 81.4mm. and 105mm. mortars were up to 1,200 meters behind the front line, sited in natural features of the terrain such as shrubs, bushes and orchards.

In the beginning the basic construction material was wood, cut from the area or reused from dismantled buildings in the villages. Later supply depots in the rear provided ready-made sheets of metal to reenforce the shelters and other structures. In the sector from Ivanovskoye to Novo Dneprovka the front trench was equipped with armored shields for the protection of riflemen and observers.

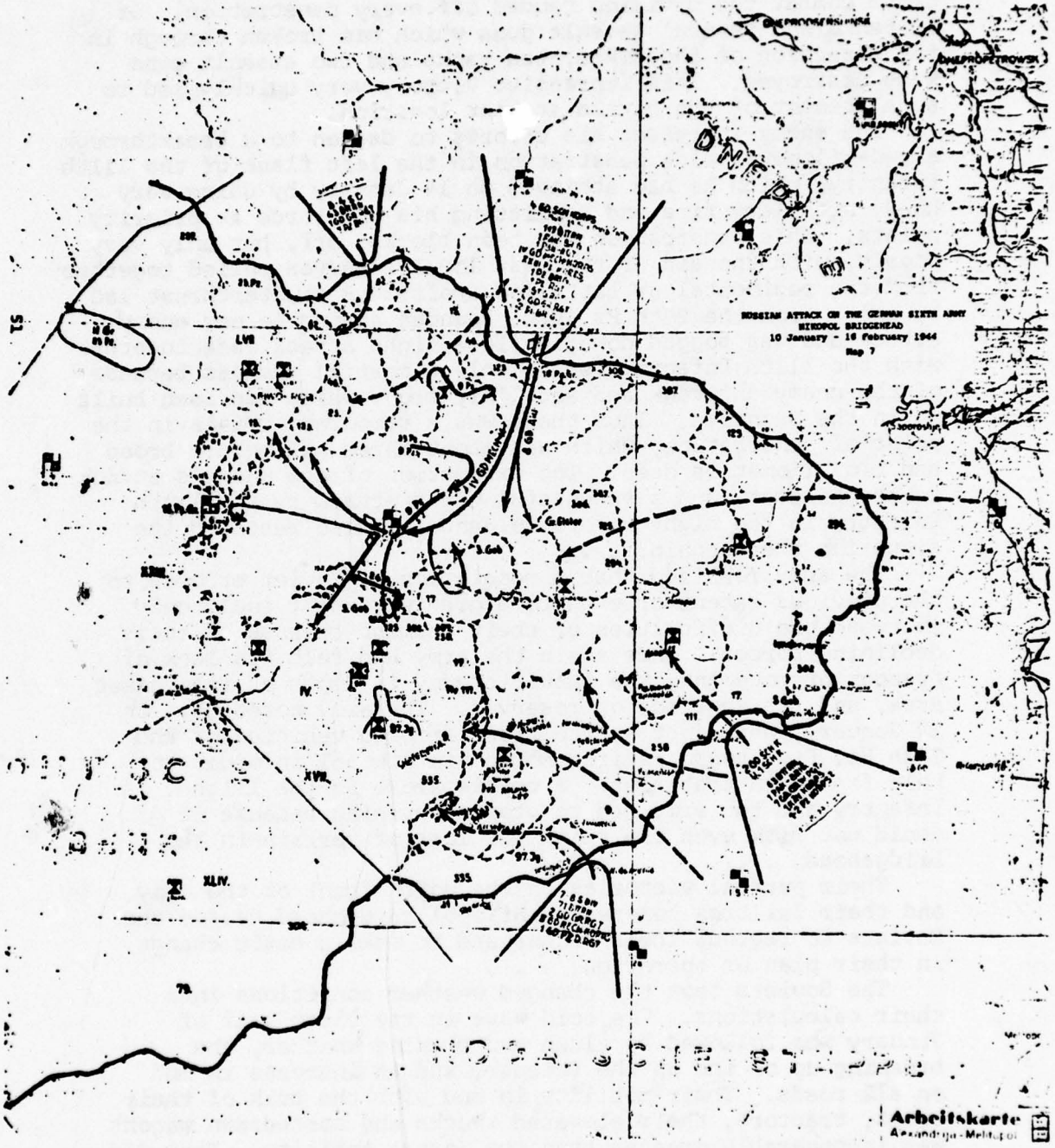
There were relatively few antipersonnel obstacles in the bridgehead defense system. Obstacles consisted primarily of barbed wire entanglements about fifty meters in front of the main defense line, in the depressions in front of the main line of defense, and in front of and at the flanks of the forward machine gun emplacements. Some sections of trench were covered over by barbed wire. Antipersonnel mines were laid at random in areas that could not be covered by rifle and machine gun fire, and from 20 to 700 meters in front of the front

line. Antitank mines were laid on the most probable avenues of approach, and an antitank ditch two and a half kilometers in length was dug along the Bol'shaya Belozerka-Dneprovka road.

The Operations

The German divisions in the bridgehead as deployed from right to left were: 335th, 97th Jäger, 9th, 258th, 111th, 17th, 3d Mountain, and 302d (see Map 7). The 24th Panzer was in corps reserve and actually was shifted to support the battle north of Nikopol and was available in the bridgehead for only a short time. The strongest Russian attack was toward the eastern end of the line, aimed at the crossing to Nikopol, against the 111th and 17th Divisions. A secondary attack focussed on the area between the 97th and the 9th Divisions, directed toward the crossing point of Bol'shaya Lepetikha. Of the divisions engaged, records only of the 335th have been found, and the operations analyzed for this study consequently are those in which it was involved. Unfortunately it was not among those most heavily engaged. The first real attempt by the Soviets to break through, starting on 12 January, was reflected in its area only in probing attacks by very small detachments. Farther to the east, however, the Russians were making significant dents in the German line. When the Russians renewed their attacks in strength, after a few days for reorganization of resources, on 31 January, the 335th became more heavily involved, and it is at this point that the analysis here begins. For what preceded elsewhere in the bridgehead, a report on several winter battles made after the action by Major Dr. Franck of the Sixth Army is here quoted:

> The anticipated major attack on the Nikopol bridgehead began on 12 January. It was preceded by heavy artillery fire from the assembly area detected the day before, the area between the Beloserka gorge and Novo Troitskiy. The preparatory fire of the artillery and of the automatic guns reached far into the depth of the main line of resistance. There were 20,000 to 25,000 shells fired against the 111th and 258th Infantry Divisions, as well as the 3d Mountain Division, leading to considerable casualties. The stress point of the attack, which was led by 10 Soviet divisions, 30 tanks, and waves of ground support planes, lay on both sides of the runway to Dneprovka and at Novo Troitskiy. However, there was little cohesion in the command; the attack was already halted in its initial assault by the German artillery, and except for a penetration at the left flank of the 111th Infantry Division, it was demolished in the concentrated fire from all the weapons. This penetration was removed in the afternoon in a counterattack aided by the assault guns and tanks of the 24th Pz. Div. Eleven enemy tanks were destroyed; thus good results were obtained on the first day.
>
> On 13 January, the attack was extended to the sector of the


RUSSIAN ATTACK ON THE GERMAN SIXTH ARMY
NIKOPOL BRIDGEHEAD
10 January - 16 February 1944
Map 7
DNEPROPETROVSK
DNIEPER
Arbeitskarte

XXIX Army Corps, also. After strong preparatory fire concentrated on a narrow area, the 97th Light Infantry Division was attacked continually the entire day by four Soviet divisions and 20 tanks from the II Guard Mechanized Corps; however, in close combat the division fended off every penetration. Of 16 tanks and several assault guns which had broken through in the direction of Lepetikha, ten tanks and two assault guns were destroyed. This impressive victory very quickly led to an abatement of the battle at that location.

The enemy increased his efforts to deepen to a breakthrough a two-kilometer wide penetration in the left flank of the 111th Infantry, which he had achieved on 14 January by using very heavy artillery fire and committing his air force at priority points. This penetration had been blocked off, but only very poorly, with the aid of the last local reserves pulled together from the regimental or battalion staffs. A counterthrust led by units from the 24th Pz. Div. bounced against a new enemy attack and was bogged down, while a night attack made together with the 111th Infantry led to only a partial success because of the enemy antitank and artillery front which had been built up in the meantime. Thus there was a temporary crisis in the point of penetration, which was about three kilometers broad and two kilometers deep. The exhaustion of the enemy's attack force, however, and a successful night attack by the 111th Infantry in the night before 19 January, also restored the situation there again. . . .

The army realized that a repetition of Soviet efforts to the previous extent or even to a greater extent could only increase the difficulties of their command because of their declining forces. Once again the army had felt its lack of freedom of movement, the insufficiency in depth of its combat area, and its shortage of reserves. The army noted this on 14 January, when just as the first armored vehicles of the 24th Pz. Div. began rolling north via Nikopol in order to help fight [in that area], a crisis arose in the 111th Infantry and the army had to stop everything because it could not risk even the slightest loss of terrain in the bridgehead. . . .

Their partial victories on the north front of the army and their failures before the Nikopol bridgehead caused the Soviets to regroup their forces and to make a basic change in their plan of operation. . . .

The Soviets took the changed weather conditions into their calculations. The cold wave in the first half of January was followed by slush and thawing weather, the breaking up of ice on the Dnieper, and an increase in mud on all roads. Their mobility in mud with the bulk of their tanks, tractors, their elevated trucks and horsedrawn wagons was incomparably greater than the German mobility. They did not need to worry whether, if their operation was a success, anyone could get out of this mousetrap.

The combat mission of the Sixth Army--to hold unconditionally the Nikopol bridgehead and with this also the position arc east of Nikopol, with the forces remaining there--underwent no change. The basic change in the enemy picture and also the weather situation and the depletion of German infantry forces compelled the command to make far-reaching decisions.

On the whole, the goal of the army was to take all panzer and panzer grenadier units out of the front line, mold them together into an armored corps, and then bring them up to their actual mission as a strong, mobile ready reserve. With this, the Army's combat command would have been assured at long range.

Hence on 18 January the request was made to the Army Group to consider the changed enemy situation in front of the bridgehead and to release the 24th Pz. Div. for engagement at the northern front. . . .

With the weather situation and the shortage of tonnage, and without shortening the front, there were great obstacles involved in the releasing and mobilizing of new reserves in the bridgehead. A withdrawal of the left flank of the IV Army Corps (302 Infantry) did not achieve any savings in forces because of the unfavorable terrain behind there; giving up further ground would have too greatly restricted the operational area for the heavy weapons, and offered the enemy a look into the rear terrain. A withdrawal of the 302d would also have had to lead to the removal of the 294th Infantry Division on the opposite bank to the same degree. Thus, practically everything had to stay as it had been. The Army, however, did let one division and one regimental group be withdrawn from the front and set up as a reserve behind the XXIX and/or IV Army Corps sector. Further, on the order of the highest command instances, construction was started on a switch line at Rogatshik in the event the north flank in the bridgehead had to be given up. This adjoined the "Dagmar" Position (reduced bridgehead at Lepetikha).[17]

The Operations of the 335th Division

The 335th Infantry Division occupied the positions on the right of the German bridgehead (Map 8), a sector which extended from the Dnieper River across two kilometers of floodplain cut with lakes and streams, and then as much as 15 kilometers of higher ground to the boundary of the 97th Jäger Division on its left, a boundary that was shifted eastward as the battle progressed. The area of floodplain

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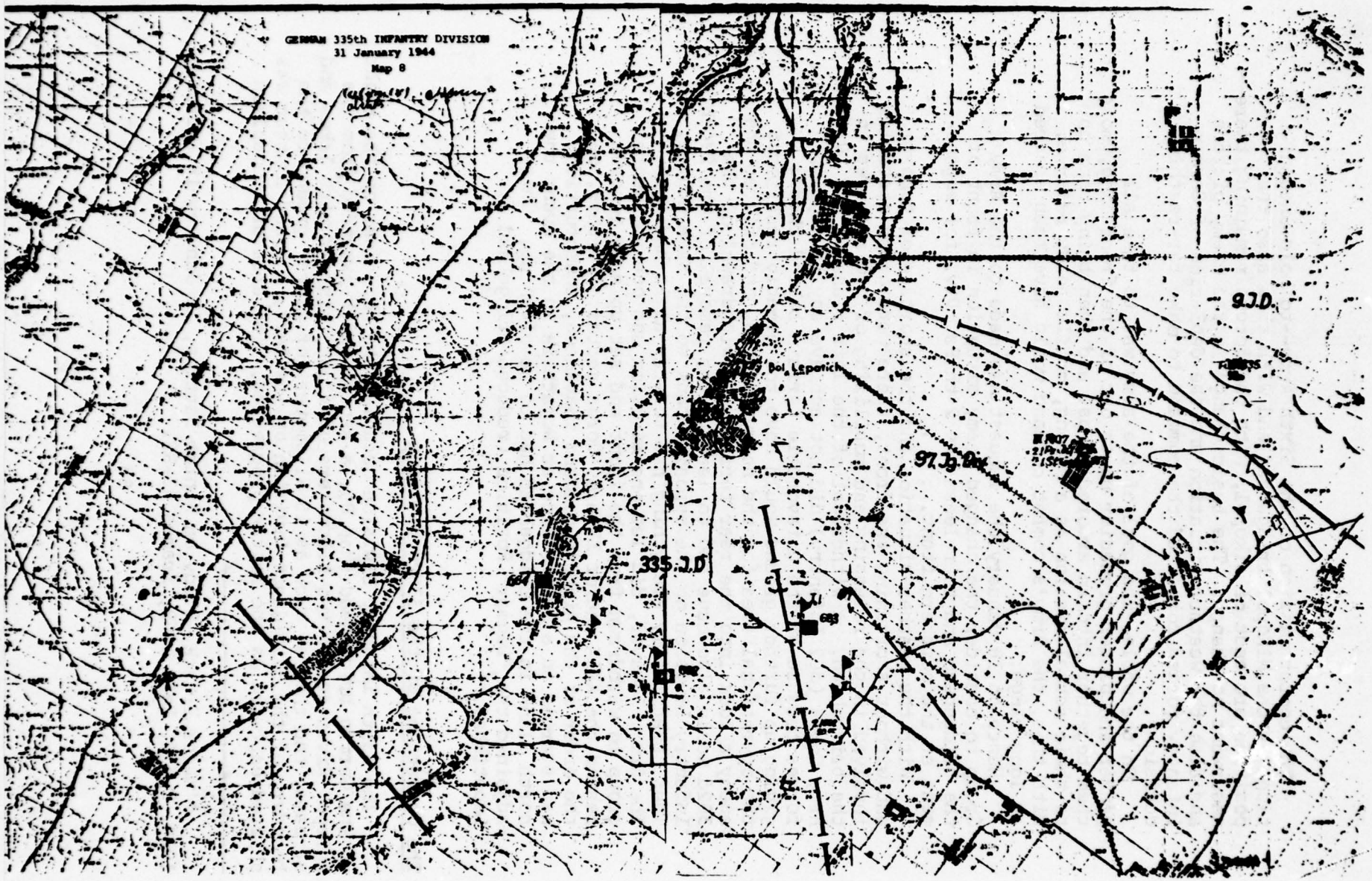
[17]Major Franck, Study on Winter Battles, 10 January-18 February 1944, T-312, Roll 1469, frames 43-82.


GERMAN 335th INFANTRY DIVISION
31 January 1944
Map 8
9 J.D.
Bol. Leporich
97 Jg. Div
335 J.D

on the right of the 335th Division front is now covered by a reservoir, and no map of the pre-reservoir situation has been available for this study. The division's antitank defenses are shown on Map 9.

On 31 January the full scale Russian attack was renewed. At first the 335th Division got little of it. Several times concentrations of 100 to 200 Russian troops were sighted in front of the 682d Grenadier Regiment, but all were dispersed by artillery fire. In the 9th Infantry Division's sector, however, before dawn the Russians captured several lines of trenches north of Nikolayevka, at the boundary with the 97th Jäger Division, and advanced with about 700 men toward Vasilyevka. The 335th at 0645 was ordered to send the Fusilier Battalion to Vasilyevka to be attached to the hard-pressed 9th Division. The battalion, which had been in reserve at Bol'shaya Lepetikha, left there at 0820, and four hours later arrived at Vasilyevka. By that time the Russians had moved up 50 tanks into the breach and increased their infantry strength to 3,000 men. At 0900 the 335th Division was ordered to send the 2d Antitank Battery of the 335th Antitank Battalion to Konstantinovka to be attached to the 3d Battalion of the 207th Infantry Regiment. The 335th Engineer Battalion was ordered to the 9th Division at Malaya Lepetikha during the morning. It had great difficulty trying to cross the ravine north of Severnye Kairy. Some of its trucks were hauled out by a prime mover, but five were mired down completely and had to be abandoned.

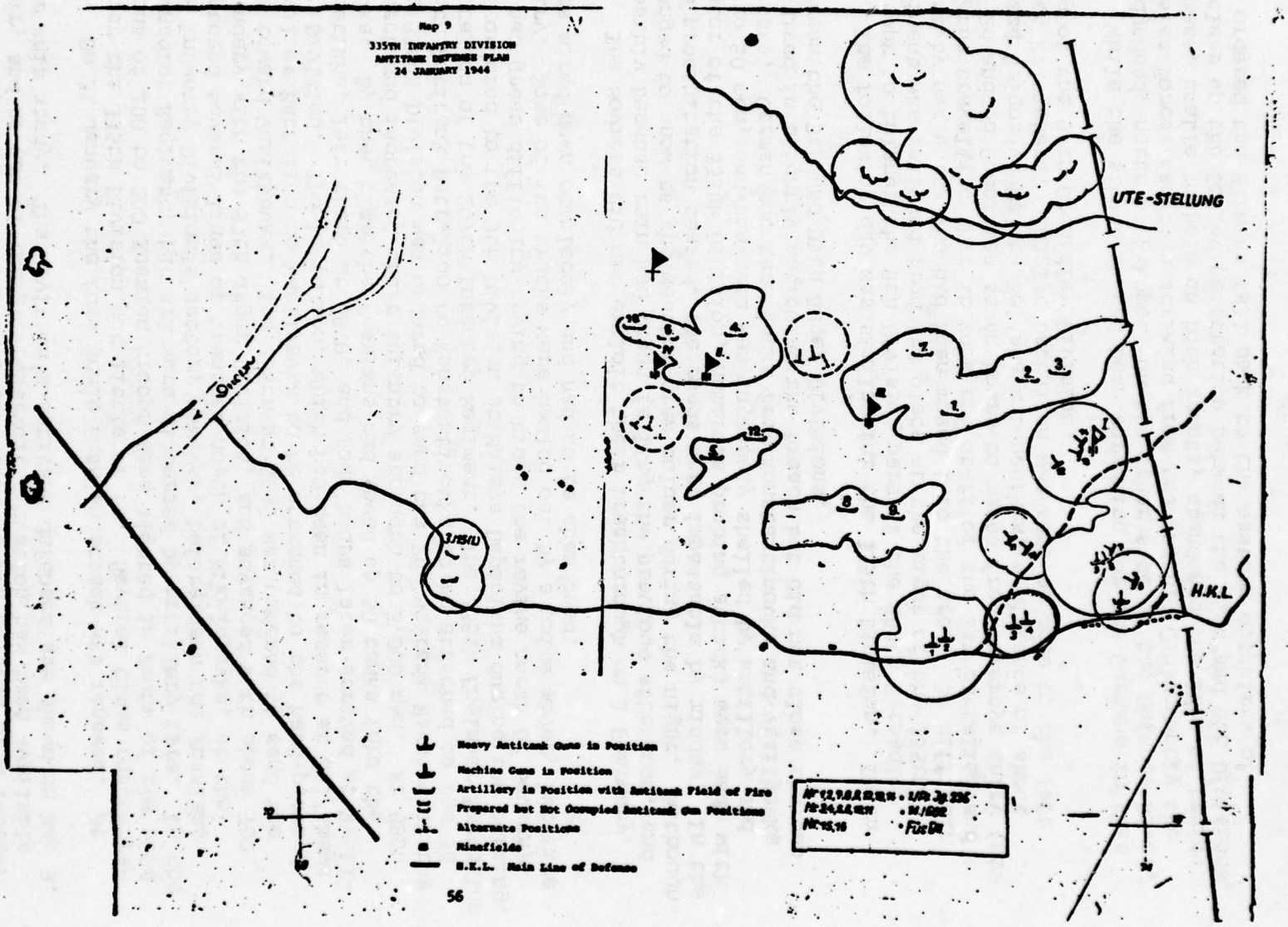
The Soviets did not exploit their breakthrough on 1 February, possibly because rain had begun falling the previous afternoon, and changed to snow as the weather grew colder during the night. Although the precipitation ceased, the roads were impassable by midday. In the sector of the 335th Division, numerous probing attacks were made with 10 to 50 men, and the area was intensely shelled by artillery and mortars. German counterattacks from Konstantinovka and Vasilyevka resulted in slightly narrowing the breach but did not close the gap between the 9th and 97th Jäger Divisions.

The following day was similar for the 335th Division. In an attempt to bolster the 9th Division, part of the 684th Grenadier Regiment was relieved from its place at the right of the 335th's front by new units who had been moved into the area. So difficult was the travelling that it took the staff of the 1st Battalion and the 2d and 3d Companies seven hours to march from Severnye Kairy (now Knyaze Origor'yevka) to Bol'shaya Lepetikha, a distance of about seven kilometers. The 1st Battalion was sent at once to the left wing of the 97th Grenadier Division.

While the situation had been worsening for the Germans in this bridgehead, north of Nikopol, on the other side of the Dnieper River, Russian forces had been striking from the north. Consequently the Germans, unable to hold on both fronts, abandoned the idea of trying to clear up the Soviet penetration between the 97th and 9th Divisions, and ordered the 97th to fall back to the eastern outskirts of

Map 9

335TH INFANTRY DIVISION
ANTITANK DEFENSE PLAN
24 JANUARY 1944



Konstantinovka. German reinforcements, attempting to reach Bol'shaya Lepetikha by ferry (and probably units trying to withdraw as well), were under repeated attack by Soviet aircraft and some shelling from Soviet artillery. The river was still full of floating ice, which made it impossible to reinstall the badly needed bridge.

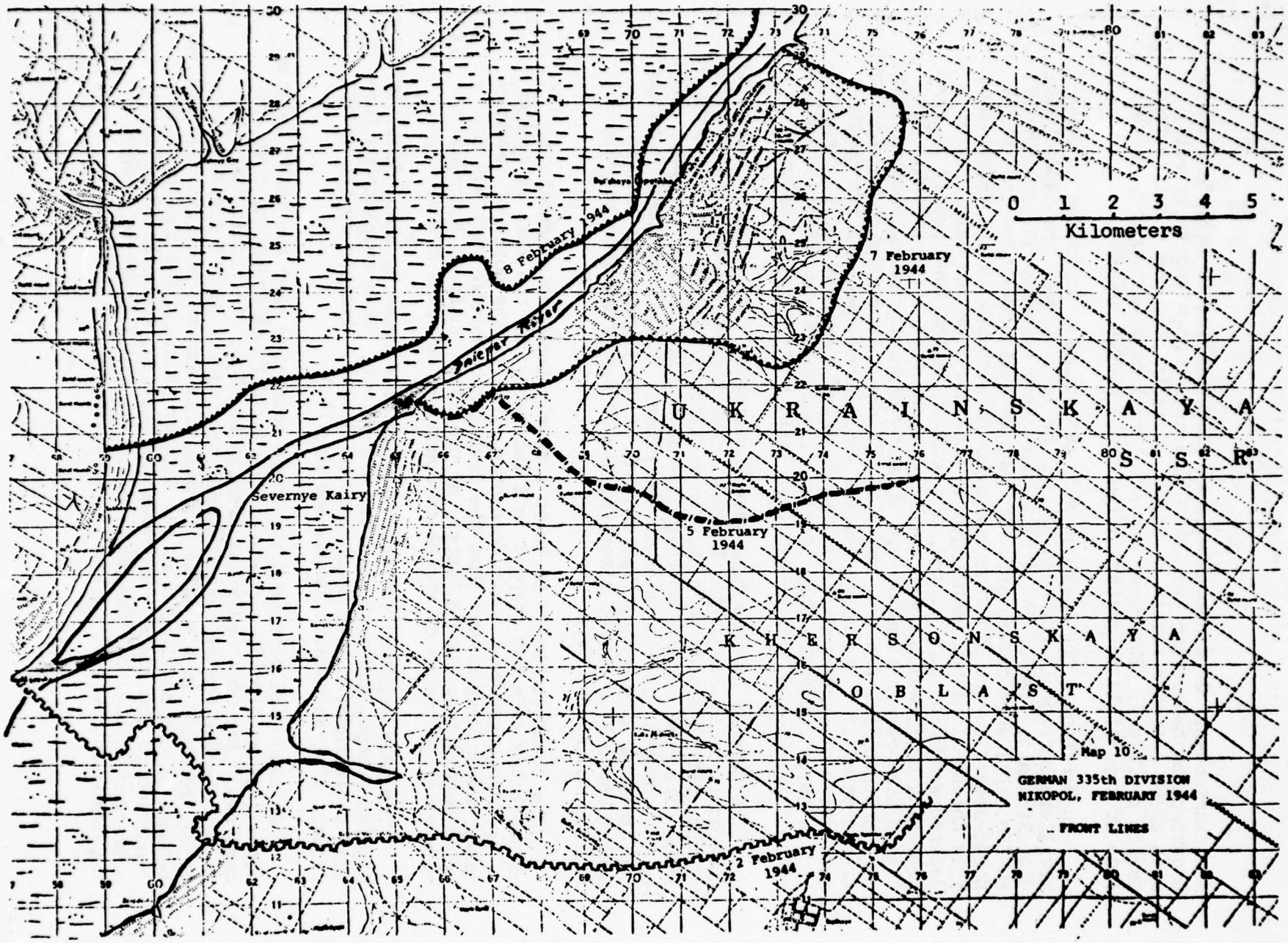
On 3 February the Russians made two attacks, following a heavy artillery barrage in the morning, on the left wing of the 683d Grenadier Regiment. Two of the attacks were made by about 30 men and one by 300. All were driven off. At 1600 an oral order came from Corps Headquarters to the division commander to withdraw to the Sigrid Line. This defense line had been begun at the same time the main line of defense was being constructed, and work on it had been pushed in the preceding days, while the front line troops were under attack. The Sigrid Line ran in a wobbly arc at about eight to ten kilometers from Malaya Lepetikha, the town north of Bol'shaya Lepetikha and almost an extension of it. The north end was near Shevchenko, and the south just north of Severnye Kairy. The division commander was informed by the corps commander that because of political considerations the Nikopol bridgehead must be held, at least on the Sigrid Line.

The Germans by this time were withdrawing supply troops and other non-combat units across the Dnieper. Two ferries were at the disposal of the 335th Division from 0030 on 4 February to 0230 and from 0730 to 1500. The rest of the day they were either broken down or immobilized by the movement of ice floes in the river. Soviet artillery fired on the crossing site constantly, and one of the ferries was hit by a bomb dropped by a Soviet aircraft, one of many that attacked the ferries during the day.

The roads continued to be in a nearly impassable condition, although the rain had stopped on 2 February. In the late afternoon of the 4th heavy rain again descended. The ravine north of Severnye Kairy was so deep in mud that the division commander sent several prime movers from the 3d Battery of the 335th Antitank Battalion to help move the trucks of the 684th Grenadier Regiment through it.

The 683d Regiment was hit that day four times by about 30 to 40 Russian troops, and each time drove them off. This complicated further the attempt to withdraw that was already hindered by the muddy roads. (For successive lines, see Map 10.)

At 1150 word came from the corps commander that the inner defense zones (Adele, Sigrid, and Brunhild) should be defended for only one more day. But this order was changed at 1800. The Sigrid zone was to be defended for at least several more days. As the division commander recorded in his daily journal, this was the only possible course, because of the bottleneck at the Dnieper crossing and the hopeless condition of the roads. Moreover the Russians could be expected to push hard in the next few days toward the crossing at Bol'shaya Lepetikha and to bomb it heavily from the air.


0 1 2 3 4 5
Kilometers
8 February 1944
7 February 1944
Dnieper River
U K R A I N S K A Y A
S S R
Severnye Kairy
5 February 1944
K H E R S O N S K A Y A
O B L A S T'
2 February 1944
Map 10
GERMAN 335th DIVISION
NIKOPOL, FEBRUARY 1944
FRONT LINES

The Soviets did not attempt to interfere seriously with the retreat to the Sigrid Line. The worst enemy, the division commander reported, was the bottomless morass that took all the strength from men and horses. The 682d Regiment had the greatest difficulty, because it had to negotiate the ravine southeast of Severnye Kairy. The 684th and the 335th Artillery Regiment, on the other hand, withdrew without major problems. On the whole the losses of weapons during the retreat were smaller than expected. However, the division lost 25% of its antitank weapons.

At 0730 on 5 February the 683d Regiment was in its new position in the Sigrid Line, and the 682d at 0900. Three batteries of the artillery regiment were ready to fire at 0800 and the fourth at 1000. It was 1400 before the fifth battery was set up. The 2d and 3d Battalions of the 684th Regiment remained in the southern part of Bol'shaya Lepetikha in corps reserve.

The Russians did not start to advance until morning. A German observation unit across the Dnieper at Katshkarovka reported at 0945 that a Russian column was marching north from Zavodovka to Severnye Kairy. Fifteen minutes earlier about 600 Soviet troops had started moving along a secondary road toward the 335th positions about four kilometers from the outskirts of Bol'shaya Lepetikha. Artillery fire forced them to stop, and they started to entrench. But at 1130 they turned and withdrew toward the southeast. At 1400 200 Russians attacked farther to the east, but they were halted about 600 meters in front of the German line. The 97th Division was attacked by a force of 600 men with 12 guns in the evening, but managed to stand them off.

Meanwhile the Germans were struggling to move their vehicles and non-combat units back across the Dnieper. The ferry that had been hit by a truck was still out of commission. At 1415 the bridge at Bol'shaya Lepetikha was finally opened, but first priority was given to the 151st Artillery Battalion of General Headquarters. The Corps ordered the 335th to share the use of the bridge with the 97th--three hours for the 335th and two for the 97th. The Russians shelled the crossing intermittently, and Russian planes bombed and strafed with no opposition from German fighters. Ammunition was running low, and none was being sent to the beleaguered defenders.

The Corps ordered all the detached units, including the 335th Engineer Battalion, 1st Battalion, 684th Grenadier Regiment, staff of the 4th Artillery Battalion and the 4th and 6th Batteries of the 335th Artillery Regiment, and three antitank guns of the 1st Battery, 335th Antitank Battalion, returned to the division. But one of the antitank guns had been destroyed, and only the Engineer Battalion and two of the antitank guns reached the division. The artillery was outside the area, and the 9th Division refused to release the 1st Battalion of the 684th Grenadier Regiment.

On the 6th of February, for the most part the Russians were probing the new defense positions, and they fired intermittently on the 683d Regiment's positions, on Bol'shaya Lepetikha and on the crossing site. A strong attack to the left of the 335th Division, probably in the zone of the 97th Division, penetrated about 200 to 300 meters. On the right wing of the 335th at about 1530 some 150 Soviet troops attacked, but they were driven off.

Again Russian planes attacked the bridge and the crossing site. Three Russian planes were shot down by German antiaircraft fire, but the bridge was damaged during an air attack and was inoperative until 2000. Only one 24-ton ferry farther up the river was working. The 335th Engineer Battalion arrived during the morning and, in spite of heavy bombing and shelling, managed to build a double pneumatic ponton ferry and have it in operation at about 1800. Unfortunately, it could carry only people and light vehicles.

Elsewhere in the bridgehead, the division commander finally learned, things were going no better. Russian forces were closing in on Ivanovskoye and on Nikopol from the southwest and the southeast. The decision to evacuate the bridgehead on the night of 7/8 February had been made. The 335th Division was ordered to withdraw to the last defense line, Brunhild, close around Bol'shaya Lepetikha, during the night of 6/7 February, leaving one reinforced regiment to hold it. The rest of the division was to cross the Dnieper and concentrate in the area of Dudchany and Kovalevka on the west bank, ready to advance toward the north or northwest. Because of the very bad roads and the constant Russian air attacks, most of the division's arms and equipment would be left behind.

The operational group of the staff left Bol'shaya Lepetikha at 2000 and arrived at Dudchany at 0200 the next day.

On 7 February the 335th Division was ordered to continue to hold the east bank of the Dnieper from the existing right boundary to the outskirts of Malaya Lepetikha. The 111th Infantry Division, reduced to 200 to 300 men, was on its left. The 97th Division had crossed the river and was near Ukrainka. The 1st Battalion of the 684th Grenadier Regiment and the Fusilier Battalion were to cross the bridge near Mikhaylovka, north of Malaya Lepetikha, during the day. The ferries were working better, although one was full of holes from bomb splinters. The new ponton ferry was working especially well, and all infantry elements of the 683d Regiment and a combat group of unknown composition were evacuated during the day.

The Russians continued to attack by air in the morning, hitting heavily at the crossing site and on the road to Gavrilovka on the west bank, where a tremendous traffic jam had long since developed. Five Rumanian planes finally appeared and drove off the Russians. Artillery fire then commenced. In the afternoon the planes came back. The ferries were working well, despite the attacks by air and artillery, and by 1400 only 60 vehicles were left on the east bank.

Mud and traffic slowed the movements of units once they got across the river. Although the 683d Regiment arrived at Dudchany at noon, most of its vehicles were bogged down in the lowlands. The artillery withdrew across the river without losing a gun, but by evening not a single gun was in place for firing. The 97th Division was not so fortunate, however. Most of its vehicles had to be abandoned and destroyed.

The bridgehead, meanwhile, was attacked four times by Russian troops and tanks, but they were driven off each time. The last elements of the division left the east bank at 0100 on 8 February, leaving only six vehicles behind. They were not pursued. They found the road to Gavrilovka still impassable, and the traffic caught in the jam was under heavy fire from Russian artillery and mortars. Many vehicles and antitank guns at the end of the column were blown up. Who issued the order to do this was not known.

Soon after sunrise the Russians started crossing the river at various points in rubber boats, and in considerable strength, and supported by artillery and mortars sited across the river in Bol'shaya Lepetikha. By afternoon it was apparent that the Russians intended to establish a sizable bridgehead on the western bank of the Dnieper. There was no plan to defend it, for the terrain along the bank was not suitable for defense. It was decided to leave outposts along the bank and pull back to a more defensible position.

C. Il Giogo Pass, 12 - 17 September 1944

The basic German plan for defense of Italy formulated by Field Marshal Albert Kesselring, Commander in Chief Southwest, shortly after the Allied landings at Salerno in September 1943, included construction of a series of barriers or defense lines roughly east and west across the peninsula. Work on a line on the southern side of the Apennine Mountains, to bar approaches to the Po Valley, was begun by Army Group B, commanded by Field Marshal Erwin Rommel, in 1943, when the combat zone was still in southern Italy. Originally called the Gothic Line and later the Green Line (Map 11), the position was not yet defensible in June 1944, when Rome fell and it appeared that German troops would be falling back to it in the immediate future. The reasons given by Field Marshal Kesselring were the frequent changes in command responsibility, physical difficulty in establishing a connected line and improving positions, and problems of procuring laborers and delivery of building material.[18]

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[18]Albert Kesselring, The Construction of Positions in the Italian Theater of War after the Withdrawal of Royalist Italy from the Axis Alliance, MS #C-031, August 1949. Historical Division, European Command.

As the Germans withdrew from Rome, responsibility for completing construction of the line's defenses was given to the armies, with the Fourteenth covering the line from La Spezia to just east of the Florence-Imola Road. When General Walter Warlimont, Deputy Chief of the Wehrmacht Operations Staff, and former Chief of Land Fortification, visited the western portion of the Green Line in the second week of June 1944, he found construction of the defenses, particularly in the most vulnerable areas, well advanced.[19]

Most of the construction work up to that point had been done by the German paramilitary construction organization known as Organization Todt (OT), using Italian workers, originally as many as 28,000 of them. Many of these had deserted by the beginning of summer, and there were only about 1,800 left as the army engineers took up responsibility for completing the positions. The number dropped still farther after 11 June, when Italian guerrillas allegedly threatened to shoot anyone still working on that date.[20] The intention of the Fourteenth Army commander, Lt. General Joachim Lemelsen, was to have each division responsible for final construction of the sector of the line that it would eventually be called on to defend. This complicated the construction problem somewhat, since planned assignments of units changed several times during the summer. But improvement staffs and field training battalions were placed in the line in July, and work was rushed, for the battle was already approaching.[21]

The Allies, pushing up the Italian peninsula in the summer of 1944, found the Germans withdrawing before them. But the withdrawal was slow and deliberate. They stood briefly on each of their defense lines and blew up bridges and blocked roads as they fell back. On 4 August they finally crossed the Arno River and withdrew to the last intermediate defenses before the Green Line.

Faced with the problem of trying to break through the man-made constructions that enhanced the natural barrier of the Apennine Mountains, General Sir Harold Alexander, commander of the Allied forces in Italy, adopted the strategy of striking first with the right wing of the British Eighth Army at the extreme eastern end of the line, where the mountains fade away toward the Adriatic Sea. After German reserves were attracted to the east, the American Fifth Army and the left of the Eighth Army would then follow with attacks into the mountains, the Fifth Army's main attack being made by the

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[19]Report of Deputy Chief, OKW/WFSt, 9 June 1944; T-311, Roll 8, Frames 7008232-3.

[20]Preliminary Report by Staff Group II on Sectors A-F, 17 June 1944; T-312, Roll 99, Frame 7625869.

[21] Special Staff Greiner, "Memo on Green Line," 3 July 1944; T-312, Roll 490, Frames 8083066-67.

II Corps on the Army's right. The II Corps was confronted on the west with the Futa Pass--traversed by the main road to Bologna and known to be strongly fortified--while on the east was the Il Giogo Pass, through which ran a secondary road, to Firenzuola and Imola. Relatively little was known by the Allies of the defenses that had been constructed in the Il Giogo area. However, since it appeared to be less strongly fortified than the Futa Pass, the Il Giogo was selected as the area for the major effort.

The US II Corps was to attack with three divisions abreast. The 34th and 91st, left to right, astride the main road through the Futa Pass and extending east into the mountains on the west of Il Giogo Pass, were to attack first, to draw attention from the 85th, which would be making the main attack into the mountains that controlled the Il Giogo Pass from the east (Map 12). The 88th Division was to be held in reserve. To the right of the US II Corps the British XIII Corps was also to launch a supporting attack. By the time the attack was made, the rugged terrain of the Apennine mountains was riddled with German strongpoints, trenches, pillboxes, mines and barbed wire.

The Green Line followed the south face of the mountains, where a main line of defenses approximately 170 kilometers long had been constructed, with a weaker backup line about a kilometer behind it. Defense positions were clustered in the few mountain passes and around the roads that led into the mountains. A German inspection team in June 1944 reported that in Sector F of the Line, which included the Il Giogo Pass, on a frontage of 19.5 kilometers 506 field positions had been built or were under construction, so placed as to be mutually supporting. Dugouts for protection of the troops had in most instances been blasted out of the rocky mountainsides or placed behind protective screens of concrete, three to five meters thick. Most of the dugouts were attached to the gun positions, to which they were connected by zigzag trenches. The dugouts were 70% complete at that time. Stakes for wire obstacles had been placed, but in June most of the wire had not been laid. The entire sector was heavily wooded, but tree branches and foliage were subsequently removed to clear fields of fire.

In the portion of Sector F which included defenses of the Il Giogo Pass itself, there were 56 fortified positions, including gun emplacements and dugouts, on a four kilometer front, with 15 more a kilometer to the rear. Between them no positions had been constructed.[22] Four units with 13 OT men and 1,450 Italians were working on the Il Giogo Pass. No plans for laying mines had been made, but General von Zangen, whose Army Group had been in charge of the construction since January, on an inspection trip earlier in June had recommended mining on both sides of the road, using night shifts if necessary.[23]

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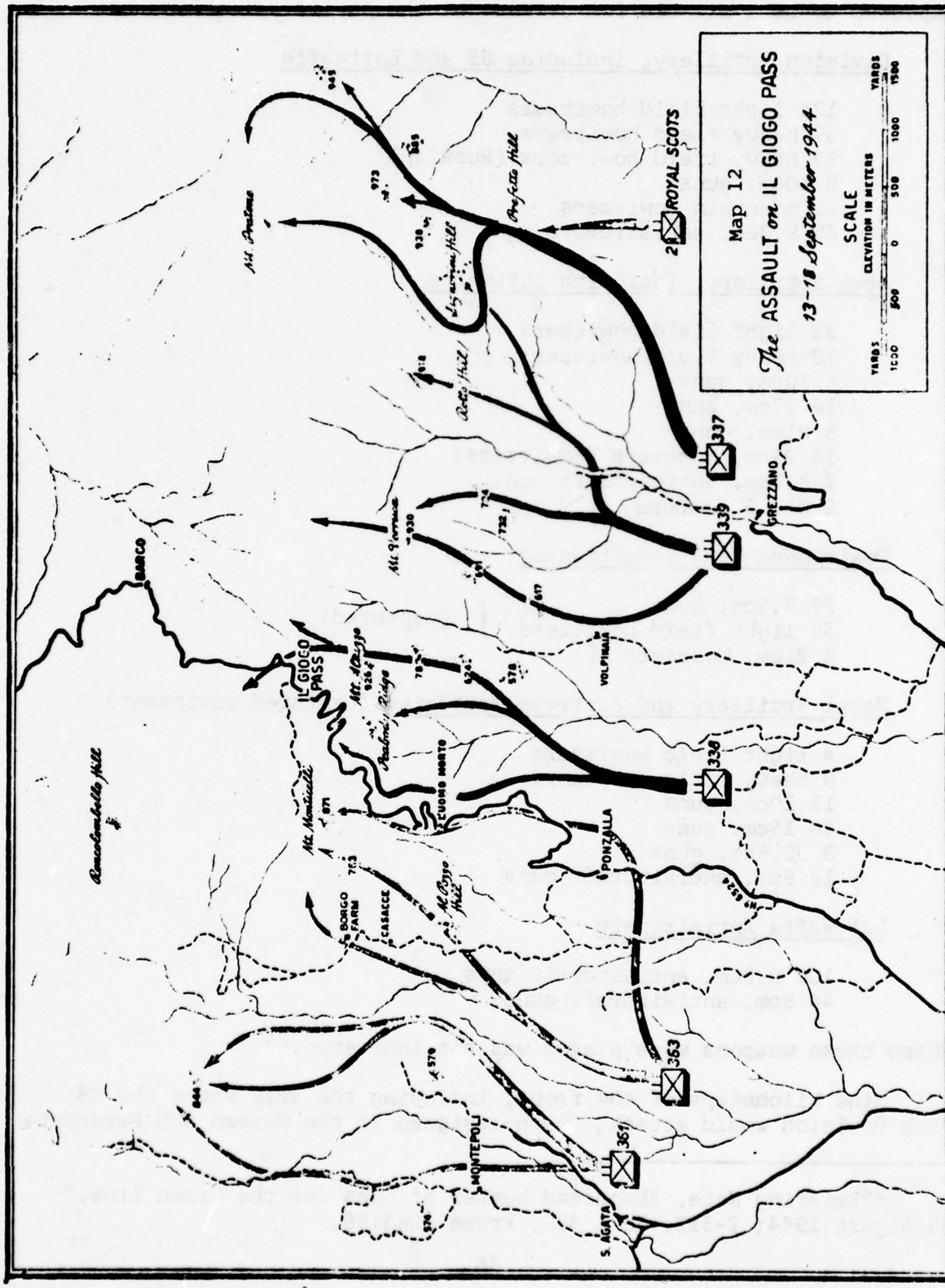
[22]Report by Staff Group II, 17 June 1944; T-312, Roll 99, Frame 7625868.

[23]Report on von Zangen's Inspection Trip to the Gothic Position, 2-5 June 1944; T-312, Roll 1638, Frames 1069-1077.


Map 12
The ASSAULT on IL GIOGO PASS
13-18 September 1944
SCALE
ELEVATION IN METERS
YARDS
ROYAL SCOTS
337
339
338
363
361
GREZZANO
IL GIOGO PASS
Mt. Altuzzo
Mt. Verruca
Mt. Pratone
Prefetto Hill
Rotto Hill
Mt. Monticelli
Peabody Ridge
VOLPINAIA
PONZALLA
S. AGATA
MONTEPOLI
BORGO FARM
CASACCE
BARCO

On 25 August, when the British opened the offensive near the Adriatic, Field Marshal Kesselring's staff reported the armament expected to be available for defense of the entire Green Line as:

Division Artillery, including SS and Luftwaffe

174 light field howitzers
37 heavy field howitzers
12 heavy field howitzers (Russian)
8 10cm. guns
12 mountain howitzers
35 8.8cm. antiaircraft guns

Army Artillery, including Luftwaffe

35 light field howitzers
12 heavy field howitzers
6 10cm. guns
16 17cm. guns
5 21cm. guns
14 21cm. Moersers (howitzers)
7 8.8cm. antiaircraft guns
2 No. 5 cannons

Positioned Guns (additional)

37 7.5cm. guns
30 light field howitzers } (captured)
2 21cm. Moersers

Naval Artillery and Fortress Batteries (captured equipment)

4 light field howitzers
8 heavy field howitzers
11 10cm. guns
20 15cm. guns
8 30.5cm. guns
18 9cm. antiaircraft guns

Luftwaffe Antiaircraft

108 8.8cm. antiaircraft guns
44 9cm. antiaircraft guns

Where these weapons were placed was not indicated.[24]

Nine kilometers of the front, including the area where the US 85th Division would attack, were assigned to the German 4th Parachute

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[24]Briefing Note, "Expected Number of Guns for the Green Line," 25 August 1944; T-312, Roll 490, Frame 8083156.

Division. On it were 72 artillery pieces, including 11 light weapons from Division Artillery, nine light and 24 heavy from Army Artillery, and 28 heavy antiaircraft guns. This meant an average of eight guns per kilometer.[25] The division's personnel strength on 1 September, before it moved back into its position, was 10,233 men.[26] The 12th Regiment, on the 4th Parachute Division's left, would defend the area where the 85th would make its attack.

No description of the defenses constructed in the 4th Parachute Division's area has been found in the German records at the US National Archives. However, a detailed survey of the state of construction on 30 July of defense positions and obstacles in the sectors of the Green Line immediately east of the 4th Parachute Division gives a good indication of the numbers and types of obstacles that may be assumed to have been installed in the adjoining one.[27]

	Ready	Under Constr.	Planned
Machine gun positions	80	102	5
Positions for antitank guns, mortars, and infantry guns	5	16	-
Dugouts	71	123	3
Infantry observation posts	2	5	-
Small cut-and-cover shelters	9	4	-
Connecting trenches (length, meters)	120	-	-
Observation posts for artillery observers with dugouts	-	1	-
Antitank ditches (length, meters)	-	40	-
Surface wire obstacles (or low fences)	2,200	-	1,800
Road construction (meters)	200		

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[25]Enclosure to Fourteenth Army Daily Journal, 12 September 1944, T-312, Roll 491, Frame 8083523.

[26]Tables of Personnel Statistics, Fourteenth Army, 1 September 1944, T-312, Roll 491, Frame 8083619.

[27]Position Construction Progress Report, Green position, Sectors 30 and 31 (715th Inf. Div. Sector), August 1944, T-312, Roll 99, Frame 7626640.

Although the exact locations of obstacles and fortified covering positions cannot be determined from German sources, the records of the US 85th Division spot the location of many of them. Sources of the information include fighting infantrymen who encountered them, Italian partisans who had worked on their construction or who were used as scouts before and during the operation, and German prisoners of war taken during the attack. Using the grid coordinates in use at the time, these obstacles have been sited on the attached chart (Figure III-2), which represents the area in which the 85th Division attacked from 12 to 17 September 1944. The chart has no representation of ground contours. However, peaks are located at the coordinates given in the records (which vary in their degree of accuracy); thus a comparison with a conventional contoured map is facilitated.

As described in the 85th Division G-2 report on the operations, "The enemy's defenses consisted chiefly of bunkers constructed of earth and logs, fortified houses, machine gun positions cut into rock and innumerable mortar emplacements. The positions were well planned and generally mutually supporting. The fortified houses on Hill 732 (9296) and Verruca were circled by bands of mines and barbed wire; the heavy growth was cleared and openings in the walls at ground level allowed machine guns within to employ grazing fire. Bazookas were ineffective against the thick walls of these houses. Similarly, bunkers and pillboxes were so well constructed that they survived all but direct hits by the artillery or by the aerial bombardment."[27]

The Operations

According to plan, the British Eighth Army struck the German defenses in front of the eastern end of the Gothic Line, held by units of the Tenth Army, on 25 August 1944. The Germans at first fell back before them, apparently in deliberate delaying tactics. The forward positions of the line were penetrated on 30 August, and for the next three days British, Canadian and Polish units hammered at the German defenders. On the night of 2/3 September the Germans' resistance was broken and Eighth Army forces pursued them north across the coastal plain as far as the ridge six miles below Rimini, which runs northeast from San Savino and Coriano to Reccione. The combination of a heavy rain on 6 September and German reinforcements rushed to the area halted the British attack, with a single ridge between it and Rimini and the roads to Bologna.

Field Marshal Albert Kesselring, the German Commander in Chief, Southwest, shifted the 356th Division from the left of the Fourteenth Army sector to bolster that portion of the Tenth Army front that was under British attack, and moved the boundary between the Fourteenth

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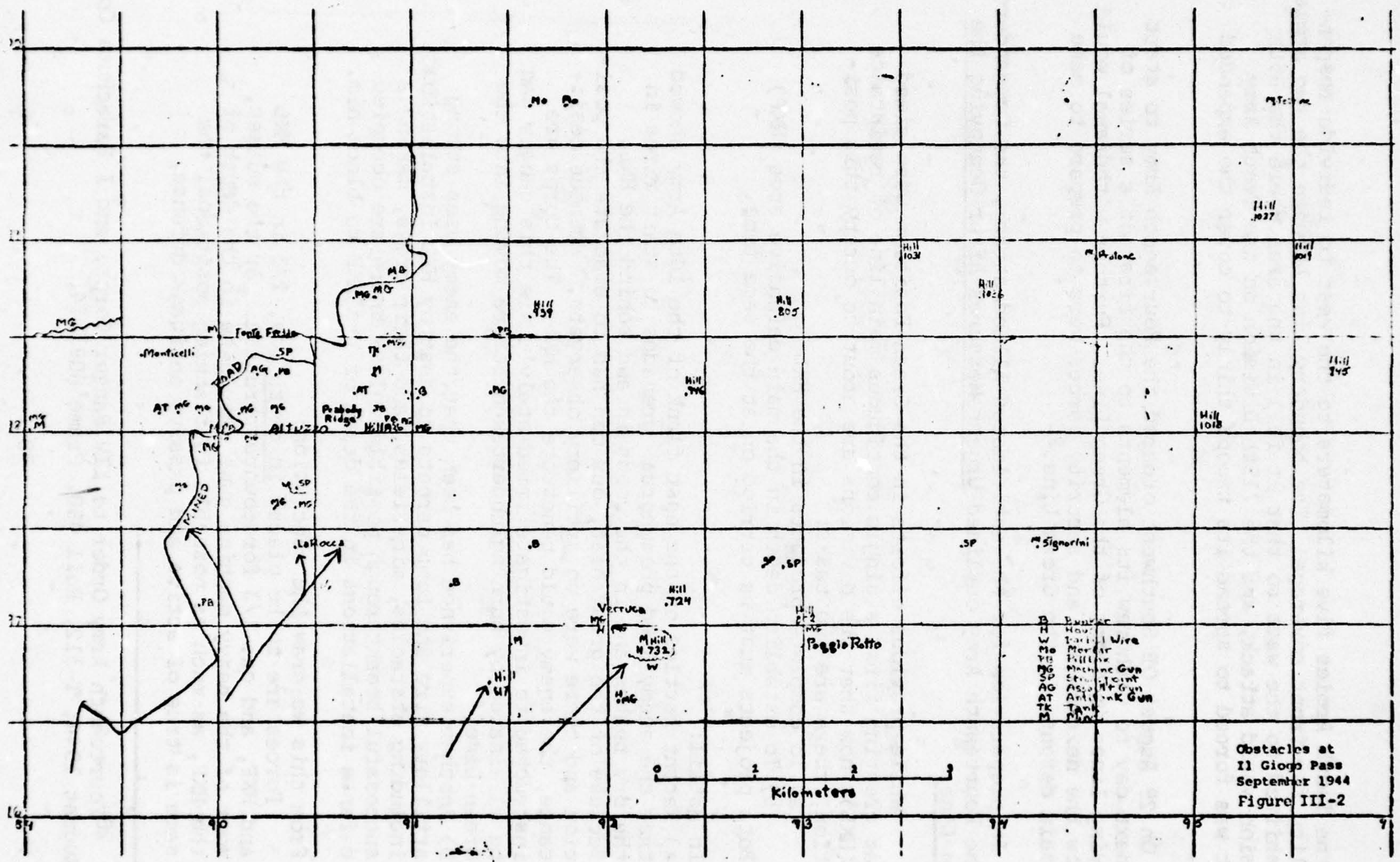
[27] G-2 Report of Enemy Operations September 1944, 9 November 1944. File 385-2, Box 12745.



Obstacles at
Il Giogo Pass
September 1944
Figure III-2

and the Tenth Armies five kilometers to the west to redivide responsibility for front coverage. The boundary line between the two armies was shifted to the west so that it fell in the area where the 85th Division would attack, and the 715th Division on the Tenth Army right was forced to spread its troops thinly to cover the expanded area.

On 29 August OB Southwest ordered the Fourteenth Army to start the next day to withdraw its elements to the first of a series of delaying lines in front of the Green Line. Further withdrawal would follow the next night, and security forces were to prepare to make the main defense in the Green Line.[28]

In preparation for the anticipated Allied attack, the Commander of the Fourteenth Army outlined Urgent Measures After Occupying the Green Line.

> While previous efforts in the Green Position were aimed at creating first a single continuous main line of resistance (HKL), now that the divisions are about to occupy this position, there are two tasks:
>
> a) To complete projects in the HKL
>
> b) To establish depth in the main defensive area (HKF)
>
> Both projects must be carried on at the same time.
>
> In detail:
>
> a) Recent battles on the east flank of the 10th Army showed that the enemy used phosphorus grenades to start fires in the dry bushes and in the woods in and behind the HKL. Because of the great heat, our men had to evacuate the position and there were no artillery observers. Without resistance, the enemy could penetrate the HKL. The Corps are instructed to investigate immediately where this danger can be eliminated by burning undertaken before moving into the Green Line.
>
> b) Another experience has been that the enemy uses strong artillery fire and bomb carpets to destroy HKL installations, including obstacles, minefields, and their crews, making a successful breakthrough possible unless there are occupied defense installations in the depth of the HKF to block him.
>
> From this we draw the conclusion:
>
> Forces are to be placed in depth (ca. 2/3 in the HKL and HKF, and ca. 1/3 for counterthrusts). At the outset, most of the heavy machine guns should be in the depth of the HKF, as much as possible in flanking positions; the same is true of active and passive antitank defense,

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[28]Fourteenth Army Order to XIV Panzer Corps, and I Parachute Corps, 29 August 1944; T-312, Roll 490, Frame 8083134.

minefields, and tank ditches behind the HKL in the HKF . . . At focal defense points, such as stretches of roads and ways in the mountains, deep barrier zones (Sperrzonen) must be established, to be secured by wire-enclosed infantry-combat installations. Principally engineers should be used for this task, and I expressly re-emphasize that engineers are not to be used as infantry.
c) Italian workers have surely betrayed the permanent installations of the Green Position to the enemy so we can expect that he will have an exact picture of the course of the HKL. Hence it is all the more important to mislead him by creating dummy installations ahead of and behind the HKL, and between the installations now in existence . . .
d) Enemy air attacks will now concentrate on the passes and especially those bridges that are difficult to circumvent. The passes are of vital importance in supplying the troops; every measure must be taken to restore bridges quickly and to detour around bridge sites. In this connection, attention is called to the fact that bridges prepared for demolition--already loaded--must be guarded with special care.[29]

On the right of the US Fifth Army, the II Corps prepared to attack, the 85th Division east of Il Giogo Pass, and the 91st extending west from just east of the road that ran through the pass (Map 12). The Corps front would receive support from the 423d Field Artillery Group (two battalions minus one section of 240 mm. howitzers, three sections of 8-inch guns, and two battalions of 155 mm. guns). The 85th was supported by the 178th Field Artillery Group (three 155 mm. howitzer and one 155 mm. gun battalions) and the three 105 mm. howitzer battalions of the 88th Division. Initial objectives for the 85th were Mount Altuzzo (9098) and Mount Verruca (9297). After these were secured, the push would be north to Mount Frena, Mount Coloreta and Mount Canda. The road to Firenzuola through the Il Giogo Pass runs west of Mount Altuzzo, which was strongly fortified to defend it. Verruca to the east, also heavily defended, threatened the right flank of forces attempting to take Altuzzo.

Altuzzo and Verruca rise steeply, in places in sheer cliffs, to nearly 3,000 feet, with cart roads on the lower slopes leading to single houses, and not even mule trails farther up. Bare rock protruded through the thin covering of earth on the hillsides, and here and there were thin groves of evergreen, oak and bramble. On Verruca there were heavy growths of pine and chestnut trees. The natural defenses of the area had been strengthened with mutually supporting bunkers and pillboxes near the summits and wire barriers and minefields on the lower slopes. As described by the commander of the 1st Battalion, 338th Regiment, "The terrain itself was an obstacle beyond

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[29]Memo Ia No. 4748/44, TS, 6 September 1944; T-312, Roll 491, Frames 8083582-83.

description, and the emplacements were built to last forever. They were dug about 10-12 feet deep in solid rock and covered with several feet of logs, steel beams, and natural soil. . . . A line of ridges /ran/ parallel to the axis of attack, separated by deep claws, topped by peaks or knolls. The ridges were razor back and extended from north to south. All routes of approach were zeroed in by artillery and mortars and supplemented by machine gun and sniper fire."[30] Although the 752d Tank Battalion was attached to the 338th the terrain prevented its use except as artillery.

The German 12th Parachute Regiment was holding the Division sector from Monticelli to Verruca. The 13th Company was deployed between Monticelli and Altuzzo, the 1st and 11th Companies were on Altuzzo, and the 9th and 10th were on Verruca. East of Verruca was the 9th Company, 1st Battalion, 715th Grenadier Regiment.

Two battalions each of the 338th and 339th Infantry of the US 85th Division started moving out at 0600 on 13 September, passing through units of the 91st Infantry Division and the British 1st Division in the cultivated, terraced fields. By 0800 they were approaching the hills. On the lower slopes wire barriers and minefields, covered by concentrated mortar fire, slowed their advance. The German defenders, in their pillboxes and bunkers about 100 to 200 yards below the crests of the hills, could clearly see the attackers as they tried to push ahead, and pinned them down with fire from machine guns, mortars, and small arms. On the division left, fire from Altuzzo and Monticelli, and on the right fire from Verruca and Hill 802 (9397), halted the US advance. By nightfall the 338th Infantry, on the left, was near Hill 926 (909980). The 339th had approached Hill 732 (922969), perhaps the most strongly fortified point on the Verruca Mass. Stone houses on the slopes of Hill 732 and Hill 591 had been converted by the Germans into small fortresses, their thick walls almost completely impervious to bazooka fire. Trees around them had been felled to provide uninterrupted fields of fire, and barbed wire and logs further impeded any approach to them. Tank destroyers were moved up to fire on the houses on Hill 591 during the night, and the next morning the hill was captured.

The official Fifth Army History describes the pattern to be followed in the next few days:

> The strength of the enemy defenses and the determination on the part of the 4th Parachute Division to hold its positions at all costs left no alternative open to General Keyes /commanding the II Corps/ but to feed additional companies and battalions into the attack while concentrating every available weapon on the enemy defenses. Where possible antitank guns,

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[30]Report of Commander 1st Battalion, 338th Infantry, dated 3 October 1944; File 385-INF (338) - 0.3. Box 12835.

tanks, and tank destroyers were brought up to employ direct fire on pillboxes, and the heavy-caliber 8-inch guns and 240-mm howitzers fired with precision adjustments to destroy emplacements out of range of these weapons or too strongly constructed to be disposed of by light or medium artillery. Corps medium artillery, in addition to firing on located enemy defenses and supporting the division artillery, kept up a 24-hour a day schedule of harassing fires on the reverse slopes of the mountains in an effort to isolate the area under attack from supplies and reinforcements. The effect of this fire could not be felt immediately, and the experience of the Cassino fighting was proof that, when well dug in, troops could withstand prolonged periods of shelling without suffering heavy losses. It remained for the infantry to drive the enemy from his positions and to hold the ground won against his quickly organized counterattacks. So far as possible the attacks were coordinated at the Corps and division level and were launched simultaneously on a broad front, but in most cases the fighting resolved into a series of small-unit actions which resulted less in ground gained than in the gradual wearing down of the enemy strength.[31]

In midafternoon elements of the 2d Battalion were moved to Monticelli to silence the fire from there. Tanks and tank destroyers were used in support to fire on the German pillboxes. Forward elements managed to reach La Rocca (904974) by dark. During the night the Germans laid more mines on the approaches to Altuzzo.

The 1st and 2d Battalions of the 339th Infantry were halted by fire from the Signorini Mass (938974) in the morning of 14 September. The regiment

> . . . unable to gain ground in its attacks against Mount Verruca, concentrated its efforts on 14 September toward knocking out the enemy defenses. Division artillery and the Cannon Company shelled the heights, and direct fire was placed on each visible pillbox. The 1st Battalion brought up 37-mm antitank guns on Hill 617, and tanks of Company C, 752d Tank Battalion, were ordered up to fire on pillboxes on Hill 691; artillery and tank destroyers tore up the three-house strongpoint below Hill 732; and in the afternoon fighter-bombers hit the reverse slope of the main ridge directly to the north and Mount Pratone to the northeast. A regimental attack was then launched at midnight and continued the next morning in an effort to take Hill 691 and Hill 732 by storm. The troops were unable to get through the mines and barbed wire protecting the enemy positions, and they were

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[31] Fifth Army History, Part VII, The Gothic Line, p. 60.

> repeatedly driven back by mortar and machine gun fire. Although little ground had been gained, the enemy defenses were gradually being pounded to pieces by the continuous shelling, and the infantry attacks gave the enemy troops no respite.[32]

At 2200 an intense artillery barrage was fired on Hill 732 in anticipation of another attack at midnight. The renewed attack, with elements of all three battalions, made little headway, however, so effectively did the Germans command the approaches. To quote the Fifth Army History:

> At the end of two days of continuous fighting the 91st and 85th Divisions had gained but little ground, and there was no visible evidence that the enemy had been weakened at any point along the front. Our losses were heavy and steadily mounting; enemy losses, due to the protection afforded by his prepared defenses, were probably much lower; and, if the steady pounding of the greatly superior artillery of II Corps had knocked out many of the enemy pillboxes and reinforced dugouts, many others were still intact. Added to the strain of being almost constantly under fire, the forward troops received only a minimum of supplies. Once the troops left the foothills of the mountains all rations and ammunition had to be brought forward at night by mule or hand carry. What was not immediately evident was that the enemy was experiencing ever greater difficulty in supplying his troops and particularly in getting replacements and reinforcements forward to the 11th and 12th Parachute Regiments, which were attempting to hold an area extending from west of Mount Calvi to Mount Verruca. The two regiments had been engaged from the beginning of the II Corps offensive, and the losses suffered in the costly war of attrition being fought all along the II Corps front rapidly reduced their strength.[33]

So little progress had been made by the two attacking regiments that on 15 September the 337th Regiment was sent forward to Luco Di Magello (914953) to the right of the 339th, in the zone of the British 1st Division. The 66th British Brigade was ordered to move northwest into the 85th Division zone and capture Mount Pratone (945989). Then the 337th was to proceed from there, taking over the attack from the 339th. The purpose of this operation was to force the Germans to withdraw from Verruca to protect their flank.

At 0900 on 15 September, after a heavy artillery barrage, the 338th and 339th Regiments attacked, and again were halted, by heavy

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[32] Ibid., p. 61.

[33] Ibid., p. 63.

mortar, machine gun and small arms fire. The 1st Battalion, 339th, made slight progress during the day, but three separate attempts by the 3d to take Hill 732 were driven off. The 338th made no progress and had to drive off two counterattacks in the afternoon from Hill 926. The unit under attack was withdrawn to Hill 782.

The effects of the attack were being strongly felt by the Germans, who by this time were running short of food and ammunition. Supply from the rear was very difficult, and replacements were desperately needed. Prisoners taken by the attackers confirmed intelligence reports of the situation and reported that although the German bunkers and pillboxes were withstanding all but direct hits, US artillery fire was inflicting heavy damage. According to the Fifth Army History,

> It was not until 14 September that the enemy realized the strength of the attack on the Il Giogo Pass area and took hurried measures to reinforce the two parachute regiments. It was then too late to bring up more than small units . . . /from the/ 4th Antitank Battalion, the 4th Parachute Replacement Battalion, and miscellaneous headquarters and service personnel. When these reinforcements proved inadequate the 10th Parachute Regiment was pulled out from in front of the 34th Division and thrown in behind Mount Altuzzo and Mount Monticelli. Units also arrived from other divisions. The 305th Fusilier (Reconnaissance) Battalion (305th Grenadier Division) was rushed over from the Rimini area to reinforce the elements of the 715th Grenadier Division below Mount Pratone; the 2d Battalion, Infantry Lehr Brigade, which had been attached to the 65th Grenadier Division, was ordered to relieve the 3d Battalion, 12th Parachute Regiment, on Mount Verruca on the night of 16/17 September; and a Lithuanian labor battalion was sent up to provide replenishment for the 1st Battalion, 12th Parachute Regiment. The bulk of these replacements did not arrive until 16/17 September, when the battered paratroopers were approaching a state of exhaustion. The curtain of harassing fire laid down by the II Corps artillery permitted only a trickle of supplies and ammunition to reach the beleaguered troops, and many of the replacements either failed to arrive or were too demoralized to offer substantial support.[34]

Some penetrations of the Gothic Line were made on 16 September, but nowhere was it broken. The 85th Division Artillery, supported by II Corps Artillery, shelled the German positions almost continually during the day. From 0800 on 16 September to 0800 on 17 September Division Artillery fired 104 harassing missions, seven missions against pillboxes, one registration mission, 11 missions against personnel and vehicles, 28 TOTs, two missions against mortars, one against a self-propelled gun, and five preparations.

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[34] Ibid., p. 63.

The attack of the British 66th Brigade on Mount Pratone was halted by German fire, and the 337th Infantry was ordered to pass through and continue the attack. Reaching Poggio Signorini (9497), the 3d Battalion, 337th Infantry, attempted to advance on Pratone, but heavy mortar and machine gun fire halted it. The 1st Battalion moved up on its right, to continue the attack the next day.

The 338th continued its attack on Mount Altuzzo against heavy resistance. The 1st Battalion struck out at 1530 and after very slow and difficult progress during the night succeeded in taking Hill 926 at 0320 on 17 September. Thereupon the 3d Battalion passed through to advance the attack.

Elements of the 2d and 3d Battalions, 339th Infantry, attacked the Signorini Mass in the morning of 16 September, while other elements moved up the draw between Hill 732 and Poggio Rotto and the 1st Battalion advanced up the draw between Altuzzo and Verruca. During the night some units of the 3d Battalion took positions high on the Signorini Mass.

Approximately 100 German troops of the Genz (rifle) Battalion, 4th Parachute Division, arrived during the early hours of 16 September and moved into position on Mount Altuzzo. A few more reinforcements, from the 2d Battalion, Lehr Brigade, were sent down to Verruca through Firenzuola the following night, suffering heavy casualties en route from US artillery fire. They were engaged by the attackers of Verruca before they had a chance to dig in.

In the morning of 17 September the 1st and 3d Battalions, 337th Infantry, continued its attack, capturing Hill 945 (957983) and the high ground east of the summit of Mount Pratone. One company was on the crest of Pratone by 1730, and the 3d Battalion had it firmly secured before midnight. During the night the 1st Battalion advanced to points 1037 (953991) and 1019 (955989), north of Acqua Buona.

The 1st and 3d Battalions, 338th Infantry, consolidated their hold on the crest of Mount Altuzzo during the morning of the 17th. In the afternoon, probes of the enemy line brought heavy fire from Mount Fredda (902985), one of the strongly defended positions still in German hands. After sunset the two battalions began a slow advance to the remaining high points of the Altuzzo Mass, in the face of small arms and mortar fire.

The 3d Battalion, 339th Infantry, had taken Hill 732 by 0750 on 17 September and proceeded to take Hill 724 and prepare for the final attack on Verruca. Elements of the 2d Battalion had taken the crest of Poggio Rotto by 1100, and one company of the 1st Battalion was closing in on Verruca. The crest was occupied by 1215, and other elements moved up to consolidate the positions there. During the afternoon and night other units pushed forward from Signorini and took two points on the southwestern heights of Pratone, Hills 1036

and 1031 (939987 and 935989). Hill 946, on the northern end of Verruca, was also taken.

The 337th was then ordered to consolidate its positions on Pratone, prepared to repel counterattacks on the division flank and to proceed northward. The 339th was to consolidate its position along the ridge from 920984 on the northern slope of Verruca to Hill 805 (928986), Hill 1031 and Hill 1036, and to be prepared to move northwest to attack Hill 939, Pian di Giogo, to assist the advance of the 338th, which was to capture the remainder of the Altuzzo Hill Mass.

Although some German reinforcements had been identified--elements of the 735th Grenadier Regiment on Rotto, the 305th Fusilier Battalion on Signorini, and the Lehr Brigade on Verruca and Pian di Giogo-- the Germans were trying to extricate themselves from the positions they still held. "Scattered small arms fire continued to come from Il Giogo (9098), directly north of Altuzzo," the 85th Report said, "and from Hills 1019 and 1098 (9598), east of Pratone, and several pockets of resistance on the Altuzzo Mass still to be wiped out. But enemy resistance was gradually overcome during the night of 17/18 September. Having captured the dominating features of Altuzzo, Verruca and Pratone on 17 September the Division had broken through the Gothic Line. Beyond these key features the enemy had no strongly prepared line of defense."[35]

The Gothic Line barrier had withstood the attacks of the 85th Division for four days. Now that the defenses had fallen in the Il Giogo Pass there was no strong line that would delay the US troops long in their advance to the north. In a postwar assessment of the reason the Gothic Line did not hold longer, German historian Percy Schramm reasoned:

> If the Green Line had not lived up to what had seemed to be its initial promise, several factors were involved: The enemy could push his forces back and forth on the plain, but the defender could not since a position on the forward slope (Vorhangstellung)had been selected. This caused great difficulties not only in shifting reserves but also in moving supplies. Because the position was built from the south, even in the area close to the front road conditions were better for the enemy than for the German troops. A further disadvantage was the frequent change in command. . . . Moreover, guerrillas had not been taken into account in setting up the position, which was made still more difficult by lateral shifts (Quervershiebungen) /of personnel and boundaries/. In addition it had been assumed that mountain divisions would be engaged there, but the situation demanded that divisions without

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[35]The 85th Infantry Division, "Report of Operations - September 1944," 5 November 1944. File 385-0.3, Box 12737.

mountain experience and equipment had to be committed. The prerequisites for the position were not met, and it was no longer possible to make a subsequent change since then it would have been necessary to cope with two half-finished positions. Besides, division widths had to be overextended. The original thought of the OB SE had been to hold the Green Line with Grenadier divisions and to maintain motorized units behind them at the ready. But since he had to release three of them to the west and the east, in order to form reserves elsewhere he pulled out divisions that had been intended for the front. That led to the fact that the committed divisions had to take on one-two additional regimental widths. Since two more divisions then had to be diverted for the Alpine Front, the Green Line ended up with five divisions fewer than planned. Hence the divisions had sections of 20-25 km. in width. The combat strength was further reduced by the fact that fighters had to be used as mule drivers and in other functions.

In this way the enemy was always able to find some weak spot or other where he could penetrate and then work his way ahead. As there were no reserves behind the front they first had to be released in the adjoining sectors, which were then correspondingly weakened. Bringing up forces first to the rear and then in the next valley, again to the front, usually took such a long time that the new forces came too late to clear up the situation.[36]

The official report of the 85th Division similarly evaluated the situation:

The constant artillery pounding and repeated assaults by the infantry, the harassing of the enemy's supply lines, and his inability to bring up sufficient reinforcements--each contributed to our success in making the breakthrough.

Supporting aviation also contributed to the success of the attack. Except on 16 September when the weather prevented, planes carried out assigned reconnaissance missions, and bombed and strafed the enemy's supply lines and depots and designated targets in the GOTHIC LINE itself.[37]

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[36]Percy Ernst Schramm, ed., Kriegstagebuch des Oberkommandos der Wehrmacht (Frankfurt am Main, 1965), Vol. IV, 1, p. 558.

[37]The 85th Infantry Division, "Report of Operations - September 1944," 8 November 1944.

D. The Battle of the Bulge 16 - 24 December 1944

The Battle of the Bulge uniquely involved a stream of events and situations that offers an opportunity to examine the uses of barriers and obstacles in a context significantly different from that of the other operations under study. From the German standpoint it was: (1) an effort to break through the US and Allied forces then generally standing before the West Wall and in the process of preparing for a climactic attack on metropolitan Germany, and (2) a desperate attempt to regain an initiative that had long since been lost. The overall German plan envisioned a quick breakthrough, then a dash to the Meuse River, followed by the seizure of Brussels and Antwerp.

The story of this battle is complex. For this analysis, focussing on barriers and obstacles, the course of events will be examined in two of the American elements involved. For a detailed examination of hasty and local preparations of defensive obstacles under some pressure, the 4th Infantry Division has been selected. For the larger perspectives the First US Army is surveyed, since it did--under severe time constraints--develop a larger barrier and see parts of the system tested in combat. The following section is intended to provide the larger perspective. The next section will deal with the 4th Division experience.

US First Army, 16 - 23 December 1944

The timing, intensity, and location of the German attack were unexpected. The American troops were, in their own minds, preparing for the last great assault on the West Wall and thence into the heart of Germany. These troops generally may be described as battle-wise and battle-weary. Research for this study has not produced any evidence of serious American thought and effort going to major defensive barrier preparation until such time as the massive attack of the Germans and some of their initial successes registered on the US high command. The attitude expressed earlier by General Patton may very well project the thinking among Allied leaders at the time of the German attack and give some understanding of the state of defensive readiness that existed on 16 December 1944. In Letter of Instruction No. 4, dated September 1944, the Third Army Commander set out his views. He noted that an acute supply situation had caused the Supreme Commander to direct that until further orders Third Army would assume the defensive. He said that this change must be concealed from the enemy, and that further, we must possess a suitable line of departure for resumption of the offensive. The Letter went on: "In order to carry out the requirements . . . we will not dig in, wire, or mine, but will utilize a thin outpost zone backed at suitable places by powerful mobile reserves . . . "

It is pertinent that such defensive terms as OPLR (Outpost Line of Resistance) and MLR (Main Line of Resistance) did not appear with any frequency in plans and orders at the time. This does not mean that the battle-wise troops of the First and Third Armies were careless or neglectful; in the actual case, preparations for local security of temporary holding positions were routinely made. It is to be noted, however, that the plans and work programs of engineer units were not directed to deliberate preparations for the sort of massive and sudden attack that finally took place. When it became necessary to install barriers, circumstances dictated the "style" of their use.

The Setting. The use of large armor formations in the Ardennes is conditioned by the terrain. There is very little smooth and level going. Much of the country is rugged and irregular, with deep gullies, steep river banks, and narrow corridors along the east-west axis of movement. The road net, while adequate for local purposes, is only marginal for large military vehicular movements requiring several parallel roads. Much of the countryside is covered with patches of forest, providing good cover and concealment for foot troops but very unfriendly to tank movement. To the westward the ground becomes somewhat less difficult as the Meuse River is approached. Unfortunately for the German forces, they had to cope with the hard going first.

The weather in December is cold, and heavy snowfalls are not infrequent. Alternate freezing and thawing make the ground treacherous and unpredictable, supporting vehicles on one day and bogging them down the next. Heavy fogs and mists are common and, by affecting air support and reducing visibility, influence the course of extended battle. Rains also are frequent.

Operations. On 16 December the fourteen divisions of the US First Army were deployed facing the West Wall, covering the massive supply and communications areas from which the further advance into Germany was to spring. Army headquarters was located in Spa. Routine precautions and practices were in effect, but it is pretty well established that there was no indication of the scope and intensity of the attack to come and hence no elaborate preparations had been made for defense in depth.

Only natural river barriers and the sort of local position defenses that would be placed by experienced troops to cover a temporary halt before resuming the attack greeted the initial assault. At least one US unit on the north flank had also prepared some wire and mine obstacles and trip flares which gave local protection and engaged some of the German infantry for a time. Just to the south, where the principal armored sweep hit, there were no barriers of consequence.

The German plan called for great sweeps by two panzer armies, forcing an early crossing of the Meuse and pressing on to Antwerp and

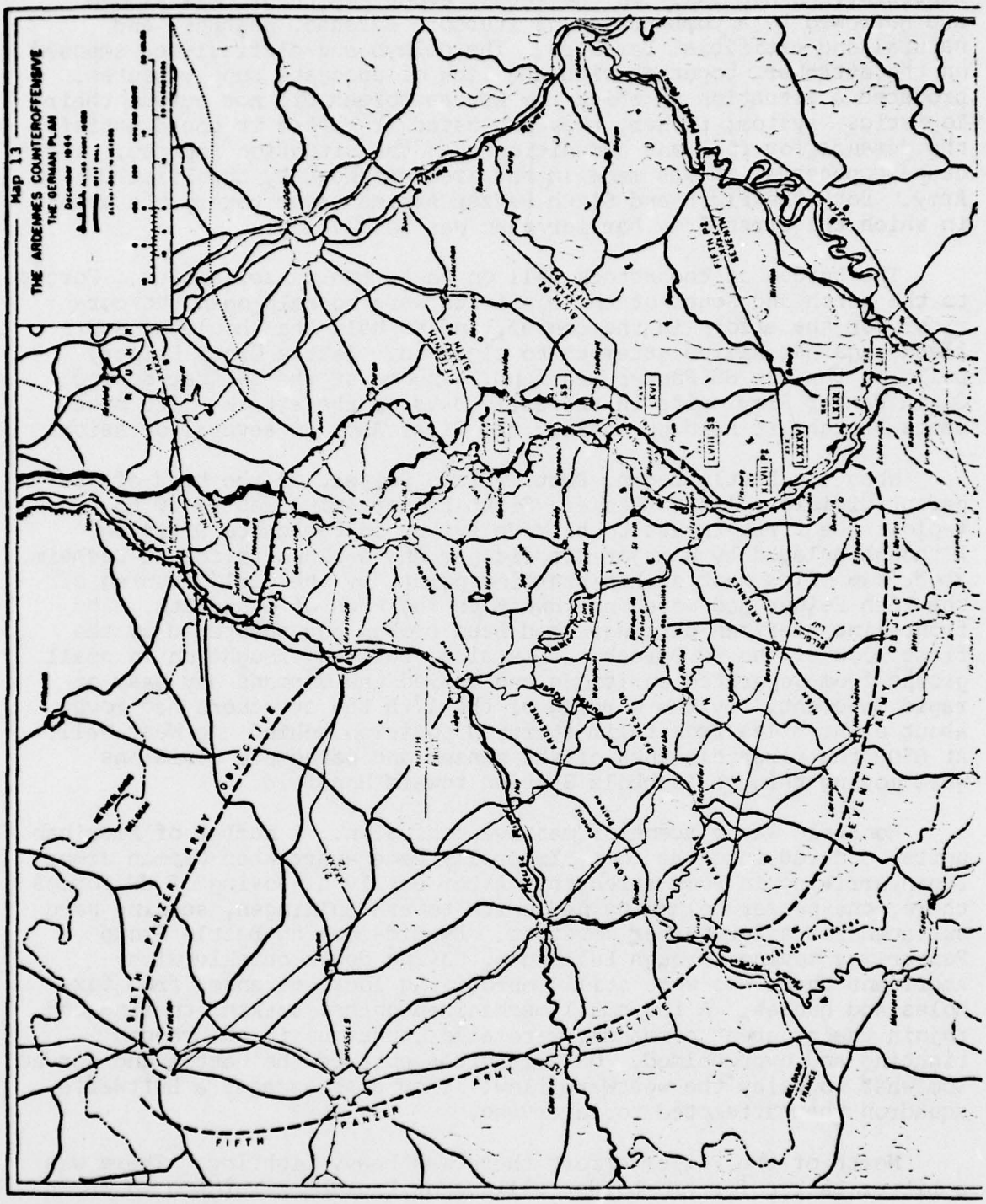
Brussels.(see Map 13). In the actual event the thrust was slowed and narrowed by a combination of stubborn defense, weather, and natural and artificial barriers. The delays and difficulties imposed on the attacker, together with the lack of adequate supply routes, produced a situation in which the German forces did not outrun their logistics system; rather, they exhausted it before it could satisfy the demands for fuel and ammunition that the situation imposed. The deepest penetration was made in the area defended by the First US Army. Both the Fifth and Sixth Panzer Armies drove toward the areas in which the First Army barrier plan was to develop.

The burden of the attack fell on these two panzer armies. Forces to the north and south of their efforts were to help open the corridor for the effort in the center, and to hold the shoulders and flanks against Allied attempts to close in. Battle Group Peiper, built on the 1st SS Panzer Regiment, was one of the swifter-moving Sixth Panzer Army units in the early days of the attack. Its movements brought it hard up against the First Army on several occasions.

When the battle began, Battle Group Peiper, at the head of its parent division, 1st SS Panzer, Sixth Panzer Army, was ready to exploit the first thrust to be made by the 3d Parachute Division. Although delayed by a major traffic jam and a blown bridge at Losheim, about two miles west of his starting point, by the early evening of the 16th Peiper had moved northwest to the town of Lanzerath. The front-line American defenders had been broken and scattered by the first blow of the 3d Parachute Division, but they fought on in small groups from separated positions and denied the Germans any easy or rapid movement. By the morning of the 17th the attackers had moved about eight miles from their starting position behind the West Wall. At 0500 the first elements of the panzer and parachute divisions were moving through Buchholz Station toward Honsfeld.

Honsfeld was a scene of massive confusion. A number of American units, ordered into the town, literally came apart when German armor began arriving in some strength. After easily disposing of US forces there, the panzer column turned north toward Bullingen, seeking hard surfaced roads for faster movement. By mid-morning Battle Group Peiper was moving through Bullingen, having dealt quickly with Americans there who were still improvising local defenses from foxholes and houses. A few small mechanized units, seeking to find and rejoin their parent commands, were also caught up in the random fighting and overwhelmed. US air forces entered the battle and served somewhat to delay the westward flow. They also engaged a Luftwaffe squadron that attempted to intervene.

North of the Peiper effort there was heavy fighting. There was a bitter battle for the border village of Louseheimergraben in which a small US force, lightly armed and defending from foxholes and houses, was overcome by the superior force that the attackers could summon. By the end of the day (17th) American troops in the attack



area were still under great pressure, but some reorganization was beginning and the Germans were being slowed and made to pay for the ground they were gaining. Barriers and obstacles did not appear to have any significant influence along the line of contact, although at noon on 17 December German infantrymen confronted and were delayed by a barrier line at Waimes. The general picture was one of isolated, small-scale fights, with the attacker usually able to field whatever firepower was needed to break up an American position. As information became available and control reestablished, the American withdrawal became more orderly, but it had to continue.

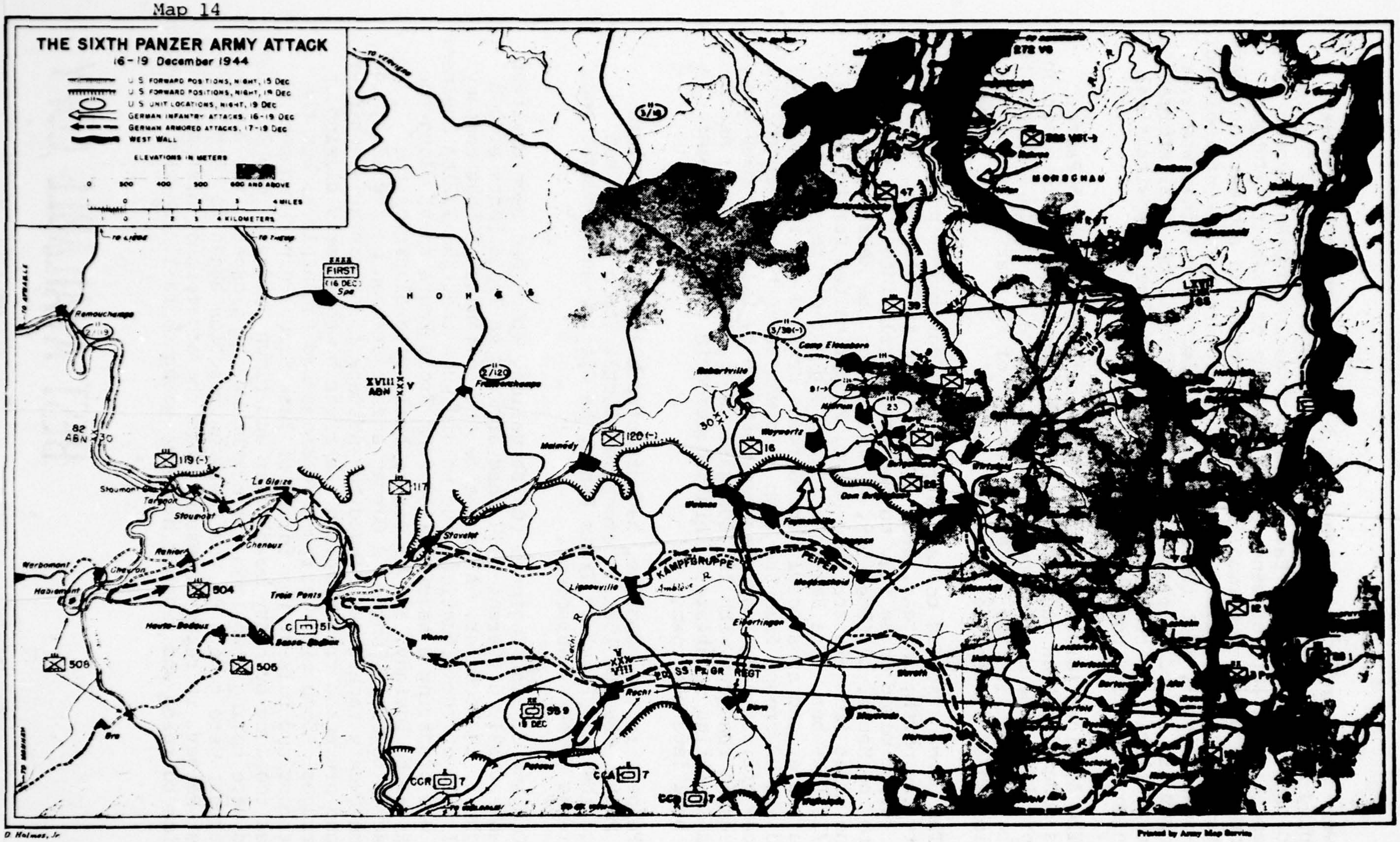
The American forces in the northern part of the Sixth Panzer Army's zone of action managed to withdraw into a defensible position that provided some continuity and depth. There they held and occupied sizable German units for the entire period of the battle. (For the position as of 19 December see Map 14))

The Germans seemed to pass a chance to cut in behind the US position to the north; instead, from its position in Bullingen, Battle Group Peiper moved on swiftly to the west, still intent on a fast dash to the Meuse. At Stavelot, 42 miles from the Meuse, and 25 airline miles from his starting point, Peiper halted for the night of 17/18 December. The American forces did not destroy the only bridge there, and as a result the Germans crossed the river and forced the US troops from the town. It was there that an ingenious American officer made a spectacular obstacle by filling a deep and unavoidable road cut with 124,000 gallons of gasoline from a nearby dump and setting it ablaze. This succeeded in turning the panzer force back into the town.

Peiper, in the meantime, had directed a strong force toward Trois Ponts. By the 19th, elements of Battle Group Peiper had reached the Salm River at Trois Ponts, La Gleize, and Stoumont and the Lienne Creek at Werbomont.

Company C, 51st Engineer (C) Battalion, which had been diverted from an entirely different task, had arrived in Trois Ponts around midnight 17/18 December. At the time the commander of that company knew little of the situation, but he did know that the 1111th Engineer Group was preparing a barrier line from Trois Ponts south along the Salm River to Bovigny, and he was to build road-blocks on the approaches to Trois Ponts. A German attack at noon on the 18th, led by some twenty tanks, was slowed by antitank fire from this engineer unit and prevented from crossing the river by the timely blowing of the bridges. Some minor stream crossings had taken place, but the main thrust and bulk of the forces of Task Group Peiper had been delayed too long by hasty roadblocks and blown bridges. New American forces were coming down from the north and the prospects for a lightning thrust were gone. As the American reaction began to be directed against Peiper, it became apparent that the attempts of his parent division to reach and support him were going to fail. On the afternoon

Map 14


THE SIXTH PANZER ARMY ATTACK
16-19 December 1944
U.S. FORWARD POSITIONS, NIGHT, 15 DEC
U.S. FORWARD POSITIONS, NIGHT, 19 DEC
U.S. UNIT LOCATIONS, NIGHT, 19 DEC
GERMAN INFANTRY ATTACKS, 16-19 DEC
GERMAN ARMORED ATTACKS, 17-19 DEC
WEST WALL
ELEVATIONS IN METERS
600 AND ABOVE
4 MILES
4 KILOMETERS
FIRST
(16 DEC)
Spa
MONSCHAU
KAMPFGRUPPE
PEIPER
Malmedy
Stavelot
Trois Ponts
Le Gleize
Stoumont
Cheneux
Habiemont
Werbomont
Remouchamps
Ligneuville
Recht
Vielsalm
Butgenbach
Weywertz
Camp Elsenborn
Francorchamps
XVIII ABN
82 ABN
508
504
505
117
119(-)
120(-)
16
23
38
47
CCR
CCA
CCB
7
51
99
18 DEC
2 SS PZ GR REGT
Ambleve R
Recht R
D. Holmes, Jr.
Printed by Army Map Service

of the 23d Peiper received permission to break out. Leaving tanks and other equipment behind, the movement to the east began. On the night of December 24 the force crossed the Salm River and on the morning of Christmas day rejoined the 1st SS Panzer units south of Stavelot.

By the evening of 19 December the attack of the Sixth Panzer Army had penetrated the lines of the American units as much as 15 miles westward, opening a corridor that was in some places five to ten miles wide. Caught up in the attack were many small US units, as the Germans achieved the surprise they sought, including most notably two thirds of the inexperienced 106th Division, encircled at St. Vith. For the Germans the capture of St. Vith, an important road center, was particularly important. Together with Bastogne, besieged by the Fifth Panzer Army to the south, it represented the key to the maintenance of logistic momentum of the German attacking forces.

German units had been delayed by roads jammed with their own traffic (in one case a mixture of horse-drawn and motor units) and blown bridges. A number of German tanks had fallen to mines laid hastily by the withdrawing American forces and to antitank fire from covering forces. Fighting at St. Vith was characterized initially by many small engagements and by the collision of troops in motion. One bridge was blown in the face of a German unit, slowing it for a time, and several engagements featured fights in and around built-up areas where houses served as both cover and barrier. The general state of mind at the time of the fighting in St. Vith may be felt in the attempt to move a large amount of engineer equipment farther to the west for use in the building of a barrier line. The forces in St. Vith withdrew, passing through 82d Airborne lines on 23 December, but not before they had made a significant contribution to the overall slowing of the German momentum.

By 19 December the attacking Germans of the Sixth Panzer Army began to feel the effects of the delays imposed on them by the combination of resisting troops, effective local barrier operations (particularly the denial of crossings by blown bridges) and the congested and inadequate road net. The leading elements of the onslaught were running low on fuel and, worst of all, were now pinpointed for the focussing of counterattack efforts.

South of the Sixth Panzer Army, the Fifth Panzer Army moved past the American forces being contained by the initial onslaught of the Seventh Panzer Army on the left. Fifth Panzer troops stood before Bastogne and Houffalize by the evening of the 19th of December. The record indicates that there were only a few, and uncoordinated, obstacles encountered up to these points.

The stand of American forces at Bastogne testified to the importance of that road center to both sides. The desperate resistance

put up by the US troops there caused a further disruption of the vital time table of the attackers and, in this fashion as well as others, provided an important element in the total "spoiling" of the plan for a dash to the Meuse. Engineer troops had erected a hasty and partial barrier on the east approach to Bastogne. There is little in the record to support an exact evaluation of this position, but its trace on the map coincides with the line held by the airborne troops who took over; so it obviously had a place in the total defense. Natural impediments entered into local tactical situations around Bastogne to the benefit of the defenders. Tank maneuver was impeded by soft ground off the road in several places and in at least one case an armor-supported attempt at penetration was foiled by a large ditch. The earlier defenses of Bastogne, beyond the perimeter finally held, was largely in the hands of small blocking forces (armor and engineers), aided at times by some demolitions and mining activity.

The dominant urge to reach and cross the Meuse directed the German effort. When the effort of the Fifth Panzer Army was exhausted, the Sixth continued in the same pattern and met defenses that lay on the westward extension of the First Army line facing the Fifth. The fighting that took place from 19 December onward was typified by a series of relatively small engagements which came about as a product of local judgments and opportunities, rather than as coordinated efforts on a broad front. The need to save or capture the bridges over the Meuse controlled the actions on both sides.

When Peiper's forces were stalled shortly after crossing the Salm River, the German thrust was picked up by units further south, primarily those elements of the Sixth Panzer Army which had moved on eastward north of the pocket at Bastogne. The Germans crossed the Salm in force, and engaged and pushed back troops of the 82d Airborne Division to a line from Trois Ponts to Manhay. Elements of some five American divisions and one British Tank Regiment became involved in holding the line Manhay-Hotton-Marche and containing attacks farther to the westward. The high water mark of the attack was reached at Celles and Fois-Notre Dame. Defenses along the Meuse River were alerted, and some British help was given, but the attack was spent, and December 27 saw the end of the planned attack.

The positional relationship between the opposing forces induced some special characteristics in the progress of the battle. The German forces, aiming at a rapid thrust toward distant terrain objectives, were committed to the maintenance of their advance even as it became more and more apparent that the drive was being throttled along its flanks. In the first three days the unprepared US forces were overrun or swept aside--with the notable exceptions of the road centers of St. Vith and Bastogne. As the American command began to react the Germans were faced with increasingly strong forces pressing at right angles on both the northern and southern flanks of their drive. These forces had to be dealt with,

and yet any delays further compromised their chance of seizing crossings on the Meuse. It was here that the barriers of the First Army had greatest effect on German progress. The necessity to deal with a major threat meant, in effect, a 90 degree turn away from the most direct route to the Meuse, into strong US forces and an organized obstacle system.

The First Army's Barrier System

The First Army, facing the massive thrust of the German effort, found it necessary to create an area-wide barrier system behind forces that were being pushed back by the German offensive (Map 15). The Army Engineer described the effort as being in "much larger scale than at any previous time." His After Action Report goes on to say:

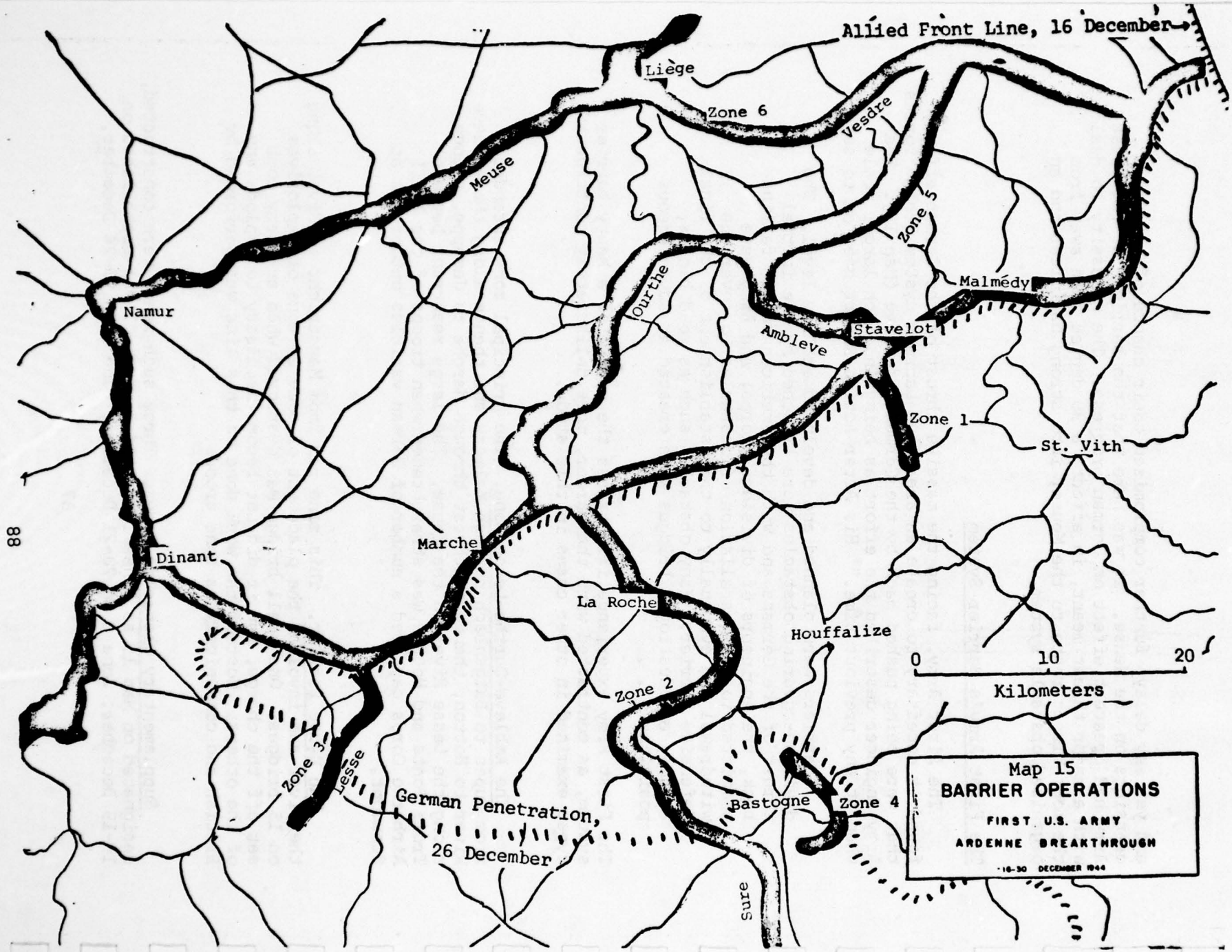
> Barriers were planned and developed at Army level. The division-covering obstacles were breached by the initial thrust of the Germans and with the American forces falling back, the engineers of divisions, corps, and Army were committed to the installation of obstacles to cover the withdrawal and eventually to the establishment of the final defensive barrier. Many obstacles such as road blocks, abatis, and destroyed bridges were created at advantageous positions . . .

The First Army experience illustrates the nature of a hasty barrier system, as contrasted with the harder, more deliberately constructed types examined in other cases in this study.

The Ambleve-Ourthe-Lesse Zone. The principal zone extended from Eupen to Butgenbach through Malmedy and thence along the Ambleve River to Hotton, thence southwest through Marche to Jemeppe, thence along the Lesse River to the Meuse. The large reentrant between Trois Ponts and Hotton was straightened when troops of the XVIII Airborne Corps captured a number of German vehicles out of gas at Stoumont.

The Meuse Barrier. This zone ran from Maastricht to Givet along the river and involved the placement of some 22 tons of explosives on 15 bridges. One small bridge was destroyed when an enemy bomb set off the charge, but it did not become necessary to explode any of the others. Most of the work done on this line was performed by British and communications zone troops.

Supplementary Obstacles Zones. Three such zones were constructed, designated on Map 15 as Zones 1, 2, and 3. Zone 1 was established on 18-19 December; Zone 2 on 20-21 December; Zone 3 on 23-24 December.


Allied Front Line, 16 December
Liège
Zone 6
Vesdre
Meuse
Zone 5
Malmédy
Ourthe
Namur
Stavelot
Ambleve
Zone 1
St. Vith
Marche
Dinant
La Roche
Houffalize
0
10
20
Kilometers
Zone 2
Zone 3
Lesse
German Penetration,
26 December
Bastogne
Zone 4
Sure
Map 15
BARRIER OPERATIONS
FIRST U.S. ARMY
ARDENNE BREAKTHROUGH
16-30 DECEMBER 1944

All three of these were hasty and thin, and all were pierced, but they were considered to have made a useful contribution to the overall slowing of the German advance. The Bastogne installation (Zone 4) has been mentioned earlier. A switch position, Zone 5, was prepared and manned by the 1105th Engineer Combat Group on 19-21 December but was not tested significantly. Plans were made but never executed for Zone 6, with the exception that some bridges were prepared for demolition.

The engineer units of the First Army were caught up in the general melee that characterized the early days of the counter-attack. Despite the conventional doctrinal injunctions about the use of these specially trained units, the necessities of the situation made them infantry attackers or defenders on many occasions. As the battle progressed and as they could be redirected, these units were put to work at their basic missions. Omitting the accounts of non-engineer activity, the following is a description of the major tasks of the Engineer Combat Groups in the First Army. These, it must be remembered, were Army units and were usually assigned in support of the several Corps. The engineer battalions of the infantry divisions performed much additional barrier and obstacle work in their own zones of action, thus contributing to the total engineer output. Finally, it must be remembered that infantry units make substantial contributions to the work of preparing positions.

The 1111th Engineer Combat Group prepared defenses and road blocks in the vicinity of Malmedy, beginning on 17 December at 1000 hours. They were reinforced by elements of the 30th Infantry Division at 2230. The unit destroyed all key bridges in the area and later claimed that this stopped the advance of the armored column headed for Liege. This group was also assigned the task of making the initial obstacle installations along the Ourthe and Lesse Rivers. The defense of these obstacles produced a number of German prisoners (some, it was said, wearing American uniforms) and much useful intelligence.

The 1128th Engineer Combat Group was initially operating in the rear areas of VIII Corps, but by 18 December it was in contact with advancing Germans. The Group was given a general mission to construct and defend road blocks. More specifically, it was to install zones of obstacles about Bastogne and along the Ourthe River from Hotton south to its junction with the stream Rau de Laval, thence along the stream to Sibret, thence along La Strange River and Sure River to Martellange. All three battalions participated not only in the preparation, but also in the defense of these obstacles. An interesting event took place when the 158th Engineer Combat Battalion was obliged to fight a heavy infantry engagement in order to reach and destroy a Bailey Bridge of its own construction in order to deny its use to the enemy.

The 1105th Engineer Combat Group was directed to construct a hasty obstacle zone connecting the Ourthe River zone with the Vesdre

AD-A050 781 HISTORICAL EVALUATION AND RESEARCH ORGANIZATION DUNN--ETC F/G 15/7
HISTORICAL EVALUATION OF BARRIER EFFECTIVENESS.(U)
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River east of Verviers. The 61st Battalion completed this task by 21 December and at that time it was the easternmost obstacle between the enemy advance and Liege. This obstacle was considered to be of primary importance because of the major US supply installations at Liege and along the Vesdre River. This battalion also built a hasty obstacle zone along the Lesse River from its junction with the Homme River south to the vicinity of Gembes. Enemy advance elements reached this area quickly, and obstacles were prepared and bridges blown while the two sides were actually in contact.

The 1110th Engineer Combat Group was not initially in the area under attack, but on 21 December it received two urgent missions. One was to assist in the construction of a hasty obstacle zone along the Lesse River between Dinant and Cinay; the other was to install a Bailey Bridge over the Ourthe at Hanoir.

The First Army's records and reports for the period are, in general, quite complete, although the level of detail is sometimes not all that could be wished. A study involving the roles and tasks of engineers in the rapidly changing flow of modern war should be aware of a general statement made by the Army Engineer.

> Important engineer activities during the latter part of the month (December) included establishment and defense of successive barriers before the advancing enemy, procurement and issue of large quantities of mines and fortification materials, movement of the 18 thousand ton Army Engineer Depot to a new location in a rear area, displacement of the large Floating Bailey Bridge Park to the rear, and reproduction and issue of large quantities of maps made necessary by the loss of the Army Map Depot.

Some of the US troops that entered the lines as the focus of action moved westward became heavily involved in barrier preparation. The 30th Division took up positions along the line Stoumont-Stavelot-Malmedy. The 105th Engineer Combat Battalion and the infantry troops immediately began preparation of obstacles. By the afternoon of 19 December hasty blocks had been established. The Germans were making determined efforts to take Stavelot, and it was decided to blow the bridge there over the Ambleve River. After several attempts 1,000 pounds of TNT was placed and the bridge destroyed around midnight. Farther west the engineers became involved in combat around Stavelot. Their principal task was placing road mines along the German routes. A company of engineers also built (and initially manned) blocks at Malmedy. As the organization of the division area progressed, engineers were freed from their additional duties and were able to concentrate on their basic work. On 22 December they began deliberately laying a series of minefields. Some of the area was described as flat and featureless, requiring in consequence more elaborate artificial obstacles. By 24 December the front line position was ready, and reconnaissance was being made for fall-back locations.

As recounted elsewhere, the bridges at Trois Ponts were blown, as well as several others. Still more bridges within the American lines were prepared for destruction if necessary. Help in setting out concertina was given to infantry units.

The 84th Division, also inserted along the northern flank as the battle moved westward, was in position along the line Hampteau-Menil - Verdenne-Hollonge-Waha-Hassanville-Honge by 22 December. One day earlier the 309th Engineer Combat Battalion had begun preparing a defensive position. Along the line from Marche to Hotton protective blocks and minefields were prepared. Between the 24th and 31st two engineer companies continued the installation of minefields and roadblocks and preparing bridges for demolition.

The US 4th Infantry Division 16 - 24 December 1944

The experience of the 4th Infantry Division during the German counterattack in mid-December 1944 was not one of defense behind a manmade barrier system. The division was deployed behind one of the most effective barriers there is, a swiftly flowing river. It was anticipating attack rather than defense, and only a few obstacles had been constructed. The river barrier did not prevent the Germans from attacking, but it did prevent them from promptly exploiting the bridgehead they established, for by the time they were able to construct a bridge on which to take over tanks and heavy weapons the Americans had moved in reinforcements and, most importantly, tanks. Meanwhile the unsupported German infantry had not been able to break through the hastily-organized American defense.

When the Germans launched their attack in the Ardennes region on 16 December 1944, the west banks of the Our, the Sauer and the Moselle Rivers were occupied by the VIII Corps of the US First Army. This was the right wing of the Army front, and on its extreme right was the 4th Infantry Division, which had been moved to that quiet sector in the first week of December, after a rough time in the Hürtgen Forest.* The division was understrength, both in men and in equipment. Along the 35-mile front, which followed the convolutions of the Sauer and the Moselle, the three regiments of the division were abreast, with the 12th on the left, adjacent to the right flank of the 9th Armored Division. The 12th covered the area from a point south of the village of Dillingen to the left flank of the 8th Infantry Regiment, south of Girst, with a front of not quite five miles from point to point but actually about nine because of the curves and bends in the river. The remaining 26 miles, stretching just beyond the southern border of Luxembourg, was divided almost equally between the 8th Infantry in the center and the 22d on the right. Beyond the 22d Infantry was the US Third Army.

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*4th Engineer Battalion (C) files contain excellent material on the construction of barriers in the Hürtgen Forest, 6 November - 7 December 1944.

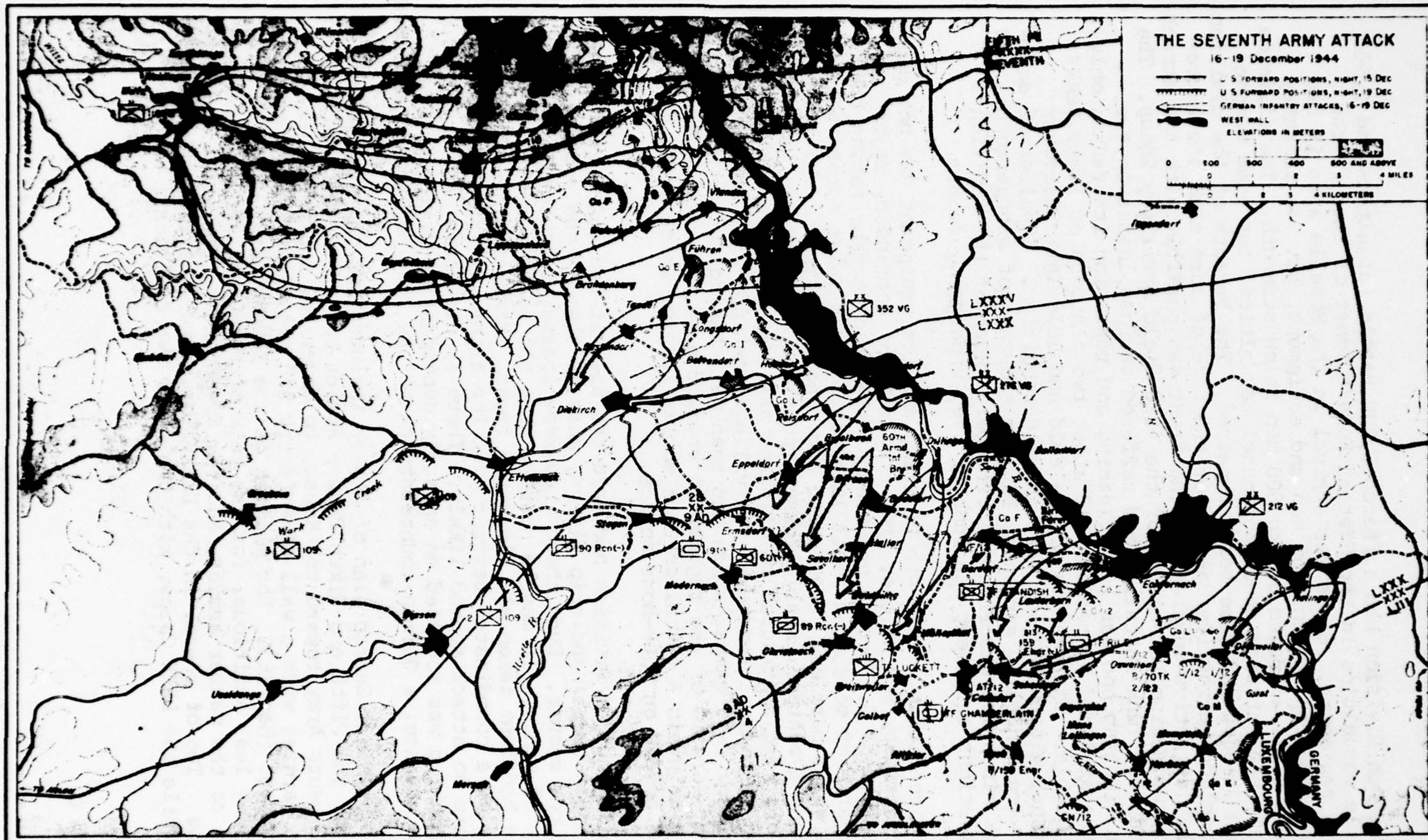
The 4th Division had suffered 5,000 battle casualties and 2,500 nonbattle casualties in the Hürtgen Forest, most of them in the infantry regiments. Since its arrival in the Moselle area it had received some replacements of men and equipment, but the infantry regiments still averaged 500 to 600 men below strength. The division artillery had suffered fewer personnel casualties, but some weapons had been damaged and were being repaired. The breadth of the division zone precluded effective massing of the fire of more than one battalion, but effective coverage of the front was possible with the attachment of two medium battalions of the 422d Field Artillery Group. The attached 70th Tank Battalion had suffered serious losses in the Hürtgen fighting and was busy cleaning and repairing its tanks; only 11 of the assigned 54 mediums and about two platoons of light tanks were operable. The weapons of the 802d and 803d Tank Destroyer Battalions, also attached, were in good condition. Supplies of ammunition were generally adequate, but the shortage of antipersonnel and antitank mines was described as critical. Much of the division's communications equipment was inoperative, undergoing repair.

The condition of the 4th Division and its equipment was not considered serious, for no one, from the division commander, Major General Raymond O. Barton, up, thought that the Germans facing them were capable of more than small local attacks or raids across the natural water barrier. The length and winding nature of the river front made a static linear defense impossible, and the regimental commanders were instructed to maintain small outposts at the river line and the main strength in the villages behind. But Barton moved the division rest camps, which had been well behind the area, to positions forward of the regimental command post. He also had each regiment maintain a battalion as a mobile reserve which could be moved as needed on four-hour notice.

While the 83d Division had held the area it had installed some mines, booby traps, and trip flares, most of them in the southern part of the sector. Even there they were sparse, because of the shortage of mines. It may be assumed that the usual security precautions had been taken all along the front. However, there is no evidence of a coordinated barrier plan for either division, in this area where no attack seemed likely. There as elsewhere on the Allied front thinking was focussed on an early continuation of the Allied eastward advance; a German counterattack to the west was not anticipated.

The original German plan of attack included not only the main thrusts of the Fifth and Sixth Panzer Armies but on the left an attack by the Seventh Army toward the Meuse, to cover the southern flank of the other armies with a wall of infantry and artillery facing south and southwest (Map 16). The mission of the Seventh Army as it finally evolved was less ambitious, for the bulk of the German forces had been assigned to the panzer armies, and the Seventh was left with only four divisions. Two of these, in the LXXXV Corps, were to cross the Our River, while the LXXX Corps, with the other two divisions, was to

Map 16



D. Holmes, Jr.

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cross the Sauer south of its union with the Our, establish a bridgehead at Echternach, and advance to the southwest. The Army had a total of 319 artillery pieces, some of them horse-drawn, including a few batteries of long-range 120 mm guns, and 108 rocket launchers. There were a few tanks, and the Army had 30 assault guns, half of which were assigned to the 5th Parachute Division, on the extreme right.

The left wing of the Seventh Army attack would hit the area occupied by the 12th Infantry Regiment of the US 4th Division. Except for the reserve battalions of the other two regiments, which were moved in to support the 12th, that regiment was the only one involved in the first phase of the action, the German attack.

The area occupied by the 4th Division is rough, broken by sharp rises and deep ravines and in many areas covered with thick woods. On the left, northeast of Waldbillig and north of Mullerthal, a plateau is cut by a gorge, 300 to 500 feet deep, through which flows a rapid brook known as the Schwarz Erntz. This formed a natural boundary between the 4th Division and the 9th Armored Division on the left. It also offered a route of penetration between the two divisions.

On 16 December the 12th Regiment of the 4th Division lay in the path of the 212th Volks Grenadier Division, on the left of the Seventh Army. In accordance with General Barton's orders, a company each had been posted in five villages on the main and secondary roads leading southwest from the Sauer: Berdorf, Echternach, Lauterborn, Osweiler and Deckweiler. In each case the rifle platoons and weapons sections were in outposts along the river, and only the command posts were in the villages.

Undetected by the US forces, between 13 and 16 December the German 212th Division concentrated on the east bank of the Sauer River in preparation for the attack, leaving the front to the south, where it had been, only weakly defended. The division had recently been renovated after three hard years of action on the Eastern Front, and General der Panzertruppen Erich Brandenburger, commanding the Seventh Army, considered it his best. It was at full strength in personnel and well equipped, except that it had only four assault guns. An excellent intelligence effort had equipped it with knowledge of the location of most if not all of the 4th Division's outposts and artillery positions.

Following a heavy artillery bombardment in the early hours of 16 December, which destroyed the 4th Division's landlines in the forward area and further complicated the communications problems, two regiments of the 212th Volks Grenadier Division crossed the Sauer River in boats. Even as they crossed, German guns were pounding command posts in the areas of Berdorf, Lauterborn, Alttier, Osweiler, Dickweiler, and particularly Echternach. The 423d Regiment landed on the German right, north of Echternach, and the 320th on the left,

east of Echternach since the river there curves to the east. The light rubber boats had trouble with the swift current of the river, and the 320th was forced to land near Edingen, considerably east of its intended landing spot, and did not get ashore until well after daylight. The Germans encountered no serious obstacles on the shore, human or man-made, and proceeded toward their objectives. For the 423d this was the plateau around Echternach and the road west through Lauterborn and beyond. For the 320th it was the hills north of Osweiler and Dickweiler and the towns themselves. The two regiments were to join forces after taking their objectives. German troops of the 423d Regiment overran or cut off the outposts north of Echternach and were approaching the town of Berdorf before word of the crossing reached the US regimental headquarters at 1015. Other Germans attacked US troops at Lauterborn soon thereafter. At about 1100 Echternach was under attack. The outposts east of Echternach were apparently warned of the German landings upstream, thanks to the current that interfered with the 320th Regiment as it tried to cross, and most of the outposts managed to withdraw. Some reached a hat factory southwest of Echternach, where they organized a strongpoint. An attack on Dickweiler late in the morning was driven off by the defending Company I.

It was noon before the picture at regimental headquarters became clear enough to reveal an attack in force. With communications in all sectors of the regimental area poor to non-existent, it was impossible to determine the degree of enemy penetration. Artillery fire was of limited value, for so scattered were the artillery units along the division front that only the 12 105 mm. howitzers of the 42d Field Artillery Battalion and three howitzers of the regimental cannon company could reach the area with their fire. Because of the accuracy of the German artillery fire on US artillery positions, these guns were forced to displace several times during the day.

General Barton authorized commitment of the regimental reserve battalion and eight medium and ten light tanks. The tanks were handicapped, however, because rain and snow had turned the land into mud, and they were confined to the roads for maneuver.

A company of infantry of the reserve battalion, mounted on tanks, reached Lauterborn and drove the Germans from the town and part way back to Echternach before nightfall. A similar group failed to drive the Germans from Berdorf. At the end of the day Dickweiler was still in American hands, but the Germans had increased their strength in the area, practically isolating Osweiler and Dickweiler and moving southwest toward Herborn.

On 17 December, both sides sent in more troops. The Germans moved up a shock company from their reserve regiment and put part of the 23d Festung Battalion across the Sauer near Girst, on the right of the US 12th Regiment front. But American artillery kept the Germans from building a bridge near Echternach, and German efforts consequently were hampered by lack of tanks and heavy weapons.

The US 4th Division moved all readily available support into the area during the night. The 2d Battalion, 22d Infantry, and two tank platoons, from regimental reserve, were ordered to report to the 12th Infantry command post, together with a medium tank company of the 19th Tank Battalion, 9th Armored Division. The division reserve--the 4th Engineer Combat Battalion and 4th Cavalry Reconnaissance Troop--were moved behind the 12th Infantry, and three battalions of 155 mm. howitzers and two of 105 mm. were shifted north to reinforce the 15 howitzers that had been supporting the 12th Infantry on the first day of action.

The Schwarz Bantz gorge, on the division left, far from providing protection, offered a threat of a German flanking operation, for the Germans had gained access to a ravine west of Berdorf with a winding road leading down to the road that ran through the bottom of the gorge. They emerged at Breitweiler as well as branching up several ravines into the regimental flank and into the flank of the 9th Armored Division across the gorge. Consequently, three hours before sunrise General Barton sent the 4th Engineer Combat Battalion and 4th Cavalry Reconnaissance Troop to Breitweiler. Troops of the German 987th Regiment, reserve regiment of the 276th Volks Grenadier Division, which had been attacking the US 9th Armored Division, were observed advancing through the gorge shortly after 0930, and Company C of the US 70th Tank Battalion, with eight tanks, was rushed to Breitweiler. A mile and a half south of Breitweiler, in Colbet, a task force, named for its commander, Colonel James S. Luckett, was hastily assembled, with the 2d Battalion, 8th Infantry, the reconnaissance company of the 803d Tank Destroyer Battalion, a battery of 105 mm. howitzers, the assault gun and mortar platoons of the 70th Tank Battalion, and two platoons of Company A, 19th Tank Battalion, from the 9th Armored Division, added to the engineers and cavalry already near Breitweiler. The Germans, pounded by American artillery, advanced to Mullerthal, threatening the command post of the 2d Battalion, 12th Infantry, at Consdorf; but, attacked by elements of the 9th Armored Division in the afternoon, they did not proceed further.

The 4th Engineer Combat Battalion, in the meantime, with the arrival of some of the elements of Task Force Luckett, had gone to work constructing obstacles to prevent the Germans from emerging from the gorge. Working rapidly, Company A prepared the bridge west of Breitweiler for demolition, and west of Mullerthal constructed a roadblock of abatis and mines, Company B constructed a roadblock of mines on the road from Mullerthal to Consdorf, and Company C built one west of the bridge at Breitweiler (Map 17). Records do not indicate whether the roadblock west of Mullerthal discouraged the Germans from advancing further, but the other three were beyond the area of penetration.

Elsewhere on the 17th the Germans made some gains. At Berdorf they continued to hold the village, despite a tank-supported US attempt to relieve it. Troops of the 320th Regiment and fusilier

Map 17

OBSTACLES IN THE SCHWARZ ERNTZ
17 - 21 December 1944

battalion bypassed Lauterborn and advanced to Scheidgen. On the right of the 12th Infantry front, American troops held off the Germans in the Osweiler area, at considerable cost to the attackers.

The 10th Armored Division of the Third Army was sent north to Luxembourg in the morning of 17 December, and Major General Troy Middleton, commanding the VIII Corps, ordered one combat command to proceed to Bastogne; the remainder of the division was to prepare to counterattack with the 4th Infantry Division. CCA proceeded to the area and prepared for a three-pronged counterattack on 18 December, one task force to advance through the Schwarz Erntz gorge, one on the Consdorf-Berdorf road, and one through Scheidgen to Echternach.

In a thick fog on the morning of 18 December a small tank-infantry team of the task force on the left (Chamberlain) advanced down the narrow defile that led into the gorge from Entweiler. It was so narrow that the tanks proceeded in single file. Progress was extremely slow, under constant fire, and when the lead tank was immobilized by an antitank projectile the rest of the column had to maneuver slowly around it. They finally stopped at a road junction south of Mullerthal.

Task Force Luckett advanced west of Mullerthal in the afternoon. Elements reached beyond the road to Waldbillig but failed to seize the objective, the wooded bluff that commanded the gorge road north of Mullerthal.

The center task force of CCA (Standish) made little progress in stiff fighting in an attempt to take Berdorf. The third (Riley) took Scheidgen, which the Germans, moving on to the south, had abandoned. An attempt by five US tanks and two companies of engineers to take a hill overlooking the Lauterborn road was halted by a thick fog. Other elements of Task Force Riley proceeded to the area north of Lauterborn and the southwest edge of Echternach. Company E, 12th Infantry, still holding out on the outskirts of Echternach, refused to withdraw under cover of the tanks, and the task force pulled back to the area of Lauterborn.

Southeast of there General Barton sent in the 2d Battalion, 22d Infantry, to strengthen the defenses in the Osweiler-Dickweiler area. Actually, however, German pressure there had lessened, as German troops widened and deepened their penetration between Scheidgen and Osweiler, reaching Geyershof and Maisons Lellingen, northwest of Herborn.

Although the Americans were unable to install an artificial barrier, the Sauer River, covered by US artillery fire, was proving a difficult obstacle to the attacking Germans. American artillery destroyed a ponton bridge the Germans attempted to put into use at Echternach, and still the German attackers were forced to operate without tanks and heavy weapons on the west side of the river. Infantry could travel in boats, however, and elements of the 316th Infantry were

moved across to join the Germans already in the bridgehead. Although the operations on 18 December netted little advance for the Americans and some further penetration for the Germans, the US tanks were holding the German infantry from sweeping on to the west.

The following day, 19 December, was very cold and foggy, and neither side made much progress. On the left of the 4th Infantry Division zone, Task Force Luckett, with fire support from the tanks of Task Force Chamberlain, tried again to reach the high ground north of Mullerthal. Casualties were heavy, and Task Force Luckett abandoned the effort, deploying on the ridge southwest of the Waldbillig-Mullerthal road, with the new mission of denying the Germans use of the road net, between 965338 and 979324. To accomplish it Colonel Luckett ordered the 4th Engineer Combat Battalion to build roadblocks at two vital points, southwest and southeast of Mullerthal, with abatises and mines, covered by machine guns.

Concealed by the fog, the Germans spent most of 19 December regrouping and bringing over reinforcements. During the afternoon a bridge was completed at Edingen, near where the 320th Infantry Regiment had crossed on 16 December. At last the Germans could start moving tanks and heavy weapons across the river. Task Force Standish made some progress at Berdorf in its house-to-house effort to clear the town, and gained the ridge southeast of it. During the evening they became involved in a fire fight with the 2d Battalion, 423d Regiment, which was attempting to capture Consdorf and had cut the road between it and Berdorf. Task Force Riley resupplied Company E in Echternach, but orders for the company to withdraw arrived too late for the infantrymen to be removed on the tanks of the task force. They ultimately surrendered.

Elsewhere on the front, at Osweiler-Dichweiler and at Scheidgen, the situation was quiet, with no German attacks and no attempt to enlarge their penetration in the center of the 12th Infantry area.

South of the 12th Infantry Regiment there had been no German attack. With completion of a bridge, however, the threat of a German thrust to the south seemed greater. The supply of mines to the 8th Infantry apparently increased, and mines were installed at strategic positions on the avenues of approach to the area. In the next three days mines were laid in 22 places. There is no indication that any of them was ever tested in combat.

As part of the Third Army plan to hold the Germans on the south flank of the Bulge while Third Army units rushed north to counter-attack, CCA of the 10th Armored Division was alerted to withdraw to serve as a mobile reserve. The plan in the 4th Division area on 20 December, therefore, was to shorten lines and strengthen defenses while withdrawing the support of the 10th Armored Division's CCA. The Germans, meanwhile, had interpreted the appearance of CCA as the beginning of an American counterattack in strength. General der

Infanterie Franz Beyer, commanding the LXXX Corps, decided to place the corps on the defensive. He ordered the 212th and 276th Volks Grenadier Divisions to crush small points of resistance and continue local attacks to secure the most favorable ground on which to build a coordinated corps front to resist the anticipated US attack. Thus both sides were actually shifting to the defensive on 20 December. Nevertheless there was considerable fairly heavy fighting, as both sides attempted to improve their positions.

On the left of the 4th Division front, elements of the 276th Volks Grenadier Division pushed the 9th Armored Division's defenders out of Waldbillig. However, Task Force Luckett continued to cover the road from there to Mullerthal and the roadnet around that town, as Task Force Chamberlain of CCA, 10th Armored Division, went into reserve.

A German counterattack at dawn recaptured the small amount of ground the Americans had gained at Berdorf in the previous two days. A team of Task Force Standish, CCA, succeeded in reopening the road from Berdorf to Consdorf, which the Germans had cut, and the American defenders of Berdorf withdrew during the evening to positions north and east of the town. Relief of the Americans of Company E still holding out in Echternach proved impossible. Task Force Riley withdrew from Lauterborn as the base there was abandoned, and new lines were set up west of Osweiler to take the high ground northwest of the town, but after a gain of 500 to 700 yards against stiff opposition the attack halted.

By the end of 20 December the 4th Division line ran from the 9th Armored Division boundary on the left, west and south of Mullerthal, through Consdorf, Hill 313 southwest of Lauterborn, Osweiler, and Dickweiler to the river south of Girst. Both ends were firm, although the center was still somewhat weak. The Germans controlled the northern edge of the road net that led into Luxembourg, but they were not prepared to exploit it.

On 21 December Task Force Luckett maintained its defense on the roadnet at Mullerthal, readjusting to protect its flank from the enemy at Waldbillig. Three roadblocks were installed in the area, one with mines and abatis near Breitweiler, one with mines southwest of Mullerthal, and a third of unknown character west of Consdorf.

In an attempt to increase their penetration into the American area, elements of the German 212th Füsilier Battalion attacked through Lauterborn and drove parts of two engineer battalions back to Scheidgen. In midafternoon German troops attacked Consdorf, but were driven off. An attempt to take Osweiler was also halted, in the woods near Rodenhof.

As part of the reorganization of the American forces in preparation for a counterattack, on 21 December the 4th Infantry Division was attached to the XII Corps. The 5th Infantry Division was relieved

from its position near Saarlautern and sent to assist the weary 4th Division. Arriving in Luxembourg, the 10th Infantry Regiment, 5th Division, was ordered to attack northeast from the area between Scheidgen and Michelhof on 22 December, in coordination with the 12th Infantry.

German artillery shelled the center of the 4th Division area heavily, as the American units were preparing to attack. About a half hour before H-Hour, two German battalions hit the 1st Battalion of the 12th Infantry in the vicinity of Scheidgen. The defenders held, but the plan for an Allied attack was abandoned. Two battalions of the 10th Infantry, south of Scheidgen, also came under attack as they tried to advance, and they were unable to clear the line of departure. Elsewhere the area was fairly quiet. Task Force Luckett maintained its position on the left, and the 3d Battalion, 22d Infantry, moved up to secure the line of defense from Osweiler to Dickweiler. For the first time since the German attack started, the weather was clear and air support was possible.

The 10th Infantry attacked again on 23 December, supported by elements of the 12th and 22d Infantry, primarily with artillery and mortar fire. In the heavily forested, ridged area, the Americans had heavy going and made little progress despite the support of six artillery battalions. Task Force Luckett and the remainder of the 4th Division remained in their positions with little activity.

On 24 December the 5th Infantry Division attacked north and east through the 4th Division, and the elements of the 4th held in place, supporting the attack by the 5th with artillery fire. As the 5th Division took over the fighting from the 4th, Task Force Luckett and the 12th Infantry shifted to new assembly areas. The adjusted front of the 4th Division extended from northwest of Osweiler to the vicinity of Mertert. Along the front in the following weeks the 4th Engineer Combat Battalion joined Combat Team 8 of the 8th Infantry Regiment in installing a complex of obstacles that would probably have rendered a German attempt to invade across the river in that area very costly.

IV. COMPARISONS AND QUALITATIVE ANALYSIS OF BARRIER EXPERIENCE

Introduction

The four examples of combat experience described in Chapter III represent as many types of barrier experience, both in form and in function. It is now desirable to compare these operations in the general areas of the planning, execution and functioning of the barriers involved in each. The qualitative comparisons and analyses in this chapter form a basis for the quantitative analysis in the next.

Plans

Origin

Kursk. Of the examples in Chapter III, the barrier plan at Kursk was the most complex. The decision to fortify the Kursk salient in great strength in order to withstand an anticipated German attack was made by the Supreme Soviet High Command (Stavka) on 12 April 1943, three months before the attack came. Responsibility for the construction was assigned to the two Army Groups and within each group to each of the armies, divisions and other units for its own sector. Identification of the most vulnerable areas and plans for organization and arrangement of the defenses were coordinated and approved in meticulous detail for the whole area by the various levels of command up to and including the Stavka.

Nikopol. At Nikopol the German High Command was determined to hold a bridgehead on the left bank of the Dnieper River and ordered construction of a barrier system while combat was going on and the Soviet forces were advancing. When the front stabilized, it became possible to proceed in methodical fashion and build defended positions in depth.

Il Giogo. Construction of a defense line or barrier on the southern slope of the Apennine Mountains between Florence and Bologna was part of the total German plan for successive defensive positions on the Italian peninsula. Because of the extremely rugged nature of

the terrain the defenses could be concentrated on the passes through the mountains. To what extent plans prepared above the operational echelons were more elaborate than definition of the barrier line is not known. Work on construction was undertaken initially by Organization Todt, with about 28,000 Italian laborers, and accelerated in June 1944 after the fall of Rome, when responsibility for the defenses was assigned by the Commander in Chief, Southwest, to the units which were to defend the line.

Ardennes - First Army. There was no systematic barrier plan for the Ardennes area. Unlike the other three areas, in the Ardennes there had been no anticipation of attack and consequently no deliberate decision to construct a barrier system. Once the attack came, obstacles were constructed under a general sort of plan to hold in position. The positions were selected by the development of combat, since there was no time to do otherwise. Apparently fragmentary directives were issued by the First Army, directed to the engineer units designated to do the construction work.

The 4th Division, whatever directive it may have received from the First Army, used its engineers to block what appeared to be the most vulnerable area, the division commander approving the orders of the regimental commander as part of the daily plan. During the period of the German attack there apparently was no coordinated barrier plan, either for the regiment or for the division.

Purpose, Function and Design

The barrier requirement is set as an integral part of a defense. The range of alternatives coincides with the range of perceptions of the highest command. The style of the barriers eventually produced is influenced not only by command perceptions, but also by the numerous physical factors and by certain natural conditions.

Kursk. The Soviet barrier plan at Kursk was conceived as part of the major defense to be offered to a German attempt to reduce the large salient which the Russians had established around Kursk in their winter offensive of 1942-43. It was thought that a strong position, with great depth, would wear out the Germans, destroy their tanks, and then make it possible for the Soviet forces to introduce fresh troops in a general offensive and to inflict a major defeat on the main German forces.

The entire salient at Kursk, as described in Chapter III, was made a fortified area, with obstacles and barriers in a coordinated system in great depth, improving upon the natural obstacles in the terrain. The general pattern of the defenses followed Russian barrier doctrine. The extent of the construction is partially illustrated

by the fact that in the 550 kilometers of front in the whole salient there were 10,000 kilometers of trenches, in the 244 kilometers held by the Voronezh Army Group there were 4,200 kilometers, and in the 64 kilometers of the Sixth Guard Army's sector there were 500 kilometers. In addition to careful planning of the barrier system adequate provision was made for manpower, in both numbers and deployment, to defend it.

Nikopol. The German position at Nikopol was intended to maintain a bridgehead on the east bank of the Dnieper River from which later operations would be launched. The barrier system that was constructed there was carefully planned to take advantage of the ravines that would make natural obstacles for tanks and to make the strongest defenses in the sectors which seemed most likely to come under Russian attack, and at the same time where they would best protect the two river crossings which were vital for the defenders supply and evacuation. In fact, the Russians did focus their attacks on the areas where the Germans expected them.

Il Giogo. The barrier system of the Green Line in Italy was intended to function as a position to which the Germans could fall back if necessary, which they would hold if possible, and where they would wear down Allied units and keep Allied forces involved which might otherwise have been diverted to the fighting in northwest Europe. Since the Apennines are in themselves a barrier, the barrier system was designed to improve on the natural obstacles and in particular to prohibit to an attacker ready access to the passes through which the roads ran north. The positions for fortification were well selected and mutually supporting. In this area alone of those discussed in this study it was necessary to cut into the rock. In the Green Line also was the only extensive use of concrete, steel prefabricated pillboxes and such structural materials.

Ardennes. What emerges from the detailed record of combat in the Battle of the Bulge is a planned barrier system devised after the German breakthrough on a line which seemed to be defensible, and a loosely organized system of obstacles which made maximum use of natural or manmade features and quickly constructed impediments to the progress of tank and infantry units. The principle of coverage by fire and surveillance was routinely observed. As the battle progressed it became more and more apparent that streams were the most significant obstacles, and thus the blowing of bridges and controlling of other crossing points were critical considerations for both sides. Mines, often randomly placed (and sometimes placed and left behind by friendly forces), were particularly effective, and their use in narrow passageways gave high returns.

The barrier system was made up of local defenses, based on the intensive use of mines, craters, and blown bridges--anything that would impede the rapid German advance to crossings of the Meuse River. The design of the system was produced by events. The barriers were constructed along the lines that the American troops entering the battle as it progressed were likely to reach and make their stand on. In many cases the "final defense obstacle" was built behind troops already engaged, in anticipation of their gradual withdrawal. Accounts from lower levels lead to the conclusion that the location of barriers was set, in effect, by the positions and missions assigned the divisions as they arrived on their new positions.

General. A deliberately conceived barrier system originating at higher command levels was usually established in general terms by designation of a major trace or an area to be protected. The decision involved, in some cases, a major strategic goal--as in the Russian plan deliberately to withstand a massive German thrust by a defense that would destroy the German forces involved as important fighting entities. In other cases the high command wanted to preserve a tactical option, maintain the security of a base area or an area for the support of future operations, or simply to delay and damage an attacker. It appears that it was usually at the division level that the details of fitting barrier to ground were executed. Given time the officers of the division, regiment, and smaller units selected the locations of individual positions and laid out the actual location of the individual items that together formed an obstacle. The records show no significant variance from the logical process.

Time Allowed or Allowable for Construction

Kursk. In the Kursk area, the Voronezh Army Group had stopped the German attack at the end of March 1943. Defensive preparations began immediately. The major strategic decision to conduct an initial strong defense, and consequently to prepare elaborate defenses, was taken on 12 April. The German attack was not expected before June and actually took place on 4 July. With plenty of laborers to do the work, the time available for preparation of barrier systems was, in general, adequate. By the time of the attack the effort seems to have passed the point of diminishing returns.

Nikopol. The work done by German forces at Nikopol took place under more restricted conditions. The opponents were in contact from the beginning, and much of the construction was done in range of Russian artillery. The time available for constructing a barrier system for the bridgehead was almost three months, and the record notes that several strongpoints built to protect roads to the rear were not completed at the time of the Russian attack. The Germans

worked on front line defenses only at night, but work on the inner defense lines was continued around the clock.

Il Giogo. General preparations in the area that included Il Giogo began in late 1943, when the combat zone was still far to the south. After Rome fell in June 1944 the direct order for fortification work was issued. In the earlier period construction of the barrier defenses of the Green Line were not given a high priority on men or material because the barriers farther down the Italian peninsula still lay between it and the Allied attack. Frequent changes of responsibility further mitigated against concentrated effort during the period prior to June 1944.

Ardennes. In the strictest sense, there was no formal time allowance for US barrier preparations in the Ardennes in advance of the attack. Since the Allies were anticipating attack rather than defense the work that was done was not on a barrier system designed to withstand an attack in force but merely sufficient to halt small raiding parties. Had a defense been contemplated the First Army had two to three months in which one might have been constructed.

Terrain

The importance of terrain features as natural obstacles is well illustrated in all of these examples, and in each case the obstacles were designed to capitalize on them.

Kursk. The ground held by the Sixth Guard Army at Kursk is rolling, with numerous ravines, three rivers and several small streams. Small wooded areas, towns and villages were scattered through the area. The obstacles were adapted to the terrain features to enhance the delaying value of natural configurations and to provide mutual support. There was one hardtopped main road and numerous secondary ones.

Nikopol. The generally flat terrain of the Nikopol bridgehead is broken by a few ravines, some of which were natural tank obstacles. Orchard areas, stone fences, and burial mounds were all put to use as part of the barrier system. The improved roads radiated from the crossing sites. A network of dirt roads crisscrossed the area.

Il Giogo. In the Il Giogo area the ground is steep and rocky, with cliffs as high as 3,000 feet, and razor-backed ridges running parallel to the axis of attack, flanked by deep ravines, peaks and knolls. Except for the main road through the pass, the roads were mainly unimproved and often nothing but mountain trails, impossible

for wheeled vehicles to negotiate. Defense positions and obstacles were primarily sited to cover the main road through the pass.

Ardennes. The terrain is rough, broken by sharp rises and deep ravines and in a large part of the First Army area covered with thick woods. A deep gorge on the left of the 4th Division area proved more advantageous to the attackers as a route of approach than to the defenders as an obstacle.

General. Terrain often formed an important part of a barrier and thus shared in whatever success or failure the barrier may have had. In the cases studied, the nature and use of local terrain substantiates some general comments on the function of terrain features.

a. Steep and rocky ground is a barrier in itself. The natural slowing effect is easily enhanced by skillfully placed obstacles. Such ground inhibits the use of larger mechanized weapons, thus limiting the scale or style of combat. Difficult going tends more quickly to tire attacking infantry and to shorten their period of endurance. Exposure to fire while moving, combined with coordination of barriers with "killing zones," increases the attackers' casualties. Cratering and demolition on roads make substantial contributions to barrier effectiveness at relatively low cost. A small number of mines make roads and trails useful components of a barrier.

b. The flatter the country the greater the material requirements of a barrier system. Obstacles must be uniformly placed and density must be increased when no natural features can be exploited. Successive lines to block or retard penetration add further to construction problems. The absence of canalizing or delaying natural features require that man-made devices be substituted. In level ground the combined effect of obstacles and front line weapons can be great, but the weapons positions are more exposed to attack.

c. "Mixed terrain"--of the type met in the Ardennes and at Kursk --poses a requirement for careful analysis. The continuing need for symmetry between the major tactical and strategic plan and the installation and coordination of local elements of the total system are demonstrated by the experience at Kursk. Maximum exploitation of terrain within the constraints of an overall concept produced a classical demonstration of the role of ground in barrier planning and development. The real value of the skillful use of a specific terrain "package" in a meticulously-planned major defense can only be seen as essential.

d. The trafficability of an area grows in importance with the roles of armored and mechanized forces. An inadequate road system reduces the momentum of the attack. When cross-country going is limited or impossible, the barrier effect further increases. Finally,

when rain, thawing snow or ice, or static ground water produce heavy mud, the natural barrier effect is maximized. The frequency with which mud and swampy areas imposed serious obstacles to an attacker suggests very strongly that the possibilities for local weather control in the combat zone should be explored.

e. The single most important natural feature in the cases studied was the river. The stream itself, if of proper depth and width, is a continuous obstacle throughout its length. Bridges are in effect defiles that can be destroyed, thus sealing passage entirely. The attacker, when he attempts to replace the crossing, creates a defile where defensive effort can be concentrated. A bridge destroyed behind an attacking force reduces its logistic flexibility and cuts off following troop support.

Execution

Manpower

Kursk. Just as the barrier system in the Kursk bulge was the most complex of those studied, so the manpower used to construct it was the greatest. Of the 625,511 men of the Voronezh Army Group 466,236 were in combat units, and it may be assumed that the majority of them were actively engaged in the preparation of the defense lines. (In the Eleventh Guard Army, for example, the record indicates that 90% of all infantry divisions and engineer units were assigned to building obstacles, about 75% to 80% on any given day.) The local population also was put to work, primarily in the rear areas. In April there were 105,000 civilians so employed, and in June 300,000.

All of the trenches, most of the antitank ditches, observation posts, unit headquarters, and artillery and mortar positions were prepared by the troops that occupied them. Reserve positions temporarily not occupied were prepared by infantry and artillery units specially detailed for this purpose. Barbed wire and other non-explosive obstacles were installed by fighting units under the supervision of engineers. Engineer courses lasting five or six days were held for selected groups of infantrymen from each company.

The engineers planted mines and other explosive obstacles as well as constructing more complicated obstacles, mining bridges and dams, and building higher headquarters and observation posts. There were 258 engineer companies in the combined arms armies of the Voronezh Group, or slightly more than one company per kilometer of front, attached as follows:

Each infantry regiment: one engineer company
Each infantry division: one engineer battalion (three companies)

Each rifle corps: one engineer battalion
Each combined arms army: one engineer battalion

In addition there was an engineer brigade in the First Tank Army, an engineer battalion in each of the two separate tank corps, five engineer brigades and fourteen separate engineer battalions attached directly to the Group. Many of these were special purpose engineers such as bridge building units. Those of the First Tank Army and the two tank corps were not engaged in preparation of the defense positions.

The manpower figures given for the construction of the barrier system at Kursk give some idea of the magnitude of the task and the apparent continuing demands of construction. The period from 1 April to 1 July saw the use of civilians in numbers that varied from 105,000 to 300,000. If, as estimated, 80% of the Voronezh Army Group troops were similarly involved, the rough daily manpower availability was close to a half a million. The defenses as they stood on 1 July were judged to be substantially complete. Even though the total effort that went into the Kursk system was most formidable, the simple fact is that the ratio of men to work and time was enhanced by the energy of one civilian for about every three soldiers and the real manpower input must be so measured. This manpower resource, together with the 90-day work period, produced the depth and density that finally wore down and halted the massive German attack.

Nikopol. At Nikopol civilian labor also was used in constructing the barrier systems, but the figures are not as complete as at Kursk. They were used for the construction of obstacles and trenches in the depth of the defense zone, while troops and engineers were responsible for the front line, and for the more sophisticated constructions of the fortified area. The 335th Division had an understrength battalion of field engineers and a battalion of construction engineers, which during the height of the attack was transferred to the hard pressed 9th Division. Of the troop strength at Nikopol it is reasonable to assume that about 40% of the infantry participated in some way in the construction of obstacles and the digging of trenches. For the 335th Division this means approximately 3,200 working at some time, if only to build themselves shelters and foxholes. It must be remembered, however, that much of the construction was done while the units were actually in combat.

Il Giogo. The work done in the Green Line before June 1944 was largely accomplished by about 28,000 Italian civilians under supervision of Organization Todt personnel. By the beginning of summer most of the civilians had deserted and only about 1,800 were left. Each combat unit in the line in June 1944 was made responsible for construction in its area, and "improvement staffs" and field training units were placed in the line in July to speed the work. As an interesting sidelight it was noted by the Germans that the Italian

workers who deserted probably told the Allies what they knew of the defense structures (which in fact some of them did) and it was therefore necessary to add a number of dummy positions. There is no indication of whether the figure of 28,000 civilians is an average, a maximum, or a total figure. Assuming that it is an average, for the line, 230 kilometers, the figure becomes approximately 120 men per kilometer. It seems more likely that it is a maximum figure and that the number of men working per kilometer per day during the period was somewhat less. During the pre-combat period of June to September the units themselves were responsible for their own areas. It must be assumed that the work they did for the most part was in the laying of minefields, barbed wire, abatis and other easily placed obstacles and preparation of defended positions in houses and areas that involved neither blasting into rock nor pouring concrete; that work was undoubtedly performed by personnel supervised by Organization Todt or by engineer troops trained to do it. Whatever they did not finish remained undone.

Ardennes. The hasty production of the Ardennes barrier required contributions from all units present. The standard practice of using trained engineer personnel as teachers, supervisors and operators of special equipment, and as skilled technical workers in such special fields as engineer intellignece could not always be followed, and engineer units were frequently involved in direct infantry combat. The following data do, however, reflect the engineer strength and employment during the critical period.

Included in the First Army were the following types and numbers of units: four engineer combat groups; 13 engineer combat battalions; five special-type battalions; 17 special-type companies; two special-type platoons. The engineer troop strengths at the beginning and end of December 1944 indicate the level of effort available:

1 December			31 December[37]			Cas/mo			Repl/mo		
O	WO	Enl.	O	WO	Enl.	O	WO	Enl.	O	WO	Enl.
576	44	10,888	480	38	9,305	16	-	366	10	-	170

The First Army Engineer Section also recorded the distribution of its effort by percentage of total time spent on various tasks in December 1944.

Mine warfare - barrier	21%
Miscellaneous (incl. combat)	12%
Engineer depot work	9%

[37]The record does not explain the discrepancy between 1 December and 31 December. It is known, however, that troops were sent on leave and rotated out of units, particularly during the first half of the month.

Fortification work	8%
Training	6%
Reconnaissance	4%
Camouflage	2%
Bridge construction	2%

The remainder of the engineers' time was spent on general engineering tasks, including road maintenance.

A rough distribution of the manpower effort of the First Army produces impressive figures on the time spent on barriers, obstacles, and related activities. Taking the average strength of Army engineer units for the month of December as 10,665, and the man-days available as 330,615, the numbers of man-days spent on barrier work is

Mine and barrier work	21%	69,429 man-days
Fortification work	8%	26,449 man-days
Reconnaissance	4%	13,225 man-days
Camouflage	2%	6,612 man-days

To this expenditure of effort must be added that of the divisions of the Army. While there are no broadly equivalent data sources for these units, it has been recorded that they laid almost as many mines as did the Army-reported units. It is reasonable to believe that other troop work, involving wire-laying and similar tasks, added significantly to time spent by Army engineers as given above. One engineer combat battalion did record data that help give some feel for the scale of effort at that level. For the month of December the 105th Engineer Combat Battalion attached to the 84th Division made this report: " . . . five and one-half miles of road were swept for mines, 5,833 AT mines were laid, 125 friendly mines removed, 58 enemy mines removed, and three enemy minefields marked. Twenty-five bridges were prepared for demolition and six were destroyed."

Adding a man-day expenditure by all troops equal to that reported by First Army for its engineer troops in mine and barrier work produces a figure of roughly 140,000 total man-days. It must be remembered also that the major part of this work took place after the 16th of December. Before that date engineers were primarily occupied with road maintenance, sawmill operations, and the building of winter troop shelters.

Since the work done on barriers in the Ardennes was largely improvisation under immediate and sometimes heavy pressure, then the manpower data should indicate something near the minimum requirements for defensive preparations in fluid situations of similar nature. In the First Army, engineers comprised 3.3% of total strength, and 35% of their total effort went into barrier, obstacle, and related work. It is also estimated that the general troop labor input was at least equal to that of engineer troops. Doubling the engineer strength (for this purpose only) suggests then that 6.6% of the Army's manpower was involved in barrier and related work for 35% of their time.

Allocation and Control of Resources

Fortification material in all cases was normally controlled and allocated by the echelon that issued the order specifically designating the trace and nature of the barrier. There did not appear to be any major deviation from this principle and no need for change was apparent in the cases studied. The engineers' actual distribution of mines down to the level of the unit placing them was criticized on one occasion as being wasteful of transport and trained engineers.

Manpower allocation was generally symmetrical with work assignments; that is, troops worked on the positions they were to man. Non-organic engineer units--above the division level--were assigned support missions for designated units or, in the general support role, worked at the priority tasks as developed by corps or army headquarters. Quasi-military units, such as Organization Todt, were generally controlled and assigned to support the priorities and sequences of the highest local command directly involved in the barrier plan. Local civilian labor was handled in accordance with its sympathies. In Russia, the Soviet Army put civilians to work primarily on tasks related to the defense of their villages or areas. The Germans, both in Russia and Italy, conscripted locals and placed them under the command actually responsible for construction. In larger projects they made up labor units of local civilians with Organization Todt supervisors.

Priorities of barrier construction were the natural product of the physical situation. In cases where contact was actual or imminent, building naturally was from front to rear. Whether anti-personnel or anti-tank construction was to take precedence was determined entirely by the nature of the opposing force, conditioned by the availability of appropriate material. The time required for the development of particular elements of a position was a factor in such places as Italy, where the first priority went to the major task of blasting or digging the positions of the line from the rocky hills. In the Ardennes the priority of installation of obstacles was set by what was known of the enemy and his plans as demonstrated by his movements. Within the overall context of improvisation, priority was given to antitank measures: hastily laid mines, blown bridges, and some abatis. A few craters and land slides were made, but largely in random exploitation of a local condition.

Material Used

Kursk. Material for shelters and trenches came from local sources and was mainly wood, dirt and brick. The amount used may be judged from the extent of the constructions. The Sixth Guard Army built:

500+ kilometers of trenches
1,100 command and observation posts
c. 4,000 shelters and dugouts
900 dirt and timber pillboxes
140 kilometers of antitank ditches
110+ kilometers of wire entanglements

The Army planted 89,888 antitank and 63,843 antipersonnel mines, an average density in the most vulnerable areas of 1,500 antitank and 2,000 antipersonnel mines per kilometer of frontage. The mines were laid six to ten meters apart in irregular rows 15 to 40 meters apart, to a depth of at least 100 meters. A continuous antipersonnel minefield was laid in front of the first line of defense, and antitank mines and other tank obstacles were laid along segments of roads and all bridges.

The divisions of the first echelon of the Sixth Guard Army deployed 40% to 50% of all available mines in front of the first line of defense, 30% to 35% in the depth of the defense, and kept 15% to 20% in reserve for the Mobile Engineer Obstacle Detachments to plant during the course of the battle. (In the 81st Rifle Division one MEOD during the battle of 5 July laid a minefield of 1,000 mines on which 17 of 40 attacking German tanks were destroyed.)

As of 1 July 1943 the two army groups in the Kursk salient had prepared the constructions shown on Table IV-1.

Nikopol. At Nikopol extensive use was made of wood from buildings that had been evacuated, and sheets of steel were used for construction of shields for personnel and weapons. Although there are no specific figures on the total length of trenches and obstacles constructed in the bridgehead, there were at least 2,498 entrenchments, 3,416 shelters and 996 strongpoints in the various defense lines. The pattern and spacing of trenches and obstacles differed, according to the likelihood of attack in the four sectors of the defense zone.

Il Giogo. German records have not produced figures on the numbers of obstacles placed in the area attacked by the 85th Division at Il Giogo Pass nor the amount of material used in the construction of the Green Line. On page 67 of Chapter III, however, is a table showing the extent of the constructions in the sector immediately to the east of the German 4th Parachute Division. At Il Giogo alone of the areas studied, extensive carving into the living rock was necessary, and prefabricated as well as poured concrete structures were commonly used. There as at Kursk and Nikopol houses were used as strongpoints and obstacles placed thickly around them.

TABLE IV-1

ENGINEERING CONSTRUCTION OF THE DEFENSIVE ZONES IN THE CENTRAL AND VORONEZH ARMY GROUPS AS OF 1 JULY 1943

Work Performed[1]	Zones of Defense	
	Main Zone of Defense	Second and Third Zones of Defense
Trenches and Machine Gun Emplacements	30,673	35,228
Antitank Rifle Emplacements	10,049	16,048
Trenches and Connecting Trenches (km)	2,593	3,399
Command Posts and Observation Posts	4,983	4,350
Artillery Positions	6,353	7,575
Mortar Positions	13,924	20,221
Antitank Mines[2]	434,667	68,996
Antipersonnel Mines[3]	410,980	28,368
Barbed Wire (km)	c. 700	-

[1]Average operational density of engineer troops: about one engineer company per kilometer frontage. There were some 230-240 engineer companies in each of the two army groups.

[2]Average density of antitank mines: 1,500 per kilometer.

[3]Average density of antipersonnel mines: 1,700 per kilometer.

Ardennes. The following table shows the extent of activity in barrier construction by the First Army Engineers in the period 17-31 December:

Barrier Data, First Army Engineers*
17-31 December 1944

Minefields laid	505
AT Mines in fields	115,000
AP mines in fields	2,000
Roadblocks	
Constructed	370
With AT mines	257
Prepared for cratering	34
With abatis	44
Bridges	
Prepared for demolition	257
Demolished	70

*Mines laid by division engineers 120,000.

The five largest minefields laid by First Army contained 4,159, 3,345, 3,125, 3,057, and 2,850 antitank mines.

Although there was no real shortage of mines the comment of the 12th Army Group in its postwar report is informative:

> At the time of the German Ardennes offensive, army engineer supply status was generally good, although previous large US Third Army losses of assault equipment on the Moselle had not been replaced. Stemming the breakthrough resulted in large demands for mines, explosives, and barbed wire. It became necessary to control rigidly at Army Group level the supply of AT and AP mines. This was accomplished by Engineer recommendations which invariably received G-3 and G-4 concurrence. In order to insure against an unfavorable outcome of major proportions the Engineer Section initiated a demand upon the United States for a further supply of 1,500,000 AT mines and 325,000 AP mines to be delivered over the ensuing six months.[38]

General. The material used in barrier construction is essentially a matter of availability, either in the form of local resources or in

[38] 12th Army Group, After Action Report, 1945. Federal Records Center.

the form of supplies delivered to the barrier construction areas. The element of time available for construction of barriers naturally determines whether obstacles shall be complicated or those that can be hastily erected. Improvisation and ingenuity have a part to play and can not be anticipated, either as to personnel or as to type of obstacle.

Clearly the requirements for materiel depend upon the terrain in which a barrier is to be constructed, since the most effective barriers utilize the natural obstacles already in position. All of these operations show evidence of planning for availability of obstacles material, primarily mines and barbed wire, during combat as well as in anticipation of it.

Phases and Priorities

Kursk. The anticipatory phase, between the period the ground was occupied and the period of preparation of barriers for imminent combat, ran from the middle of March to the middle of April 1943; the pre-combat phase ran to the beginning of the attack on 5 July.

During the anticipatory phase the troops of the Voronezh Army Group were consolidating their new defensive positions after halting the counteroffensive of the German Army. The decision whether to stay in defense or turn to counterattack had not yet been taken by the General Headquarters.

The main Soviet effort was directed toward the preparation of the first and second defense positions and building antitank defenses on the most dangerous and probable avenues of tank approaches. Most of the planning was done on regimental and divisional levels. Mines were planted in no man's land, some wire entanglements were erected, bridges were mined, and a few antitank ditches were dug. All of the work was done by combat units in the areas occupied by them and in contact with the enemy.

The pre-combat phase was characterized by meticulous planning of the entire defense system, from the Army Group level down to divisions. The combined arms armies planned the construction of obstacles in their respective defense zones, after receiving instructions from the Army Group. Corps and divisions were responsible for executing the armies' plans. Construction of obstacles by divisions was coordinated with the overall Corps and Army defense plans.

During this phase, while the engineering defense system in the tactical zone (corps zone, about 16 to 18 kilometers deep) was being built, the troops started to build a strong defense system in the operational zone, to the rear of the tactical zone (up to about 40 kilometers deep).

Nikopol. Since the troops were in active contact with the enemy throughout the period of construction at Nikopol, the obstacles were generally completed from front to rear. However, some construction was going on simultaneously throughout the zone, with civilians and special engineer units working particularly in the rear, while combat units were preparing the obstacles and defenses at the front. It must be assumed that easier and quicker devices such as barbed wire and mines were placed first while those requiring extensive digging or construction were undertaken later.

Il Giogo. The heavy work of blasting, digging and placing of concrete structures was done first, much of it during the long anticipatory period. Barbed wire and mines were placed only shortly before the attack on the position. Only 70% of the zigzag connecting trenches between troop shelters and gun positions were ever completed. At Il Giogo, as undoubtedly elsewhere, some mining was done at night while the battle was in progress.

Ardennes. First Army records covering the period in which obstacles were installed make no mention of priorities or phases. It was standard practice to place mines at critical points as quickly as possible, with bridge demolition having equal precedence when circumstances dictated. Cratering and abatis were generally undertaken later. The sequence of construction was established by the flow of battle, and the simple priority was to build from east to west. US records do note on several occasions that panzer units forced into a defensive posture very quickly placed mines and barbed wire for local security.

Associated Conditions

Weather

Kursk. Heavy rain on the second night of the operation at Kursk created extremely muddy conditions in the ravines and on the secondary roads as well as swelling the streams in the combat area. German tanks were halted for considerable periods by their inability to negotiate muddy areas and by the miring down of vehicles in them. By 11 July many of the smaller roads were barely passable.

Nikopol. The weather at Nikopol was unfriendly to whoever was trying to move and undoubtedly contributed to the Russian decision not to exploit its initial penetrations of the German defense line. The weather initially was very cold, then became warmer, with rain and thaws that made secondary roads virtually useless and cross-country travel by vehicles impossible. The breaking up of ice in the river

created dangerous floes that made it impossible to maintain a floating bridge at Bol'shaya Lepetikha and hazardous to operate boats and ferries. The impassable roads made the withdrawal from the bridgehead particularly difficult, for, once across the Dnieper by ferry or bridge, units had to proceed on a narrow road through the marshes and swamps for about two kilometers before reaching higher ground. Vehicles mired in the soft mud created an immense traffic jam that offered a tempting target for artillery and air attack.

Il Giogo. Weather in the mountains created no real problems for either attacker or defender and gave the advantage to neither.

Ardennes. Weather in the Ardennes was cold with occasional snow or rain, and thawing from time to time, a combination guaranteed to make minor roads very difficult and vehicular travel off the roads almost entirely impossible. The bad weather and fog that accompanied it grounded American planes for the first seven days of the attack and gave the Germans a considerable advantage.

General. As a barrier component, it can be said that extremes of temperature and precipitation favor the defender, but to a perhaps lesser degree than might be imagined. Snow and ice impede movement and tend to act as obstacles that delay and channel. Cloudy and overcast skies reduce the level of effectiveness of air operations against troops and vehicles that have been stalled or positioned by barriers. Clear weather, conversely, adds to the effectiveness of air in exploitation of barrier effects.

Air Support

Kursk. Both sides had and used aircraft in support of the ground operations.

Nikopol. The Soviets had air superiority in this area, and there is little evidence of German air participation. However, the Soviet air effort was apparently minor. After several days of uncontested air attacks on the forces withdrawing from the bridgehead, five Rumanian planes appeared and drove off the attackers, who obviously were not very numerous.

Il Giogo. The Allies in Italy had enjoyed almost complete air superiority from the beginning of their attacks, and it continued to be useful to them as they attacked the Green Line.

Ardennes. Although the Allies in Italy had undisputed air superiority in northwest Europe by December 1944, it was of no use to them during the days of bad weather which started the German counterattack. When Allied aircraft finally appeared to support the beleaguered American troops, they contributed significantly to slowing down the German advance.

Logistical Considerations

Kursk. Logistical considerations did not significantly influence either the pattern of the barrier system or the outcome of the battle that was fought by the Sixth Guard Army. The German attack also was well supported, despite constant Russian air attacks on the railroad system behind the German lines.

Nikopol. The bridgehead at Nikopol was dependent on two narrow lines of support, crossing the Dnieper River at Bol'shaya Lepetikha and Nikopol. They seem not to have had a significant effect on the construction of the barrier system, but in its defense they limited the movement of reinforcements of men and ammunition. Most importantly they proved to be bottlenecks when the order was given to withdraw.

Il Giogo. The construction of the barrier system of the Green Line was hampered by the necessity of taking supplies long distances over mountain trails to the positions that were to be reinforced with obstacles. This problem made a considerable contribution to the limited depth to which obstacle construction proceeded and the incomplete nature of some of the positions on the front line. In the defense of the barrier, logistics considerations became important, since it was extremely difficult to move men and supplies over the mountain roads, particularly so when the line was under attack.

Ardennes. Some shortages, although not extreme ones, of mines and other equipment are recorded in the files of the First Army and the 4th Division and explain in part why there were not more obstacles constructed in front of the Allied Line before the German attack. It was the Germans who suffered logistically during the operation, as their supplies and the delivery systems to take them forward proved inadequate to maintain the initial impetus of the attack. The river barriers contributed significantly to the problem of delivering reinforcements of men, weapons, and supplies to the combat troops.

Performance in Actual Encounters

Results, Immediate and Specific

The detailed narratives in Chapter III have been written with emphasis on the functioning of obstacles in combat, to indicate the effect they had on the progress of the attacking forces. Some of the specific experience is summarized here.

Kursk. Table IV-2 shows the average daily advance made by the Germans attacking both Soviet Army Groups in the Kursk salient from 5 to 12 July. As is clear from the narrative, everywhere the German XLVIII Corps wanted to go it encountered minefields, antitank ditches, barbed wire, bunkers, strongpoints, fortified houses, trenches, water, mud, or a combination of them. Table IV-3 shows the average daily distance of withdrawal of the units of the Soviet Sixth Guard Army and the First Tank Army. Table IV-4 is a summary in tabular form of the experience of the various German divisions as they tried to overcome the intervening obstacles and reach their objectives. The times cited for delay include in most cases the total time involved in attaining the objective, with no attempt to estimate the portion of it that the operation would have taken had there been no obstacles.

Nikopol. The records do not permit an analysis of the delay suffered by the Russian attackers in specific areas at Nikopol as do those of Kursk. In the sector of the 335th Infantry Division the first period saw only small probing attacks which were apparently abandoned when the units came upon the defended obstacles of the German front line of defenses. Except on the far left, where the 683d Regiment had taken over some of the former territory of the 97th Jäger Division, the front line of the 335th had not been penetrated when the division was ordered to withdraw to the Sigrid Line on 3 February. Elsewhere in the bridgehead the first intensive Russian attacks penetrated the line in two areas, but the Russians halted without achieving their objective the first time. The second attack caused the Germans to withdraw to their inner defense lines, which they held long enough to permit an orderly withdrawal across the Dnieper River. The Russians never penetrated the Sigrid Line and in fact did not attempt to attack it in force until the Germans had abandoned it and crossed the river.

The Nikopol bridgehead was not a large area, and the Russians had an overwhelming superiority in men and weapons to bring to bear against it. It took them in fact almost a month to wipe it out. Although they were not making an all-out effort to do so during the entire period, it is clear that the German barrier defenses were contributing to their decision not to conduct a sustained attack but to wear down the defenders with smaller attacks and artillery and air bombardment.

TABLE IV-2

AVERAGE DAILY ADVANCE OF THE GERMAN FORCES
5 - 12 JULY 1943
(Central and Voronezh Army Groups)

Date	In Central Army Group Defense Zone		In Voronezh Army Group Defense Zone	
	Frontage (km)	Depth (km)	Frontage (km)	Depth (km)
5 July	45	4-5	30	7-9
6 July	40	3-4	25	5-6
7 July	15	1-2	20	5-7
8 July	2	0.5-1	20	3-5
9 July	2	0.3-0.5	15	1-2
10 July	--	--	15	1-3
11 July	--	--	15	2-3
12 July	--	--	18	--

DEFENSE OPERATIONAL SUMMARY
SIXTH GUARD ARMY AND FIRST TANK ARMY
BATTLE OF KURSK, 4 - 12 JULY 1943

Date	Engagement Designation	Remarks	Average Distance Withdrawn (km)
4 July	Gertsovka-Butovo	Outpost line driven in by Germans in limited pre-offensive operation	2.5
5 July	Cherkasskoye-Dubrova	Defense of the first defensive zone; partial German breakthrough	8.0
6 July	Pena River	Defense of approaches to second zone; defense continues in parts of first zone	5.5
7 July	Pena River	Defense of second zone; defense continues in part of first zone	6.0
8 July	Pena River	Defense of the second zone; Germans secure Pena River	4.0
9 July	Berezovka-Verkhopenye	Defense of the second zone and approaches to Psel River	1.5
10 July	Berezovka-Verkhopenye	Same	2.0
11 July	Kalinovka	Same	2.0
12 July	Kalinovka	Same; Soviet counterattack; Germans to defensive	0.0

Table IV-3

TABLE IV-4. EFFECTS OF OBSTACLES AT KURSK, JULY 1943

Date	Unit	Place	Time Delayed	Remarks
4 July	11th Pz Div	Butovo	6-8 hours	Mines and other obstacles
	3d Pz Div	Gertsovka	11 hours	Strongpoints, trenches, minefields, barbed wire
	332d Inf Div	Workers' barracks	14 hours	Defense center
5 July	3d Pz Div	Berezovyy	6-8 hours	Mud and mines
		Korovino	4 hours	Mines, trenches, barbed wire
	11th Pz Div	En route to Cherkasskoye	3-4 hours	Antitank ditches
		Hill 237.8	2 hours	
		Cherkasskoye	10 hours	Bunkers, mines, ditches
		Hill 244.5	3 hours	
		Hill 246	3 hours	
	Gr D Gren Div	East of Berezovyy	24 hours	Antitank ditch and ravine and mud
6 July	11th Pz Div	Dubrova	5-6 hours	Antitank ditches and minefields
	3d Pz Div	Rakovo	Halted	
	Gr D Gren Div	Road to Dubrova	14 hours	Bridge destroyed at Butovo, minefields, wire, antitank ditches in Bolshoy ravine and Ol'khovka
7 July	Gr D Gren Div	Dubova	16 hours	Antitank ditches and other obstacles
		Syrtsevo	48 hours	Heavily fortified; surrounded by trenches, minefields and antitank ditches
	11th Pz Div	Hill 245.2	3 1/2 hours	Minefields and other obstacles
		Krasnaya Dubrava	10 Hours	Antitank barriers along the road
	3d Pz Div	Road to Lukhanino	6 hours	Bad roads, difficult terrain, mines
	3d Pz Div tanks	River at Lukhanino	18 hours	River, mines, no bridge
8 July	3d Pz Div	Lukhanino	24 hours	Mines, fortified houses, trenches, barbed wire
	Gr D Gren Div	Verkhopenye	halted	AT and AP minefields, pillboxes, trenches, AT ditches, counterattack
9 July	3d Pz Div	Hills 1.9 & 219	10 hours	
	Gr D Gren Div	Hill 251.4	6 hours	
	11th Pz Div	Il'inskiy	3 hours	Minefields
		Kraznaya Polyana	4 hours	
10 July	11th Pz Div	Hill 248	24 hours	Strongly fortified; attack was unsuccessful
		Hill 232.8	12 hours	
	Gr D Gren Div	Kalenovka	40 hours	Strongly fortified
		Hill 258.8	5 hours	Mines, ditches, AT trenches
11 July	3d Pz Div	Berezovka	12 hours	Various obstacles
	Gr D Gren Div	North of Rakovo	1 hour	Large minefield
		Tolstoye Woods	Hatled	Heavily fortified
	11th Pz Div	Kalinovka	Halted	Mud, many obstacles
	332d Inf	Rakovo River crossing	2-3 hours	Detour necessary

Il Giogo. The strength of the Il Giogo defenses installed and manned by the 4th Parachute Division required the US attackers to feed in more troops and to use all their AT weapons, tanks, tank destroyers, and 8-inch and 240-mm. artillery. The Germans finally had to be driven from their positions by US infantry. For the infantry the engagement was not so much a question of "ground gained" as a problem of gradually wearing down the enemy. Table IV-5 shows how little ground was actually gained during the five days of the attack.

Table IV-5. IL GIOGO PASS. DAILY ADVANCE, US 85TH DIVISION, 13 - 17 SEPTEMBER 1944

Date	Engagement Designation	Average Distance of Advance
Sept. 13	First assault	0.70 km.
Sept. 14	Pinned down I	0.17 km.
Sept. 15	Pinned down II	0.10 km.
Sept. 16	Beginning to move	0.48 km.
Sept. 17	Breakthrough	2.50 km.
	Total Advance	3.95 km.
	Advance/Day	0.79 km.

The Americans found that their original attacks made little headway. Even after heavy direct fire on pillboxes, the infantry found it impossible to penetrate the mines and wire around them. The first real penetration came after three days of fighting, during which little ground was gained, but the real break came on the next day. Beyond the main line there were few strongly prepared positions, and once it was penetrated there was relatively little beyond natural obstacles to slow the American advance.

Ardennes. The American barrier system in the Ardennes was, as the narrative reveals, largely the product of improvisation after a massive and unexpected German counterattack had been launched. Unlike the positions at Kursk, Il Giogo, and Nikopol, the trace of the barrier responded to the actual course of battle rather than to an original defensive concept which had been drawn in advance from close analysis and deliberate identification of the key elements of the terrain. The records consequently show only isolated incidents in which barriers were erected in time and at a place to contribute to the slowing, diverting or halting of the German advance.

The initial German assault on the First Army, aside from problems encountered in trying to cross the natural river barriers, met only the sort of local position defenses that would be placed by experienced troops to cover a temporary halt before resuming the attack. On the northern flank of the attack, US units had also prepared some wire and mine obstacles and trip flares which gave local protection and engaged

some of the German infantry for a time, but there was nothing of this sort facing the principal armored sweep just to the south. Their contribution of these few obstacles was principally to the containment of the German thrust on the extreme northern flank and, perhaps indirectly, to the jamming and slowing of the major armored columns.

The initial obstacles hastily built in the hours just after the attack had mixed results. The local system erected by the 158th Engineer Combat Battalion on the east side of Bastogne on 18 December held up for them and subsequently for the troops of the 101st Airborne Division. The central features of this system were the coordinated use of roadblocks, dug in positions, mines and AT obstacles to control tank approaches. Soft going off the roads was also a feature that aided the defenders all around Bastogne. There were also several large natural ditches in the area that served to reduce the mobility of the panzer attackers. At least one tank attack was foiled by such a ditch.

The main thrust and bulk of the forces of Task Group Peiper were slowed by hasty roadblocks and blown bridges and finally halted when no support could reach them. As the main effort of the Germans moved to troops south of the expended attack of Peiper, the attacking units of the Fifth Panzer Army came face to face with the principal American defense position. On the way to the Salm River, these troops had also been delayed by local obstacles, streams, and bad roads. By 21 December sizable American forces were arriving on positions that until then had been occupied only by engineer units working on the barrier.

The renewed German attack began on the morning of 24 December, and by 27 December the US forces had withdrawn to a position from Trois Ponts to Marche. Contemporary accounts tell of some piecemeal German penetrations, but not of massive breakthroughs. Much credit for keeping the German forces off balance went to artillery and air strikes. During local withdrawals US units occasionally made abatis, but in at least one case this proved an embarrassment to friendly troops counterattacking through the area on the following day.

In the early period of the attack German forces did gain control of, or make penetration at, Hampteau, Grandmenil, Manhay, and Villettes. An attempt to move a German column north out of Grandmenil over a narrow road was halted by felled timber in a place that could not be bypassed. In the fighting from the Salm River westward obstacles seem to have played a largely complementary role. Blown bridges and abatis were involved, and mines were laid by units on their own initiative. From Marche west the fighting was characterized by tangled and isolated encounters. The ultimate exhaustion of the German forces, only five miles from the Meuse, was brought about by a combination of conditions, from which the general and principled use of barriers is hard to separate.

Engineer reports imply that the delays that caused panzer elements to run out of fuel at Stoumont and Celles were attributable to barriers.

Bridge destruction was credited with stopping the armored column that was headed for Liege. The Germans reached the outer edge of a system built at Stoumont Station, and the barrier was said to have protected the vital supply installations along the Vesdre River and in Liege. In many instances the engineer troops designated for barrier work were obliged by the speed at which operations were progressing to act also as infantry defenders of their installation.

In the 4th Infantry's 12th Regiment sector, the Sauer River proved a real deterrent to the attackers, who for days were unable to move tanks and heavy weapons across it and were forced to meet the American defenders with infantry supported by artillery sited on the east bank of the river. The only formal barrier construction, the roadblocks in the Schwarz Erntz gorge, may have deterred the attacking Germans, but there is no clear evidence that they interfered significantly with the German progress in the area. Elsewhere in the sector there was nothing beyond the normal use of mines and barbed wire, with perhaps some other easily constructed obstacles to assist the defenders. Figure IV-6 shows the average daily advance of German units in the 4th Division sector.

Table IV-6. GERMAN PENETRATION INTO 4TH DIVISION SECTOR, 16 - 24 DECEMBER 1944

Date	Average Ground Gained
December 16	2.64 km.
December 17	3.7 km.
December 18	0.72 km.
December 19	2.2 km
December 20	1.3 km.
December 21	1.69 km.
December 22	0.65 km.
December 23	0.55 km.
December 24	1.6 km.
Total	15.05 km.
Average/Day	1.67 km.

Long Term Results

The long term results achieved by barriers and obstacles can be assessed only by calculating the overall results of the battles in which they figured and their contribution to those results. This involves answering the questions, "To what extent did the barrier achieve its purpose?" and "What would have happened had the barrier system(s) not been there?" Without trying to give weight to such other influences as fighting ability, firepower, weather, terrain, or air support, it is possible to make some general statements.

Kursk. At Kursk the defense was successful, not only in the local and immediate sense, but in terms of contribution to the final outcome of the war. The battle narrative is replete with accounts of delays and frustrations for the Germans as they faced strongly prepared defensive localities. The progressive reduction in rate of advance testifies that the exhaustion of the attackers' "store of combat energy" was real and very nearly complete after eight days of heavy fighting. In fact, the attack moved forward at the rate of only one to three kilometers per day during the last three days. The skillful and determined defense extracted a heavy price in terms of German resources and banished from German commands any hope for a major extended offensive. The barriers contributed significantly to the Russian objective of bleeding the Germans as they tried to penetrate them, until they were unable to withstand a sustained counterattack, while totally denying the German objective of cutting through to Kursk and pinching off the salient.

Nikopol. The barrier defenses did not prevent the Germans from having to withdraw from their bridgehead at Nikopol and were a failure in that the bridgehead was abandoned. But this was due to a threat of envelopment, not penetration. Loss of the bridgehead made it impossible for the Germans to halt the Russian advance across the lower Dnieper and on to the west. In any event, the defense did provide time and space in which the German divisions could withdraw intact. The barrier effect was considerably enhanced by the pervasive mud which figured as an addition to the barrier in its slowing action on the attacker, but also seriously hindered the movements of the defender in the process of withdrawal.

Il Giogo. The barrier at Il Giogo had no long term effect on the war, which by that time was close to a finish in Italy. It did, however, delay the Allied advance for several days and extract a high price for the ground that the Germans gave up. It also served as an object lesson to objective German staff analysts for the later "Winter Line" defenses. Among their evaluations were these:

1. The main line was built on the forward slope, with many positions 200 meters below the crest. This favored the attacker and prevented lateral movement within the position.

2. Positions must have depth and contain active and passive AT measures--AT weapons, mines,ditches.

3. Focal defense points must have deep barrier zones, particularly along stretches of road in the mountains. They must be covered by wire-protected infantry.

4. Frequent changes in command and in troop units inhibit efficiency in barrier work.

5. Local guerrillas are a danger to barriers and obstacles.

6. The defenses at Il Giogo required specially trained mountain troops. None were furnished.

7. There were no "mobile reserves." This, together with the extension of frontages brought about by withdrawal of troops for use elsewhere, made it possible for the enemy to find weak spots. Enemy action also served to delay reinforcements.

8. Several enemy (American) improvisations were successful. They were able to "shoot paths" through defenses by heavy use of artillery and air. Heavy "carpet bombing" was particularly effective against obstacles and minefields. The attackers had also used phosphorus grenades to start fires in the woods and brush, driving troops from their observation posts and firing positions.

Most telling is the final comment of Field Marshal Kesselring in the narrative prepared by him for US Army historians after the end of the war:

> It is to be regretted that the defensive installations in depth of the entire area were not made use of tactically in a manner corresponding to the idea back of the whole system. It is inconceivable why Hitler did not permit the employment of delaying tactics after having helped, in a model manner, to create the necessary preconditions.[39]

Ardennes. In the German counterattack in the Ardennes speed of armored movement was the absolute essential for success. The failure of the counterattack resulted from a combination of combat pressure, delay, and the shortage of gasoline. German units were forced to use much of their dwindling total German fund of resources in this counterattack, and so the German defense in the following months of the war was substantially weakened.

The barriers and obstacles hastily installed by American forces in the Ardennes had some significance in the final outcome. Delays imposed by mines and blown bridges in particular were effective in building the growing factor of delay into an element that finally stalled the essential thrust of German armor, and in channelling the attack away from some key routes and areas. The defense succeeded in large part because destroyed bridges and hasty mining held the panzer spearhead to a much slower rate of advance, on a much narrower front

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[39]Field Marshal Kesselring, op. cit. Appendix A to this study.

than the plan required for success. In distributing the ratio between the expenditure of human effort and combat supplies, on the one hand, and rate of advance on the other, the First Army succeeded in forcing the expenditure of the attacker's "fund of combat energy" before his goal was reached.

The 4th Division's hastily prepared barrier in the Ardennes battle was never completely tested as a system. Obstacles were tested at individual and separated locations, but in general the significant action took place to the north and west of the division's defenses. There is still the unanswerable question as to whether the existence of the preparations on the 4th Division front south of the main penetration of 16 December was known to the German command and whether its existence influenced developing attack plans. Later analyses have suggested that the containment and "jamming" of the shoulders of the German offensive were important elements in the outcome.

General. The examples studied show no exception to the precept that a barrier not under observation or surveillance and covered by fire is not an effective barrier and may be no barrier at all. In every case there was evidence that an obstacle was overcome and the system of which it was a part was penetrated only after its weapons defense had been destroyed or driven off. It must be concluded that barriers, properly placed and with adequate surveillance, enhance the total firepower of the defender positively in that they hold the attacker, who is to some degree exposed and seeks to move forward, in the areas covered by weapons in place and well-sited, for longer periods of time.

Obstacles and the Principles of War

Regardless of what one may think of the utility or the validity of the classical Principles of War as combat guidelines for commanders and staffs, their comprehensiveness makes them collectively an excellent tool for military analysis of historical operations. It is therefore useful to consider how the use of obstacles and barriers in the four example engagements of this study were consistent with the Principles of War:

Objective	Offensive	Economy of Force
Simplicity	Mass	Security
Unity of Command	Maneuver	Surprise

Kursk. The manner in which the entire Kursk defensive system, and particularly the barrier components of that system, contributed to the objective of wearing down the Germans, to facilitate a planned Soviet defensive-offensive, is obvious. All of the Principles may be

noted here, but most importantly that of Economy of Force, which permitted the massing of reserves to enter the battle fresh after the Germans had been delayed and exhausted.

Nikopol. A comparable analysis is possible for Nikopol, although (with one exception) less clearcut because of the course and conclusion of the battle. That one exception is again Economy of Force. The obstacles and field fortifications of the 335th Division permitted the detachment of at least one fourth of the division to reinforce hard-pressed units to the north, while still retaining a substantial combat power superiority over the opposing Soviet units.

Il Giogo. Here, again, Economy of Force is the most important Principle related to the natural and artificial obstacles at Il Giogo Pass. However, the Germans overdid it, and the force defending the pass was inadequate. They failed to utilize the Principle adequately elsewhere on the front, so as to permit Maneuver and Mass at the Il Giogo sector in time to stop the American breakthrough.

Ardennes-Sauer. The German ability to achieve Surprise was in part due to American failure to devote sufficient effort to obstacles and barriers in the weeks before December 16. The American failure in the related Principle of Security was also at least in part attributable to this lack of attention to obstacles. The hasty defenses, blocks, and minefields installed along the entire front of the 4th Division beginning on 17 December facilitated the use of Economy of Force along the southern four-fifths of the Division Sector, and the massing of about half of the division in about one fifth of the sector, opposite the only serious German threat.

General. From the above it is clear that the principal military value of obstacles and of barrier systems is to permit Economy of Force (and, of course, indirectly to permit Mass elsewhere as a result of such economy). The importance of using obstacles and barriers to avoid Surprise, and to facilitate both Security and Maneuver, is also evident. The relationship of obstacles and barriers to other Principles is evident, but less obvious and direct.

V. QUANTITATIVE ANALYSIS

Part I - The Operations

General

The quantitative analyses of each of the four examples in this study have two parts: (1) the defensive construction period, and (2) the combat period. The methodology for each of these parts is discussed briefly below.

Defensive Construction Period. Each of the four analyses focusses on a Defensive Data Construction Summary, in which are included the essential data permitting an assessment of the amount and nature of the defense construction effort for the defensive sector. The presentation is on a basis of one kilometer of front, for the entire depth of the defense zone in that sector.

Several analytical assumptions are made in these analyses:

1. There is a meaningful difference in the nature and intensity of construction effort in three different periods, as follows:

a. Anticipatory period. The time during which preliminary defensive work is begun under generalized directives, but without a specific deadline or mission within an operational directive for impending combat. The construction efforts are considered to be only half maximum possible effectiveness during this period.

b. Pre-operational period. The time following the issuance of a specific operational directive for impending combat, until the day of major hostile attack. The defense construction efforts are assumed to be fully effective during this period.

c. Combat period. The time during which the defenses are being attacked, and are still being improved by the defenders. All troops are engaged in some defensive construction efforts in this period, but only at 25% of normal effectiveness. This figure may be high for troops under fire in intensive combat. It is probably low for troops assigned specifically to general fortification work and minefield emplacement. It is doubtful if a precise factor is possible to obtain. The assumption of 25% effectiveness appears to be reasonable on the basis of combat experience.

2. Engineer troops by virtue of training and special equipment can perform defense construction, including the preparation of obstacles, considerably more effectively than non-specialized personnel. For this analysis an arbitrary factor of 5 has been used.

3. Non-specialized troops and civilian labor are assumed to be comparable in untrained construction effectiveness.

4. Where records do not indicate a breakdown of defensive construction efforts between field fortifications and obstacles, it is assumed that 80% of the effort goes to fortifications and ancillary construction, and 20% to preparation and installation of obstacles. (A suggested alternative assumption has also been tested: that all specialized engineer effort is devoted to obstacles and that all non-specialized effort is applied to general field fortifications; the results are not logical.)

5. The effectiveness of construction efforts can be inhibited by five kinds of constraints:

a. Terrain; inherent difficulties of movement (e.g., roadnet, mountains, swamps, etc.) and construction (e.g., rock formations, precipices, etc.) are considered here; the fact that difficult terrain reduces the level of obstacle preparation is considered elsewhere (see Hypothesis 3a, p.172).

b. Weather; in terms of precipitation and extremes of cold or heat.

c. Logistics; the capability of getting construction materials and personnel to the defensive area.

d. Mission; the extent to which other assigned operational tasks can interfere with the construction effort. (This is a different kind of constraint from the inhibiting effect of combat, para 1c, above.)

e. Ongoing operations; the effect of air or artillery harassment, or of actual active local ground operations, on the intensity of the effort. (It is assumed that this constraint differs from that of assumption 1c, above; more study, based on an enlarged data base, is required.)

For these four operations, all of these assumptions appear reasonable. They need testing, however, against data collected for a statistically significant sample--probably at least 20 well-documented defensive operations.

Combat Period. These analyses endeavor to ascertain the extent to which both field fortifications and obstacles, collectively and

by category, have enhanced the combat effectiveness of the defenders, insofar as this can be determined from the existing records (those which were consulted under the time constraints of this study).

Such quantitative analysis is impossible without some reliable method of analyzing and comparing opposing combat efforts in a variety of circumstances. The only known method for such comparison is the Quantified Judgment Method of Analysis of Historical Combat (QJMA) developed over recent years by HERO, with the assistance of T.N. Dupuy Associates, Inc., (TNDA).[40] Although such use of the QJMA had not been anticipated in the study proposal, it became evident during the course of the study that the quantification required would otherwise be impossible.

For each defensive example, therefore, a QJMA analysis has been prepared for the first day of the main defensive battle. It would have been desirable to prepare a QJMA analysis for each succeeding day (where records were adequate to make this meaningful), or at least at important change points in the battle, such as the introduction of substantial reinforcements by one side or the other, or significant changes in operational mission on either side. Unfortunately, time did not permit either the depth of research, or the time for analysis, this would have required. Estimates were made in one case, Kursk, however, of the extent to which such developments could modify the first day QJMA Analysis. This and other judgmental estimates in this study reflect the considered professional judgment of two retired ground force officers with extensive combat experience in World War II: Colonel A.M. Fraser, USMC, Retired, who had active infantry combat experience in the Pacific Theater, 1943-45, and Colonel T.N. Dupuy, USA, Retired, who had active infantry and artillery combat experience in Burma, 1943-45. Both officers are also recognized authorities on military history, and the relevance of past combat experience to problems of recent and contemporary combat.

The results of the basic data collection, and of the QJMA analyses, and extimated changes, are then assessed for each example, and conclusions drawn as to the influence of defensive construction, and the obstacle-barrier effort, on these results. To facilitate an understanding of terms and symbols used in the QJMA, a list of symbols and glossary are provided in Figure V-1.

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[40] A brief summary description of the QJMA is contained in Appendix B. For a full discussion of it see HERO Monograph, The Quantified Judgment Meghod of Analysis of Historical Combat Data.

Figure V-1

QJMA LIST OF SYMBOLS AND GLOSSARY

a	Attacker identifier
b	Logistics/supply factor
cas	Casualties
D	Depth
d	Defender identifier
E	Effectiveness
e	Enemy identifier
f	Friendly identifier
g	Artillery identifier
h	Weather factor
hw	Heavy weapons identifier
IC	Intensity of Combat (the casualties incurred by a unit, in relation to its strength, and in comparison with historical norms)
i	Armor identifier
J	Vehicles (number)
le	Leadership factor
m	Mobility factor
M	Force characteristics of mobility
MF	Mission factor (quantification of assessment of a force's qualitative performance of mission)
mg	Machinegun identifier
N	Personnel strength or numbers
n	Infantry identifier
o	Morale factor
OLI	Operational Lethality Index value*
P	Combat potential (force strength modified by operational variables)
P/P	Combat power ratio
Q	Distance of opposed advance
R	Result (quantification of engagement outcome)
r	Terrain factor
S	Force strength (inventory of Proving Ground OLIs, modified by environmental factors)
SE	Score effectiveness (the ability of a unit to inflict casualties; directly related to combat effectiveness)
s	Small arms identifier
sp	Spatial effectiveness identifier (for capability to gain or hold ground)
sur	Surprise factor identifier
t	Training/experience factor
u	Posture factor
v	Vulnerability factor
V	Characteristics of Vulnerability
W	Proving Ground OLI, weapons effects, firepower
w	Weapons identifier
y	Air identifier
z	Season factor

*This can be expressed as a value for a single weapon, or be the sum of values for an inventory of weapons, and can be used as a unit of measure for the unmodified or ideal performance of weapons ("Proving Ground"), for weapons performance modified by environmental factors (Force Strength), or for weapons performance modified by environmental and operational factors (Combat Potential).

Battle of Kursk

Defensive Construction Period. Figure V-2 presents a summary of relevant construction data, based primarily on Soviet post-war literature, which is very extensive, and reasonably objective, in its coverage of all aspects of this important battle.

The data shown here represents the defensive construction effort per kilometer of front in the forward defensive zone of the Sixth Guard Army, and the rear area defense zone of the First Tank Army, on the Voronezh Front, along the southern shoulder of the Kursk Bulge, from April through 12 July, the climactic day of the battle in this sector. This zone (described on pp. 16-24) was about 40 kilometers deep.

The principal result of the data summary is the calculation that approximately 143,843 effective man-days of construction effort per kilometer of front was devoted to the fortification of the defensive zone, throughout its entire depth. This is believed to represent the maximum defensive field fortification effort since World War I, and may even exceed levels of defensive construction effort for any single sector of that, the most-fortified war of history.

Combat Period. The data upon which this analysis is based has been derived almost equally from German records and Soviet post-war secondary sources. Time was not available for as detailed a search of either of these sources as is possible, given the wealth of material available in both, and some of the figures are averages, or extrapolations which are subject to further refinement. Nonetheless, the component elements of the data are believed to be reliable within 10%, and the overall results of the analysis are believed to be substantially accurate.

Figure V-3 summarizes the weather during the combat period. Figure V-4 and Figure V-5 present inventories of the principal weapons available to the opposing forces, and an assessment of the firepower values of these inventories.

Some statistical comparisons of the opposing forces in the Sixth Guard Army (Oboyan) Sector of the Battle of Kursk are interesting:

DEFENSE CONSTRUCTION DATA SUMMARY SIXTH GUARD ARMY SECTOR
VORONEZH ARMY GROUP, APRIL - JULY 1943

1. Defender's objective: Determined defense of Oboyan approaches to Kursk, southern sector, Kursk bulge

2. Length of front: 64 km.

3. Construction time:
   a. Anticipatory: 20 days (x .5 = 10)
   b. Pre-operational: 81 days (x 1 = 81)
   c. Combat period: 8 days (x .25 = 2)
   d. Standard days: 93

4. Average manpower availability/day:

	Anticipatory	Pre-operational	Combat
a. Engineers	6,600	6,600	6,600
b. Other troops	58,000	58,000	58,000
c. Civilians	12,000	36,000	0

5. Standardized manpower availability/day:

a. Engineers	16,500	33,000	8,250
b. Other troops	29,000	58,000	14,500
c. Civilians	6,000	36,000	0
	51,500	127,000	22,750

6. Manpower effort/day/km:
   a. Anticipatory: 805
   b. Pre-operational: 1,984
   c. Combat: 355

7. Total defense construction effort:
   a. Anticipatory (20 days): 16,260
   b. Pre-operational (81 days): 160,704
   c. Combat (8 days): 2,840
   Total 179,804 man-days

8. Approximate allocations of effort:
   a. Field fortifications: 143,843 (80%)
   b. Obstacles: 35,961 (20%)

9. Allocation if Engineers do all obstacle construction:
   a. Engineer effort: 5,156 + 41,766 + 1,031 (to obstacles) = 47,953 (27%)
   b. Other effort (to field fortifications): 131,851 (73%)

10. Materials used:
    a. Mines, AP: 63,843: 1,000/km
    b. Mines, AT: 89,888: 1,405/km
    c. Barbed wire: 110 km: 1.72/km

11. Summary terrain description:
    a. Contour: rolling, numerous ravines, two rivers, several small streams
    b. Vegetation: scattered small forests
    c. Structures: scattered towns and villages

12. Construction constraints:

	Constraint Nature	Factor
a. Terrain	None	1
b. Weather	Intermittent rain	0.8
c. Logistics	None	1
d. Mission	None	1
e. Ongoing ops.	None, pre-combat	1
	Manpower degradation factor	0.8

13. Total normal construction effort in sector:
    179,804 x .8 = 143,843
    Preparation factor: 1.6 (achieved 4.3 times)
    Fortification depth theoretically attainable: 43 km*
    Fortification depth achieved: c. 40 km
    (Sixth Guard Army sector and zone only

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*See Figure V-2♦, p. 169.

Figure V-2

WEATHER, SIXTH GUARD ARMY SECTOR,[1]
BATTLE OF KURSK, 4 - 12 JULY 1943

4 July	Fair, warm; roads passable for all vehicles
5 July	During night of 4/5 July severe cloud burst; mostly sunny during the day; roads passable for all vehicles
6 July	Few rain showers; roads slow but passable for all vehicles
7 July	Sunny and warm; roads slow but passable for all vehicles
8 July	Sunny in the morning; few thunderstorms in afternoon; roads slow but passable for all vehicles
9 July	Sunny, very warm; few short storms in afternoon; roads barely passable
10 July	Severe thunderstorm, warm; roads bad
11 July	Cloudy, few short storms; roads bad
12 July	Cloudy, few rain showers; roads passable for all vehicles

[1]From German sources.

Figure V-3

MAJOR WEAPONS INVENTORY
GERMAN XLVIII PANZER CORPS[1]
4 July 1943

Number	Weapons Type	Type OLI[2]	Inventory OLI
62,000	Small arms	.15	9,300
8,300	Machine guns, light	1.12	9,296
1,469	Machine guns, heavy	1.79	2,630
400	Mortar, 50 mm	70	28,000
231	Mortar, 81 mm	73	16,863
45	Mortar, 120 mm	245	11,025
182	Flamethrower	.5	91
108	Panzerfaust	10	1,080
13	Gun, AT, 37 mm	13	169
240	Gun, AT, 75 mm	122	29,280
40	Gun, AT, 75 mm, S/P	238	9,520
180	Gun, AA, 20-28 mm	9	1,620
100	Gun, AA-AT, 88 mm	208	20,800
24	Gun, 105 mm, recoilless	215	5,160
64	Howitzer, 75 mm, infantry	87	5,568
18	Howitzer, 150 mm, infantry	167	3,006
18	Howitzer, 150 mm; S/P, infantry	190	3,420
120	Gun-howitzer, 105 mm	232	27,840
54	Howitzer, 150 mm	212	11,448
24	Gun-howitzer, 150 mm	257	3,420
12	Gun, 105 mm	294	3,528
12	Gun, 170 mm	320	3,840
12	Nebelwerfer, 21 mm	400	4,800
48	Car, armored, medium	15	720
230	Tank, Mk-IV	352	80,960
120	Tank, Mk-V	405	48,600
50	Tank, Mk-VI	440	22,000
250	Assault Gun (av.)	270	67,500
350	Close air support sorties/day	471	164,850
	Total Proving Ground Inventory Value		596,334

[1]Approximate data, subject to refinement, data available.

[2]For a definition of OLI, see Figure V-1.

Figure V-4

MAJOR WEAPONS INVENTORY
SOVIET SIXTH GUARD ARMY AND FIRST TANK ARMY[1]
4 July 1943

Number	Weapons Type	Type OLI[2]	Inventory OLI
98,000	Small arms	.15	14,700
16,094	Machine gun, light	1.2	19,313
2,840	Machine gun, heavy	1.7	4,828
600	Mortar, 50 mm	70	30,000
608	Mortar, 82 mm	73	44,384
300	Mortar, 120 mm	245	73,500
55	Multiple rocket launchers, truck mtd.	220	10,100
2,866	Rifle, AT	.5	1,433
175	Gun, AT, 45 mm	26	4,550
175	Gun, AT, 57 mm	32	5,600
24	Gun, AT, 122 mm, S/P	250	6,000
315	Gun, 76 mm	100	31,500
107	Howitzer, 122 mm	250	26,750
106	Gun-howitzer, 122 mm	270	28,620
52	Gun-howitzer, 152 mm	290	15,080
12	Howitzer, 203 mm	320	3,840
77	Gun, AA, 37 mm	15	1,155
108	Gun, AA, 76 mm	150	16,200
240	Tank, light, T-26	100	24,000
477	Tank, medium, T-34	370	176,490
100	Tank, heavy, KV-1	400	40,000
90	Armored car, heavy	20	1,800
350	Close air support sorties/day	400	140,000
	Total Proving Ground Inventory Value		719,843

[1]Approximate data, subject to refinement, data available.

[2]For a definition of OLI see Figure V-1.

Figure V-5

Designations	Soviets	Germans	Ratio
	Sixth Guard Army & First Tank Army	XLVIII Pz Corps	
Manpower	98,000	62,000	1.58 - 1.00
Tanks and Assault Guns	817	650	1.26 - 1.00
Artillery and Mortars (75mm & over)	1,675	1,014	1.65 - 1.00
Air Support Sorties (est.)	3,150	3,150	1.00 - 1.00
Proving Ground Firepower (OLI/1000)*	719.8	596.3	1.21 - 1.00
Casualties	22,000	13,600	1.62 - 1.00
Casualties/Day	2,444	1,511	1.62 - 1.00
% Casualties/Day	2.49	2.44	1.02 - 1.00
Intensity of Combat	10.00	8.6	1.16 - 1.00
Tank Losses	450	350	1.25 - 1.00

*OLI = Operational Lethality Index, a measure of weapon effectiveness used in the QJMA.

Perhaps the most remarkable aspect of this comparison is the fact that the attacking force was outnumbered in the ratio of 3-to-2 in manpower, or 6-to-5 in firepower (using the Operational Lethality Index as a firepower measure). The traditional planners' rule of thumb is that the attacking force should outnumber the defender by 3-to-1, and that a defender can expect to be successful if the ratio is only 2-to-1.

These statistics, however, do not reveal two major advantages which the Germans had over the Russians: (a) the combat effectiveness of German units was, on the average, more than double that of Soviet units;[41] and (b) the German army was substantially more mobile than

[41]HERO analyses have demonstrated that in World War II the Germans had a combat effectiveness superiority over the Western Allies (American and British) in the range of 1.18 to 1.22, even as late as December 1944. In other words a calculated German Force Strength was the equivalent of an Allied Force Strength 18% to 22% greater, or, to make valid comparisons of effective Combat Power, German Force Strengths had to be multiplied by a factor of about 1.2. This differential has been assumed to reflect German superiority in leadership, training, and doctrine. Prior to this study, no comparable combat effectiveness factor had been calculated for German-Soviet comparisons. However, less intensive World War I analyses had demonstrated a German superiority over the Western Allies (American, British, and French) also of about 20%. The German superiority over the Russians in World War I

the Soviet. Bearing these major considerations in mind, a Quantified Judgment Method analysis (see Figure V-6) reveals that the attacking Germans had a slight superiority in overall combat power to the defending Soviet forces, probably as late as 11 July, but that this superiority was lost on 12 July, when substantial Soviet reinforcements were thrown into battle on the Voronezh front.

The principal comparisons emerging from a QJMA analysis are as follows:

	Soviets	Germans	Ratio
Force Strength (OLI/1000)	602.7	502.0	1.20 - 1.00
Mobility	1.0	1.24	1.00 - 1.24
Combat Power, 4 July 1943 (OLI/1000)	1,326.6	1,390.1	1.00 - 1.05
Combat Effectiveness (assumed)	1.0	2.35	1.00 - 2.35
Score Effectiveness*	1.39	2.55	1.00 - 1.83
Outcome, 4-11 July	3.57	4.49	-0.92 (Ger)
Estimated Combat Power, 12 July 1943	1,250.0	1,000.0	1.25 - 1.00
Estimated Outcome, 12-13 July	5.50	3.00	2.50 (Sov)

*Normal German preponderance about 3.00 - 1.00.

These figures reveal that the Soviet success was due not only to the reinforcements introduced on 12 July, but also to a Soviet ability to inflict casualties substantially greater than in most previous and subsequent battles on the Eastern Front. The German score effectiveness (casualty-inflicting capability) was on the average in the 1941-1944 period apparently almost 3-to-1 greater than that of the Soviets. This conclusion, based upon sketchy analysis of Eastern Front statistics,(consistent with extensive and detailed Western Front results, and with World War I results) suggests that a combat effectiveness superiority of 2.35-to-1 would be expected to result in a casualty-producing superiority of 2.94-to-1. Accordingly, the 1.83-to-1 German score effectiveness superiority at Kursk is substantially less than the average, and less than would be expected, and apparently reflects an exceptionally high Soviet combat-inflicting capability during that battle

On the other hand, this does not suggest a comparable general enhancement of overall Soviet combat capabilities, since the combat power ratio of 1.05-to-1 in favor of the Germans at the start of the battle is quite consistent with the slow, but steady, German advance in the first few days.

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was approximately 200%, or a combat effectiveness superiority factor of approximately 3.0. The Kursk data shown here suggests that the German combat effectiveness superiority over the Soviets in July 1943 could be represented by a factor of about 2.35.

ENGAGEMENT CALCULATION SHEET (RETROSPECTIVE)

Engagement: No. Kursk-Pena Engagement Date: 4-11 July, 1943 Calculation Date: 28 Jan, 1974

Friendly Unit: Sov 6 Gd & 1st Tank Armies Posture: Fort Def Mission Factor 4

Enemy Unit: Ger XLVIII Pz Corps Posture: Attack Mission Factor 4

$S_f = (W_s + W_{mg} + W_{hw} + W_{gi}) \times r_n$
$(14,700 + 24,141 + 157,984 + 17,583) \times .85$ = 182,247

$(W_q + W_{qy})(r_{wg} \times h_{wg} \times z_{wg} \times w_{yg})$
$(105,790 + 17,355) \times .9 \times 1 \times 1 \times 1$ = 110,831

$W_i \times r_{wi} \times h_{wi}$
$242,290 \times .7 \times 1$ = 169,603

$W_y \times r_{wy} \times h_{wy} \times z_{wy} \times w_{yy}$
$140,000 \times 1 \times 1 \times 1 \times 1$ = 140,000

S_f (total) = 602,681

$S_e = (W_s + W_{mg} + W_{hw} + W_{gi}) \times r_n$
$(9,360 + 11,926 + 73,133 + 50,449) \times .85$ = 123,057

$(W_g + W_{gy})(r_{wg} \times h_{wg} \times z_{wg} \times w_{yg})$
$(54,876 + 12,020) \times .9 \times 1 \times 1$ = 60,266

$W_i \times r_{wi} \times h_{wi}$
$219,790 \times .7 \times 1$ = 153,846

$W_y \times r_{wy} \times h_{wy} \times z_{wy} \times w_{yy}$
$164,350 \times 1 \times 1 \times 1 \times 1$ = 164,350

S_e (total) = 501,989

$V_f = N_f \times u_v / r_u \times \sqrt{S_e/S_f} \times v_y \times v_r$ S_f/S_e = 1.2006 S_e/S_f = 0.8329
$98,000 \times .5/1.45 \times .9226 \times 1 \times 1 = 30,840$

$v_f = 1 - V_f/S_f = 1 - 30,840/602,681$ = 0.9488

Mobility Factor $(N_f + 20J + W_i) \times m_{yf}/N_f$
$(98,000 + 20(2878) + 242,290) \times 1/98,000$ M_f = 4.0597

$m_d = 1$ $M_a = \sqrt{M_d/M_d}\sqrt{7.3042/4.0597}$ = 1.3413

$P_f = S_f \times m \times le \times t \times o \times b \times u_s \times r_u \times h_u \times z_u \times v_f$
$602,681 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1.6 \times 1.45 \times 1 \times 1 \times .9488$ = 1,326,631

$V_e = N_e \times u_v / r_u \times \sqrt{S_f/S_e} \times v_y \times v_r$
$62,000 \times 1/1 \times 1.0957 \times 1 \times 1 = 67,933$

$v_e = 1 - V_e/S_e = 1 - 67,933/501,989$ = 0.8647

Mobility Factor $(N_e + 20J + W_i) \times m_{ye}/N_e$
$62,000 + 20 \times 3554 + 220,790) \times 1/62,000$ M_e = 7.3042

$m_a = M_a - (1 - r_m \times h_m)(M_a - 1)$
$1.3413 - (.3 \times .3413)$ = 1.2339

$P_e = S_e \times m \times le \times t \times o \times b \times u_s \times r_u \times h_u \times z_u \times v_e$
$501,989 \times 1.2339 \times 2.35 \times 1 \times 1 \times 1 \times 1 \times 1 \times .8647$ = 1,340,133

P_f/P_e = 0.95 P_e/P_f = 1.05

Result Calculations

$E_{fsp} = \sqrt{(S_e \times u_{se})/(S_f \times u_{sf}) \times (4Q + D_e)/3D_f}$
$\sqrt{.8329/1.6 \times (-4 \times 3.5 + 37.1)/3 \times 59.61}$ = .07

$E_{esp} = \sqrt{(S_f \times u_{sf})/(S_e \times u_{se}) \times (4Q + D_f)/3D_e}$
$\sqrt{1.2006 \times 1.6(4 \times 3.5 + 59.11)/3 \times 37.61}$ = 1.26

$E_{fcas} = \sqrt{S_e/S_f}\left[\sqrt{(Cas_e \times u_{sf}/S_e)/(Cas_f \times u_{se}/S_f)} - \sqrt{100Cas_f/N_f}\right]$
$.9126\left(\sqrt{1.2006 \times 1625 \times 1.6/2625} - \sqrt{262500/98,000}\right)$ = -.50

$E_{ecas} = \sqrt{S_f/S_e}\left[\sqrt{(Cas_f \times u_{se}/S_f)/(Cas_e \times u_{sf}/S_e)} - \sqrt{100Cas_e/N_e}\right]$
$1.0957\left(\sqrt{.8329 \times 2625/1.6 \times 1625} - \sqrt{162500/62,000}\right)$ = -.77

$R_f = MR_f + E_{fsp} + E_{fcas}$ = 4 + .07 - .50 = 3.57

$R_e = MR_e + E_{esp} + E_{ecas}$ = 4 + 1.26 - .77 = 4.49

$R_f - R_e$ = -0.92 $R_e - R_f$ = 0.92

Figure V-6

It is difficult to escape the conclusion that this higher rate of Soviet casualty-producing capability was the result of delays imposed upon the German advance by the exceptionally extensive use of obstacles by the Soviets. The ability to determine, or even estimate, the extent to which this was the result of obstacles, as opposed to the field fortifications, is dependent upon comparative analyses with a far larger data base than is currently available. These Kursk results, however, do contribute to the formulation of hypotheses, discussed below, which can be fruitfully examined when the larger data base is available.

Nikopol Bridgehead Defense

Defensive Construction Period. Figure V-8 presents a summary of relevant construction data, based on both German records and Soviet postwar literature. The German records, unfortunately, seem to be incomplete, and good data was found only for 335th Infantry Division, which was not seriously attacked during the defense. The Soviet secondary sources devote considerable attention to the nature of the German defenses, but give only scanty details of the Russian operations against these defenses.

The data shown here represents the defensive construction effort per kilometer of front in the sector of the German 335th Infantry Division, on the extreme right (south) flank of the Nikopol bridgehead. The defensive construction effort began in early November 1943, and continued through January in the 335th's sector, although intensive Russian attacks were being directed at German units farther north in the bridgehead. This defensive zone is described in Chapter III, pp. 45 to 50.

The principal result of the data summary is the calculation that approximately 22,027 effective man-days of construction effort per kilometer of front was devoted to fortification and construction of obstacles in the defensive zone, which varied in depth in the 335th Division's sector from zero to nearly 20 kilometers; an average of about 10,000 meters. This was an effective effort per kilometer approximately one-sixth that which the Russians had devoted to the Kursk defenses, with a depth only about one-fourth of that fortified at Kursk. If, as seems likely, the Kursk effort had gone beyond the point of effective returns, it may be assumed that the Nikopol effort was more than 67% of a maximum effective effort, but probably less than 90%. (The representation of the theoretical results of the plotting of Hypothesis Number 1, in Part II of this chapter, Figure A, suggests that the Nikopol effort was approximately 87% of a maximum effective effort.)

DEFENSE CONSTRUCTION DATA SUMMARY, GERMAN 335 INFANTRY DIVISION,
NIKOPOL BRIDGEHEAD, NOVEMBER 1943 - FEBRUARY 1944

1. Defender's objective: To defend the right flank of the Nikopol Bridgehead, including Dnieper River crossing at Bol'shaya Lepatikha

2. Length at front: 15 km. (plus 4 km. of water)

3. Construction time:
   a. Anticipatory: 15 days (x .5 = 7.5)
   b. Pre-operational:
      (1) Nov 21-Jan 9: 50 days (x .75 = 37.5)
      (2) Jan 10-Feb 2: 23 days (x .50 = 11.5)
   c. Combat: 5 days (x .25 = 1.3)
   d. Standard days: 57.8

4. Average manpower availability/day:

	Anticipatory	Pre-operational	Combat
a. Engineers	215	215	215
b. Other troops	8,000	8,000	8,000
c. Civilians	2,000	2,000	0

5. Standardized manpower availability/day:

a. Engineers	538	1,075	269
b. Other troops	4,000	8,000	2,000
c. Civilians	1,000	2,000	0
	5,538	11,075	2,269

6. Manpower effort/day/km:
   a. Anticipatory: 369
   b. Pre-operational: 738
   c. Combat: 151

7. Total defense construction effort:
   a. Anticipatory (15 days): 5,535
   b. Pre-operational (50 days): 36,900
   c. Combat (5 days): 755
   Total 43,190 man-days

8. Approximate allocations of effort:
   a. *Field fortifications:* 34,552 (80%)
   b. Obstacles: 8,638 (20%)

9. Allocation if Engineers do all obstacle construction:
   a. Engineer effort: 538 + 3,583 + 90 (to obstacles) = 4,211 (10%)
   b. Other effort (to field fortifications): 38,979 (90%)

10. Materials used:
    a. Mines, AP: 6,500 (est.): 433/km
    b. Mines, AT: 1,200 (est.): 80/km
    c. Barbed wire: 30 km (est.): 2.0/km

11. Summary terrain description
    a. Contour: flat steppe, dotted with burial mounds; five deep ravines with spurs
    b. Vegetation: orchards; open farming country
    c. Structures: two villages, several scattered hamlets

12. Construction constraints:

	Constraint Nature	Factor
a. Terrain	None	1
b. Weather	Rain, snow, cold	0.6
c. Logistics	None	1
d. Mission	None	1
e. Ongoing ops.	Harassment & combat (23 days, pre-combat)	0.85
	Manpower degradation factor	0.51

13. Total normal construction effort in sector/km:
    43,190 x .51 = 22,027
    Preparation factor: 1.56 (formidable, but less than completely fortified zone)
    Fortification depth theoretically attainable: 10 km
    Fortification depth achieved: 10 km

Figure V-7

Combat Period. The data upon which this analysis is based is almost entirely from German records, those of the 335th Infantry Division. Further search of German records, and of Soviet literature, would probably provide additional information, particularly about the Soviet forces. It would appear from the records consulted, however, that two Soviet divisions were opposed to the 335th, and that the massing of Soviet forces in this sector was considerably less than farther north, where the most intensive fighting took place in late January and early February 1944.

Figure V-8 summarizes the weather during the combat and pre-combat period. Figures V- 9 and V-10 present inventories of the principal weapons assumed to have been available to the opposing forces, and the firepower values of these inventories.

Subject to refinement, as a result of further research, Figure V-12 includes the principal statistical comparisons of the opposing forces in the 335th's defensive sector (allowing for a detachment of approximately one-fourth of the German division to bolster neighboring units).

The record shows that the Soviets never seriously tested the defensive position of the 335th Infantry Division; the focus of their attention was farther north, where their massing of forces was considerably greater. Their forces opposite the 335th were inadequate to overcome the combination of German defenses and obstacles and German combat effectiveness superiority, as demonstrated by Quantified Judgment Method analysis (Figures V-11 and V-12). No engagement analysis is possible, since the Soviets did not seriously interfere with the withdrawal of the 335th Infantry Division.

Il Giogo Pass Defense

Defensive Construction Period. Figure V-13 presents a summary of relevant construction data, based primarily upon German records on microfilm in the US National Archives. This data has some gaps; it is possible that time for further research could have eliminated all or part of some of these gaps.

The data shown here represents the defensive construction effort per kilometer of front in the sector of the 4th German Parachute Division in the Green Line, in the Apennines north of Florence, from late 1943 through early September of 1944. Particular attention is paid to the defensive sub-sector of the 12th Parachute Regiment of that division, on a front of about four kilometers, including Il Giogo Pass. A description of the defensive effort, and its results, will be found in Chapter III, pp. 61 to 68.

WEATHER, 335TH INFANTRY DIVISION SECTOR
NIKOPOL BRIDGEHEAD, JANUARY 10 - FEBRUARY 7, 1944

10 Jan. Thaw; rain in the evening; snowfall at night

11 Jan. Snow at night changing into rain; thaw; temperature +1°C at 0700

12 Jan. Light frost; -4°C at 0700

13 Jan. Light frost; -3°C at 0700

14 Jan. Light frost; -6°C at 0700

15 Jan. Light snow; -6°C at 0700

16 Jan. Snow all day; accumlating up to 10 cm; -7°C at 0700

17 Jan. Light frost

18 Jan. Cloudy; rain in afternoon

19 Jan. Cloudy; poor visibility; 0°C at 0700

20 Jan. Cloudy in morning; sunshine in afternoon; -2°C at 0700

21 Jan. Thaw; -4°C at 0700

22 Jan. Cloudy; 0°C at 0700; -2°C at 1800

23 Jan. Clear and sunshine; -3°C at 0700

24 Jan. Cloudy; 0°C at 0700; thaw

25 Jan. Cloudy; +1°C at 0700; snow melting

26 Jan. Cloudy; thaw

27 Jan. Cloudy; heavy rain in afternoon

28 Jan. Cloudy; intermittent light rain

29 Jan. Morning frost followed by thaw (roads impassable)

30 Jan. Morning temperature -2°C; midday +6°C; rain in evening changing to snow

1 Feb. Light frost in morning; thawing by midday (roads impassable); snow in evening

2 Feb. Rain in afternoon (roads impassable)

3 Feb. Cloudy (roads impassable)

4 Feb. Light clouds in forenoon; heavy rain toward evening (roads impassable)

5 Feb. Clear in morning; cloudy in afternoon (roads impassable)

6 Feb. Sunny and mild

7 Feb. No weather information

Figure V-8

MAJOR WEAPONS INVENTORY
NIKOPOL BRIDGEHEAD, GERMAN 335TH INFANTRY DIVISION
2 - 8 February 1944

Number	Weapons Type	Type OLI	Inventory OLI
8,300	Small arms	.15	1,245
268	Machine guns, light	1.12	300
100	Machine guns, heavy	1.79	179
70	Mortar, 50 mm	70	4,900
38	Mortar, 81 mm	73	2,774
16	Mortar, 120 mm	245	3,920
18	Flamethrower	.5	9
20	Panzerfaust	10	200
11	Gun, AT, 37 mm	13	143
10	Gun, AT, 75 mm	122	1,220
3	Gun, AT, 88 mm	208	624
4	Gun, AT, 88 mm, S/P	270	1,080
15	Gun, AA, 20-28 mm	9	135
36	Gun, AA, 88 mm	208	7,488
10	Light infantry gun, 75 mm	87	870
4	Heavy infantry gun, 150 mm	200	800
7	Field guns, 75 mm	87	609
6	Field howitzer, 105 mm	232	1,392
2	Field howitzer, 150 mm	212	424
12	Gun-howitzer, 105 mm	240	2,880
6	Gun-howitzer, 150 mm	270	1,620
5	Close air support sorties/day, av.	471	2,355
	Total Proving Ground Inventory Value		35,167*

*At least one-fourth of this division was sent to support divisions to the north, leaving a maximum firepower OLI inventory of approximately 26,375 in the 335th Division sector.

Figure V-9

MAJOR WEAPONS INVENTORY, NIKOPOL BRIDGEHEAD
SOVIET 109TH AND 380TH RIFLE DIVISIONS
ATTACKING IN THE GERMAN 335TH INFANTRY DIVISION SECTOR
28 FEBRUARY 1944

Number	Weapons Type	Type OLI	Inventory OLI
12,000	Small arms	.15	1,800
575	Machine guns, light	1.2	690
330	Machine guns, heavy	1.7	561
136	Mortar, 50 mm	70	9,520
60	Mortar, 82 mm	73	4,380
58	Mortar, 120 mm	245	14,210
4	Multiple rocket launchers, truck mtd.	220	880
180	Rifle, AT	.5	90
30	Gun, AT, 45 mm	26	780
40	Gun, AT, 57 mm	32	1,280
70	Gun, AT 76 mm	122	8,540
40	Howitzer, 76 mm	100	4,000
20	Gun, 76 mm	100	2,000
40	Howitzer, 122 mm	250	10,000
20	Gun-howitzer, 122 mm	270	5,400
20	Gun-howitzer, 152 mm	290	5,800
16	Gun, AA 37 mm	15	240
16	Gun, AA 76 mm	150	2,400
6	Self propelled guns, 76 mm	238	1,428
25	Close air support, sorties/day, av.	400	10,000
	Total Proving Ground Inventory Value		83,999

Figure V-10

NIKOPOL STATISTICAL COMPARISON

	Soviet	German	Ratio
Manpower	12,000	6,225	1.93 - 1.00
Artillery and Mortars (75mm & over)	354	116	3.05 - 1.00
Air Support Sorties (est)	125	25	5.00 - 1.00
Proving Ground Firepower (OLI)	83,999	26,375	3.18 - 1.00
Force Strength (OLI)	66,273	21,614	3.07 - 1.00
Mobility	0.84	1.00	1.00 - 1.19
Combat Power (OLI)	34,902	91,720	1.00 - 2.63
Combat Effectiveness (assumed)	1.00	2.35	1.00 - 2.35

Figure V-11

ENGAGEMENT CALCULATION SHEET (RETROSPECTIVE)

Engagement: No. Nikopol Engagement Date: 2-8 Feb, 1944 Calculation Date: 28 Jan, 1974

Friendly Unit: Sov 109th & 380th R Divs Posture: Attack

Mission Factor _____

Enemy Unit: Ger 335th Inf Div Posture: Fort Def

Mission Factor _____

$S_f = (W_s + W_{mg} + W_{hw} + W_{gi}) \times r_n$
$(1800 + 1251 + 32,990 + 12,118) \times .9$ = 43,343

$(W_g + W_{gy})(r_{wg} \times h_{wg} \times z_{wg} \times w_{yg})$
$(23,700 + 2640) \times .9 \times .9 \times 1 \times 1$ = 20,930

$W_i \times r_{wi} \times h_{wi}$
0 = 0

$W_y \times r_{wy} \times h_{wy} \times z_{wy} \times w_{yy}$
$10,000 \times 1 \times .2 \times 1 \times 1$ = 2,000

S_f (total) = 66,273

$V_f = N_f \times u_w/r_u \times \sqrt{S_e/S_f} \times v_y \times v_r$ $S_f/S_e = 3.0665$ $S_e/S_f = 0.3261$
$12,000 \times 1/1 \times .5711 \times 1 \times 1 = 6853$

$v_f = 1 - V_f/S_f = 1 - 6853/66273$ = 0.8966

Mobility Factor $(N_f + 20J + W_i) \times m_{yf}/N_f$ M_f = 1.3533
$(12,000 + 20 \times 212) \times 1/12,000$

$m_d = 1$ $M_a = \sqrt{M_a/M_d} = \sqrt{1.3533/2.0361}$ = 0.6647

$P_f = S_f \times m \times le \times t \times o \times b \times u_s \times r_u \times h_u \times z_u \times v_f$
$66,273 \times .8391 \times 1 \times 1 \times 1 \times 1 \times 1 \times .7 \times 1 \times .8966$ = 34,902

$S_e = (W_s + W_{mg} + W_{hw} + W_{gi}) \times r_n$
$(1245 + 479 + 13,191 + 3261) \times .9 \times .75$ * = 12,411

$(W_g + W_{gy})(r_{wg} \times h_{wg} \times z_{wg} \times w_{yg})$
$(6751 + 7673) \times .9 \times .9 \times 1 \times 1 \times .75$ * = 8,732

$W_i \times r_{wi} \times h_{wi}$
0 = _____

$W_y \times r_{wy} \times h_{wy} \times z_{wy} \times w_{yy}$
$2355 \times 1 \times .2 \times 1 \times 1$ = 471

S_e (total) = 21,614

$V_e = N_e \times u_w/r_u \times \sqrt{S_f/S_e} \times v_y \times v_r$
$8300 \times .75 \times .58/1.45 \times 1.7511 \times 1 \times 1 = 4360$

$v_e = 1 - V_e/S_e = 1 - 4360/21,614$ = 0.7983

Mobility Factor $(N_e + 20J + W_i) \times m_{yf}/N_e$ M_e = 2.0361
$(8300 + 20 \times 430) \times 1/8300$

$m_a = M_a - (1 - r_m \times h_m)(M_a - 1)$
$0.6647 - (1 - .48)(.6647 - 1)$ = 0.8391

$P_e = S_e \times m \times le \times t \times o \times b \times u_s \times r_u \times h_u \times z_u \times v_e$
$21,614 \times 1 \times 2.35 \times 1 \times 1 \times 1.56 \times 1.45 \times 1 \times 1 \times .7983$ = 91,720

P_f/P_e = 0.38 P_e/P_f = 2.63

* Reflects 3/4 Div. strength available

Result Calculations

$E_{fsp} = \sqrt{(S_e \times u_{se})/S_f \times u_{sf}) \times (4Q + D_e)/3D_f}$ = _____

$E_{esp} = \sqrt{(S_f \times u_{sf})/(S_e \times u_{se}) \times (4Q + D_f)/3D_e}$ = _____

$E_{fcas} = \sqrt{S_e/S_f}\left[\sqrt{(Cas_e \times u_{sf}/S_e)/(Cas_f \times u_{se}/S_f)} - \sqrt{100Cas_f/N_f}\right]$ = _____

$E_{ecas} = \sqrt{S_f/S_e}\left[\sqrt{(Cas_f \times u_{se}/S_f)/(Cas_e \times u_{sf}/S_e)} - \sqrt{100Cas_e/N_e}\right]$ = _____

$R_f = MF_f + E_{fsp} + E_{fcas}$ = _____ = _____

$R_e = MF_f + E_{esp} + E_{ecas}$ = _____ = _____

$R_f - R_e$ = _____

$R_e - R_f$ = _____

Figure V-12

DEFENSE CONSTRUCTION DATA SUMMARY 4TH PARACHUTE DIVISION SECTOR,
IL GIOGO REGION, OCTOBER 1943 - SEPTEMBER 1944

1. **Defender's objective:** To prevent Allied movement northward through the Apennine Mountains

2. **Length of front:**
   a. Division's front: 9 km.
   b. 12th Parachute Regiment: 4 km.

3. **Construction time:**

a. Anticipatory:	300 days	(x .5	= 150)
b. Pre-operational:	17 days	(x 1	= 17)
c. Combat period:	8 days	(x .25	= 2)
d. Standard days:			169

4. **Average manpower availability/day:**

	Anticipatory	Pre-operational	Combat
a. Engineers	c. 25	200	200
b. Other troops	0	3,400	3,400
c. Civilians	1,450	c. 500	0

5. **Standardized manpower availability/day:**

a. Engineers	63	1,000	250
b. Other troops	0	3,400	850
c. Civilians	725	500	0
	1,328	4,900	1,100

6. **Manpower effort/day/km:**
   a. Anticipatory: 332
   b. Pre-operational: 1,225
   c. Combat: 275

7. **Total defense construction effort:**
   a. Anticipatory: 99,600
   b. Pre-operational: 24,225
   c. Combat: 2,464
   Total 126,289 man-days

8. **Approximate allocation of effort (est.):**

	Field Fortifications	*Obstacles*
a. Anticipatory period:	89,640 (90%)	9,960 (10%)
b. Pre-operational:	9,690 (40%)	14,535 (60%)
c. Combat	1,232 (50%)	1,232 (50%)
c. Estimated totals	100,562 (79.6%)	25,727 (20.4%)

9. **Allocation if Engineers do all obstacle construction:**
   a. Engineer effort: 4,725 + 4,250 + 500 (to obstacles) = 9,475 (8%)
   b. Other effort (to field fortifications): 116,814 (92%)

10. **Materials used:** no data available

11. **Summary terrain description:**
   a. **Contour:** mountains, very rough, steep slopes, deep ravines, rocky, sheer cliffs, frequent landslides
   b. **Vegetation:** stunted brush, bramble, scattered trees, patches heavily wooded
   c. **Structures:** isolated houses built of stone with very thick walls used as fortresses (usually located at the end of small cart trails)

12. **Construction constraints:**

	Constraint Nature	Factor
a. Terrain	Rough, steep, rocky, poor roads	0.3
b. Weather	Occasional rain and snow	0.8
c. Logistics	Some shortages	0.9
d. Mission	None	1.0
e. Ongoing ops.	Little to none	1.0
	Manpower degradation factor	0.22

13. **Total normal construction effort in sector:**
126,289 x .20 = 25,258
Preparation factor: 1.58 + 0.1 = 1.68 (max 1.60; achieved 1.13 times)
Fortification depth theoretically attainable: 11,000 meters
Fortification depth achieved: 12,000 meters (suggesting that actual preparation factor may have been about 1.55 instead of 1.6)

Figure V-13

The principal result of the data summary is the calculation that approximately 25,258 effective man-days of construction effort per kilometer of front was devoted to the fortification of the defensive zone, which had a depth of about five kilometers. This effort, combined with the natural fortress-like nature of the extremely rugged terrain, is estimated to have been adequate to have obtained the maximum possible fortification effect from the position 12,000 meters deep. This suggests, in fact, that a substantial amount of this effort was wasted, for reasons not clear in the record.

Combat Period. The data upon which this analysis is based is mainly from the records of the American 85th Infantry Division and the US Fifth Army, with some additional data from the records of the German Fourteenth Army. It is possible that some more information is available in the German records in the Military Archives in Freiburg, Germany. More precise data on the American air effort is available, particularly on the level of air support; this data was not sought, because of time considerations.

Figure V-14 summarizes the weather during the combat period. Figures V-15 and V-16 present inventories of the principal weapons available to the opposing forces in the Il Giogo sector, and the firepower values of those inventories, as expressed in OLI units.

The principal statistical comparisons of the opposing forces in the Il Giogo Sector are:

Designations	Americans	Germans	Ratio
Manpower	15,721	3,700	4.25 - 1.00
Tanks and Assault Guns	70	0	Infinite
Artillery and Mortars (75mm & over)	187	64	2.92 - 1.00
Air Support Sorties (est.)	100	0	Infinite
Proving Ground Firepower (OLI)	74,881	15,201	4.93 - 1.00
Casualties (German losses est.)	560	560*	1.00 - 1.00
Casualties/Day	112	112*	1.00 - 1.00
% Casualties/Day	0.71	3.03*	1.00 - 4.27
Intensity of Combat	4.0	3.7*	1.08 - 1.00*

*Probably high.

The American superiority in manpower and in firepower would appear to have been sufficient, according to the traditional planners' rule of thumb, to be confident of overcoming the enhancement of the defender's strength provided by terrain, fortifications, and obstacles. The estimate of German casualties is based upon American assessments, and is probably high.

WEATHER, IL GIOGO PASS
12 - 17 SEPTEMBER 1944

12 September	Clear
13 September	Clear
14 September	Clear
15 September	Rain
16 September	Heavy rain, no air support
17 September	Rain

Figure V-14

MAJOR WEAPONS INVENTORY, GERMAN 12TH PARACHUTE REGIMENT
(4TH PARACHUTE DIVISION) IL GIOGO PASS
12 - 17 September 1944

Number	Weapons Type	Type OLI	Inventory OLI
3,700	Small arms	.15	555
111	Machine guns, light	1.17	124
26	Machine guns, heavy	1.79	47
30	Mortar, 50 mm	70	2,100
15	Mortar, 81 mm	73	1,095
8	Mortar, 120 mm	245	1,960
24	Panzerfaust	10	240
8	Flamethrowers	.5	4
4	Gun, AT, 37 mm	13	52
8	Gun, AT, 75 mm	122	976
4	Gun, AT, 88 mm	208	832
8	Gun, AA, 20-28 mm	9	72
8	Gun, AA, 88 mm	208	1,664
5	Howitzer, 105 mm	232	1,160
4	Gun-howitzer, 105 mm	240	960
8	Gun-howitzer, 150 mm	270	2,160
4	Gun, 170 mm	300	1,200
200	Trucks		
	Total Proving Ground Inventory Value		15,201

Figure V-15

MAJOR WEAPONS INVENTORY, AMERICAN 85TH INFANTRY DIVISION (+)
IL GIOGO PASS, 12 - 17 SEPTEMBER 1944

Number	Weapons Type	Type OLI	Inventory OLI
15,721	Small arms	.2	3,144
243	Rifle, BAR	.7	170
90	Machine guns, heavy	2.2	198
77	Machine guns, light	1.1	85
239	Machine guns, AA, cal .50	2.2	526
9	Gun, AT, 37 mm	13	117
57	Gun, AT, 57 mm	27	1,539
90	Mortar, 60 mm	75	6,750
57	Mortar, 81 mm	80	4,560
557	Rocket Launcher, 2.36"	9	5,013
18	Howitzer, 105 mm, M-3 (Inf)	200	3,600
72	Howitzer, 105 mm, M-3-A1	239	17,208
12	Gun, 4.5"	250	3,000
48	Howitzer, 155 mm, M-1	304	14,592
8	Gun, 155 mm	365	2,920
4	Howitzer, 240 mm	264	1,056
1	Gun, 8"	370	370
13	Car, armored	43	559
17	Tank, light	180	3,060
53	Tank, medium	280	14,840
20	Close support sorties/day (av.)	500	10,000
1,564	Trucks		
22	Armored tracked vehicles (non weapon)		
8	Aircraft		
	Total Proving Ground Inventory Value		83,307

Figure V-16

A Quantified Judgement Method analysis (Figure V-17) reveals that there was adequate basis for American confidence. The principal comparisons emerging from a QJMA analysis are as follows:

	Americans	Germans	Ratio
Force Strength (OLI)	53,035	10,266	5.17 - 1.00
Mobility	1.26	1.00	1.26 - 1.00
Combat Power (OLI)	71,365	21,309	3.35 - 1.00
Combat Effectiveness	1.00	1.18	1.00 - 1.18
Score Effectiveness*	1.54**	3.55	1.00*- 2.31
Outcome	8.78	0.55	8.23 (American)

*Normal German preponderance,1.59 - 1.00

**Probably high.

A further analysis of these results suggests that if an entire German division had held the Il Giogo sector, and if attachments from corps and army artillery had been nearly doubled, an American success would have been impossible. The fortifications and obstacles appear to have been adequate in strength, although surprisingly thin in depth; the force to hold and to cover them with fire was not adequate. This inadequacy could probably have been offset by timely commitment of additional forces. This appears to have been one of the few times in the Italian Campaign that German reserves were not used judiciously, and in which lateral front-line unit movements, to make up for shortages of reserves, were initiated too late.

ENGAGEMENT CALCULATION SHEET (RETROSPECTIVE)

Engagement: No. Il Giogo Engagement Date: 12-17 Sept, 1944 Calculation Date: 28 Jan, 1974

Friendly Unit: US 85th Inf Div Posture: Attack Mission Factor 8

Enemy Unit: Ger 12th Para Regt (+) Posture: Fort Def Mission Factor 3

$S_f = (W_s + W_{mg} + W_{hw} + W_{gi}) \times r_n$
$(3144 + 453 + 14,910 + 3335) \times .7$ = 15,289

$(W_g + W_{gy})(r_{wg} \times h_{wg} \times z_{wg} \times w_{yg})$
$(39,146 + 263) \times .8 \times 1 \times .9 \times 1$ = 28,374

$W_i \times r_{wi} \times h_{wi}$
$18,459 \times .3 \times 1$ = 5,533

$W_y \times r_{wy} \times h_{wy} \times z_{wy} \times w_{yy}$
$10,000 \times 1 \times .9 \times 1 \times 1.1$ = 9,900

S_f (total) = 59,101

$S_e = (W_s + W_{mg} + W_{hw} + W_{gi}) \times r_n$
$(555 + 171 + 5159 + 2100) \times .7$ = 5,590

$(W_g + W_{gy})(r_{wg} \times h_{wg} \times z_{wg} \times w_{yg})$
$(5480 + 1736) \times .8 \times 1 \times .9 \times .9$ = 4,676

$W_i \times r_{wi} \times h_{wi}$
0 = 0

$W_y \times r_{wy} \times h_{wy} \times z_{wy} \times w_{yy}$
0 = 0

S_e (total) = 10,266

$V_f = N_f \times u_v/r_u \times \sqrt{S_e/S_f} \times v_y \times v_r$ $S_f/S_e = 5.7570$ $S_e/S_f = 0.1737$
$15,721 \times 1/1 \times .4168 \times .9 \times 1 = 6677$

$v_f = 1 - V_f/S_f = 1 - 6677/59,101$ = 0.8938

$V_e = N_e \times u_v/r_u \times \sqrt{S_f/S_e} \times v_y \times v_r$
$3700 \times .5/1.55 \times 2.3994/1.1 \times 1 = 3150$

$v_e = 1 - V_e/S_e = 1 - 3150/10,266$ = 0.6931

Mobility Factor $(N_f + 20J + W_i) \times m_{vf}/N_f$ M_f = 4.26
$(15,721 + 20 \times 640 + 12,544) \times 1/15,721$

$m_d = 1$ $M_a = \sqrt{M_f/M_d} = \sqrt{4.26/1.87}$ = 1.5093

Mobility Factor $(N_e + 20J + W_i) \times m_{vf}/N_e$ M_e = 1.87
$(3700 + 20 \times 200) \times .9/3700$

$m_a = M_a - (1 - r_m \times h_m)(M_a - 1)$
$1.5093 - (.50) \times .51$ = 1.2543

$P_f = S_f \times m \times le \times t \times o \times b \times u_s \times r_u \times h_u \times z_u \times v_f$
$59,035 \times 1.2543 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1.1 \times .8938$ = 72,271

$P_e = S_e \times m \times le \times t \times o \times b \times u_s \times r_u \times h_u \times z_u \times v_e$
$10,266 \times 1 \times 1.18 \times 1 \times 1.6 \times 1.55 \times 1 \times 1 \times .6931$ = 20,822

P_f/P_e = 3.47 P_e/P_f = 0.29

Result Calculations

$E_{fsp} = \sqrt{(S_e \times u_{se})/(S_f \times u_{sf})} \times (4Q + D_e)/3D_f$
$\sqrt{.1737 \times 1.6} \times (4 \times 0.79 + 2.25)/3 \times 9.56$ = 0.23

$E_{esp} = \sqrt{(S_f \times u_{sf})/(S_e \times u_{se})} \times (4Q + D_f)/3D_e$
$\sqrt{5.7570/1.6} (-3.16 + 9.56)/3 \times 2.25$ = 1.85

$E_{fcas} = \sqrt{S_e/S_f} \left[\sqrt{(Cas_e \times u_{sf}/S_e)/(Cas_f \times u_{se}/S_f)} - \sqrt{100Cas_f/N_f}\right]$
$.4168 (\sqrt{5.7570 \times 112/1.6 \times 112} - \sqrt{112.00/15,721})$ = 0.44

$E_{ecas} = \sqrt{S_f/S_e} \left[\sqrt{(Cas_f \times u_{se}/S_f)/(Cas_e \times u_{sf}/S_e)} - \sqrt{100Cas_e/N_e}\right]$
$2.3994 (\sqrt{.1737 \times 1.6} - \sqrt{112.00/3700})$ = -2.90

$R_f = M_f + E_{fsp} + E_{fcas}$ = 4.26 + 0.23 + 0.44 = 8.67

$R_e = M_e + E_{esp} + E_{ecas}$ = 3 + 1.85 - 2.90 = 1.95

$R_f - R_e$ = 6.72 $R_e - R_f$ = -6.72

Figure V-17

Ardennes Campaign; Sauer River Defense

Defensive Construction Period. Figure V-18 presents a summary of relevant construction data, based on records of the US 4th Infantry Division, US First Army, and US Third Army. German records for the entire Ardennes Campaign are sketchy.

The data shown here represents the perfunctory defensive preparations of two divisions (initially the 83d, later the 4th) of an army in an essentially offensive posture, during a lull in operations and while occupying a quiet sector. In other words, in somewhat perfunctory compliance with doctrine, the units were dug in, but primary attention was given to training, rest and recreation to the extent possible; the positions could hardly be considered to have been prepared for defense. There was no barrier plan; there were few obstacles other than those provided naturally by somewhat rugged terrain.

The principal result of the data summary is to show that this perfunctory pre-combat effort, combined with an intensively hasty effort to organize defenses in combat after severe surprise, provided approximately 5,135 effective man-days of construction effort per kilometer of front in the 4th Division sector, and particularly in that part occupied by the 12th Infantry Regiment, on the division left. This amount of effort produced an inadequately prepared defense that was somewhat more effective than a completely improvised hasty defense.

Combat Period. This data, too, is based primarily upon 4th Division records, augmented with additional data from microfilms of German records in the National Archives. Additional German data probably exists but could not be located for this study.

Figure V-19 summarizes the weather during the combat period. Figures V-20 and V-21 present inventories of the principal weapons available to the opposing forces in the 12th Infantry's Sauer River sector (including available reserves), and the firepower value of those inventories in OLI units.

The principal statistical comparisons of the opposing forces in this sector are:

DEFENSE CONSTRUCTION DATA SUMMARY, US 4TH INFANTRY DIVISION
ARDENNES, NOVEMBER - DECEMBER 1944

1. Defender's objective:
   a. Before 16 December: Occupy quiet sector in preparation for further offensive
   b. After 16 December: Delay advance by defending in place and denying roadnets and bridges; then to push enemy back across Sauer River and strengthen division front along the river line.

2. Length of Front:
   a. Overall division front: 56 km.
   b. Active front: 10 km.

3. Construction time:
   a. Anticipatory: 83 days (x .5 = 41.5)
   b. Pre-operational: 0
   c. Combat: 9 days (x .25 = 2.25)
   d. Standard days: 43.75 or 44

4. Average manpower availability/day:

	Anticipatory	Combat
a. Engineers	595	595
b. Other troops	13,000	13,000

5. Standardized manpower availability/day:

a. Engineers	1,488	744
b. Other troops	6,500	3,250
	7,988	3,994

6. Manpower effort/day/km:
   a. Anticipatory: 143
   b. Combat: 107 (factor of 1.5 allows for doubling of defense in 2 days)

7. Total defense construction effort:
   a. Anticipatory (83 days): 11,869
   b. Combat (9 days): 963
   Total 12,832 man-days

8. Approximate allocation of effort:
   a. Field fortifications: 10,102 (80%)
   b. Obstacles: 2,526 (20%)

9. Allocation if Engineers do all obstacle construction:
   a. Engineer effort: 2,205 + 179 (to obstacles) = 2,384 (19%)
   b. Other effort (to field fortifications): 10,448 (81%)

10. Materials used (est.):
    a. Mines, AP: 100
    b. Mines, AT: 630

11. Summary terrain description:
    a. Contour: sharp rises, deep ravines, hills, plateaus, gorges, steep river banks
    b. Vegetation: thick woods
    c. Existing structures: scattered farm dwellings

12. Construction constraints:

	Constraint	Nature	Factor
a.	Terrain	Rough, forested	0.9
b.	Weather	Intermittent rain	0.8
c.	Logistics	None	1.0
d.	Mission	No defensive preparation (considered under construction time)	1.0
e.	Ongoing ops.	During anticipatory period troops were training and resting; doing little construction (83 days of 92)	0.55
		Manpower degradation factor	0.40

13. Total normal construction effort in sector:
    12,837 x .40 = 5,135
    Preparation factor: 1.27 (provided for only hasty defense in division sector and zone; approximately 10 km. deep)

Figure V- 18

WEATHER, 4TH DIVISION SECTOR
ARDENNES, 16 - 24 DECEMBER 1944

16 December	Thick fog, foul weather, low clouds, cold
17 December	Cloudy, fog, cold, very poor visibility
18 December	Thick fog, no change
19 December	Cold and foggy, no change, poor visibility
20 December	Thick fog, no change
21 December	Foggy, no change
22 December	Clear, snow, mist, but improved visibility
23 December	Clear
24 December	Clear and cold

Figure V-19

MAJOR WEAPONS INVENTORY, GERMAN 212TH VOLKS GRENADIER DIVISION
ARDENNES, SAUER RIVER OFFENSE, 16 - 17 DECEMBER 1944

Number	Weapons Type	Type OLI	Inventory OLI
10,000	Small arms	.15	1,500
300	Machine gun, light	1.12	336
150	Machine gun, heavy	1.79	269
80	Mortar, 50 mm	70	5,600
40	Mortar, 81 mm	73	2,920
20	Mortar, 120 mm	245	4,900
20	Flamethrower	.5	10
30	Panzerfaust	10	300
4	Gun, 105 mm, recoilless	215	860
10	Howitzer, 75 mm, infantry	87	870
4	Howitzer, 150 mm, infantry	190	760
10	Gun, AT, 37 mm	13	130
20	Gun, AT, 75 mm	122	2,440
16	Gun, AT, 88 mm	208	3,328
4	Gun, AT, 88 mm, S/P	270	1,080
12	Gun, AA, 20-28 mm	9	96
16	Gun, AA, 88 mm	208	3,328
24	Gun-howitzer, 105 mm	232	5,568
8	Howitzer, 150 mm	212	1,696
8	Gun-howitzer, 150 mm	257	2,056
4	Gun, 105 mm	294	1,176
4	Gun, 170 mm	320	1,280
4	Nebelwerfer, 210 mm	400	1,600
456	Trucks		
10	Armored support vehicles		
	Total Proving Ground Inventory Value		42,103

Figure V-20

MAJOR WEAPONS INVENTORY, US 12TH INFANTRY REGIMENT SECTOR,
4TH INFANTRY DIVISION, ARDENNES,
SAUER RIVER DEFENSE, 16 - 17 DECEMBER 1944

Number	Weapons Type	Type OLI	Inventory OLI
8,634	Small arms	.2	1,727
225	Rifle, BAR	.7	158
102	Machine gun, light	1.1	112
260	Machine gun, heavy (incl. .50 cal)	2.2	572
29	Gun, AT, 57 mm	27	783
60	Mortar, 60 mm	75	4,500
35	Mortar, 81 mm	80	2,800
468	Rocket Launcher, 2.36"	9	4,212
3	Howitzer, M-3, 105 mm (Inf)	200	600
36	Howitzer, M-2 A-2, 105 mm	239	8,604
24	Howitzer, M-1, 155 mm	304	7,296
19	Car, armored, M-8	43	817
20	Tank, light	180	3,600
17	Tank, medium	280	4,760
3	Howitzer, 75 mm, SP	113	339
51	Tracked vehicles		
938	Trucks		
12	Aircraft		
	Total Proving Ground Inventory Value		**40,880**

Figure V-21

Designations	Americans	Germans	Ratio
Manpower	8,634	10,000	1.00 - 1.16
Tanks and Assault Guns	40	4	10.00 - 1.00
Artillery and Mortars (75mm & over)	98	162	1.00 - 1.65
Proving Ground Firepower (OLI)	40,880	42,103	1.00 - 1.03
Casualties (German losses est.)	134	268*	1.00 - 2.00
Casualties/Day	67	134*	1.00 - 2.00
% Casualties/Day	0.78	1.34*	1.00 - 1.72
Intensity of Combat	2.8	3.6*	1.00 - 1.29*

*Probably high.

The estimates of German casualties shown here are probably considerably higher than they actually were; it is doubtful if German losses were any greater than those of the Americans. The reason for using a high estimate of German casualties is to assure that the QJM calculations are not possibly biased in favor of the Germans. It is hoped that this can be more precisely determined by further research.

It will be noted that the Germans had only a slight superiority in manpower and firepower, due to the ability of the Americans to shift both artillery and armor promptly from reserve and adjacent sectors to the 12th Infantry's front. It is probable that the Germans were willing to attack under these circumstances because of two considerations: (1) they were counting on the effects of surprise, and (2) this was a secondary attack, designed to pin down American forces and prevent them from being shifted to meet the main effort farther north.

In previous QJM analyses HERO has developed some tentative factors that appear to reflect the effect of surprise on the mobility of an attacker, as well as on the vulnerabilities of both attacker and defender. These factors were applied in the QJMA analysis of the engagement along the Sauer River on 16 and 17 December. (The arrival of substantial additional American reinforcements on the 18th resulted in an entirely new balance of forces, and thus a new engagement, beginning on 18 December.)

The principal comparisons emerging from a QJMA comparison, in which the tentative surprise factors have not been applied (see Figure V-22), and in which they have been applied (Figure V-23), are as follows:

ENGAGEMENT CALCULATION SHEET (RETROSPECTIVE)

Ardennes-

Engagement: No. Sauer (1) Engagement Date: 16-17 Dec, 1944 Calculation Date: 28 Jan, 1974

Friendly Unit: US 4th Inf Div (-) Posture: Hasty Def Enemy Unit: Ger 212th VG Div Posture: Attack

Mission Factor 5 Mission Factor 6

$S_f = (W_s + W_{mg} + W_{hw} + W_{gi}) \times r_n$
$(1727 + 402 + 7900 + 4995) \times .9$ = 13,522

$(W_g + W_{gy})(r_{wg} \times h_{wg} \times z_{wg} \times w_{yg})$
$(15.900 + 440) \times .9 \times .9 \times 1 \times 1.1$ = 14,559

$W_i \times r_{wi} \times h_{wi}$
$9516 \times .8 \times .6$ = 4,568

$W_y \times r_{wy} \times h_{wy} \times z_{wy} \times w_{yy}$
0 = 0

S_f (total) = 32,649

$S_e = (W_s + W_{mg} + W_{hw} + W_{gi}) \times r_n$
$(1500 + 605 + 15,720 + 6198) \times .9$ = 21,801

$(W_g + W_{gy})(r_{wg} \times h_{wg} \times z_{wg} \times w_{yg})$
$(13,376 + 3,424) \times .9 \times .9 \times 1 \times .9$ = 12,247

$W_i \times r_{wi} \times h_{wi}$
$1080 \times .8 \times .6$ = 518

$W_y \times r_{wy} \times h_{wy} \times z_{wy} \times w_{yy}$
0 = 0

S_e (total) = 34,566

$V_f = N_f \times u_v/r_u \times \sqrt{S_e/S_f} \times v_y \times v_r$ S_f/S_e = 0.9446 S_e/S_f = 1.0587
$8634 \times .72/1.45 \times 1.0289 \times 1 \times 1 = 4411$ = 0.8649

$v_f = 1 - V_f/S_f = 1 - 4411/32,649$

Mobility Factor $(N_f + 20J + W_i) \times m_{yf}/N_f$ M_f = 4.4139
$(8634 + 20 \times 998 + 9516) \times 1/8634$

$m_d = 1$ $M_a = \sqrt{M_a/M_d} = \sqrt{2.06/4.4139}$ = 0.6832

$P_f = S_f \times m \times le \times t \times o \times b \times u_s \times r_u \times h_u \times z_u \times v_f$
$32,649 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1.27 \times 1.45 \times 1 \times 1 \times .8649$ = 52,000

$V_e = N_e \times u_v/r_u \times \sqrt{S_f/S_e} \times v_y \times v_r$
$10,000 \times 1/1 \times 0.9719 \times 1 \times 1.2 = 11,663$

$v_e = 1 - V_e/S_e = 1 - 11,663/34566$ = 0.6626

Mobility Factor $(N_e + 20J + W_i) \times m_{yf}/N_e$ M_e = 2.0600
$(10,000 + 20 \times 476 + 1080) \times 1/10,000$

$m_a = M_a - (1 - r_m \times h_m)(M_a - 1)$ = 0.8226
$0.6832 - (1 - .56)(.6832 - 1)$

$P_e = S_e \times m \times le \times t \times o \times b \times u_s \times r_u \times h_u \times z_u \times v_e$
$34,566 \times .8226 \times 1.18 \times 1 \times 1 \times 1 \times .9 \times 1 \times .6626$ = 20,008

P_f/P_e = 2.60 P_e/P_f = 0.38

Result Calculations

$E_{fsp} = \sqrt{(S_e \times u_{se})/(S_f \times u_{sf}) \times (4Q + D_e)/3D_f}$
$\sqrt{1.0587/1.27} \times (-4 \times 3.17 + 6.08)/3 \times 5.25$ = -0.59

$E_{esp} = \sqrt{(S_f \times u_{sf})/(S_e \times u_{se}) \times (4Q + D_f)/3D_e}$
$\sqrt{.9446 \times 1.27} \times (12.68 + 5.75)/3 \times 6.08$ = 1.09

$E_{fcas} = \sqrt{Se/Sf}\left[\sqrt{(Cas_e \times u_{sf}/S_e)/(Cas_f \times u_{se}/S_f)} - \sqrt{100Cas_f/N_f}\right]$
$1.0289\left(\sqrt{134} \times .9446 \times 1.27/67 - \sqrt{6700/8634}\right)$ = 0.69

$E_{ecas} = \sqrt{S_f/S_e}\left[\sqrt{(Cas_f \times u_{se}/S_f)/(Cas_e \times u_{sf}/S_e)} - \sqrt{100Cas_e/N_e}\right]$
$.9719\left(\sqrt{67} \times 1.0587/1.27 \times 134 - \sqrt{13400/10,000}\right)$ = -0.50

$R_f = MF_f + E_{fsp} + E_{fcas}$ = 5 - .59 + .69 = 5.10

$R_e = MF_e + E_{esp} + E_{ecas}$ = 6 + 1.09 - .50 = 6.59

$R_f - R_e$ = -1.49 $R_e - R_f$ = 1.49

Figure V-22

ENGAGEMENT CALCULATION SHEET (RETROSPECTIVE)

Engagement: No. Ardennes-Sauer (2) Engagement Date: 16-17 Dec, 1944 Calculation Date: 28 Jan 1974

Friendly Unit: US 4th Inf Div (-) Posture: Hasty Def

Mission Factor 5

$S_f = (W_s + W_{mg} + W_{hw} + W_{gi}) \times r_n$ = 13,522

$(W_g + W_{gy})(r_{wg} \times h_{wg} \times z_{wg} \times w_{yg})$ = 14,559

$W_i \times r_{wi} \times h_{wi}$ = 4,568

$W_y \times r_{wy} \times h_{wy} \times z_{wy} \times w_{yy}$ = 0

S_f (total) = 32,649

$V_f = N_f \times u_v/r_u \times \sqrt{S_e/S_f} \times v_y \times v_r \times v_{sur}$ S_e/S_f = 0.9446 S_e/S_f = 1.0587

8634 x .72/1.45 x 1.022 x 1 x 1 x 3 = 13,233

$v_f = 1 - V_f/S_f$ = 1 - 13233/32,649 = 0.5947

Mobility Factor $(N_f + 20J + W_i) \times m_{yf}/N_f$ M_f = 4.4139

$m_d = 1$ $M_a = \sqrt{M_a/M_d} \times M_{sur}$ = 1.5276

2.06/4.4139 x 5

$P_f = S_f \times m \times le \times t \times o \times b \times u_s \times r_u \times h_u \times z_u \times v_f$

32.649 x 1 x 1 x 1 x 1 x 1.27 x 1.45 x 1 x 1 x .5947 = 35,755

P_f/P_e = 0.87

$S_e = (W_s + W_{mg} + W_{hw} + W_{gi}) \times r_n$ = 21,801

$(W_g + W_{gy})(r_{wg} \times h_{wg} \times z_{wg} \times w_{yg})$ = 12,247

$W_i \times r_{wi} \times h_{wi}$ = 518

$W_y \times r_{wy} \times h_{wy} \times z_{wy} \times w_{yy}$ = 0

S_e (total) = 34,566

$V_e = N_e \times u_v/r_u \times \sqrt{S_f/S_e} \times v_y \times v_r \times v_{sur}$

10.000 x 1/1 x .9719 x 1 x 1.2 x .4 = 4665

$v_e = 1 - V_e/S_e$ = 1 - 4665/34,566 = 0.8650

Mobility Factor $(N_e + 20J + W_i) \times m_{yf}/N_e$ M_e = 2.060

$m_a = M_a - (1 - r_m \times h_m)(M_a - 1)$ = 1.2955

1.5276 - (.44) x .5276

$P_e = S_e \times m \times le \times t \times o \times b \times u_s \times r_u \times h_u \times z_u \times v_e$

34,566 x 1.2955 x 1.18 x 1 x 1 x 1 x .9 x 1 x .8650 = 41,136

P_e/P_f = 1.15

Result Calculations

$E_{fsp} = \sqrt{(S_e \times u_{se})/S_f \times u_{sf}) \times (4Q + D_e)/3D_f}$ = -0.59

$E_{fcas} = \sqrt{S_e/S_f}\left[\sqrt{(Cas_e \times u_{sf}/S_e)/(Cas_f \times u_{se}/S_f)} - \sqrt{100Cas_f/N_f}\right]$ = 0.69

$R_f = M_f + E_{fsp} + E_{fcas}$ = _____ = 5.10

$R_f - R_e$ = -1.49

$E_{esp} = \sqrt{(S_f \times u_{sf})/(S_e \times u_{se}) \times (4Q + D_f)/3D_e}$ = 1.09

$E_{ecas} = \sqrt{S_f/S_e}\left[\sqrt{(Cas_f \times u_{se}/S_f)/(Cas_e \times u_{sf}/S_e)} - \sqrt{100Cas_e/N_e}\right]$ = -0.50

$R_e = M + E_{esp} + E_{ecas}$ = _____ = 6.59

$R_e - R_f$ = 1.49

Figure V-23

	Americans	Germans	Ratio
Force Strength (OLI)	32,649	34,566	1.00 - 1.06
Mobility (normal)	1.00	0.82	1.22 - 1.00
Mobility (surprise considered)	1.00	1.30	1.00 - 1.30
Combat Power (normal) (OLI)	52,000	20,008	2.60 - 1.00
Combat Power (surprise considered) (OLI)	35,755	41,136	1.00 - 1.15
Combat Effectiveness*	1.00	1.18	1.00 - 1.18
Score Effectiveness	2.16**	1.79	1.21** 1.00
Outcome	5.10	6.59	-1.49 (German)

*Normal German preponderance, 1.59 - 1.00

**Probably high.

If, as is probable, German casualties were less than has been assumed, then the extent of the German success was slightly greater than shown. It is interesting that the application of the factors for surprise provided a combat power ratio fully consistent with the quantitatively calculated outcome. That quantitative outcome, furthermore, is fully consistent with any qualitative assessment of the first two days of the Sauer River operations: the Germans accomplished their mission quite satisfactorily; they advanced steadily during those two days, and held substantial American forces in this area; in the light of these accomplishments, even the relatively high casualty rate which has been assumed was quite acceptable.

On the other hand, bearing in mind the nature of the German surprise, and the inadequacy of prepared defenses for such an attack, the performance of the 4th Division is also commendable; the German success was undeniable, but far from decisive.

For the purposes of this study, and of possible future elaborations of this study, the 4th Division experience will be useful as an indication of the defensive capabilities of an experienced division, with minimum field fortifications, and virtually no obstacles to enhance defensive capabilities.

Part II - Synthesis

General

The objectives of the quantitative analysis have been threefold:

1. To ascertain the effects of obstacle construction effort in the enhancement of defensive capability;

2. To ascertain the effects of existing natural terrain features or man-made obstacles upon the defensive value of terrain; and

3. To explore the delaying effects of natural and man-made obstacles.

With only four case studies, this exploration could not possibly produce definitive values for any of the effects sought. To the extent time permitted exploration in the records, however, these case studies have permitted (a) the establishment of a series of hypotheses and a suggested methodology which it is believed will permit determination of reliable average values from an adequate data base, and (b) the very tentative estimation of possible values for such effects.

The hypotheses have been formulated from an examination of a very limited data base, compiled in a brief period of time, without full exploitation of all major data sources. It does not include a complete representation of all of the potential effects of obstacles which must be considered in any thorough quantification of obstacle effects. However, the hypotheses appear to be generally consistent with such relevant data as was found in the data base. They represent a composite starting position for future research and analysis, but cannot be considered as formal, definitive values or conclusions from historical experience.

Effects of Obstacle Construction Effort

From analyses of 78 World War II engagements in other studies, the Quantified Judgment Method of Analysis of Historical Combat Data (QJMA) confirms Clausewitz's assertion that "the defensive is the stronger form of conducting war"[42] and indicates that the combat capabilities of a military force are enhanced, or multiplied by, factors ranging from 1.15 to 1.6, depending upon the extent to which the defensive position has been prepared or fortified. While no

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[42]Karl von Clausewitz, On War (O.S.M. Jolles translation, Washington, D.C., 1950) p. 318.

claim of absolute precision in these values is possible, the validation of the results of QJMA analyses makes it certain that these posture factors are reasonably accurate.

The preparation of a defensive position involves four major kinds of effort: (1) the construction of entrenchments and other forms of field fortifications; (2) the preparation of demolitions to block passage of roads, defiles, or bridges; (3) the preparation of various forms of constructed obstacles to block limited or broad avenues of movement; and (4) the emplacement of mines or other explosive charges to impede hostile progress across otherwise favorable, generally broad, avenues of movement.

The historical records so far reviewed do not provide any direct evidence of the relative importance or of the relative contribution of these four components of the combat capability enhancement value of posture factors. However, it appears that more than 50% of defensive construction efforts is devoted to the preparation of field fortifications. On the basis of this and other evidence in these four case studies, and in the light of professional experience of study participants, the following hypothesis is offered as a reasonable representation of the relative effects of mines, demolitions, constructed obstacles, and field fortifications in the defense:

Hypothesis Number 1.

a. The maximum defensive capability effect of field fortifications is approximately equal to the combined maximum defense capability effect of obstacles;

b. The maximum defensive capability effects of mines, demolitions, and of constructed obstacles are approximately equal;

c. A given level of manpower defensive effort will generally contribute to defensive capability more quickly when applied to obstacles than when applied to field fortification construction; in general the maximum defensive capability of demolitions can be achieved more quickly than that of mines, and the maximum defensive capability of mines can be achieved more quickly than that of constructed obstacles.

d. Under ideal conditions, a total effort of approximately 33,000 man-days per kilometer of front approaches the maximum possible combat capability enhancement in a defensive zone approximately 10 kilometers deep.

e. The defensive construction capability of trained combat engineers is approximately five times that of non-engineers, military or civilian.

f. Without any construction or preparation by the defenders, the minimum factor value of defensive posture is 1.15, and within one day, even under combat conditions, becomes at least 1.2.

g. The effect of construction effort is reduced from that of ideal conditions, by various constraints including:

(1) Terrain: rugged terrain and/or an inadequate road net can reduce the effectiveness of the construction effort;

(2) Weather: rain, snow, extreme heat, and extreme cold can reduce the effectiveness of the construction effort;

(3) Logistics: shortages of supplies (mines, barbed wire, construction equipment, etc.) can inhibit the effort, as can a poor or defective distribution system;

(4) Ongoing Operations: involvement in active ground combat, long range artillery harassment and air harassment can reduce the effectiveness of the construction effort;

(5) Mission: directives from higher authority can reduce the level of effort in a manner tentatively estimated as follows:

(a) Front line position: actual or anticipated offensive posture, .5; any diversionary mission, .75;

(b) Rear area position: anticipatory, no specific or urgent preparatory directive, .5; pre-combat, specific operations anticipated in near future, 1.0.

Elements a through f of Hypothesis Number 1 are presented graphically in Figure V-24; elements g(1-4) are presented graphically in Figure V-25.

Defensive Value of Terrain Features and Obstacles

It has been conclusively demonstrated by the QJMA analyses that certain terrain features enhance the combat capabilities of troops carrying out defensive missions, and that this effect can be represented by quantitative factors. As with posture factors, absolute precision in the determination of these terrain-defense factors cannot be claimed; however, a range of values from 1.05 to 1.55 has been demonstrated to be reasonably accurate. (It is to be noted that this is a factor representing the inherently defensive or defensible nature of the terrain, and is quite independent of the enhancement of this defensive nature by artificial defense construction, as discussed above.)

The terrain features that contribute to the defensive value of terrain are the following:

Hills and mountains	Streams and rivers
Forests	Ravines and gullies
Swamps	Urban areas

Based upon the earlier qualitative and quantitative analyses of the four case studies, a general hypothesis is offered as a reasonable

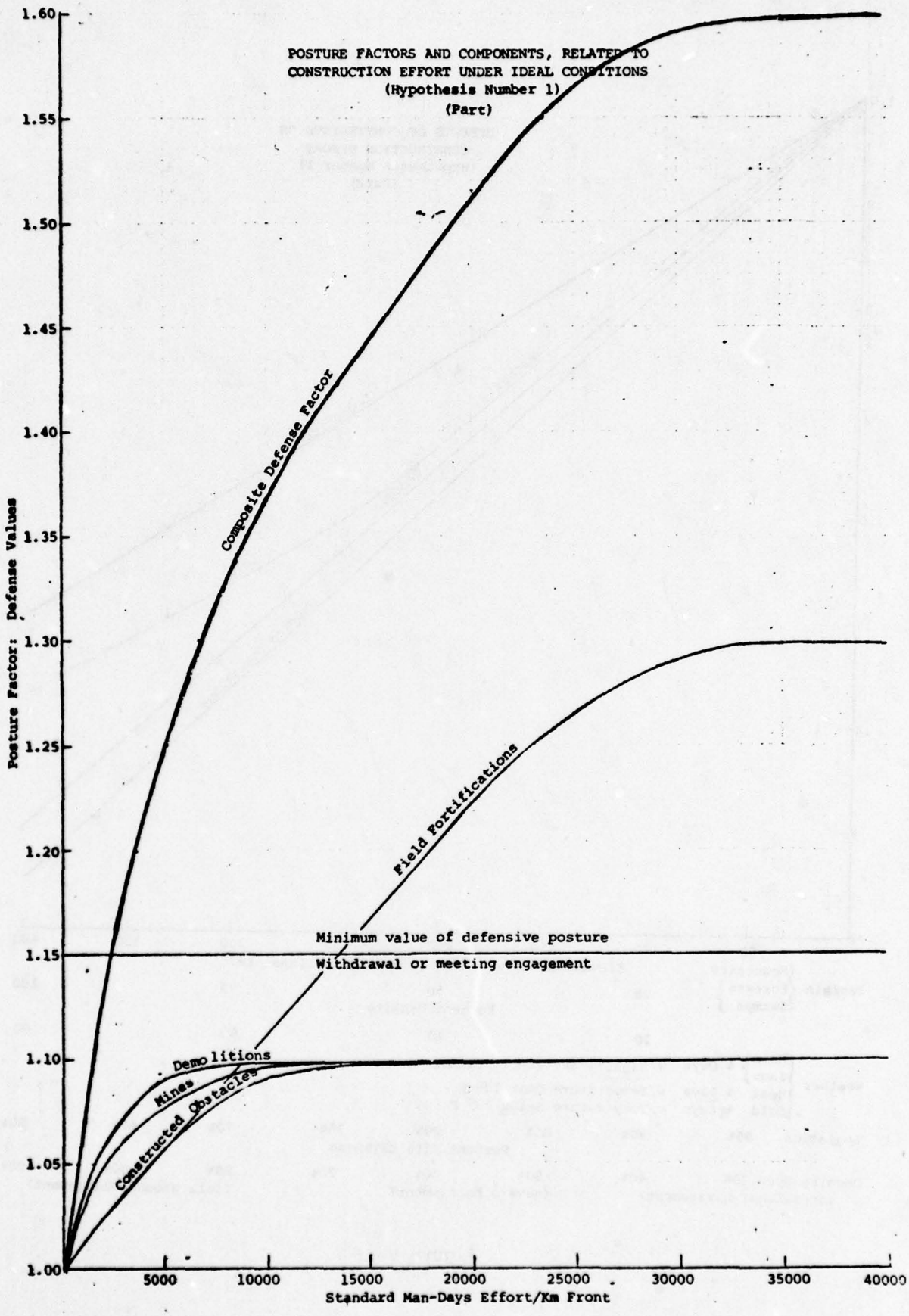
POSTURE FACTORS AND COMPONENTS, RELATED TO
CONSTRUCTION EFFORT UNDER IDEAL CONDITIONS
(Hypothesis Number 1)
(Part)
Posture Factor: Defense Values
1.60
1.55
1.50
1.45
1.40
1.35
1.30
1.25
1.20
1.15
1.10
1.05
1.00
Composite Defense Factor
Field Fortifications
Minimum value of defensive posture
Withdrawal or meeting engagement
Demolitions
Mines
Constructed Obstacles
5000
10000
15000
20000
25000
30000
35000
40000
Standard Man-Days Effort/Km Front

Figure V-24

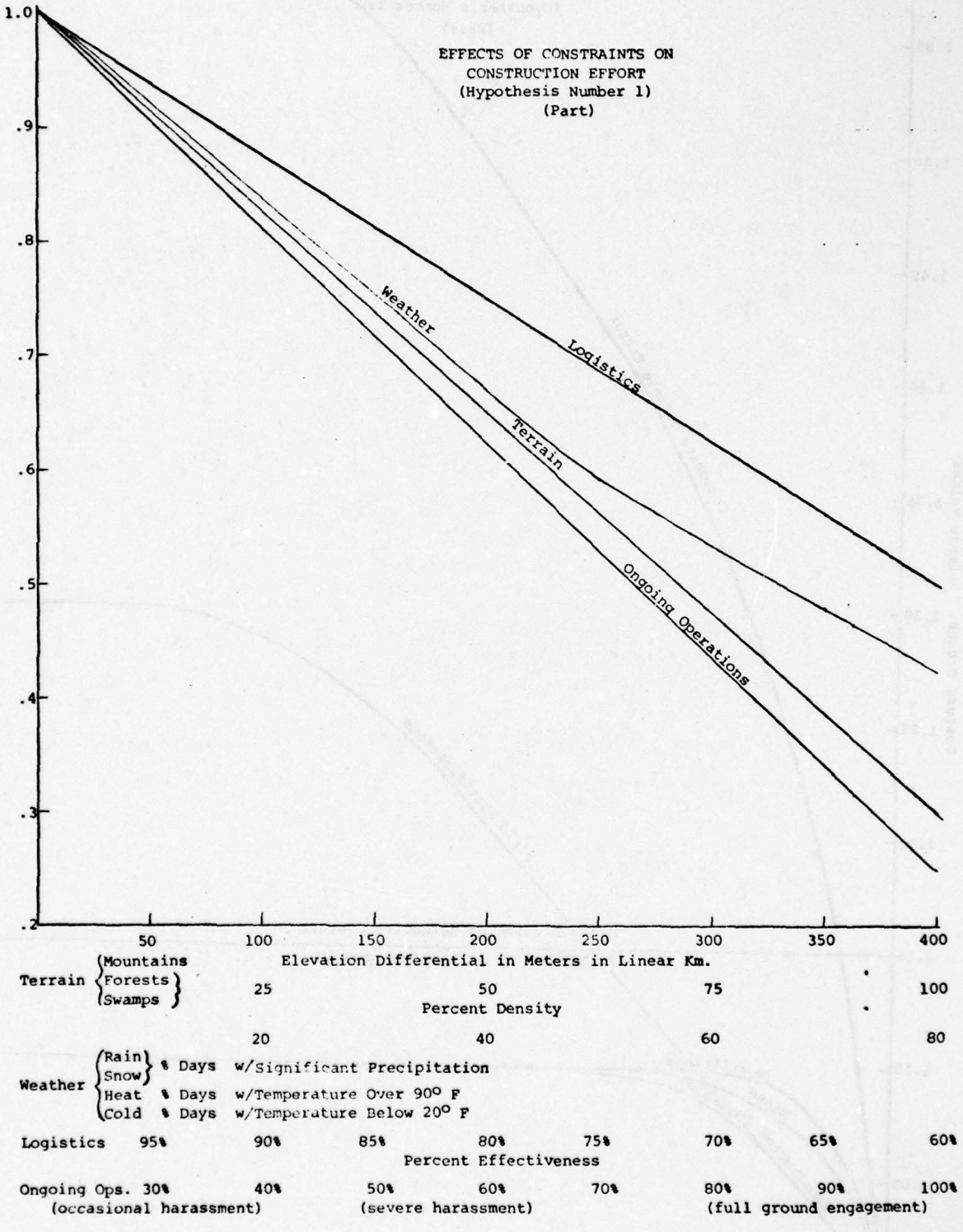
EFFECTS OF CONSTRAINTS ON
CONSTRUCTION EFFORT
(Hypothesis Number 1)
(Part)
1.0
.9
.8
.7
.6
.5
.4
.3
.2
Weather
Logistics
Terrain
Ongoing Operations
50
100
150
200
250
300
350
400
Elevation Differential in Meters in Linear Km.
Terrain {Mountains, Forests, Swamps}
25
50
75
100
Percent Density
20
40
60
80
Weather {Rain, Snow} % Days w/Significant Precipitation
Heat % Days w/Temperature Over 90° F
Cold % Days w/Temperature Below 20° F
Logistics 95% 90% 85% 80% 75% 70% 65% 60%
Percent Effectiveness
Ongoing Ops. 30% 40% 50% 60% 70% 80% 90% 100%
(occasional harassment)
(severe harassment)
(full ground engagement)

Figure V-25

representation of the relative effects of these different kinds of terrain features upon the generally defensive attributes of terrain:

Hypothesis Number 2.

a. The defensive characteristics of hill and mountain formations increase in direct proportion to the maximum differentials in elevation of any two points ascertainable in any given linear kilometer of the terrain, with the maximum defensive value of the terrain achieved when the differential is 400 meters or more;

b. The defensive value of forests is dependent upon the area relationship of forested tracts and open terrain within a defensive sector (including its approaches); the defensive value of forests reaches a maximum when the density of forests (as opposed to open or clear areas) is approximately half of this sector, and declines thereafter as the increasing density reduces defensive observation and fields of fire.

c. The defensive value of swamps and marshes is dependent upon the area relationship of swamplands and firm terrain within a defensive sector, increasing in direct proportion to the density of swampland in the sector to a maximum value when the sector is completely marshy.

d. Streams are assumed to have an "obstacle unit value" (discussed below) varying with such characteristics as width, depth, height differential of the opposite banks, the slope of the defender's bank, and the current; the defensive value of a stream or streams in a defense sector is directly proportional to the combined obstacle units values per square kilometer of all streams within a defensive sector.

e. Ravines and gullies are also assumed to have obstacle unit values, similar to those of streams (although calculated in slightly different fashion; see below), and their defensive value is also directly proportional to the combined obstacle units values per square kilometer of all ravines and gullies within a defensive sector.

f. Although there were no essentially urban areas in the examples considered in this study, the defensive value of individual existing structures was noted; furthermore, this consideration of the inherent defensive value of terrain would be incomplete without such consideration; in at least two of our case studies the defensive value of existing man-made structures is assumed to increase with the density of such structures per average square kilometer of the defensive sector, to a maximum defensive value with an urban density of 800 "type" housing units (each 500 m^2) per square kilometer; this defensive value is assumed to increase slowly for lower densities, but more rapidly above densities of about 300 such units per square kilometer.

The features of Hypothesis Number 2 are presented graphically in Figure V-26, using the left-hand ordinate. This is the first attempt to analyze the obstacle components of terrain defensive factors. Some or all of these curves will undoubtedly require modification in slope and shape on the basis of future terrain analyses of the site of engagements in a substantial data base.

Fortification Attributes of Mountains and Urban Areas

The analysis represented by Hypothesis Number 2, as well as the Il Giogo example in Chapter III, suggests that in addition to the terrain aspects of defensibility there is an inherent contribution of such terrain to the posture capabilities of troops defending such terrain. Although not determinable from the examples of this study, general historical experience would suggest that there is a similar inherent posture characteristic in dense urban areas. This requires the offering of another hypothesis as a reasonable representation of the fortification, or posture, enhancement effect of mountains and urban areas, as follows:

Hypothesis Number 3.

a. The posture enhancement effect of mountains is noticeable when the maximum elevation differential within any given linear mile of the defensive sector is at least 100 meters, and increases directly to a maximum when the differential is 400 meters or greater.

b. The posture enhancement effect of urban areas is noticeable when the density of type housing units (500 m^2) exceeds 400/square kilometer, and increases directly to a maximum when the density is 800 units or more.

The features of Hypothesis Number 3 are presented graphically in Figure V-26, using the right-hand ordinate.

Delaying Effects of Obstacles

In order to undertake a meaningful comparison of the relative effectiveness of obstacles, a common measure of comparison, termed "obstacle unit value," has been established. This permits the formulation of another hypothesis in which obstacle unit values are related to the delaying effects of obstacles, as follows:

Hypothesis Number 4. The delaying effect of an obstacle may be expressed in terms of obstacle units values, whereby one obstacle unit will impose a delay upon the attacking force, which will vary

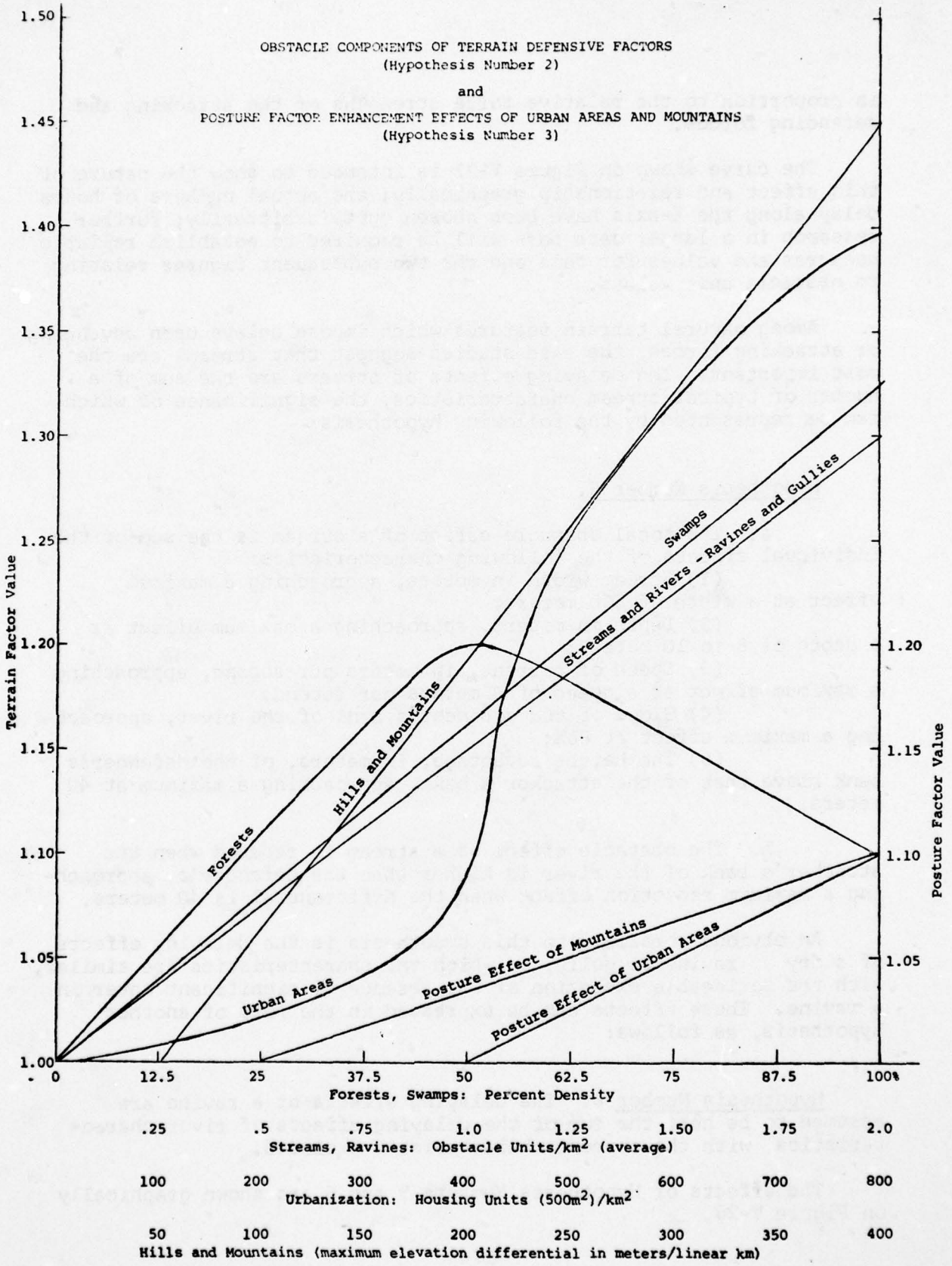
OBSTACLE COMPONENTS OF TERRAIN DEFENSIVE FACTORS
(Hypothesis Number 2)
and
POSTURE FACTOR ENHANCEMENT EFFECTS OF URBAN AREAS AND MOUNTAINS
(Hypothesis Number 3)
Terrain Factor Value
Posture Factor Value
1.50
1.45
1.40
1.35
1.30
1.25
1.20
1.15
1.10
1.05
1.00
Forests
Hills and Mountains
Swamps
Streams and Rivers - Ravines and Gullies
Urban Areas
Posture Effect of Mountains
Posture Effect of Urban Areas
0 12.5 25 37.5 50 62.5 75 87.5 100%
Forests, Swamps: Percent Density
.25 .5 .75 1.0 1.25 1.50 1.75 2.0
Streams, Ravines: Obstacle Units/km² (average)
100 200 300 400 500 600 700 800
Urbanization: Housing Units (500m²)/km²
50 100 150 200 250 300 350 400
Hills and Mountains (maximum elevation differential in meters/linear km)

Figure V-26

in proportion to the relative force strengths of the attacking and defending forces.

The curve shown on Figure V-27 is intended to show the nature of this effect and relationship graphically; the actual numbers of hours delay along the X-axis have been chosen quite arbitrarily; further research in a larger data base will be required to establish reliable measures and values for this and the two subsequent figures relating to obstacle unit values.

Among natural terrain features which impose delays upon advancing or attacking forces, the case studies suggest that streams are the most important. The delaying effects of streams are the sum of a number of typical stream characteristics, the significance of which can be represented by the following hypothesis:

Hypothesis Number 5.

a. The total obstacle effect of a stream is the sum of the individual effects of the following characteristics:

(1) Stream width in meters, approaching a maximum effect at a width of 300 meters;

(2) Depth in meters, approaching a maximum effect at a depth of 8 to 10 meters;

(3) Speed of current, in meters per second, approaching a maximum effect at a speed of 4 meters per second;

(4) Slope of the defender's bank of the river, approaching a maximum effect at 80%;

(5) The height advantage, in meters, of the defender's bank above that of the attacker's bank, approaching a maximum at 40 meters.

b. The obstacle effect of a stream is reduced when the attacker's bank of the river is higher than the defender's, approaching a maximum reduction effect when the differential is 40 meters.

An obvious corollary to this hypothesis is the delaying effects of a dry ravine or gully, in which the characteristics are similar, with the noticeable exception of the absence of significant water in a ravine. These effects can be expressed in the form of another hypothesis, as follows:

Hypothesis Number 6. The delaying effects of a ravine are assumed to be half the sum of the delaying effects of river characteristics, with the current characteristic excluded.

The effects of Hypotheses Numbers 5 and 6 are shown graphically on Figure V-28.

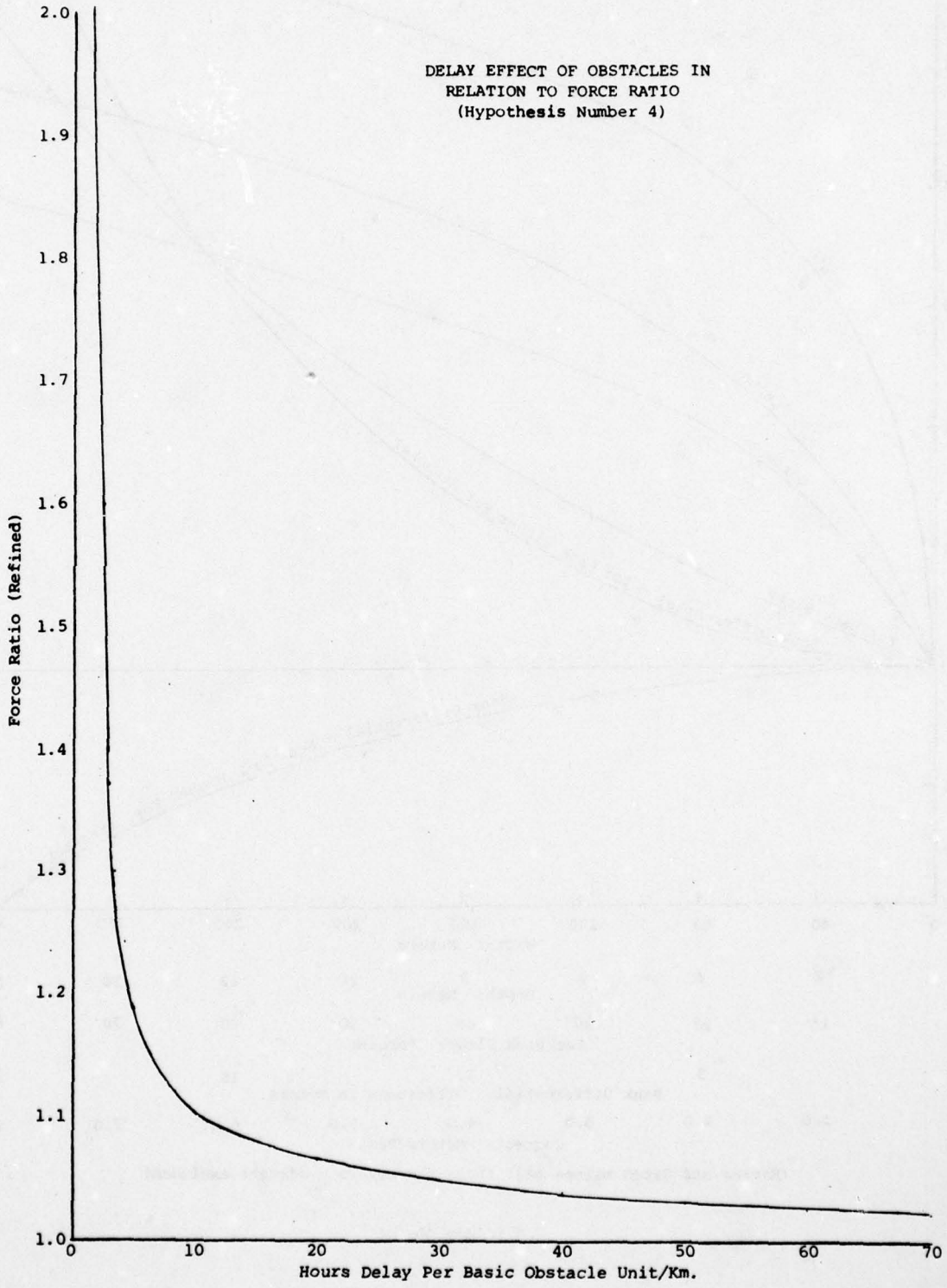
DELAY EFFECT OF OBSTACLES IN
RELATION TO FORCE RATIO
(Hypothesis Number 4)
Force Ratio (Refined)
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0
10
20
30
40
50
60
70
Hours Delay Per Basic Obstacle Unit/Km.

Figure V-27

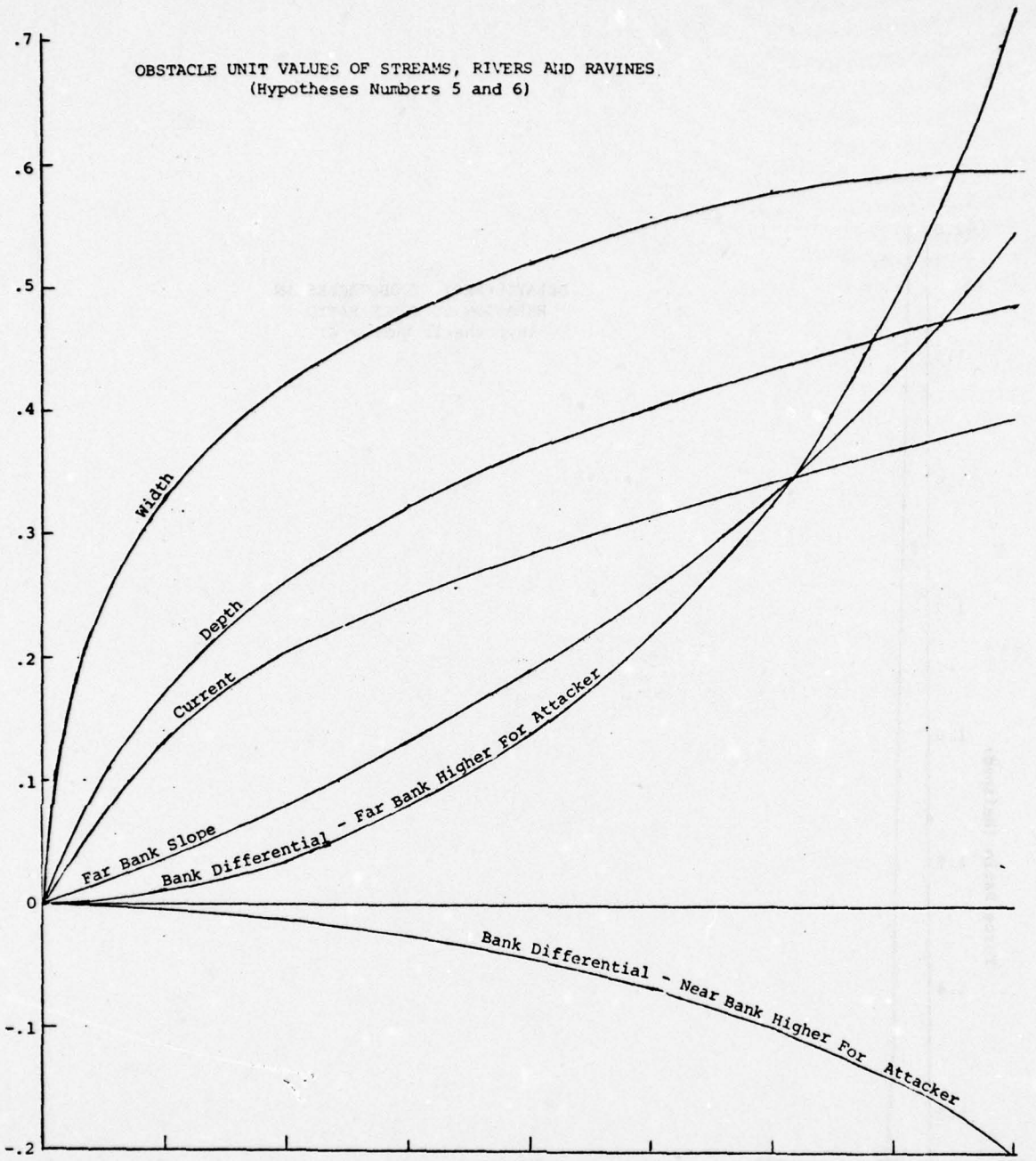
OBSTACLE UNIT VALUES OF STREAMS, RIVERS AND RAVINES
(Hypotheses Numbers 5 and 6)
.7
.6
.5
.4
.3
.2
.1
0
-.1
-.2
Width
Depth
Current
Far Bank Slope
Bank Differential - Far Bank Higher For Attacker
Bank Differential - Near Bank Higher For Attacker
0 40 80 120 160 200 240 280 320
Width: Meters
2 4 6 8 10 12 14 16
Depth: Meters
10 20 30 40 50 60 70 80%
Far Bank Slope: Percent
5 10 15 20
Bank Differential: Difference in Meters
1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0
Current: Meters/Sec.
(Ravine and ditch values half those for rivers - current excluded)

Figure V-28

The obstacle effects of terrain features other than streams (and ravines) appear to be expressable in much simpler terms than those of streams. These can be summarized in another hypothesis, as follows:

Hypothesis Number 7. The obstacle unit effects (delay) of terrain features other than streams and ravines are as follows:

a. The obstacle effects of hills are noticeable when the elevation difference of two points within a linear kilometer is greater than 50 meters, and increases to approach a maximum at a differential of 400 meters.

b. The obstacle effects of swamps are noticeable when swampy terrain has a surface density of approximately 25% of an area, and increases to a maximum at 100% density.

c. The obstacle effects of forests are noticeable when forest land has a surface density of approximately 25% of an area, and increases to a maximum at 100% surface density.

d. The obstacle effects of urban areas are noticeable when the density of "type" housing units (500 m^2) is 300 per kilometer square, and increases to a maximum at a density of 800 or more units.

The effects of Hypothesis Number 7 are shown graphically in Figure V-29.

The obstacle delaying effects of prepared obstacles can be similarly expressed in a comparable hypothesis, as follows:

Hypothesis Number 8. The obstacle unit effects (delay) of prepared or constructed obstacles are as follows:

a. The obstacle effects of mines:
(1) Antitank mines, laid in minefields according to standard doctrine, approach a maximum delaying effect with a density of 1,600 per kilometer square;
(2) Antipersonnel mines, laid in minefields according to standard doctrine, approach a maximum delaying effect with a density of 3,200 per square kilometer;

b. The obstacle effects of barbed wire and abatis approach a maximum effect with a density of 2,000 meters per square kilometer;

c. The obstacle effects of road and bridge demolitions and blocks is dependent upon the nature of the terrain, as well as the density of the roadnet; tentatively, however, the general obstacle effect of demolitions and roadblocks in "normal" terrain will assume a maximum value with a density of 40 per square kilometer. The effects of Hypothesis Number 8 are shown graphically in Figure V-30.

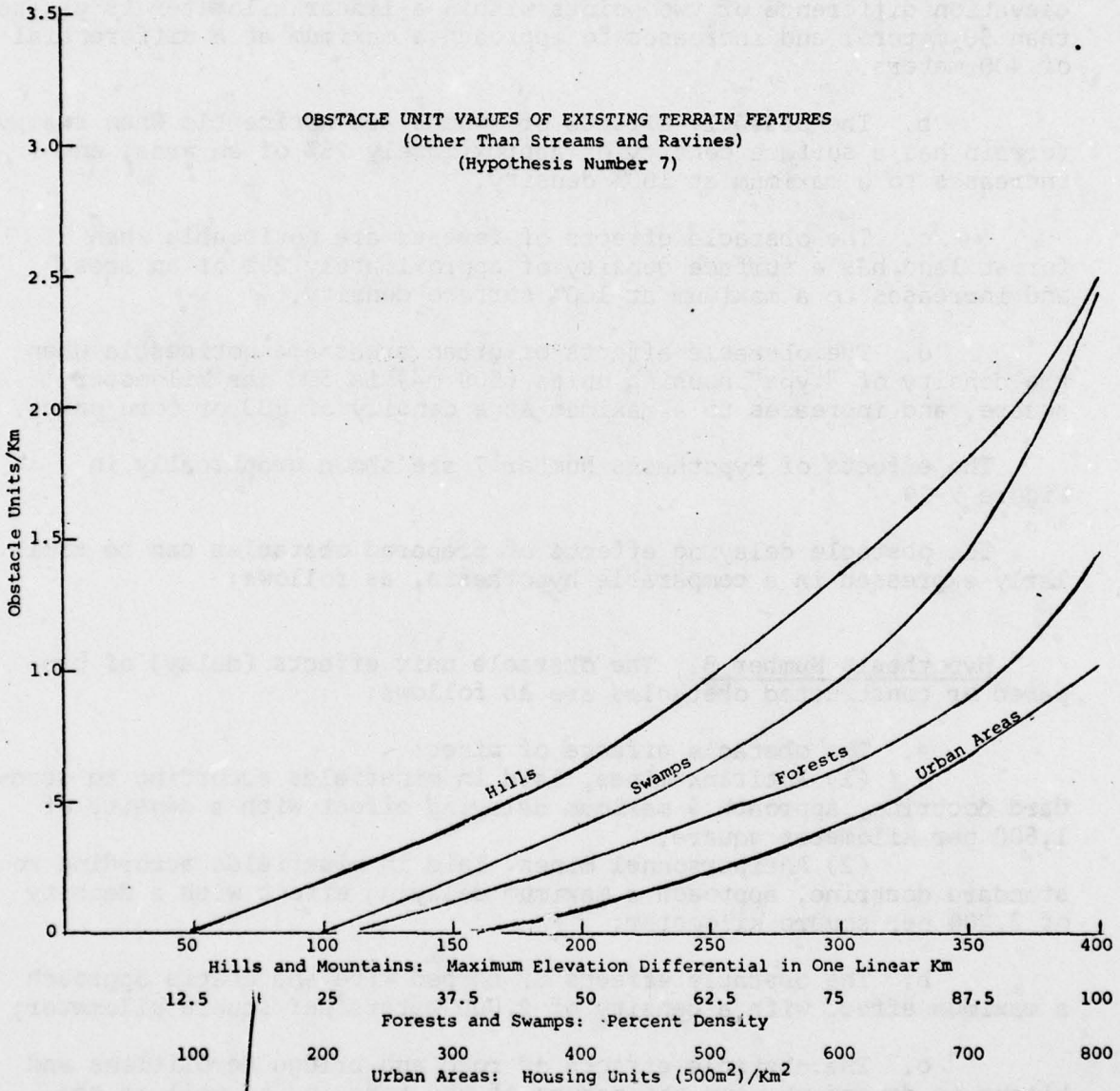
OBSTACLE UNIT VALUES OF EXISTING TERRAIN FEATURES
(Other Than Streams and Ravines)
(Hypothesis Number 7)
Obstacle Units/Km
3.5
3.0
2.5
2.0
1.5
1.0
.5
0
Hills
Swamps
Forests
Urban Areas
50
100
150
200
250
300
350
400
Hills and Mountains: Maximum Elevation Differential in One Linear Km
12.5
25
37.5
50
62.5
75
87.5
100
Forests and Swamps: Percent Density
100
200
300
400
500
600
700
800
Urban Areas: Housing Units (500m2)/Km2

Figure V-29

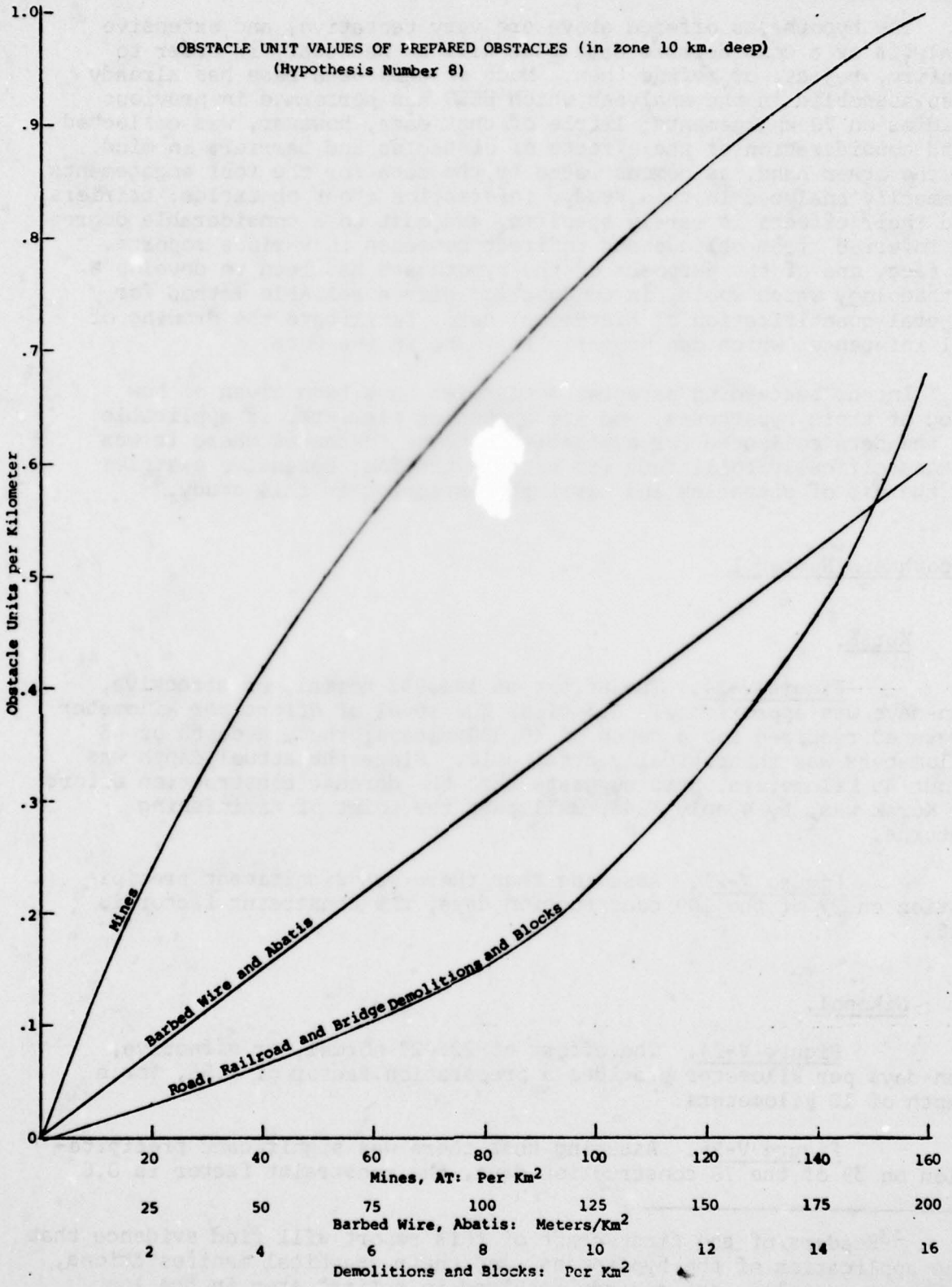
OBSTACLE UNIT VALUES OF PREPARED OBSTACLES (in zone 10 km. deep)
(Hypothesis Number 8)
Obstacle Units per Kilometer
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
0
Mines
Barbed Wire and Abatis
Road, Railroad and Bridge Demolitions and Blocks
20 40 60 80 100 120 140 160
Mines, AT: Per Km2
25 50 75 100 125 150 175 200
Barbed Wire, Abatis: Meters/Km2
2 4 6 8 10 12 14 16
Demolitions and Blocks: Per Km2

Figure V-30

Suggested Methodology; Application of Hypotheses

The hypotheses offered above are very tentative, and extensive analysis of a considerable data base will be necessary in order to confirm, reject, or refine them. Much of this data base has already been assembled in the analyses which HERO has performed in previous studies on 78 engagements; little of that data, however, was collected with consideration of the effects of obstacles and barriers in mind. On the other hand, as demonstrated by the data for the four engagements summarily analyzed in this study, information about obstacles, barriers, and their effects is rarely specific, and must to a considerable degree be inferred from oblique and indirect comments in various reports. In fact, one of the purposes of the hypotheses has been to develop a methodology which would, in conjunction with a reliable method for general quantification of historical data, facilitate the drawing of all inferences which can properly be found in the data.

In the succeeding paragraphs examples have been given of how each of these hypotheses, and its component elements, is applicable to the data collected (or available in those instances where it was not specifically collected) for each of the four defensive examples of the use of obstacles and barriers considered in this study.[43]

Hypothesis Number 1

Kursk.

Figure V-24. The effort of 143,843 normal, or effective, man-days was approximately 4.3 times the level of effort per kilometer presumed required for a depth of 10,000 meters; thus, a depth of 43 kilometers was theoretically attainable. Since the actual depth was about 40 kilometers, this suggests that the defense construction effort at Kursk was, by 4 July 1943, well past the point of diminishing returns.

Figure V-25. Assuming that there was significant precipitation on 27 of the 109 construction days, the constraint factor is 0.8.

Nikopol.

Figure V-24. The effort of 22,027 normal, or effective, man-days per kilometer provides a preparation factor of 1.56, for a depth of 10 kilometers.

Figure V-25. Assuming that there was significant precipitation on 39 of the 78 construction days, the constraint factor is 0.6.

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[43]Readers of the first draft of this report will find evidence that the application of the hypotheses, and their graphical manifestations, to these examples, has already resulted in a first step in the long iterative process of refinement, that can and should be performed with both existing and new data.

Il Giogo.

Figures V-24 and V-26. The effect of 25,258 normal, or effective, man-days per kilometer provides a preparation factor of 1.58 for a depth of 10 kilometers (Figure V-24). In addition, the natural fortification-obstacle effect of the terrain must be considered (lower-right of Figure V-26); without preparation effort, this provides a defensive factor of 1.10, or an augmentation of 0.10 to the preparation factor, for a total of 1.68. This means that the maximum defense posture factor of 1.60 was achieved 1.13 times, or that a fortification depth of 11 kilometers was achievable. The actual depth of the fortified zone was about .5 kilometers, thus suggesting that the defensive effort, for this depth, had passed the point of diminishing returns.

Figure V-24. The terrain ruggedness warrants a maximum constraint effect of 0.3. Assuming that there was significant precipitation on 81 of the 325 construction days, the weather constraint factor is 0.8. Professional judgment suggests that the logistical problems encountered by the Germans resulted from a logistical system 90% effective, which provides a constraint factor of 0.9. The composite constraint factor is: .3 x .8 x .9 = .22.

Ardennes-Sauer.

Figure V-24. The effort of 5,135 normal, or effective, man-days per kilometer provides a preparation factor of .127, for a depth of 10 kilometers.

Figure V-25. The terrain ruggedness, combined with extensive forests, provides factors of 0.95 and 0.95 respectively, or a total terrain factor of 0.9. Assuming that there was significant precipitation on 17 of the 92 days, the constraint factor was 0.8. The composite constraint factor is: .9 x .8 = .72.

Hypothesis Number 2

Kursk. From the QJMA table on terrain a defensive factor of 1.45 was selected for Kursk ("Rolling Mixed"). The components of this are arbitrarily assumed as follows:

Forest	20% density	0.08
Swamp	none	0.00
Streams	1 obstacle unit	0.13
Ravines	0.5 obstacle unit	0.07
Hills	180m differential	0.15
Urban Areas	200 units	0.02
		0.45 or a factor of 1.45

Nikopol. The components of the defensive factor of 1.45 are assumed to be as follows:

Forest	6% density	0.06
Swamp	30% Density	0.10
Streams	1 obstacle unit	0.13
Ravines	1.1 obstacle units	0.14
Hills	none	0.00
Urban Areas	200 units	0.02
		0.45 or a factor of 1.45

Il Giogo. The components of the defensive terrain factor of 1.55 are assumed to be as follows:

Forest	5% density	0.03
Swamp	none	0.00
Streams	0.5 obstacle unit	0.06
Ravines	1.0 obstacle unit	0.13
Hills	400m differential	0.45
Urban Areas	100 units	0.01
		0.69 or a factor of 1.69

(However, the maximum defensive effect of terrain is 1.55.)

Ardennes. The components of the defensive terrain factor of 1.45 are assumed to be as follows:

Forest	50% density	0.20
Swamp	none	0.00
Streams	0.75 obstacle unit	0.11
Ravines	0.35 obstacle unit	0.03
Hills	150m differential	0.10
Urban Areas	100 units	0.01
		0.45 or a factor of 1.45

Hypothesis Number 3

This is observable only in the posture enhancement effect of mountains at Il Giogo; see above.

Hypothesis Number 4

Kursk. Obstacle unit values, and delay effect are assumed as follows:

Feature effects (see Figures V-32 and V-33:

Streams	1.00
Ravines	0.50
Hills and Mountains	0.20
Swamps	0.00
Forests	0.00
Urban Areas	0.00
Mines, 25/km^2	0.35
Constructed Obstacles, 100/km^2	0.30
Demolitions, 7/km^2	0.11
	2.46 obstacle units/km^2 (for 10 km zone)

Delay effects (see Figure V-30): with an attacker's force ratio of 1.06, there are 23 hours' delay per obstacle unit. Thus the total assumed delay effect of Kursk was 23 x 2.46 or 57 hours for each of the four defense zones, or a total delay potential of 228 hours.[44]

Nikopol, Il Giogo, Ardennes. Calculate as for Kursk.

Hypothesis Number 5

Ardennes-Sauer River. The obstacle unit values, as related to characteristics, of the Sauer River (see Figure V-28) are assumed as follows:

Width (30 meters)	0.28
Depth (3 meters)	0.23
Current (2.0 meters/sec.)	0.18
Far Bank Slope (25%)	0.11
Bank Differential, Attacker's Near Bank Higher (10 meters)	-0.05
	0.75 obstacle units

Kursk, Nikopol, Il Giogo. Calculate as for Ardennes.

Hypotheses Numbers 6, 7, and 8. See Hypothesis Number 4, above.

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[44]Despite the number of arbitrary assumptions upon which this sample calculation depends (since no time was available for the additional research and analysis time required for a definitive calculation) this result is remarkably consistent with the distances and times listed in Tables IV-2, IV-3, and IV-4.

VI. CONCLUSIONS

In the light of the nature and objectives of this study, the Conclusions are of two varieties: Substantive, and Procedural. These are presented separately below.

Substantive Conclusions

1. The design and construction of barrier systems were influenced by the general combat situation, time and material limitations, and the natural terrain features. Within the system, however, it is apparent that doctrine for location and form of obstacles was followed by all three national forces.

2. It is impossible to relate the defensive or delay effect of natural or artificial obstacles directly to force ratios, in terms of either numerical strengths or firepower scores. These ratios have little meaning unless they are modified to reflect the effects of environmental and operational variables of combat upon the opposing forces.

3. Individual obstacles have little delaying or defensive effect in themselves; they become truly meaningful only when integrated with each other and with firepower in a planned or ad hoc relationship as barriers within a general defensive system.

4. World War II doctrine for obstacles and barriers, as demonstrated in the four cases studied, seems to have been sound, and to have been carried out consistently by defending forces.

5. Obstacles and barriers seem to have made an important contribution to defensive combat indirectly through the delays and exposure to firepower imposed on the hostile force. Combat effectiveness of the attacking forces was degraded at least as much by the effects of the "wearing down" process on morale caused by these delays and this exposure, as from the physical losses suffered. Analysis of several additional examples of units with prolonged combat experience should give improved understanding of the extent of this degradation.

6. Within a general historical context, it has proved possible in this study to formulate, and demonstrate, hypotheses with respect to the quantified effects of obstacles and barriers upon combat

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operations, as follows:

a. The relationship of the defensive and delay effects of types of obstacles to each other, and to overall defensive preparation (construction) efforts, in terms of levels of manpower efforts;

b. The effects of environmental and operational constraints upon the effectiveness of the defensive preparation (construction) efforts;

c. The relationship of natural obstacles to each other in contributing to the overall natural defensive value of different types of terrain;

d. The formulation of a conceptual obstacle effect value to permit comparisons, and quantification, of the defensive and delay effects of artificial and natural obstacles;

e. The delay effect of natural and artificial obstacles in relation to a force ratio which reflects the interaction of environmental and operational variables on the opposing forces.

7. It has proved possible to develop, and tentatively demonstrate, a methodology which, by analysis of an extensive data base, will permit the testing and refinement of these hypotheses, and the development of precise, reliable quantification inputs for computerized combat simulations.

Procedural Conclusions

1. Records of units in combat contain little specific or detailed information on the location, numbers, sizes, and types of obstacles placed or encountered; such information as is available is usually general, fragmentary and sporadic.

2. Considerable detailed information on doctrine, general operational practice in the employment of obstacles, specifics on numbers, and scale diagrams of various types of obstacles are available in American and German records, and in Soviet post-war analytical literature, and can be related directly or indirectly to specific operational combat examples.

3. Generalized information regarding time consumed, and effort expended in defensive preparation efforts is available in the records; this information, however, can rarely be related directly to the preparation, construction, or improvement of specific obstacles, or barriers, or defensive complexes within a large defensive system; such relationships are possible, however, by inference from the doctrinal information available and from some combat records.

4. Records of units written during combat, whose purpose is primarily to report on the location and accomplishments of the unit concerned and its problems, rarely include information on the precise location or delay or defensive value of a specific obstacle, barrier, or defensive complex. Except in general terms (a minefield, strongpoint, etc.) they seldom relate success or failure to the physical attributes of obstacles or barriers. Nevertheless the presence of a delaying agent, and its effect, may often be deduced and related to the unit's progress, or lack of progress.

5. German records of combat on the Eastern Front are generally more complete than those for other fronts, and have been little exploited for combat analyses; these records are particularly useful because of the analytical objectivity to be found in German after action reports and analyses, as well as the detailed analyses of the same engagements to be found in Soviet postwar literature.

6. Despite the paucity of German records for the Ardennes Campaign, American records are abundant (although of mixed quality). Taken together these provide a basis which, with the sketchy German records and the extensive post-war memoirs and secondary literature, offers an opportunity for further analysis of the delay effects of obstacles encountered by the German main effort.

7. The four engagements studied yielded sufficient data on the various components of defensive systems and combat experience in which they played a part to permit the drawing of some inferences in respect to the relative significance of various elements. These should be tested against a much larger data base.

8. The results of this study indicate the desirability of augmentation of the existing data base with engagements involving obstacles and barriers in the following general categories: (a) successive engagements of units engaged in prolonged, or sustained combat, the examples selected so as to permit assessment of the effects of few or no obstacles, and of substantial obstacles; (b) a variety of Soviet-German engagements from the Eastern Front; and (c) American defensive efforts in the path of the German main effort in the Ardennes Campaign and in the Hürtgen Forest.

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Appendix A

THE CONSTRUCTION OF POSITIONS IN THE ITALIAN THEATER OF WAR AFTER THE WITHDRAWAL OF ROYALIST ITALY FROM THE AXIS ALLIANCE[1]

by

General Field Marshal Albert Kesselring

I. Preliminary Remarks

German military traditions have given due weight to the construction of fortifications. So much the more striking is it to note that under the aegis of Adolf Hitler no rear positions were built either in the East or in the West. Presumably Adolf Hitler was afraid that they would have a detrimental influence upon the principle of fighting for every inch of ground, as he time and again preached and ordered. On the other hand, his attitude toward coastal defense was just the opposite. No amount of work done in this connection was sufficient to satisfy him; but even the works of the Atlantic Wall, by stressing their linear construction along the coastal line and by entirely disregarding any improvements in depth, gave clear evidence of the basically wrong idea of obstinately sticking to every inch of ground.

II. Construction of Fortifications in the Apennine Peninsula

A. To the Summer of 1944

1. When, after the invasion of the Allied troops in the Bay of Salerno, I had decided upon going over from "delaying actions" along a narrow sector to "defense" of the Apennine Peninsula between Naples and Rome and had given the necessary orders to this effect, I met with the most far-reaching moral and material support from both Hitler and the OKW. That was the reason why in the short time available I was able to build up two systems--the Reinhard and the Gustav positions--together with the necessary advanced positions.

The support from the OKW consisted mainly in the speedy transfer of engineering staffs and troops together with work battalions and construction utensils and building materials.

2. In spite of the good improvements and natural strength of the Cassino front, and the already proven power of resistance of this position, I considered it of the utmost importance that it be extended in depth by building switch lines and rear positions and, in addition to the work begun at the "Senger Switch Line," etc., . . . I requested additional resources in personnel and supplies.

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[1]MS # C-031, Historical Division European Command, August 1949.

In authorizing my request Adolf Hitler even exceeded the size of my demands, which were by no means modest and ordered that fortified improvements be constructed along the Senger Switch Line and the adjacent positions. In addition to labor, concrete, etc., a large number of armored turrets for shelters and antitank guns were assigned. The latter being emplaced flush with the ground and disappearing from the terrain entirely, were meant to close off the natural depression invincibly from use for a breakthrough to Rome by way of Frosinone.

The position actually possessed extraordinary strength; in this connection the weak points of the valley position and those of the adjacent slope and forest positions must by no means remain unmentioned.

3. Soon after that, I ordered the reconnoitering of a position south of Rome, extending up to the Adriatic, which thereupon was improved as the C position.

This position was the second point of concentration for construction work assigned to the armies; for carrying out this work special engineer staffs and Italian and Czech labor detachments, as well as a sufficient number of civilians, were at their disposal. After the landing of Allied forces at Anzio, completion of this work was speeded up; once or twice I also inspected it.

4. Parallel with these projects, the construction of coastal defenses was carried on under the leadership of Army Group C, in respect to which I refer to the elaboration by Oberst IG Klinckerstroem and to my summarizing comments on the "Campaign in Italy", Part 1, Chapter 10.

These extensive fortifications also called for a considerable commitment of personnel and materiel. Insofar as divisions occupying the coastal line were not assigned to supervise this work, special tactical staffs had to be formed and entrusted with this task. Considerable OT (Organization Todt) forces were incorporated, which for their part employed Italian construction units, firms and workmen. Besides, there were the coastal artillery formations with their batteries and reconnaissance facilities which in naval bases (as for example Genoa, Venice, Pola, Fiume, etc.) and other important coastal points were replaced by naval artillery.

5. Simultaneously with the construction of positions between Naples and Rome, the Apennine position was reconnoitered and improved by Army Group B (Field Marshal Rommel). In spite of the fact that this project was begun as early as possible, its design and construction did not answer the requirements of the prevailing situation. The reasons for this were the frequent changes of the tactical command agencies (Army Gr B, Gen Inf von Zangen, Gen Geb Feuerstein, Gen Inf Witthoeft, fortress engineer staffs of different denominations, Army Gr B with its command organs), the difficulties which the Apennine mountains presented for the establishment of a connected line and improvement of

the position, as well as the difficulties of procuring qualified laborers and bringing up material to the building sites in the mountains.

Summing up, it may be said--see also sketch--that all forces which could be made available in the vicinity of the front and in the depth of the combat zone as well as in the endangered coastal areas were strained to the utmost and everything possible was done in order to render combat conditions favorable, to provide sufficient flank security and to prepare covering positions which would serve as barriers in case of an unavoidable withdrawal.

These measures answered to the operative and tactical necessities and were therefore correct.

B. After the Summer of 1944

1. Even before reaching the Apennine position, the striking power of the Allies had decreased to such an extent that we no longer anticipated that the enemy would resume his decisive attack over and beyond the Apennines immediately.

2. Though the Apennine position offered German forces an urgently needed breathing space and opportunity to reorganize, we still had to reckon with an early resumption of enemy attacks. The defects of the Apennine position were too obvious not to take surprises into account. An additional improvement of positions within the Apennine area would not offer a satisfactory solution, especially, if the enemy should have surmounted the ridge of the Apennines toward the north. Besides, the left flank was exposed in open terrain.

The limited area exposed to attacks from three sides (south, east, and west) gave this defensive zone the character of a fortress. This rendered it imperative to fortify strongly the three fronts, and to provide depth with well-planned improvements in order to close the gateway for invasion into German territory, even against a superior enemy by permanent fortifications, before and along the southern edge of the Alps.

3. Whereas the reconnoitering of the Alp position by Army Gr B was started simultaneously with that of the Apennine position, those north of the Apennines, according to my order, were reconnoitered considerably later. In the vicinity of the front, the positions were determined by armies and even by corps (in southern Istria by Hq of Geb Res Corps--Mountain Reserve Corps) and were improved under the supervision of engineer commanders by troops supported by construction battalions, Italian formations, and the civil population. In the rear of this area which was under the direct influence of the front, the positions were reconnoitered by special staffs of which that under the command of Gen Inf Jordan, who, during his assignment as C-in-C in the east had acquired extensive front experience, which was of the greatest importance. General Jordan was assigned to care for the

decisive Alp position, then the positions in East Lombardy, about east of the Line Bologna-Verona, and in Istria. He was also entrusted with the military command of the improvement work, whereas the actual execution of the construction according to a direct order from Hitler was assigned to two Gauleiters, Hofer and Rainer. At the outset, it should be said that both of the Gauleiters, above all Gauleiter Rainer, brilliantly solved their problem. They were assisted by a considerable number of political commissars (politische Leiter) whom they had brought up from their parent Gaus (party administrative districts). What I never considered possible and what was never accomplished either by the Wehrmacht or by the Organization Todt, or by similar agencies, these Gauleiters did with their comparatively small but efficient staffs. The exceptionally great demand for labor was easily met, even in the guerrilla-infected areas (with one exception). Italians from far-off localities, who usually worked reluctantly, came to work punctually and, singing their songs, worked assidiously. I was much surprised to ascertain how well these party functionairies managed at least one thing: how to handle people! That other party functionaries at other places had just the opposite effect, is an historic fact! I am mentioning this incident in order to show what such men, if properly led, can do, whereas if poorly led, they can do the opposite.

Without having sketched in all of the positions and without pretending to have marked them correctly, I refer to the attached sketch

Sketch 2

in order to give a general picture of the work done and its military usefulness. These continuous systems of positions were supplemented by defensive works and blocking positions at entrances into the most important cities, etc.

4. I have flown over all the installations and have inspected a large number of them located at particularly important terrain points during the construction period, before or after completion of their construction and have given my directives. My general impression was as follows:

a. The positions were adapted to the terrain features and obstacles and made allowances for all kinds of presumable developments of the situation (sketch 3)

Sketch 3

Taking it for granted that the concentration of enemy attacks would continue, as heretofore, in the eastern part of the North Italian front, the possible developments could be as follows:

a1. Continuation of attacks launched from the east against the Apennine position south of the Po, which called for

extreme density of the position network from the front up to a line level with Bologna.

a2. Pressing back the Apennine front frontally or breaking through in the direction of the Po--this induced us to improve the Po position by way of a series of strong points and advanced positions along the rivers and canals.

a3. Continuation of the attacks across the Po against entrance into the Alps and against Eastern Lombardy with the object of forcing the Alps, and cutting off the Axis forces located in the western part of Italy and sealing off the rear of the Balkan front. This necessitated improvement of the forward Alp position as well as the Alp position proper, improvement of the four river positions in Western Lombardy situated one behind the other, improved of the Tessin position.

a4. Separation of the Balkan and Italian fronts by a landing in the North Adriatic. This called for securing the above mentioned coastal front.

a5. Invasion in the Gulf of Genoa, simultaneously starting an offensive from the Western Alps into the Italian plain. This rendered it necessary to improve the mountain position of Genoa up to and inclusive of the Aosta Valley.

a6. The capture of Trieste and Istria from the Adriatic rendering necessary coastal fortifications in this area and building of the Tschitschen Boden (?).

a7. A threat from the Balkans, this forced us to seek contact with the fortifications of Army Gr B.

b. In spite of reconnoitering the positions and supervising their improvement by special, selected reconnaissance parties made up of experienced officers from all arms of the service, the course taken by the line did not always correspond to the desires of the troops. I therefore came to the conclusion that even the best-selected line never corresponds to the wishes of the occupying troops in all respects; hence, it is advisable to give the troops an opportunity to give it the finishing touches.

c. The large number of positions had its advantages and disadvanteges.

The <u>advantages</u> were the following:

c1. It was by no means easy for the enemy reconnaissance to locate from the air the positions actually occupied; the enemy always had to be prepared for surprises. As a consequence, the slow feeling-forward of the enemy offered the German troops a saving of time which in many instances was of very great value.

c2. Whenever our troops arrived, they found a prepared position which they only had to alter slightly to suit their own taste. On account of this fact, the disadvantages unumerated under b. could be compensated for to a certain extent.

c3. The troops were not compelled to accept a decisive battle in a less favorable position but could move on without any great risk, to where combat conditions were more favorable.

The disadvantages were:

c4. The large-scale construction operations demanded much personnel and supplies; there was always a great risk that, on account of doing so many things, the means would be spent uneconomically and as a result no perfect work would be done anywhere.

c5. The positions needed constant supervision; this was most suitably done by having them occupied by a security detachment, even if it had to be a weak one. Only thus was there any guarantee that the installations would remain fit for defense, could be turned over to the occupying troops complete in every respect and adequately supplied, and could be secured against enemy surprise raids. A lack of troops and deficiencies in organization prevented the complete execution of these measures.

d. The considerable investment could pay for itself only in case of a flexible method of warfare. The depth of the fortified zone protested insistently against letting oneself to be exterminated at a wrong point, something which should be considered a sin against the idea of the whole situation in space. If it had been the intention to deliver a decisive battle, it would have been imperative to build an extensive system of positions either along the Apennines, or along the Po, or along the edge of the Alps, making use of all the fine points of the art of constructing fortifications; then every man in the defending troops would have to know that he had either to hold out there or die.

On the basis of experience and in view of the advanced period of the war, as well as in consideration of the limited and no longer replaceable defensive forces, this solution was by no means intentional. The fact that in actual practice matters turned out differently is to be ascribed to a deviation from my idea of the method of conducting the war, and was by no means due to any defects in planning.

e. Depending on the importance of the position and the natural defensive features of the terrain, the improvements varied from a simple field type of improvement all the way through to permanent-style concrete and armored projects and mine fields. Observation of the following principles was considered to be of decisive importance:

e1. Camouflage, and a field of fire from flanking installations as far as possible.

e2. Natural antitank obstacles, supplemented by artificial obstacles (antitank ditches, steep walls, swamping, etc.) throughout the depth of the fortified zone.

e3. Building separately protected shelters and firing positions, with the exception of "galleries" in the Alps.

e4. Camouflaged and if possible covered communication trenches (approach trenches) from the rear to the advanced and lateral positions.

e5. Mining operations.

5. The numerous river courses offered exceptionally good opportunities for defense, but these were to some extent offset by increased difficulties for supply communication as well as for mobile warfare. Everything humanly possible was done to secure communication across the Po, the Reno, etc. There was no method of bridging and communication which was not prepared and employed. The breadth of the sector made necessary a great number of crossing sites capable of handling large amounts of personnel and material. The variety of methods of water supply necessitated flexible engineering, and the air situation called for large-scale antiaircraft artillery defense.

Even under the most trying conditions, the extensive preparations had to satisfy the very highest tactical demands.

III. Closing Statement

In contrast to all other German theaters of war, full use of the construction of positions was made by the military command in Italy; it was fully supported by Hitler and the OKW.

The construction of positions was carried out by command agencies, engineers, and labor organization with a great feeling for the situation and with a hardly surpassable zest. The eventual condition of the improvements is the best proof of this.

It is to be regretted that the defensive installations in depth of the entire area were not made use of tactically in a manner corresponding to the idea back of the whole system. It is inconceivable why Hitler did not permit the employment of delaying tactics after having helped, in a model manner, to create the necessary preconditions.

sgd K

8 August 1948

Appendix B

THE QUANTIFIED JUDGMENT METHOD OF ANALYSIS OF HISTORICAL COMBAT DATA

Summary

The Quantified Judgment Method of Analysis of Historical Combat Data (QJMA) is a method of comparing the relative combat effectiveness of two opposing forces in historical combat, by determining the influence of environmental and operational variables upon the force strengths of the two opponents. The QJMA was developed by the Historical Evaluation and Research Organization (HERO) in cooperation with T.N. Dupuy Associates, Inc. (TNDA), and refined in the performance of HERO contracts for the US Army, the British Defence Operational Establishment, and in particular for the office of the Assistant Chief of Staff, Studies and Analysis, US Air Force.

The heart of the QJMA is a model of historical combat called the Quantified Judgment Model (QJM), which uses historically-conditioned professional judgment to assign comparative values to weapons, forces, and variables. The model is applied to statistics of selected historical engagements and produces values for the Combat Power Potentials of the opposing forces under the circumstances of the engagement, and a Combat Power Ratio to ascertain which of the opposing forces--on the basis of data available in the records--should theoretically have been successful in the engagement.

To complete the application of the QJMA to an engagement, the theoretically predicted outcome of the model (based upon the Combat Power Ratio) is then compared with a quantified value of the actual outcome of the engagement, which reflects the Mission Accomplishment, Spatial Effectiveness (ability to gain or hold ground), and Casualty Effectiveness (performance measured against casualties incurred and inflicted) of each side. The comparison of actual outcome value and theoretically predictable outcome value provide a basis for a wide spectrum of analytical potentialities with respect to combat processes and statistical relationships.

The QJMA has yielded very encouraging results in the analysis of 78 World War II engagements (mostly of division-size forces) in Italy and Northwest Europe, with a correlation of over 92 percent between actual and theoretically-predictable outcomes. Listed below are some of HERO's applications of the QJMA to modern combat problems:

1. Relative Force Ratio Calculations
2. Relative Force Effectiveness Assessments
3. Unit Combat Effectiveness Assessments
4. Evaluation of Air Interdiction Effectiveness
5. Relative Effectiveness: Close Air Support and Interdiction
6. Interaction of Air and Ground Weapons
7. Effectiveness of Air and Naval Gunfire Support, Amphibious Operations
8. Operational Analyses
9. Manual of Model-Simulation Inputs
10. Evaluation of Combat Processes:
    - A. Surprise
    - B. Factors Influencing Rates of Advance (FEBA Movement)
    - C. Intensity of Combat
    - D. Score Effectiveness (Casualty Inflicting Capability)
    - E. Ammunition Consumption by Posture; Related to Combat Effectiveness

Appendix C

GLOSSARY OF MILITARY TERMS*

Barrier, or barrier system:	A coordinated series of obstacles designed or employed to canalize, direct, restrict, delay, or stop the movement of an opposing force, and to impose additional losses in personnel, time, and equipment upon the opposing force (JCS Pub 1, AR 310-25).
Defensive Position:	Any area occupied and more or less organized for defense. A battle position. A system of mutually supporting defensive areas or tactical localities of varying size, each with a definite assignment of troops and a mission. A defensive position may be fortified, and otherwise organized to the extent that the situation requires or time allows.
Field fortifications:	Emplacements and shelters of a temporary nature which can be constructed with reasonable facility by units requiring no more than minor engineer supervisory and equipment participation.
Fortified line:	A permanent series of defensive positions of a depth and hardness considered typical of the French Maginot or the German Siegfried Lines. It implies concrete or steel protected gun emplacements, preplanned supporting fire coverage, heavily protected troops and supplies, and coordinated series of obstacles to stop combat vehicles. This could also be called a fortified zone.

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* For a glossary of terms used in the Quantified Judgment Method of Analysis see Appendix B.

Meeting engagement:	The initial encounter between two forces (usually of division strength or more) which had not previously (or recently) been in contact (other than possibly by minor patrol or reconnaissance elements) and which are approaching each other more or less prepared for combat but--prior to the initiation of the engagement--unsure of hostile dispositions and of the manner or precise place in which the encounter would occur.
Obstacle:	Any obstruction that stops, delays, or diverts movement. Obstacles may be natural: deserts, rivers, swamps, or mountains; or they may be artificial: barbed wire entanglements, pits, concrete, or metal antimechanized devices and the like. Obstacles may be fixed or portable, and they may be issued ready made or they may be constructed in the field (AR 310-25).
Strongpoint:	A key point in a defensive position, usually strongly fortified and heavily armed with automatic weapons, around which other positions are grouped for protection. (JCS Pub 1).