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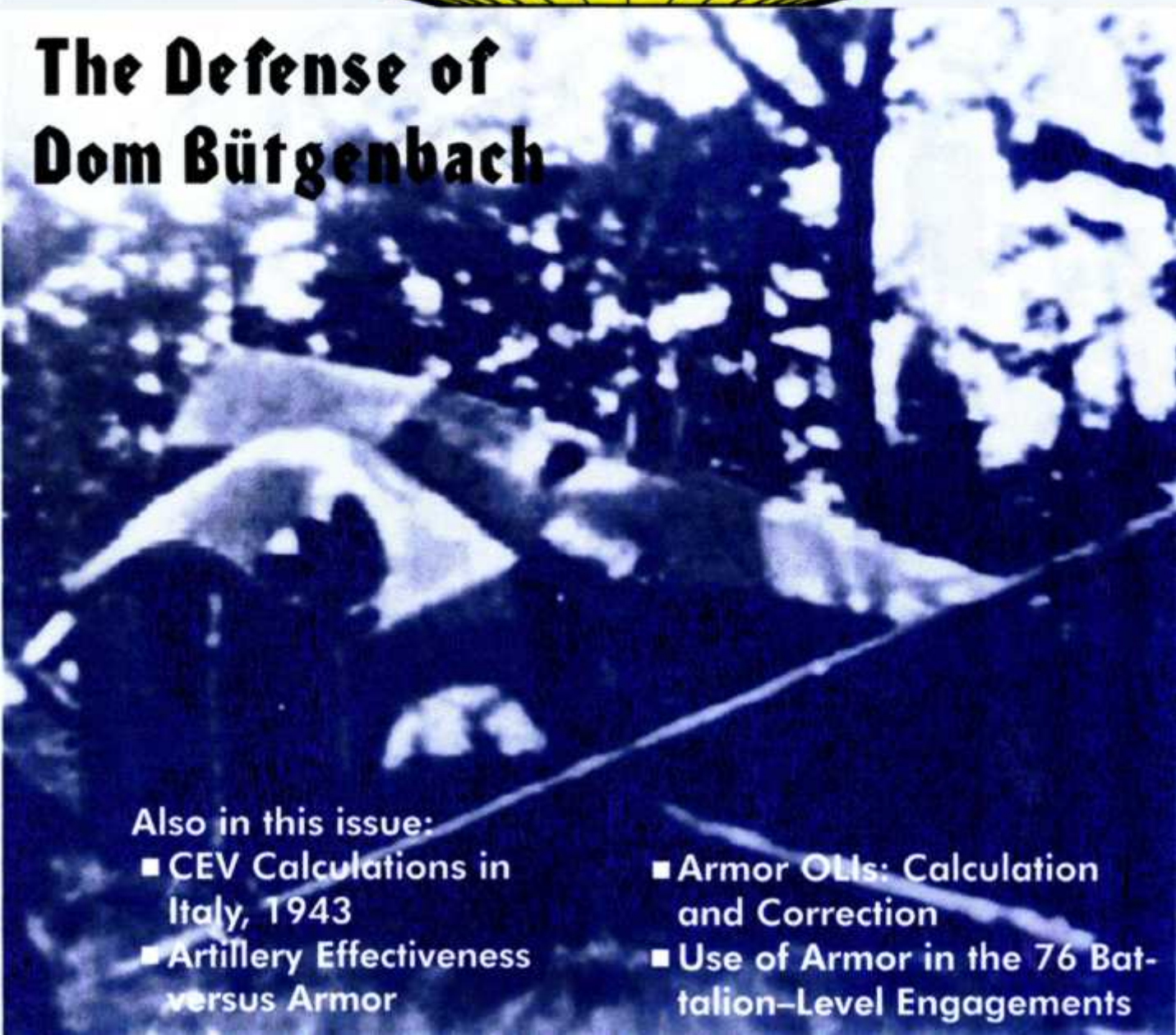

The Defense of Dom Bütgenbach

Also in this issue:

- CEV Calculations in Italy, 1943
- Artillery Effectiveness versus Armor
- Armor OLIs: Calculation and Correction
- Use of Armor in the 76 Battalion-Level Engagements

INTRODUCTION

In tribute to what Trevor Dupuy pioneered and in an effort to pursue what he wanted to achieve, TDI continues to amass historical data and strives to refine the combat variables which go into the TNDM. In this sixth issue of our newsletter Christopher Lawrence, Dave Bongard, Richard Anderson, José Perez, and Jay Karamales continue to provide information on these efforts.

As you, our readers, survey the pages of this issue, you may be curious about the total scope of work of TDI. The paragraphs below outline what is missing in applied military history and what TDI is doing to shore up that deficiency. In other words, here is *our core capability*:

1. TDI provides independent, objective, historically–based analyses of modern military campaigns. Operations research, as developed during and right after World War II, was based on recorded, detailed data from battles. It is now nearly extinct. It has been supplanted by weapons and systems effects and performance analyses totally devoid of human factors considerations. As a result the Services, particularly the Army, have only partial answers for the development of operational concepts, battle doctrine, weapons requirements, and organizations. Similarly, because they were not historically validated, the Service models and simulations are skewed. Striving for only measured weapons effects and technical systems capabilities, they miss (or significantly distort) the impact of leadership, training, organization, and psychological factors (such as fear of death) on military units in contact.

2. Over the years, TDI, a successor organization to the Historical Evaluation and Research Organization (HERO), both founded by the late Colonel Trevor N. Dupuy, has compiled a large database from modern military campaigns and battles. Using Colonel Dupuy's methodologies and some new techniques, TDI has developed the following capabilities:

a. Comparison of fighting capabilities of opposing forces (systemic strengths and weaknesses) based on:

(1) Command and organizational arrangements, leadership, force structure, intelligence, and logistics;

(2) Training, cultural and psychological profiles, and flow of information;

(3) Doctrinal flexibility or constraints in utilizing new weapons and technologies.

b. Validation of models or simulations and of scenarios for field exercises. Validation is a process, based on historical data and trends, that assists in determining whether a scenario, model, or simulation is an accurate representation of the real world. TDI has the capability to do this independently or to provide primary source historical data for agency in–house validations.

c. Estimating casualties for combat or other operations.

d. Providing lessons learned from studies of cause and effect chains among responsible players at the political, theater, operational, and tactical levels.

e. Analysis of group behavior (impact of various combat activities on units) and other human factors (historically–based aggregate measure of leadership, training, morale, organizational capacity, and cultural characteristics) in modern battles.

f. Studies, based on historic trends and experiential data, of the specific impact on combat caused by new technology and the improvement in weapons. This enables projections of ways in which future wars should be fought and understanding of what elements constitute "force multipliers."

3. The capabilities listed above merge operations research with historical trends, actual combat data, and real world perspectives creating applied military history in its most useful sense.

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IN HONOR OF THE MEMORY OF THE LATE

Trevor N. Dupuy

Col., USA

International TNDM Newsletter

Publisher
The Dupuy Institute

Editor
Christopher A. Lawrence

Production Manager
Jay Karamales
Olórin Press

Contributing Editors
Richard C. Anderson
David Bongard
Jay Karamales
José Perez

The Dupuy Institute

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Col. Trevor N. Dupuy

President
Maj. Gen. Nicholas Krawciw

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Dr. Lester A. Picker
Eugene Visco

Administrative Offices
The Dupuy Institute
1497 Chain Bridge Rd
Suite 100
McLean, VA 22101 USA

VOX: 703-356-1151
FAX: 703-356-1152
NikatTDI@aol.com

From the Editor...

This issue focuses on armor. The modeling of armor is perhaps one of the more controversial aspects of the TNDM and one that I am not entirely satisfied with. I do have some tentative suggestions for changing the way armor is addressed and am looking for comments and opinions from our readers.

The lead article by Jay Karamales is a bald–faced attempt (initiated by me, not Jay) to generate a little attention for his recent book, *Against the Panzers* (McFarland, 1996). I hope the article proves interesting for our readers. It came out of an armor/anti–armor study Jay did for CAA (Concepts Analysis Agency).

The article from Niklas Zetterling is our first real article from "outside" the Institute. It is also our first published criticism of the QJM/TNDM. I prepared a response, which follows, but suffice it to say that Mr. Zetterling has hit upon several valid points and problems.

The rest of this issue is oriented towards armor. First we have an article developed from our ongoing artillery suppression study on measuring the effects of artillery on armor. We then have a brief discussion from José Perez on the changes we made to the armor OLIs in the TNDM. There is also an article from Dave Bongard that displays the differences between the old QJM armor OLIs and the new TNDM OLIs, along with a discussion of the problems created by the new OLIs. Finally, I address how we are considering correcting these problems.

We also have two articles from our ongoing battalion–level validation effort. One is on the use of armor in the battalion–level engagements, and the other is a summation of the article on predicting casualties from the previous issue. Apparently, I needed a few more tables to properly explain everything.

For "Who is TDI," we have included a little background on Jay Karamales, who in addition to being a programmer, analyst, historian, writer, and renaissance man, does all the graphics and layout for this newsletter. If this newsletter looks sexy, its because he added the sex. As usual, Jay refuses to submit a real picture, even though he was the one who first suggested that we include people's pictures in the newsletter. I will settle for a picture of his wife. *[Note from Jay: instead I have used a picture of my daily inspiration, scientist Charles Darwin. Sorry, Chris!]*

We did meet last month with the South African users of the TNDM. They are making good use of the TNDM as part of their package of models they use for training. They are basically using it as their attrition calculator within a larger set of models. I am going to do my best to convince them to write up an article on how they are using the TNDM.

The first issue of the second year of publication will include an article written by Trevor N. Dupuy that was never before published called "Technology and the Human Factor in War." In the next issue we will also have a complete TNDM analysis of Dom Bütgenbach. I expect to also include some more articles on our battalion–level validation work. We have still to conduct our analysis of the advance rates and a summary conclusion. We also need to test all these changes to our second battalion–level validation data base of 121 battles from 1914 through 1991. This will be filling in the back pages of the Newsletter for several more issues. I expect to have some more "outside" articles for the next issue. I did have to delay the article on the use of mines and fortifications at Kursk—simply haven't had the time to edit my old draft and bring it up to standards. It will show up in next issue or the one after that.

That is all for now. If you have any questions, please contact me. Addresses, e–mail addresses, and phone numbers are in the masthead.

The Defense of Dom Bütgenbach

by Jay Karamales

[Note: Given the fact that the battle discussed in this article saw the American 26th Infantry Regiment pitted against the German 26th SS-Panzergrenadier Regiment, German unit designations throughout the article will be in boldface to minimize confusion.]

Introduction

It often comes as a surprise to casual students of World War II in Western Europe when they realize just how often the US Army was on the defensive, fending off German attacks or counterattacks. How is this possible, one might think, when the Allied Armies swept through France after Operation Cobra, not stopping until they reached the German border with dry fuel tanks? Certainly the Germans were able to surprise the Americans with the counteroffensive into the Ardennes in December, but what about the spring of 1945? Surely the Germans were too exhausted and depleted to mount attacks worth mentioning?

The reason for the surprising abundance of defensive battles fought by the US Army in Europe is twofold. First, Adolf Hitler was fascinated with the concept of the surprise armored attack, the sudden pincer movement that would disorient his opponent and initiate a sweeping reversal of the fortunes of battle. He had tried this strategy a number of times on the Eastern Front, with mixed and ephemeral results. The American Army got its first taste of this kind of battle at Mortain in August 1944, when Hitler threw most of his remaining panzer reserves in France at the boundary between the US First and Third Armies. The attack served only to destroy valuable German tanks and veteran crews, and to hasten the formation of the Falaise Pocket, but it was a clear indication of the types of counterattacks Hitler favored. In a sense, Mortain was the Ardennes writ small.

The second reason was that German tactical doctrine specified that when an important position was captured by the enemy, an immediate counterattack should be launched to retake the position before enemy consolidated his gains. If armor was available, whether in the form of tanks, tank destroyers, or self–propelled guns, this counterblow could be quite effective against a disorganized enemy.

The Battle of Dom Bütgenbach was a result of Hitler's armored drive into the Ardennes forest of Belgium in December 1944. Two mighty tank armies—the **6th Panzer Army (6th PzArmy)** in the north and **5th PzArmy** in the south—struck the thin American line along a broad front. **The 6th PzArmy** was composed largely of SS troops, Hitler's darlings, and as such was entrusted with the primary objective of the operation, the seizure of Antwerp. Unexpectedly stiff resistance from the green US 99th Infantry Division (99th ID) and veteran 2nd ID halted **6th PzArmy's** attack almost before it began, and its commander swung his forces to the southwest in an attempt to outflank the American position. The troops and tanks of the **12th SS–Panzer Division** were met at the little crossroads of Dom Bütgenbach by the men of the American 1st Infantry Division, and the ensuing clash would largely determine the outcome of the fighting for the northern shoulder of the Battle of the Bulge.

The German Forces at Dom Bütgenbach

The success of the **6th PzArmy's** thrust through the Ardennes was the responsibility of its commander, Oberstgrüppenführer der Waffen–SS (General) Josef "Sepp" Dietrich. Dietrich had been Hitler's chauffeur and bodyguard back in 1923 and was still one of the Führer's most trusted officers. Dietrich had at his command the strongest of the three German armies in the Ardennes, composed of nine divisions in three corps: the **LXVII Armeekorps** and the **I** and **II SS–Panzer Korps**. The **LXVII AK**, on the army's north flank, contained the **326th** and **246th Volksgrenadier Divisions**. Their task was to break through the American lines around Monschau and block any American counterthrust from the north. To the south, the **I SS–PzK**, with the **1st** and **12th SS–Panzer Divisions** and **12th** and **277th VGDs**, was to make the army's chief effort, attacking into the gap at Losheim and through the Krinkelter Wald at Krinkelt–Rocherath to open a route into Malmédy and on to Liege on the Meuse. To exploit the breakthrough, Dietrich held the **II SS–PzK**, with the **2d** and **9th SS–Panzer Divisions**, in reserve.

The **12th SS–Panzer Division "Hitlerjugend"** was assigned the task of taking the northernmost routes to the Meuse. The division, named after the Hitler Youth organization and containing many of that group's teenage volunteers in its ranks, had earned a reputation in Normandy for being bold and merciless. Engaged against the British and Canadians at Caen, the division had been nearly destroyed, only 300 riflemen and 10 tanks remaining when it reached the safety of the Westwall in August 1944. Over the next three months, **"HJ"** had a high priority for receiving replacements, and by 16 December it was nearly back to full strength with 23,346 men (including a hundred or so foreign non–combatant volunteers, known as *hilfswilligers*, or *hiwis*). This figure is slightly deceiving, however, since 2,000 of these replacements were Luftwaffe men hastily trained as infantry and assigned to the division during the first two weeks of November. The cadre of experienced officers and NCOs in the division was very small, and most of the staff officers were green. These defects were most apparent in the panzergrenadier regiments, who the divisional commander, SS–Colonel Hugo Kraas, felt were not even ready for defensive duty, much less for a major attack. The divisional armored reconnaissance battalion had, in actual strength, only one light armored rifle company.

The real backbone of the division, the **12th SS–Panzer Regiment**, was down to one battalion, although this battalion was fortunate in being well–manned with seasoned veterans of all ranks. To help offset its deficiency in tanks, the **560th Heavy Panzerjäger** (self-propelled tank destroyer) **Battalion** was attached to the regiment in mid–December to act as its second battalion. The **560th** was a regular Heer (army) unit, not a Waffen–SS formation. Although it was unusual to link SS and non–SS units in this way, it was not unheard of and there is no record of difficulties in command or control of the arrangement; some vehicles in the **12th SS–PzRegt** even seemed to have mixed SS/Wehrmacht crews. The battalion was composed of the heavily armored Mk IV and Mk V Jagdpanther self–propelled tank destroyers, and these non–turreted vehicles were at a distinct disadvantage in an attack role, especially against the more agile American M–4 Sherman tank. In addition, the mix of four types of vehicles in the panzer regiment—two types of panzers and two of jagdpanzers—was a logistical nightmare for the division's already overloaded support units. The panzer regiment was at 90% full strength in personnel and 80% strength in vehicles, with 39 Mk IV Tanks and 41 of the dreaded Mk V Panthers in its **I Bn** and 14 Mk V Jagdpanthers and 21 Mk IV Jagdpanthers in the **560th Hvy PzJg Bn (II Bn)**. The **12th SS–PzJg Bn**, the division's organic self–propelled tank destroyer battalion, had an additional 22 PzJg IV/48 Jagdpanzers at the start of the campaign. The division also had 120 armored half–tracks at its disposal, most of them in the **26th SS–PzGren Regt** (as was normally the case, since one of the two grenadier regiments was designed to be more mechanized than the other).

The **"HJ" Division's** artillery support, the **12th SS–Artillery Regiment**, was at a severe disadvantage in that it was comprised only of towed (rather than self–propelled) artillery pieces (105 and 150mm), plus a towed rocket–launcher (nebelwerfer) battalion. The artillery officers and staff, however, were all veterans. The division's other technical and support units had survived the withdrawal from France intact as well.

The chief handicap to the division's mobility at the start of the Ardennes Campaign was its lack of motorized transport. Fully 25% of its trucks had not been replaced after Normandy, and the **25th SS–Panzergrenadier Regiment (Motorized)** had almost no motor transport left and was relegated largely to marching on foot. To make matters worse, the division's train capacity could hold no more than 300 tons, about 50% of its TO&E capacity.

Delay at Krinkelt–Rocherath

The German Ardennes Offensive broke upon the Americans on the morning of 16 December 1944. Although the Americans were greatly surprised that the Germans were capable of mounting a large offensive operation, the Germans were, from the beginning, victims of overoptimistic planning and guilty of underestimating American tenacity. While the secondary attacks of the **5th PzArmy** and **7th Army** to the south initially made rapid progress, Dietrich's **6th PzArmy** took all day on the 16th just to clear the belt of woods to its front. By the end of the day the **12th** and **277th VGDs** had exhausted themselves just pushing the American line back a couple of miles, and the commander of **I SS–PzK** felt compelled to commit the **12th SS–PzD** to force its own penetration of the American line. Nowhere did they achieve an appreciable penetration. As a result, on the 17th the **"HJ" Division** fought its way through the Krinkelter Wald to the twin villages of Krinkelt–Rocherath. Here, the division struggled for two bloody days against the American 2nd and 99th IDs, expending precious strength in unsuccessful attempts to force the breakthrough that the volksgrenadiers were to have achieved in the first few hours.

Finally, on the 19th, the German commanders admitted the futilty of continuing to attack against such a resolute American defense, and began to shift the **12th SS–PzD** to the southwest in an attempt to make an end run around the American V Corps at Bütgenbach. Luck was again not with the division, however, as it took most of the next two days for it to move just a few miles to its assembly point at Büllingen. This was due to the fact that the more direct route from Krinkelt to Büllingen was covered by US fire, which forced the division to backtrack along the muddy forest trails to its original starting point, and then to drive through Losheimergraben with the rest of the corps' traffic.

The **12th SS–PzD** suffered heavy losses at Krinkelt–Rocherath due to the fierce delaying actions of the US 2d and 99th US IDs which were determined to hold the area until a more solid defense line could be established on the Elsenborn Ridge to the west. The **"HJ" Division** losses were two Mk IV panzers, eighteen MK V Panthers, and one PzJg IV destroyed, and a further eight Panthers and two PzJg IVs damaged. These losses, followed by the difficult withdrawal and displacement southeast on muddy roads in the bitter cold, meant that the SS troops were far from "fresh" when they finally began to dribble into Büllingen. But their morale was unbroken, they still believed in their cause and in their own fighting ability, and were determined to sacrifice everything to accomplish their assigned mission: seize the highway that ran from Büllingen through Bütgenbach to Liege and the Meuse. However, the delay at Krinkelt–Rocherath had allowed someone to get to Bütgenbach before them.

The American Forces at Dom Bütgenbach

The 1st Infantry Division (nicknamed "the Big Red One" because of its shoulder patch emblem) was transferred to V Corps control at 2400 on 16 December to plug the gaps in the US lines. The 1st was arguably the most veteran unit in the US Army, having seen battle in North Africa, Sicily, and Normandy. After fighting across France in July and August 1944, the division was badly mauled in the battle for Aachen in September and October, and again in November in the bloody fighting for the Hürtgen Forest. In early December, the 1st was sent to the Ardennes to recuperate, being short more than 3,300 men, most of which were from the front–line combat elements.

The 2d Battalion (E, F, G, and H Companies) of the

26th Infantry Regiment, which was to defend so tenaciously at Dom Bütgenbach, was among those units that had suffered heavily in the Hürtgen Forest. E and F Companies, with two heavy machine gun platoons of H Co attached, had been surrounded and destroyed in the town of Merode from 30 November to 3 December. G Co was also hard hit. On 7 December, two days after the division pulled out of the forest and moved to Aubel, Belgium, to rest, it received a wave of replacements to fill some of the gaps. When the 2/26th moved to Dom Bütgenbach on 17–18 December, E and F Cos were only up to 60% strength, with about 100 men each, and these men were 90% green replacements and 10% hospital returnees. G Co was especially weak, with only about 50 men, although only 10 to 15 percent of these were replacements, the rest veterans. The two machine gun platoons of H Co had to be completely rebuilt, and between them they could only count eight veteran members. In the entire 2/26th, there were only seven officers remaining who had been with the unit on D–Day: four in the battalion HQ, three in the line. The battalion suffered some minor equipment shortages (the companies having only four Browning Automatic Rifles (BARs) apiece, and there being a scarcity of rifle grenade launchers). The battalion heavy weapons, however, (machine guns, mortars, bazookas, etc.) were at full strength or above. The battalion's vehicle situation was excellent, since it was only short by two jeeps. In total, the 26th Infantry Regiment had about 2500 men, rather than the 3000+ it should have had.

"We Fight and Die Here"

While a handful of American engineers and scattered groups of men from the 2nd and 99th IDs were fighting a slowly losing battle to hold the Büllingen–Bütgenbach highway against the German advance, they were unaware that help was already on the way. At 1145 on 16 December, the first day of the offensive, the 1st Infantry Division, resting near Aubel, went on six–hour alert. At 0230 on the 17th, the 26th Infantry Regiment set out for Camp Elsenborn and commitment on the V Corps' southern flank, which by that time was wide open thanks to the attacks of 5th PzArmy. Although briefly delayed by the necessity of hunting down some German paratroopers who were dropping in the division's path, the first units of the 26th reached Camp Elsenborn by 0700 on the 17th (just as some engineers holding Büllingen were overrun) and the remainder of the regiment arrived by 0900. The Americans were told that the Germans had captured the town of Büllingen at 0700 that morning, and with it a large fuel dump that 1st Army had established there. Fearing that the Germans might secure the vital highway running from Büllingen through Bütgenbach to Malmédy and Liege, the 26th quickly moved to guard the important road junction at Domäne Bütgenbach, 2 km southeast of Bütgenbach. "Domäne" is a German word meaning a manor held by a lord, and, indeed, such an estate overlooked the vital crossroads.

The 2/26th, commanded by LtCol Derrill M. Daniel, drove onto the grounds of the manor house at 1300 on 17 December, some seven hours after **KG Peiper** of the **1st SS-PzD** had passed through Büllingen. The men of the 2/26th relieved the battered engineers who had been defending the crossroads for about ten hours against German probing attacks, and the engineers began moving back to Bütgenbach about 1500.

The large stone manor house, with its flanking stone–foundation wooden barns and nearby gardens, was situated in a narrow valley between two hills, one to the north (Hill 598) and one to the south (Hill 613). These hills were mostly devoid of cover except for some straight rows of tall, widely spaced spruce trees on either side of the trails that criss–crossed the estate. Along the slope of a low ridge that ran almost a kilometer south of the manor lay the edge of the Bütgenbacher Heck, a dense strip of coniferous forest. This ridge was crowned by Hill 613. A kilometer beyond that, out of sight over the hill's crest, was the crossroads known locally as Morschheck, which was occupied at the moment by paratroops of the **3d Fallschirmjäger Division**. The main east–west highway that the Germans wanted so desperately ran southwest past the manor, dipping into another small valley about 500m to the east. Through this valley the Schwarzenbach creek flowed north toward Lac de Bütgenbach. The road rose again on the other side of the stream bed and split into two roads, both of which led into Büllingen, 2 km from the manor house. Another main road led due north out of Morschheck, over the top of Hill 613, and plunged down the long hillside to a junction with the Büllingen–Bütgenbach highway about 100m east of the manor house.

After having carefully examined the advantages and disadvantages offered by the terrain, LtCol Daniel set about positioning his troops. G Co went east toward Büllingen and dug in behind a row of trees running along the top of a hill on the east side of the Schwarzenbach. E Co took up positions behind similar treelines south of the manor, about halfway up the hill which led to the Bütgenbacher Heck and Morschheck. F Co moved southwest to cover the area between the other two companies, digging its foxholes on the reverse slope of a ridge scarcely half a kilometer from Morschheck. This was the same ridgetop occupied by the engineers earlier that morning. LtCol Daniel parceled out the machine gun and bazooka teams from H Co, the battalion's heavy weapons company, among the other companies to stiffen the defense line. He positioned the 81mm mortars behind Hill 598, from where they could support the whole perimeter. Due to the depleted condition of his battalion, Daniel could spare only one platoon of G Co as a ready reserve. This he stationed behind the manor house, from where it could quickly be committed wherever needed.

The nature of the terrain and the fog which blanketed the area compelled LtCol Daniel to place his antitank assets well forward, where they would have sufficient visibility to support the foxhole lines. He set up three towed 57mm antitank guns covering the road running east to Büllingen, and supported them with three M–10 self–propelled tank destroyers mounting 3–inch guns. He sent three

more AT guns to bolster the main line of resistance, or MLR, in the E and F Co areas. As part of their ammunition supply, each of the 57mm guns had seven to ten rounds of British discarding sabot (DS) ammunition, which had been issued before D–Day. Designed originally for the British 2–pounder gun, these rounds used a disposable sleeve, or sabot, to allow them to fit in the larger American guns. The resulting round had a lighter weight and greater velocity, about 4200 ft/sec as compared to 2900 ft/sec, than the normal 57mm rounds. Given this impetus, a DS round could penetrate approximately six inches (154mm) of armor at a 30° slope. This made the obsolescent 57mm gun a dangerous weapon again, even against the fearsome Panther tank and Jagdpanther tank destroyer, whose frontal armor was impervious to the 57's normal armor–piercing (AP) round.

LtCol Daniel kept four M–4 Sherman tanks around his CP as a mobile reserve. He set up his command post in one wing of the stone manor house, along with the battalion aid station. E and H Companies established their company command posts in the barns to the west and east of the manor house, respectively, while F and G Companies colocated their CPs in a hut alongside the Büllingen road just behind their MLR. The battalion observation post was located on the third floor of the manor house, which provided a good line of sight over the entire battalion sector.

LtCol Daniel was not very happy with his battalion's defensive positions, although they were the best that could be found under the circumstances. After the war, in a letter to Donald Rivette, former commander of his AT Company, Daniel wrote:

> "The reverse slope defense on the right flank [E Co] was just necessary. We couldn't go very far south to get on the crest of the hill because that would add several hundred yards to the MLR and I just didn't have enough men for that. Besides, if we did go to the hill we would have to curve over into the woods with the MLR and that would take even more men. So we went where I thought we had a reasonable chance. The hedgerow was bad, I admit it was a perfect target. But either side (north or south) of the hedgerow was even worse. If to the south there was no concealment and each foxhole could be definitely spotted. If to the north we would have concealment from ground observation afforded by the hedgerow, but also the hedgerow would limit our own observation to a marked degree. Besides, if the line was moved far enough north to get away from fire directed at the hedgerow, the line would be too close to the CP. So we took the hedgerow, which made a reverse slope defense—no help for it."[1]

To provide as much protection as possible for his men from what was expected to be intensive German artillery fire, LtCol Daniel ordered that all front–line positions, including crew–served weapons, be enhanced with overhead cover, usually in the form of wooden planks laid over the top of the foxholes. To facilitate this, Daniel had a load of lumber trucked to the battalion from Bütgenbach. Further, his men camouflaged their positions with whatever materials were at hand, and they piled up sandbags around the fighting pits.

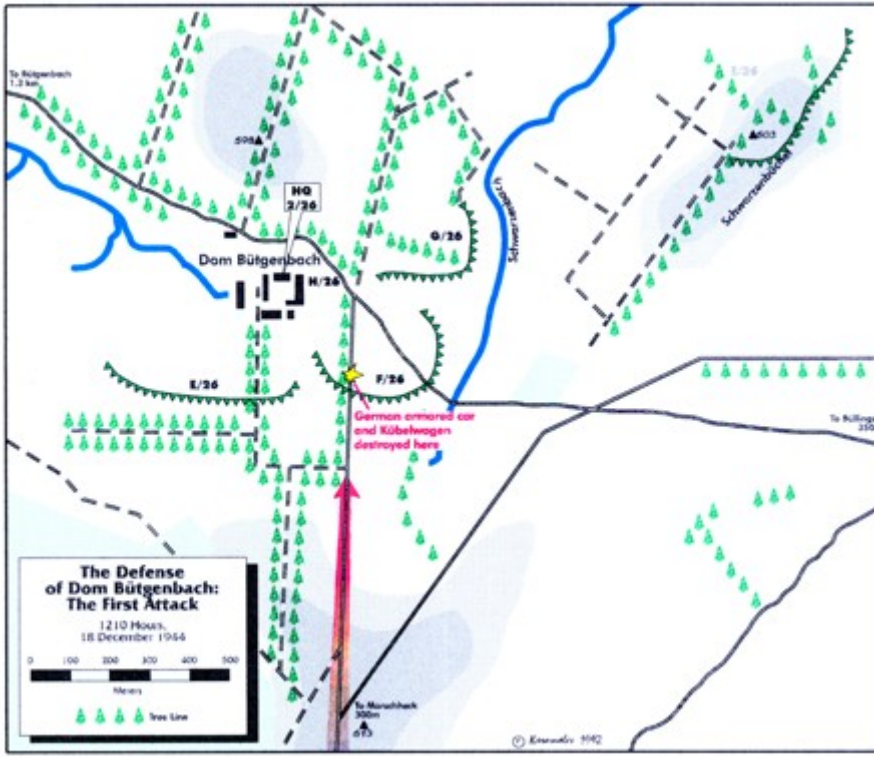
The 2/26th had finished digging in around Dom Bütgenbach by 1700 on 17 December. Meanwhile, the 3d Bn had moved to occupy the hilltop sector between G Co and the railroad embankment which paralleled Warche River. Its positions were as exposed as those of the 2d Bn except for a sparsely wooded patch on top of Hill 503 known as the Schwarzenbüchel, or "Black Beech Forest." The 1st Bn stayed in reserve in Bütgenbach. This left the 2d Bn's right flank hanging on air, and its rear vulnerable to attack from the west or southwest.

As darkness fell around 1830, LtCol Daniel ordered each of his companies to prepare one 60mm mortar to fire illumination rounds during the hours of darkness. Telephoning the regimental HQ in Bütgenbach, he also requested that each of the supporting artillery battalions have one howitzer layed to fire illuminating shells every night. Regiment agreed, and informed Daniel that since 1800, the 7th and 32d Field Artillery Battalions had established new positions from which to support the 26th. The regiment's normal supporting artillery battalion, the 33d FA Bn, had been in place since 1430. Other artillery battalions were also on the way to Elsenborn to augment the V Corps defenses. At dusk, Daniel met with the company commanders in his office in the manor house CP. They had all heard rumors over the past two days of American soldiers giving up to the Germans or fleeing to the rear. He was determined that the 2/26th would acquit itself better than that. Although at Dom Bütgenbach the regimental combat team was effectively isolated from the rest of the division, it had fought under those conditions before at Kasserine in Africa and at Barrafranca in Sicily. Daniel had therefore adopted a slogan for the battalion, which he wanted passed on to every man in the battalion: "We fight and die here."[2]

After dark, even with his men tired from the long move and hours of digging foxholes in the cold, LtCol Daniel still sent out patrols to assess the situation. It proved to be a wise move. The patrol to Büllingen soon came running back to the manor house, the men saying they had seen about 100 American prisoners in the town and over a thousand German infantrymen. A second patrol snuck up the hill to the south to establish a listening post at the edge of the Bütgenbacher Heck, while a third patrol reported a brief skirmish with Germans to the southwest of the Domäne. This skirmish led to the fear (as yet unfounded) that the town of Weywertz, to the west of 2d Bn, might have been taken. Feeling the ring of steel tighten around them, the American soldiers waited anxiously through the long winter night.

[1] Letter, Derrill Daniel to Donald Rivette, 19 October 1948.

[2] Thomas Gendron, *The Operations of the 2d Battalion, 26th Infantry (1st US Infantry Division) at Dom Bütgenbach, Belgium, 18–21 December 1944.*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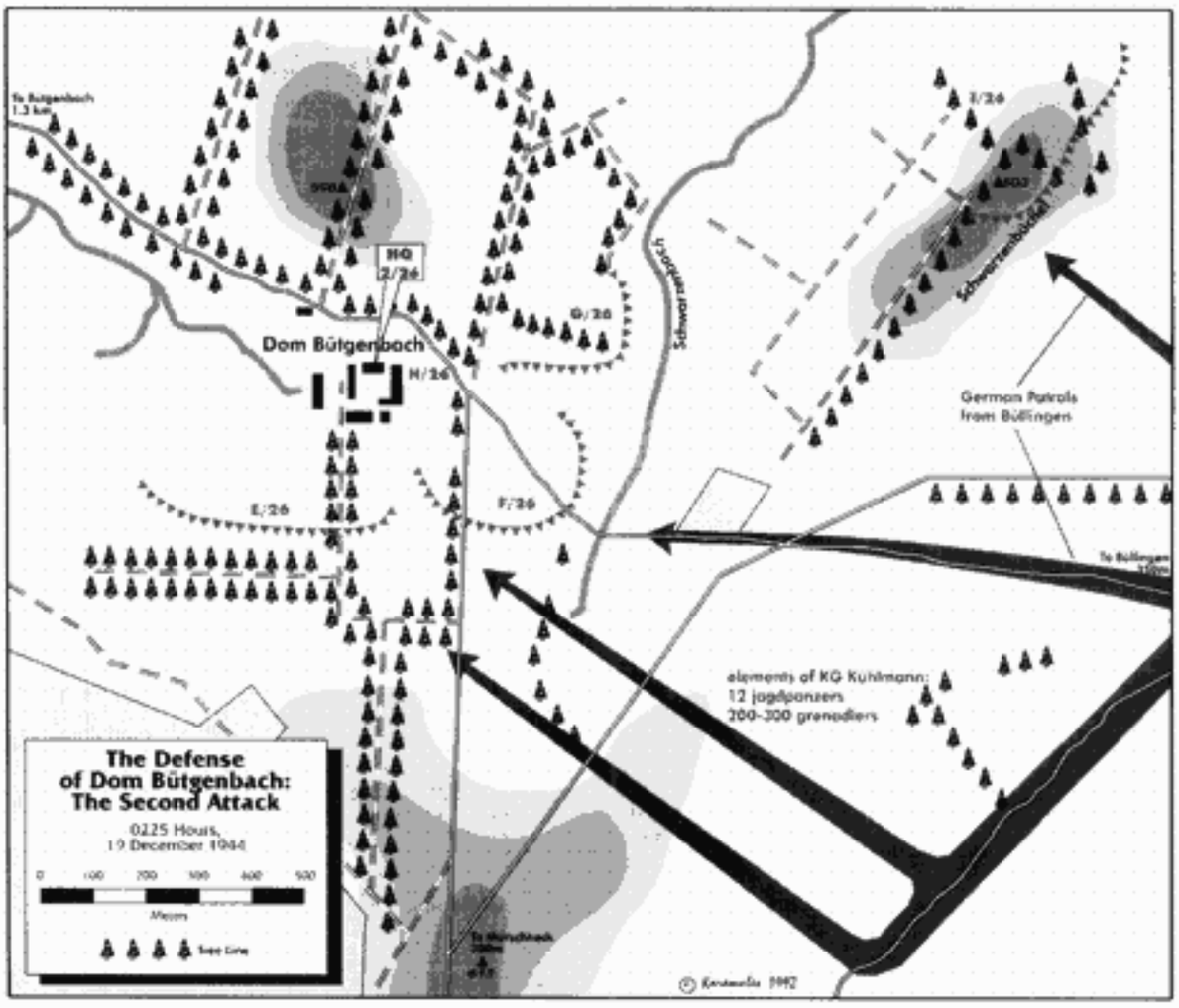


ready arrived, plus a few tanks, as well as **KG Bremer** as noted above. The rest of the division approached Büllingen via Losheim and Losheimergraben, broken into three march groups. The first of these groups to reach Büllingen was **KG Kühlmann**, composed of the **12th SS–PzRegt** under SS–Maj Kühlmann, the **III Bn** of the **26th SS–PzGren Regt**, led by SS–Capt Georg Urabl, along with that regiment's **13th Kompanie** of sIG 33 self–propelled infantry howitzers, and the **I Bn** of the **12th SS–Artillery Regt** of towed 105mm guns. The second group was **KG Müller**, with the **12th SS–PzJg Bn**, the **25th SS–PzGren Regt** (minus **I Bn** and **13th** and **15th Kompanies**), **II/12th SS–Artillery Regt** (towed 105mm howitzers) under SS–Maj Günter Neumann, one company of the **12th SS–Pionier (Engineer) Bn**, and two companies of towed AA guns. This group also included the Operations Staff of the Divisional Headquarters, minus SS–Col Kraas and his escort, who were still directing the division's withdrawal from Krinkelt–Rocherath from their CP at Hollerath. The division XO would direct the attack on Dom Bütgenbach until SS–Col Kraas arrived. The third march group was **KG Krause**, composed of the bulk of the **26th SS–PzGren Regt** (–**III Bn**), the **III** (towed 155mm) and **IV** (nebelwerfer) **Bns** of the **12th SS–Artillery Regt** plus the regimental HQ, the **12th SS–Flak Bn**, and the rest of the **12th SS–Pionier Bn**.

While **12th SS–PzD** was moving into Büllingen, the Americans at Dom Bütgenbach were far from idle. They continued to dig in and strengthen their defensive positions, while calling down harassing artillery fire on unobserved but likely German assembly areas in Büllingen and the Bütgenbacher Heck. At 2350 on the 18th the 2/26th received a shipment of 100 antitank mines, which they immediately laid to block the roads leading to the Domäne from Büllingen and Morschheck.

Around 2230, K Co of the 3/26th reported hearing vehicle noises inside Büllingen. This was the sound of **III/26th SS–PzGren Regt** of **KG Kühlmann**, assembling for a reconnaissance in force toward Bütgenbach. The SS–panzergrenadiers had relieved the men of the **12th VGD** who had been holding the town, and the volksgrenadiers crossed the Warche to rejoin their comrades on the Hohen Berg for an attack on Wirtzfeld. After establishing the battalion CP, recon patrols from the **III/26th** advanced out of the town and fanned out toward the Schwarzenbüchel, Dom Bütgenbach, Morschheck, and the Riechels–Busch. The latter two patrols encountered elements of the **3d FJD** who, despite being in the area for a couple of days, had no information concerning American defenses in the area. The patrol to the Schwarzenbüchel ran into strong defensive fire from the 3/26th and withdrew into Büllingen. The bulk of the recon force, consisting of 12 jagdpanzers of the **560th Hvy PzJg Bn** and 20 half–tracks and trucks carrying 200–300 infantry, headed southwest out of Büllingen down the road to Morschheck.[5] At 0225, after going about a kilometer, most of the half–tracks and trucks stopped and the infantry disembarked, forming up in two assault columns behind the jagdpanzers, which then set off cross–country in a northwesterly direction toward Dom Bütgenbach. This preparation occurred about 700 yards in front of F Co's positions. A smaller force of half–tracks drove straight down the main road to the Domäne, where two of them were destroyed by antitank fire in front of the American MLR.

To stop the main thrust from the southeast, the commander of F Co immediately called for prearranged artillery concentrations to be fired on the advancing Germans. He also ordered his 60mm mortars to fire illuminating rounds over the area. The 33d FA Bn responded quickly, firing salvos of

[5]American sources report that the Germans used tanks in this attack, but in *Kriegsgeschichte der 12.SS Panzerdivision "Hitlerjugend"*, Band II, Meyer is very positive that these were Jagdpanthers.

HE, white phosphorus, and starshells. This barrage hit two of the infantry trucks on the road, and their burning hulks helped illuminate the battlefield and silhouetted the approaching Germans. The right–hand column of the German double attack, consisting of five jagdpanzers with accompanying infantry, was stopped cold by the combination of artillery, mortars, small arms, and antitank fire. The other column, seven jagdpanzers with one or two companies of infantry, fared only marginally better. Some of the jagdpanzers mired in the swampy low ground even before they reached the American lines; others were discouraged by the heavy bazooka and antitank fire. The grenadiers were completely pinned down and failed to reach the US line. However, three of the jagdpanzers ran the gauntlet of the American fire and broke through E Co's positions. They got onto the Morschheck road leading to the Domäne and headed for the battalion CP. Seeing this, the 2/26th duty officer urgently requested that 155mm artillery be fired on the tanks since 105mm rounds were to small too affect them. The 5th FA Bn's howitzers responded right away, and they were soon joined by two battalions of the V Corps' heavy artillery.

By this time the jagdpanzers had reached the area of the manor house, and had wounded five or six GIs with HE fire from their main guns. The 155mm artillery shells, falling dangerously close to the battalion CP in the manor house, had the desired effect of chasing the German vehicles off. They turned around and headed back out through the US foxhole line, at which point two of the three were disabled either by artillery, tank destroyer, antitank, or bazooka fire, or some combination thereof. Their crews bailed out and ran for the safety of the German lines.

By 0325, an hour after it had begun, the first serious German effort to capture Bütgenbach had been repulsed. The grenadiers and remaining vehicles withdrew into Büllingen. They were later able to recover some of their damaged or bogged vehicles using the darkness and thick fog as cover. At daylight, two patrols from F Co ventured into the attack area and counted over 100 German dead, three destroyed jagdpanzers, and four destroyed trucks, three of them overturned by the force of the artillery blasts. A relative calm settled over the battlefield but it didn't last long.

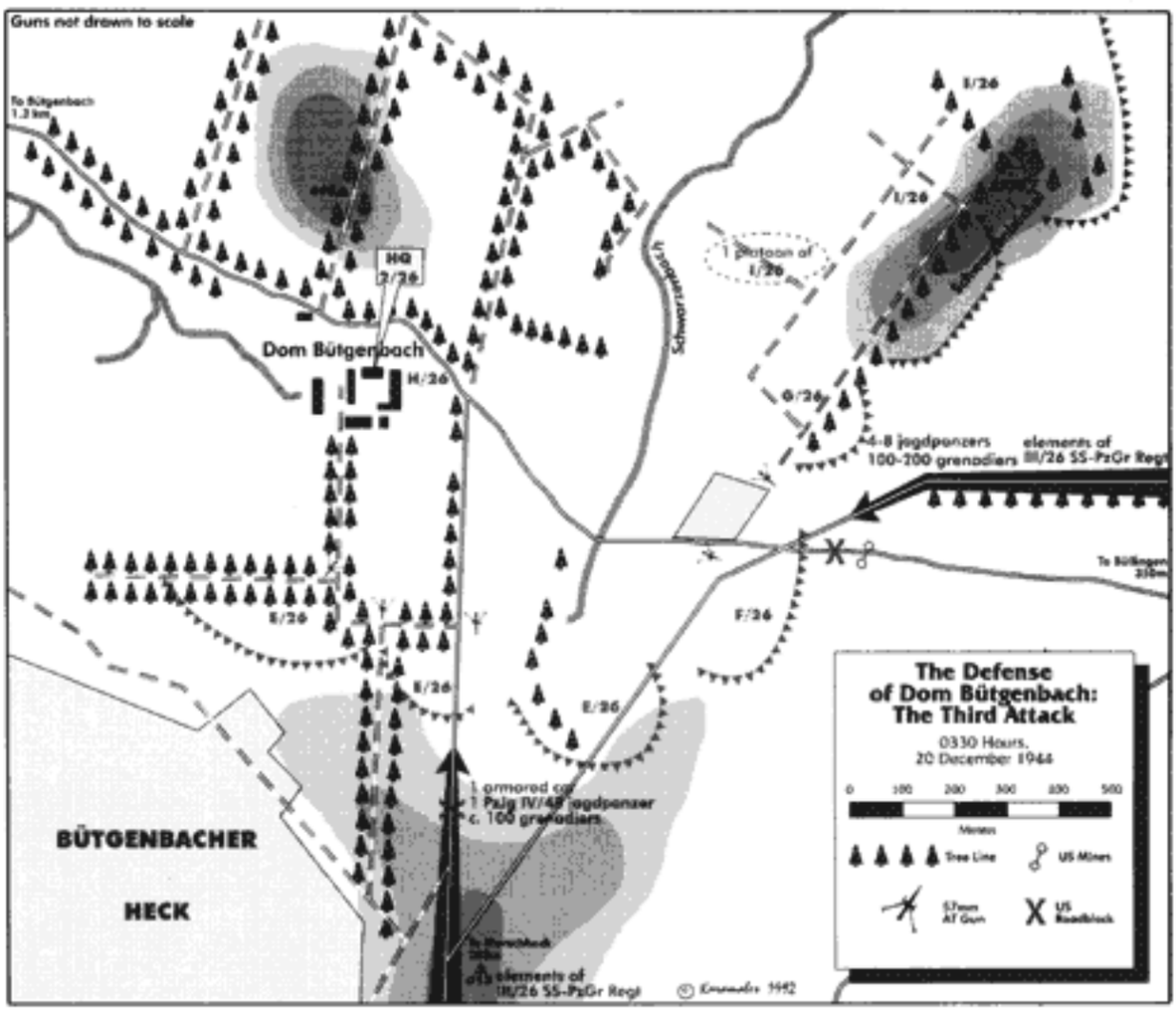
The Third Attack: The Vise

Following the hour–long German attack in the pre–dawn darkness of 19 December, Col John F.R. Seitz, commander of the US 26th Infantry Regiment, began moving elements of his 1st Bn out of reserve positions in Bütgenbach. Company B dug in along the north side of the Büllingen–Bütgenbach road between the town and the Domäne. Soon after, A Co move to new positions 1000 yards south of Bütgenbach to tie in with B Co. This had the added benefit of guarding 2d Bn's hitherto–open right flank, and by 0500 the gap between the two battalions was reduced to 600 yards. B Co would cover this gap by fire during the daytime and establish outposts there at night.

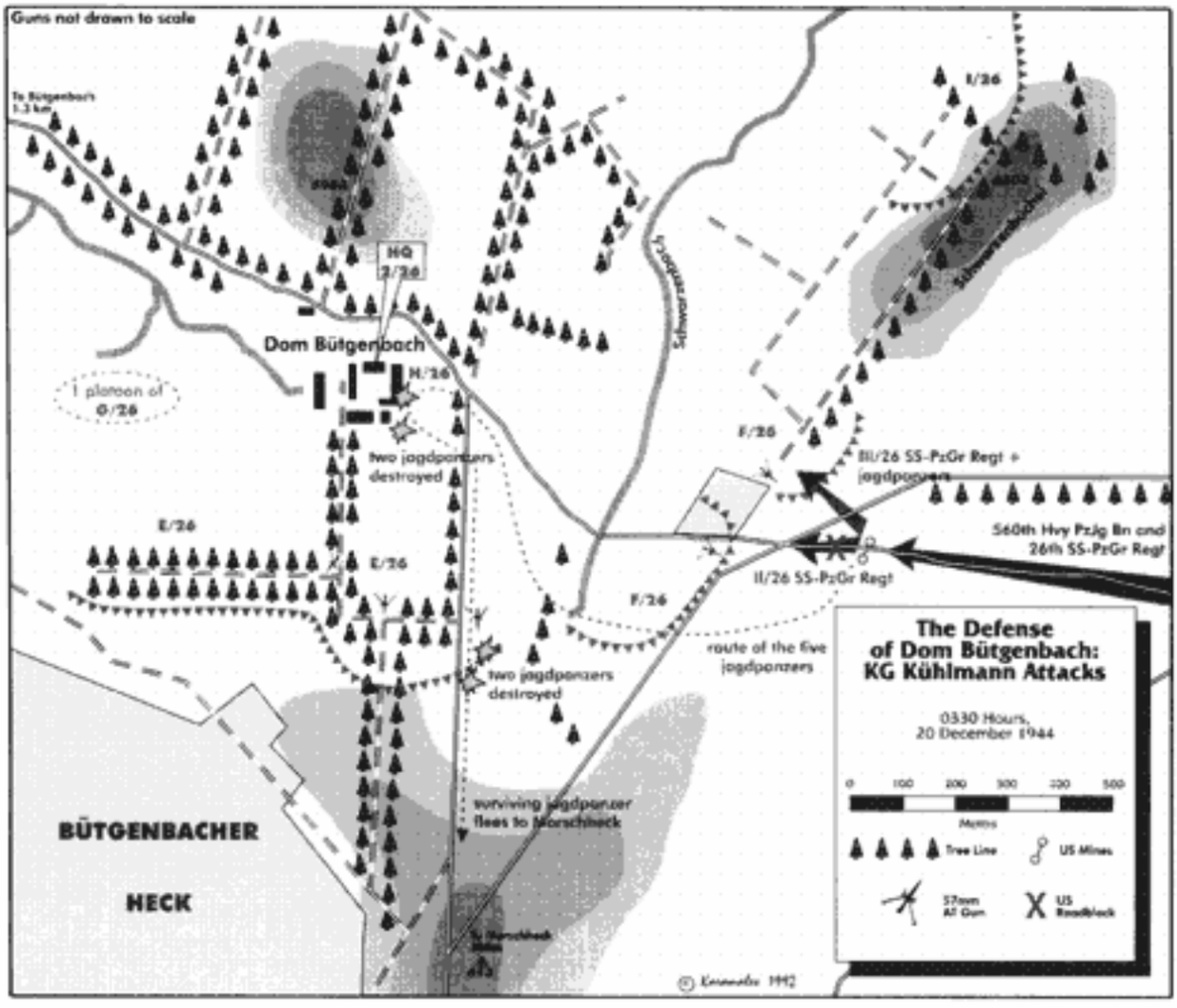
About 0630, shortly after daylight, the Germans began shelling the 2d Bn's positions with artillery and mortar fire which gradually increased in intensity throughout the morning until it reached its peak at 1000. At 1010, the second German attack of the day hit the American positions from south and east.

The first force came out of Morschheck, over the crest of Hill 613 and down the road to the Domäne used by the armored car and Kübelwagen the previous day. Leading the attack was another eight–wheeled armored car, probably an Sd Kfz 234/3, with a 75mm gun in a rotating turret.[6] Fol-

[6]American eyewitness accounts say the armored car had a 50mm antitank gun in its turret; that would indicate that it was a Sd Kfz 234/2 Puma. However, the German *gliederung* (Table of Organization) for the **12th SS–PzD** for 19 Dec 44 shows no such vehicles in the division's inventory. The *gliederung* does indicate that



lowing closely behind was a large armored vehicle. Contemporary accoubts claim this vehicle was a Mk V Panther tank, but the only Panthers in the **12th SS–PzD** were in **I Bn** of **12th SS–PzRegt**, which was at that time still on its way to Büllingen from Krinkelt–Rocherath. This second vehicle was probably from the **12th SS–PzJg Bn** of **KG Müller**, and was almost certainly a PzJg IV/48 Jagdpanzer. Together, these vehicles protected the advance of a company of SS infantry, who were probably from **III/26th SS–PzGren Regt**. Because of the heavy fog blanketing the area, the American gun crews let the Germans approach to within 100 yards of their positions in order to increase their chances of a hit on the vehicles, and to confirm their identity as enemy. The crew of 2d Gun Squad, 2d Platoon of the Regimental Antitank Co had just finished setting up their 57mm AT gun on the MLR a few minutes before the attack, and now they drew a bead on the approaching vehicles. On command, they began firing the gun as quickly as they could reload it, hammering out three armor piercing (or possibly discarding sabot) rounds in a few seconds. The first two shells were aimed at the Jagdpanzer which, being the most heavily armed and armored of the two vehicles, was the greater threat. Both rounds struck the Jagdpanzer and damaged it enough that it was forced to limp back up the hill to its own lines. But the AT gun's muzzle flashes had given away its location, and the armored car swung its turret to fire at the gun. Armored car and AT gun fired simultaneously. The American 57mm shell struck the armored car and destroyed it instantly. However, the German 75mm round also found its mark, destroying the AT gun and killing two members of the gun crew, Cpl Hale Williams and PFC Richard Wollenberg. A third crewman was blinded by the blast, and a fourth would have to be evacuated because of battle fatigue. The German advance from Morschheck now ground to a halt because the grenadiers could not advance against the deadly American artillery and small arms fire without tank support. The commanding officer of E Co, Capt Pierre Stepanian, called in 81mm mortar and artillery fire on the exposed Germans, and nearly the entire company was slaughtered before the American foxholes. Those few SS who were able to stumble back into the Bütgenbacher Heck were ambushed and killed by the men of the American listening post still hiding just inside the forest's edge.



Twenty minutes after the start of the southern attack, the Germans launched another assault westward out of Büllingen. This time they employed between four and eight of the huge jagdpanzers and an infantry force reckoned to be at least a company and possibly a battalion, probably those elements of **III/26 SS–PzGren Regt** which did not take part in the southern attack. This force advanced along the secondary road that ran parallel to and north of the main Büllingen–Bütgenbach road, perhaps because they anticipated that the Americans would have mined that route. Again, because of the fog, the Americans allowed the SS troops to approach close to their positions. The GIs could catch glimpses of the grenadiers through the fog, seeing them deployed in perfect attack formation behind the jagdpanzers. When the Germans reached a point about 100 yards from the American line, the leading SS officer called out for the Americans to surrender. The Americans answered him with a hail of fire. All the small arms of F and G Companies opened up, as well as bazookas, tank destroyers, and the two AT guns covering the east–west road. These latter destroyed the two leading jagdpanzers and again the German advance halted.

The Germans' morning barrage had cut F Co's communication lines to the battalion CP and disabled both the

the **12th SS–Recon Bn** contained 17 Sd Kfz 234/1 cars with 20mm guns, and six Sd Kfz 234/3 cars with 75mm guns. It would almost certainly have been one of these that was involved in this action. See von Senger und Etterlin, *German Tanks of World War II*, pp. 154–156; Hoffschmidt and Tantum, *German Tank and Antitank of World War II*, pp. 212–213.

company's radio and the radio used by the artillery forward observer stationed with the company, so they had to rely on the company's organic 60mm mortars to help drive off the Germans.

After an hour of frustrated attempts, the grenadiers began to fall back. Unable to penetrate the American perimeter on either side, they withdrew into Büllingen. Further attacks would have to wait until the arrival of more of the panzergrenadiers. Also, the Germans were by now running short of ammunition because the muddy roads were delaying the supply units. Under increasing time pressure to break through the US defense and open the highway to Malmedy, the **"Hitlerjugend" Division** had to content itself with artillery harassment of Dom Bütgenbach for the rest of 19 December.

The Fourth Attack: KG Kühlmann Attacks

Throughout 19 December, elements of the **12th SS–PzD** straggled into Büllingen, hampered by the muddy, clogged roads and tired from two days of hard fighting at Krinkelt–Rocherath. At some point during the afternoon the rocket–launcher (nebelwerfer) battalion of the **12th SS–Artillery Regt** arrived and fired at least one barrage of rockets at the 2/26th positions at Dom Bütgenbach; the other three artillery battalions kept up a light but steady rain of shells throughout the day.

Under pressure to attack quickly to seize Bütgenbach and open Rollbahn C, SS–Col Kraas reorganized **KG Kuhlmann** to include the tanks of **I Bn/12th SS–PzRegt**; the entire **26th SS–PzGren Regt**; the jagdpanzers of the **560th Hvy PzJg Bn**; and the **II/12th SS–Artillery Regt** of towed 105mm howitzers. This force assembled as set out as soon as it was fully dark, around 2310, to mount a concentrated attack on the US positions east of Dom Bütgenbach. The **III/26** secured the assembly area in the west section of Büllingen and pushed a screen of scouts forward while the **I/26** and the jagdpanzers of the **560th** moved down both sides of the Büllingen–Bütgenbach highway. The force took a wrong turn, however, and got lost in the darkness. It ended up south of the Domäne near Morschheck at about 0150, and Capt Stepanian of E Co, 2/26, again called upon the 1st Division's supporting artillery to blast the German column. The 5th, 33d, and 955th FA Bns, as well as one 90mm battery from the 414th AAA Bn and a battery of 8–inch guns, answered the call and the resulting 10–minute barrage knocked out two of the **560th's** Jagdpanzer's IV/48s. It was some time before the kampfgruppe could turn around and reassemble back in its proper starting area. Finally, at 0330 on the 20th, the Germans neared the Americans' eastern perimeter.

Just before reaching the American lines, the kampfgruppe split into three columns. The northernmost force, a company of Jagdpanthers and some infantry of **III/26th SS–PzGren Regt**, had the task of clearing the troops of the US 3/26th from the Schwarzenbüchel on Hill 503 in order to protect the attack's flank; it succeeded in occupying the southern part of the hill, but there the attack stalled and the grenadiers were locked in combat for hours with the American infantry along the treeline.

The center group rolled due west down the highway for a clash with F Co, which had been alerted by the sounds of battle on Hill 503. The commander of the lead Jagdpanzer was struck in the head and killed by an American bullet before his vehicle reached the foxhole line. His driver, panicking, quickly threw the vehicle into reverse before it could be hit by antitank fire, and rammed into the following Jagdpanzer. Despite the snarl this caused, the attackers pressed on, and heavy combat ensued between the Americans of F Co and the Germans of **II/26 SS**. One of the M–10 self–propelled tank destroyers of the 634th TD Bn was in the area, near the F Co CP, and could have been of great value in supporting against the German thrust, but the crew, in the confusion of battle thinking themselves surrounded, disabled their vehicle and fled toward the Battalion CP at the Domäne.

The leftmost German force enjoyed the most success. A company of Jagdpanzer IV/48s accompanied by infantry from the **I/26 SS** encountered a belt of American mines across the road a hundred yards or so in front of the MLR, so they swung southwest off the main road and headed for the seam between E and F Companies using unpaved trails along the hillsides. The Germans skirted just south of the boggy source of the Schwarzenbach Creek, but several of the 45–ton Jagdpanzers became mired in the soft mud, some up to their rear decks. Five of the Jagdpanzers from **1st Kompanie** managed to make it up the hill and through the American foxhole line, but the grenadiers were again checked by the heavy American artillery and small arms fire. Once through the MLR, the Jagdpanzers turned around briefly to spray the American positions from the rear with machine gun and HE fire. This fire knocked out some of the 57mm AT guns and caused casualties among the infantry, including destroying three bazooka teams and a machine gun section of four or five men from H Co, but it also aided in further pinning the German infantry on the other side of the MLR. After a few minutes the Jagdpanzers turned northwest to continue their mission of breaking through to the Domäne. leaving the grenadiers and GIs to fight it out in the heaviest combat the regiment had ever seen. The smoke of battle added to the fog and darkness in obscuring visibility, and several German panzerfaust teams were able to get close enough to knock out the US AT guns with their rockets. German artillery and mortar fire continued to crash down on the American positions all through the battle. The Germans had captured several American soldiers during the fighting, and when they were later interrogated the Germans learned for the first time that they were facing the 26th Regiment of the 1st Infantry Divsion.

The five Jagdpanzers of **1st Kompanie** pushed on alone, driving through the American rear area to within 100 yards of the manor house, where they began firing their 75mm guns directly into the building. Without their supporting infantry, however, they were vulnerable to close combat tactics. American bazooka teams set out to hunt the Jagdpanzers among the buildings of the Domäne and knocked out two of

them. The other three vehicles chose to withdraw and headed for the road to Morschheck. After they passed through the MLR, however, the crews of the American AT guns in the E Co sector were able to spot the vehicles' exhaust flashes through the smoke and fog, and destroyed two more Jagdpanzers in short order.

Fearing that his infantry line was in danger of collapse from the enormous pressure being exerted by the panzergrenadiers, LtCol Daniel committed his battalion reserve, the platoon from G Co, to counterattack and restore the MLR in the F Co area. He also called the Regimental CP in Bütgenbach and requested a company from 1st Bn, which was too far west to be hit by the German attack. Col Seitz approved, and sent C Co to the 2d Bn area at once. Daniel forwarded two platoons to reinforce F Co, which was being badly chewed up, and kept two platoons as his new battalion reserve.

Meanwhile, in the center astride the highway, the battle still raged. Three of the giant jagdpanzers broke through the foxhole line and engaged the US tanks and self–propelled tank destroyers along the ridgeline on the southern part of Hill 503. The US armor pounded away at the German vehicles until they were either destroyed or they retreated back through the MLR. Two Sherman tanks and an M–10 TD were knocked out in this action. Further north, some German armor also closed with the elements of the 3d Bn in the Schwarzenbüchel. I Co took out some tanks with their bazookas, tanks, and tank destroyers, while 155mm salvos knocked out others. Heavy machine gun fire from L Co kept the panzergrenadiers from advancing into the Schwarzenbüchel.

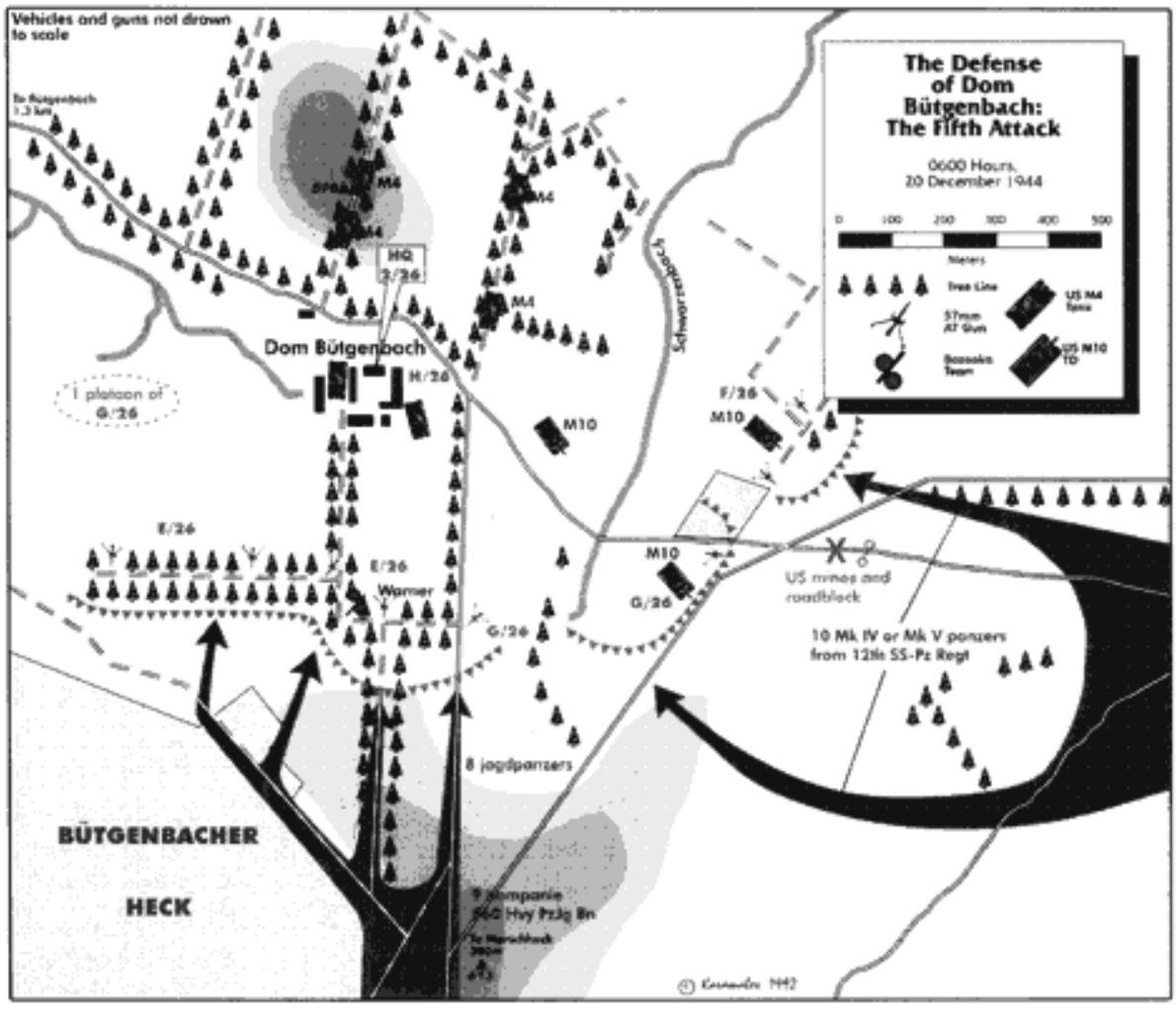
The German attack petered out by 0530. Their artillery fire continued hitting the American lines even as the panzergrenadiers and jagdpanzers pulled back into Büllingen. It had been a near run thing to say the least. By the end of the attack, only 17 rounds of bazooka ammunition were left in all of 2d Bn, and the surviving bazooka teams were reduced to scrounging odd rocket rounds from the crews of the AT Co's 57mm AT guns. The German artillery had cut with communications with Regiment early in the morning, and the 2d Bn had also lost radio contact during the fighting. The MLR was a shambles, desperately in need of repair, and LtCol Daniel was urgently calling for more mines to help block the German advance routes. He only had the two platoons from C Co as a battalion reserve. Another attack might cause the whole US defense around Dom Bütgenbach to collapse.

The **12th SS–PzD** had suffered another bloody nose as well. At least 12 jagdpanzers had been destroyed or damaged in the morning's attack, and the panzergrenadier battalions had suffered heavy casualties. As the remnants of the attacking force withdrew into Büllingen, SS–Col Kraas immediately regrouped them for a second assault, hoping the Americans would crack before his own men did. This time, the attack from Büllingen would be supported by a simultaneous attack from Morschheck.

The Fifth Attack: The Heroism of Corporal Warner

SS–Colonel Kraas launched his second attack within 30 minutes, sending a force of ten tanks westward out of Büllingen and eight jagdpanzers south from Morschheck. This time, the two remaining tank destroyers and three AT guns of F Co were ready to meet them, and as the German tanks crested the small ridge in single file about 300 yards in front of F Co, the concentrated fire from the American pieces knocked out all ten, one by one. Again, the American artillerty and small arms fire pinned down the supporting grenadiers, and the attack on the 2/26th's left flank accomplished nothing.

At the same time, the jagdpanzers of **9th Kompanie, 560th Hvy PzJg Bn**, rolled down the hill out of Morschheck, fanning out a bit to cover more of the American line. The G Co platoon that LtCol Daniel had committed earlier was now



practically annihilated by German tank fire, but the heavy American defensive artillery fire kept the German infantry from overrunning the survivors and deflected the advance of the jagdpanzers. As the armor approached the MLR, a shell from somewhere struck the **9th Kompanie** commander's Mk V Jagdpanther, setting it on fire. He managed to turn the vehicle around and drive it back into Morschheck, where he commandeered the **11th Kompanie's** command vehicle and returned to the battle. While he was gone, his panzer force was further reduced by the American defenses. Artillery fire destroyed or immobilized three of the jagdpanzers before they even reached the US lines. The commander of one of the 57mm AT gun crews, Sgt Stanley Oldenski, saw some of the panzers trying to break through the MLR to his right (west), and sent out some members of his gun crew armed with a bazooka to try to secure that flank.[7] He could also see gun flashes from two more of the German tank destroyers about 75 yards to his left. While Oldenski acted as loader, his gunner, Cpl Henry "Red" Warner, began firing DS shells at the Germans. He put four rounds into the first jagdpanzer, destroying it. Then he hit another with one round, stopping it, but he fired three more rounds into the hulk to make sure it was dead (this firing of "insurance" rounds was standard procedure among American AT and TD gun crews). On Warner's final shot, however, the AT gun's breech block jammed and the gun would not return to battery. As Warner struggled to fix the weapon, a third jagdpanzer appeared out of the mist, approaching straight toward his gun and firing its bow machine gun. The rest of the crew dove into nearby foxholes for cover, but Warner continued wrestling with the jammed gun. Unable or unwilling to fire his main gun at the American weapon, the German tank commander apparently decided to just run over it. He stood up and poked his head out of the hatch to direct the vehicle's movement. When the panzer was about 10 yards away from the gun, Warner gave up trying to fix it, pulled his .45 caliber pistol and fired at the tank commander, then dove into the slit trench between the gun trails. Warner heard the tank race its engine and speed toward him, and he fully expected to be crushed by it. When it was scant feet from the AT gun, however, the jagdpanzer stopped, went into reverse, and backed away at full speed. Warner, incredulous, peeked out from his trench and saw the German tank commander slumped half out of the hatch, apparently killed by one of his pistol shots.

Soon the Germans were again in retreat and, thanks to the combined fire of four American artillery battalions, no German infantry had been able to penetrate the MLR. By 0800 the attack was over, and although the Germans would launch smaller infantry attacks every four or five hours until nightfall, these were easily repulsed. For the rest of the day the surviving front–line troops continued to improve their defensive positions and lay protective minefields. LtCol Daniel also strengthened E Co's line by attaching to it one of the C Co rifle platoons.

[7]These men later claimed to have knocked out one German panzer with their bazooka, but their claim was never verified.

Around 1300 on the 20th, Regiment pulled the 3d AT Platoon of the Regimental AT Co out of the line on 3d Bn's sector in the Schwarzenbüchel and sent its four 57mm AT guns to replace the gun losses suffered by 2d Bn in the morning's attacks. This made a total of eight AT guns in the battalion's MLR. The 3d Plt dug in its guns in the soft earth behind the hedgerow of poplar trees running east–to–west in the E Co sector. They fully expected another German tank attack, knowing how important the Büllingen–Bütgenbach highway behind them was to the German commanders; they also knew that their gunshields (3/4–inch thick steel) would stop bullets but were useless against the main gun rounds those tanks would be firing.

In Büllingen and Morschheck, the Germans were counting their losses. When the unit reassembled later in the day, the **560th Hvy PzJg Bn** found that it had only three battleworthy Jagdpanthers and 10 Jagdpanzer IV/48s left. These were consolidated into a single company for the next attack, scheduled for 21 December, and the vehicles were sent to Büllingen for repairs, refueling, and replenishment of ammunition. Once there, however, the American shelling of the town was so heavy that the vehicles were forced to pull back another two kilometers to the hamlet of Tiefenbach to complete their replenishment.

The Last Attack: High Water Mark

Time was running out for the **12th SS–PzD**. American forces had closed in behind **KG Peiper** thirty kilometers to the west, and Peiper's armored battlegroup was surrounded and being cut to pieces by American counterattacks. A US armored division was still clinging to St. Vith in the south. After almost a week of heavy fighting, none of the roads assigned to carry **"Hitlerjugend"** to the Meuse had been opened. Worse yet, the Americans grew stronger daily as they mobilized more reserves, while each day more broken panzers littered the hillsides around Dom Bütgenbach.

Accordingly, SS–Col Kraas prepared for an all–out attack with all three of his grenadier battalions, to be supported by every operational tank and tank destroyer in his division. He planned to attack with two battalions abreast out of the Bütgenbacher Heck, the **III/25 SS** on the left supported by the remaining panzers and jagdpanzers of the **12th SS–PzRegt**, and the **II/26 SS** on the right, reinforced by the jagdpanzers of the **12th SS–PzJg Bn**. The armored infantry of the **III/26 SS** would be kept in reserve in the forest, to be used to exploit any breakthrough by attacking in conjunction with the **12th SS–PzRegt** to seize Bütgenbach. The axis of the attack was to carry the Germans south and then west of Dom Bütgenbach, bypassing the stubborn American defenders there and cutting them off by capturing Bütgenbach behind them. Once that town was occupied, blocking forces would push across the railway embankment north of town to stop any American counterattack from the north. Supporting the attack were all four battalions of the division's organic artillery: **I Bn** (105mm) at Büllingen, **II Bn** (105mm) and **IV Bn** (nebelwerfer) in Hünningen, and **III Bn** (150mm) south of Honsfeld. The starting time for the attack was 0340 hours

on 21 December.

The **II/26th SS–PzGren Regt** set out from Hünningen to its assembly area in the Riechels–Busch at 2300 hours on 20 December. A light but steady artillery barrage on the American positions around the Domäne masked the sounds of its movement. Most of the other units scheduled to attack reached their assembly areas by 0300, when the four artillery battalions began a massive bombardment of the American positions, using all the guns, mortars, and rocket launchers at their disposal. This barrage was by far the worst the defenders at Dom Bütgenbach had experienced in the whole war, and its effects were telling. The front line troops suffered one–third to one–half casualties (many of whom were still lying untended in their foxholes when the German ground attack began), and many of their weapons were destroyed by direct hits. All wire communications between units were cut, and even some of the radios, which so far had been used more or less successfully for backup communications, were damaged by the concussions. The shelling disabled the two M–4s north and northwest of the manor house, part of the battalion's mobile reserve, as well as the M–10 tank destroyer near the east barn of the manor. Both the east and west barns were also set on fire; the west barn soon burned down to its stone foundation, forcing the H Co CP there to move into the barn with the E Co CP. The nebelwerfer salvos were particulatly devastating: 96 rockets landing in one earth–wrenching blast. Before long, all that was left of the American MLR were isolated groups of infantry and AT guns separated by wide undefended gaps.

In the manor house, LtCol Daniel could do nothing while his battalion was being shredded. As yet, no German infantry or tanks had appeared, so he had no targets for his artillery. Instead, in addition to pressing for more counterbattery fire in hopes of lessening the German barrage, he called down concentrations on likely German assembly areas in Büllingen and in the Bütgenbacher Heck. He recalled later that between four and twelve battalions of artillery fired in support of his battalion that day; actually there were at least 10 battalions involved, including battalions from the 2d and 99th Divisions that were tied into the 1st Division's fire control center. Patrols later found about 200 dead Germans in the woods in front of E Co, silent testimony to the disruption this must have caused the German attack.

The American artillery was not the only problem the German attack faced that morning. By 0330, ten minutes before the scheduled attack time, all the attacking units were in their designated assembly areas except the **II/26 SS**, which had set out from Hünningen four and a half hours earlier. The battalion staff tried urgently to establish radio contact with any of the companies, and when that failed the battalion adjutant and ADC set out in a Kübelwagen to find them. Meanwhile SS–Col Kraas, in his division CP in Morschheck, ordered the attack delayed until 0430 so the missing battalion could be found. The artillery barrage against the Americans slackened but did not stop completely.

The "Hitlerjugend" Division had still not located its missing battalion by 0430. Now SS–Col Kraas was worried that the attack might not get started until dawn, at which point his troops would have to undergo flanking fire from the American positions at the Domäne while trying to bypass

rage, an eerie silence descended over the battlefield. The American AT gun crews, who had been huddling in their trenches for three hours listening to shell fragments clang off their gunshields, crawled shakily out of their holes, relieved to find their guns still intact. At the far western end of the American line, S/Sgt Noah Collier, commander of one of the 57s from 3d Plt, AT Co, told his crew, "Load Sabot. Hold your fire until you can get a flank shot at about twenty feet." Soon, the men heard the squeaking of tank treads and shouts in German.

After leaving Morschheck, the panzers and half–tracks of **"Hitlerjugend"** had no room to spread out and deploy in proper attack formation until they had passed the northeastern corner of the Bütgenbacher Heck, so for a brief interval they had to travel in a direction almost parallel to the American front line. At first they received no fire of any kind from the tree–lined hedgerows where they knew the American positions to be, and they suspected that after the previous day's attack, the Americans had little or no antitank defense left. To relieve the oppressive silence and possibly to suppress any Americans still left, the tank crews fired a few machine gun bursts into the treeline 150 meters to their right. This terrain feature was at the limit of their vision in the fog and darkness, and the Americans were, indeed, waiting there for the Germans. The lead Panther of the attack column, commanded by SS–1Lt Schnittenhelm, had just reached the protruding square patch of the Bütgenbacher Heck when one of the US 57mm AT guns fired, striking the Panther in the right flank and detonating its ammunition. The tank was flung into the air by the force of the explosion and a huge mushroom cloud of oily black smoke enveloped the tank. Two of the crew clambered out of the wreck, but SS–1Lt Schnittenhelm was not one of them. Captain Hils of the **560th Hvy PzJg Bn**, following behind in his Jagdpanther, was now in command, and over his vehicle's radio he ordered the force to turn toward the US line and prepare to attack. He examined his map once again to orient himself, then fired a flare toward the manor house to indicate the final attack direction. The men in the other panzers and jagdpanzers awaited the signal to advance, "Marsch! Marsch!" but when no such signal was given after a few moments they turned back to see Hils' Jagdpanther on fire, his crew abandoning the vehicle. Hils himself was nowhere to be seen. Unnerved by the loss of two commanders in such a short space of time, the Germans hesitantly advanced. As soon as the panzers and half–tracks full of infantry came in full view of the MLR, a terrific American defensive artillery barrage began plunging into the formation, plowing up the hillside and devastating the exposed foot infantry.

Despite the American bombardment, the young SS grenadiers in their camouflage smocks charged the American line, yelling and firing their weapons. Behind the treeline, Sgt Collier picked up a BAR left near his gun by two wounded infantrymen and began spraying the onrushing Germans. Another member of his gun crew, PFC Donald Rose, also fired his M–1 carbine into the attackers. As they rushed from the woods, the Germans were in a line almost perpendicular to the American MLR, so Rose and Collier were in an excellent position to fire into the attackers' flank. So intent were they on holding back the grenadiers that they almost failed to notice the Jagdpanther which loomed out of the fog to the left of their AT gun. Rose quickly dropped his carbine to assist the gunner, Cpl Irwin Schwartz, in taking on the behemoth. Schwartz fired the already–loaded Sabot round, which struck the Jagdpanther's front left drive sprocket. This caused the left track to jam and the vehicle's forward motion made it slue around sideways. Rose loaded another Sabot round and Schwartz fired into the Jagdpanther's now exposed right flank. A tongue of yellow flame shot out of the vehicle and, burning furiously, it ground to a halt. Despite Collier's withering fire, the nearby grenadiers were now so close that Rose and Schwartz picked up their carbines and added their fire to his. After a few minutes they saw a Mk IV panzer driving along the woodline to their front. They reloaded and fired the 57 three times in rapid succession, amd the stricken panzer stopped with smoke pouring from it.

Once again taking up their carbines, Rose and Schwartz moved about 10 feet down the line to support Sgt Collier and his BAR. As they did so, on of the grenadiers fired a panzerfaust whose rocket struck their gun and knocked it off its pintle. With no gun to man, they remained on the MLR for over an hour, firing and throwing hand grenades, until they ran out of rifle ammunition. During that time, Sgt Collier dashed out in front of the MLR to help a wounded GI even though he himself was wounded in the leg. He disappeared into the fog and was never seen again.

About 150 meters to the east, another 3d AT Platoon gun crew was also being hard pressed. As the German tanks rolled down the hill from the forest, the gun squad leader, Sgt Kolar, rousted his men from their foxholes and readied their gun for action. Two panzers appeared together out of the fog, heading straight for their gun. Kolar fired at the nearest of the two. His shell hit and penetrated, and the crew reloaded and fired again to make sure of killing the tank. Just as this second shot struck the panzer a burst of machine gun fire from the other tank hit the AT gun as it was returning to battery and disabled it. His crew now bereft of their gun, Kolar snatched up a bazooka and, with one of his crewmen, crawled out into the fog to hunt down the other panzer. Both men were wounded and captured by the Germans.

The third gun of 3d Platoon, AT Co, was another 200 meters or so east of Kolar's gun, at the intersection of the long east–west hedgerow and a north–south trail leading directly to the Domäne. This gun, commanded by Joseph Harris, pointed southwest rather than south in order to cover the whole western part of E Co's line and enable it to flank fire at any tanks advancing from the Bütgenbacher Heck. Harris, a corporal, was one of only three men remaining out of the gun's original 10–man crew, the others having been killed or wounded by the terrible German artillery barrage that morning. No sooner did the shelling stop than Harris, climbing out of his foxhole, dimly saw a tank through the fog to his right, about halfway between his gun and Kolar's. While he and his crew were loading their AT gun, the tank fired,

lobbing a huge HE shell down the hill toward the manor house. As the gun's muzzle blast briefly parted the haze, the vehicle was revealed to be not a tank at all, but a self–propelled 150mm infantry howitzer on an old Mk II panzer chassis, known as the Sd Kfz 121, or sIG 33.[8] This vehicle's armor was very thin, only 20mm thick at best, but Harris couldn't know that; he understandably considered any German tracked vehicle with a big gun to be a "tank." He fired the AT gun four times, enough to set the sIG on fire.[9] While so engaged, however, Harris and his crew failed to notice a Mk IV tank slowly moving up on their left. The panzer fired an AP round which detonated against the gunshield and rent open the AT gun's barrel just above the breech block. The force of the impact also blew the gun off its pintle. Stunned by the explosion, Harris and his men were overwhelmed and captured by the storming SS grenadiers a few minutes later.

This incident did not go unnoticed by Cpl Red Warner, the West Virginian who had knocked out two panzers and driven a third off with his pistol the previous day. Warner's gun was guarding the north–south trail paralleling the main Morschheck–Dom Bütgenbach road, about 50 meters east of Harris' gun. Since his assistant gunner (and apparently also Sgt Oldenski, the gun squad leader) had already been incapacitated, Warner loaded the AT gun himself and fired at the panzer that destroyed Harris' gun. His shell struck the Mk IV just in front of its right rear idler wheel and smoke began to pour from the rear of the tank. The panzer was immobilized, but it was still deadly: as Warner reached for another shell, the tank swept its turret around and fired a burst from its coaxial machine gun just as Warner was slamming his second shell into the breech. He was hit and died moments later, still trying to close the gun's breech. For his heroism in the defense of Dom Bütgenbach, Warner was posthumously awarded the Medal of Honor.

Having destroyed or neutralized all the AT guns west of the Morschheck road, the surviving German panzers proceeded to drive up and down the MLR, crushing automatic weapons emplacements and crews alike and machine gunning the helpless US soldiers. At one point a panzer drover through a gap in the 500–yard–long hedgerow. The tank commander climbed out of his turret hatch and dropped to the ground, forcing an American soldier into the tank at gunpoint. Some of the GIs still manning their foxholes in the eastern portion of E Co's line heard pistol shots, and they assumed that the SS were methodically shooting the American wounded and prisoners (rumors of the Malmédy massacre and other SS atrocities at Krinkelt–Rocherath and Honsfeld had already filtered down to the men at Dom Bütgenbach).

As soon as they crossed to the north side of the treeline, the attacking panzers were taken under fire by the M–4 Sherman tank stationed at the southeast corner of the barnyard and by the two M–4s on the slope of Hill 598 north of the manor house. Around 0800, eight Mk IV panzers of **5th Kompanie, 1/12th SS–PzRegt**, made a dash for the manor house. One was quickly destroyed and another damaged by the two Shermans around the CP. Those Shermans in turn were destroyed by the panzers' return fire. Three of the German tanks veered northeast and wound up in 3d Bn's sector, where the Americans eventually destroyed them with AT guns and bazooka teams. The remaining three panzers moved onto the grounds of the estate, hiding behind the barns to escape further fire from the Shermans on Hill 598. Running right behind them were five or six SS–panzergrenadiers, the only German infantry to make it through the American MLR throughout the entire siege. The Germans sought cover in an old hospital tent that had been set up to one side of the manor house but that had been abandoned a few days before when the fighting started. Four senior NCOs, staff officers and radiomen from the American CP formed a small strike force and ventured outside the manor house, eliminating the grenadiers after a brief firefight.

Inside the house, LtCol Daniel monitored the course of the battle with growing concern. He kept up a steady stream of calls into the regimental CP for more artillery fire, and the resulting unbroken ring of exploding steel was all that prevented the panzergrenadiers from passing unmolested through the former American positions on the hill. The 300 yard gap between the edge of the Bütgenbacher Heck and the Morschheck road was wide open, and German tanks were roaming freely over the area. Daniel knew that if the German infantry were allowed the exploit this gap, all of the 2d and 3d Battalions would be cut off and destroyed. He was determined not to let that happen.

The three Mk IVs near the manor house had maneuvered so that they were still covered by the south barn, but they could fire their 75mm guns directly into the manor house from only 75 yards away. This they did, trying to penetrate the building and force the command staff there to surrender, but the four–foot–thick stone walls of the old house withstood even this direct pounding. Nevertheless, as a precaution, LtCol Daniel ordered all papers in the CP to be burned.

The two platoons of C Co that had been retained as a reserve were still available, stationed around the crossroads just east of the manor house, but Daniel couldn't move them to reinforce the E Co positions because of the tanks roaming around the CP area. By the same token, however, the Mk IVs were cut off from their infantry support and were vulnerable to bazooka teams, and they couldn't withdraw to their own lines (as they had by now been ordered to do by radio) without exposing themselves to fire from the Sherman tanks on Hill 598.

In the 2d Battalion's eastern sector, F Co (having also been badly hit by the morning's bombardment) was holding off periodic attacks from Büllingen and suffering consid-

[8]According to RH 10/321, the *gliederung* of the **12th SS–PzD**, there were six of these vehicles attached to the **III/26th SS–PzGren Regt** on 15 December, but by the time of this attack on 21 December, only four were left.

[9]The AT Company commander, Captain Rivette, examined these hits two days later and found all four to be within a two–foot circle.

erable casualties. To their left, K Co of 3d Bn around the Schwarzenbüchel was attacked by 10 panzers and a battalion or so of infantry, possibly the **I/26 SS**. One of K Co's bazooka teams got one of the panzers, and the AT guns on the battalion's left flank knocked out four more, but this did not deter the advance of the grenadiers. At one point they advanced so far that Germans and Americans were fighting hand–to–hand in the trenches and the K Co commander, Capt Botts, called down final protective fire on his own foxhole. Capt Botts survived the resulting artillery fire, which prevented the SS from breaking through the line. Although their attacks continued throughout the day, the Germans achieved no penetration of the MLR.

Around 0900, the commanding officer of the AT Co, Capt Donald Rivette, left his company CP in Bütgenbach to check on his gun squads around the Domäne. As he left Bütgenbach, accompanied by his jeep driver and his Reconnaissance Sergeant, he could see three or four tanks burning on top of Hill 613 to their right front. They did not see any American infantry anywhere along the road all the way to the Domäne, nor could they see any where they knew the MLR to be, behind the hedgerow about halfway up Hill 613. Rivette, not knowing that portion of the line had been overrun, concluded that the infantry must be deep down in their foxholes. As they rounded a bend in the road the stone manor house came into view, and Rivette warned his driver to slow down while making the sharp turn into the estate's driveway. Fortuitously, however, the driver's foot hit the gas pedal instead of the brake and the jeep lurched forward just as one of the Mk IV tanks behind the south barn let loose a long machine gun burst at the vehicle. Rivette was slightly wounded in the back, and the sergeant suffered a minor cheek wound. The driver quickly wheeled the jeep to the back of the CP building and the three men dashed inside. There Rivette was informed of the grave crisis facing the 2/26th, and his 2d Platoon leader told him that several of the AT gun crews had been wiped out. The CP staff knew that the number of dead, wounded, and missing was staggeringly high, but they hadn't yet been able to compile a complete count.

The situation around Dom Bütgenbach remained relatvely static for the next few hours. The 2d and 3d Battalions' defenses east of the Morschheck road held against periodic attacks, while the German infantry was kept from exploiting the breakthrough the panzers had made in the west only by the massed fire of the American artillery battalions. Occasionally one of the panzers hiding behind the south barn at the estate would move out just far enough to fire an HE round at the CP, while inside the battalion staff prayed that the thick stone walls would hold just a little longer. The panzers also fired a few times at the E and H Co command posts in the east barn, scoring three direct hits. Every time the panzers exposed themselves this way to take a shot, the Shermans on the hill began firing furiously to try and knock them out, but the panzers were showing themselves too little and too briefly for the M–4s to get a good shot.

About 1000 a renewed infantry–tank attack struck at the remnants of the G Co platoon positioned between E and F Cos, southeast of the Domäne. As the German tanks silhouetted themselves coming over the ridgeline, however, one of the M–10 tank destroyers from A Co, 634th TD Bn, knocked out seven of them in rapid succession. The other M–10 guarding the road from Büllingen destroyed one panzer at 500 yards, while the 57mm guns of the AT platoon were credited with at least one kill, knocking out a Mk IV tank at 50 yards. Again, the combination of small arms and massive artillery fire stopped the German infantry cold, but not before they had put intense pressure on the front line troops.

At 1030 LtCol Daniel urgently requested that Regiment send another rifle company to reinforce his position, and specified that they should be equipped with extra bazookas to handle the large number of German tanks engaged against him. Regiment responded quickly, and within an hour E Co of the 18th Inf Regt was on its way to shore up the 2/26th's positions. By 1200, with no sizable penetration of the American lines after six hours of heavy combat, the Germans all across the 2d Bn's front began to pull back. Fighting was still heavy for a while, and the three Mk IVs at the manor house severely curtailed the Americans' freedom of movement in that area, but the pressure on the MLR was noticeably reduced. LtCol Daniel ensured that the curtain of artillery fire south of the manor house was maintained until he could move infantry there to reoccupy the foxhole line and evacuate his wounded. At 1250 he further requested a platoon of self–propelled tank destroyers from Regiment so that he could eliminate the panzers on the manor house grounds and restore his infantry's freedom of movement. Co E of the 18th Infantry Regiment arrived shortly afterwards, but since the panzers still threatened any movement in the area, Daniel ordered them to wait behind Hill 598.

In response to Daniel's request for tank destroyers, at 1305 a platoon of four M–36 TDs from the 613th TD Bn moved to positions just west of the Domäne, covering their advance from Bütgenbach with smoke grenades. Daniel ordered them to position themselves to fire through the south barn at the panzers. The TD platoon leader placed two of his vehicles at the east end of the manor house, from where they could fire at the east end of the barn, and two by a small roadside building to the west, with a line of sight to the west side of the south barn. They began firing their 90mm guns through the flimsy wooden upper walls of the barn, and with each salvo they worked their shots about 10 feet closer toward the center of the barn. This pattern of converging shells so unnerved two of the panzer commanders that they turned their tanks southward and raced for the safety of their own lines. The M–36s picked them both off when they were halfway up the hill. The third tank, however, held its ground. Daniel called down a barrage of mortar fire on the south barn to flush it out, but to no avail. He considered using 155mm artillery, since this was the only shell big enough to actually damage the tank, but its proximity to the manor house convinced him otherwise. Finally, at about 1600 hours and under cover of thickening fog and descending darkness, the last panzer took a parting shot at the CP then turned and fled up the hill toward Morschheck. Ironically, its last shot fi-

nally penetrated the manor house wall and wounded nine men inside.

For all intents and purposes, the last German attack on the Domäne Bütgenbach was over. The **12th–SS Panzer Division** tried one last time, on 22 December, to seize Bütgenbach, but that defense against that attack primarily involved the 1st Bn of the 26th Inf Regt farther to the west. The defense that "stuck out like a sore thumb" at the manor house had held.

Aftermath

As the grenadiers and panzers withdrew into Morschheck and Büllingen on the afternoon of 21 December, the weary US 2/26th began rebuilding its defenses and preparing for the next German attack. Engineers layed a belt of 2400 mines in front of the MLR, built two strong roadblocks to block the approaches from north and south, and erected three rows of concertina wire across the battalion's entire front.

These defenses, however, were not to be tested. After the unsuccessful attack on 22 December west of the Domäne, the Germans despaired of ever opening Rollbahn C and reaching Liege. The battered **12th SS–PzD** was withdrawn from the Bütgenbach area and sent south and west, where it was subsequently committed in the battle for Bastogne. Volksgrenadier units that were too weak to attack were sent in its stead to defend Büllingen and Morschheck against any American counterattacks. As Hugh Cole, author of the Army's official history of the Battle of the Bulge, put it, the defenders of Dom Bütgenbach "had knocked part of Hitler's personal plan into a cocked hat."

In four days of fighting, the **12th SS–Panzer Division "Hitlerjugend"** had suffered over 1,200 casualties, more than 782 of which were killed, including losses incurred at Krinkelt–Rocherath. In its first week of commitment in the Ardennes counteroffensive, the division lost a total of 47 panzers, jagdpanzers, and self–propelled guns, 15 armored half–tracks, one armored car, one Kübelwagen (jeep), two rocket launcher batteries (due solely to American counter-battery artillery fire), and an unknown but large number of trucks. US patrols sent out to the Bütgenbacher Heck on 23 December reported German dead "as common as grass" on the hillside above E Co's MLR, and found over 300 dead along the edge of the forest. The commander of M (heavy weapons) Co, 3d Bn, told Capt Rivette of the AT Co that the bodies of dead panzergrenadiers were piled so high in front of 3d Bn's positions that special patrols had to be sent out to clear them from the "final protective line."

The American casualties were proportionally no less severe. The 26th Infantry Regiment lost six bazookas, five 57mm AT guns, six BARs, two .30cal machine guns, three M–10 self–propelled tank destroyers, and three M–4 Sherman tanks defending Dom Bütgenbach. Worse, the regiment suffered 13 officers and 487 men killed, wounded, or captured. Since 1st Division as a whole lost 15 officers and 948 men between 16 and 24 December, that meant that 51% of the division's enlisted losses and a whopping 87% of the officer casulties came from the 26th Regiment alone. After the German attack subsided on the afternoon of 21 December, 2/26th had elements of six companies holding the line—its own E, F, and G Cos supported by heavy weapons from H Co, plus C Co from 1st Bn and parts of E Co of the 18th regiment. A headcount taken that night in the foxholes of the men available for duty revealed that E and F Cos had 75 men apiece, G Co had 55, and H Co had 80. C Co from 1st Bn had 75 men also, while even the "fresh" E/18 could muster only 125.

Credit for the defense must be shared with the various supporting battalions of American artillery. These units were no less instrumental than the infantry in stopping the German attacks. On 18 December, the battalions supporting the 1st Infantry fired a total of 26 missions; on 19 December, 102 missions; on the 20th, 169; on the 21st, 291; and on 22 December, they fired an incredible 334 missions, More often than not they fired until they were out of ammunition or until the guns were to hot to handle. In one eight–hour period on the 21st, when continuous artillery explosions were all that kept the German infantry from overrunning LtCol Daniel's CP, 10,000 rounds were fired to support his position. The 2/26th's mortar sections at Dom Bütgenbach fired 750 rounds that same day. The 955th FA Bn fired 555 rounds in a single interdiction and harassment mission and a total of 2,054 rounds for the day, the battalion's largest one–day ammunition expenditure of the war.

Despite the losses of men and material that the 2/26th endured, the price paid must be compared to the cost of a German breakthrough at Dom Bütgenbach. Given an open highway to Malmédy, the **I SS–PzK** could have attacked against the flanks of the 2d and 99th Divisions and possibly overrun the Elsenborn Ridge. Such a move would have nullified the courageous stand of the 2d and 99th Divisions in and around Krinkelt–Rocherath. While the Germans almost certainly would not have been able to retake Antwerp or force the Western Allies to sue for a separate peace, as Hitler had hoped, they might very well have reached the Meuse and established strong blocking positions. The American stand at Dom Bütgenbach helped channel the German advance westward, an operationally pointless direction for the advance, and allowed a strong northern shoulder to be maintained from which counterattacks would be launched once the Allies regained the initiative.

CEV Calculations in Italy, 1943

by Niklas Zetterling

Perhaps one of the most debated results of the TNDM (and its predecessors) is the conclusion that the German ground forces on average enjoyed a measurable qualitative superiority over its US and British opponents. This was largely the result of calculations on situations in Italy in 1943–44, even though further engagements have been added since the results were first presented. The calculated German superiority over the Red Army, despite the much smaller number of engagements, has not aroused as much opposition. Similarly, the calculated Israeli effectiveness superiority over its enemies seems to have surprised few.

However, there are objections to the calculations on the engagements in Italy 1943. These concern primarily the database, but there are also some questions to be raised against the way some of the calculations have been made, which may possibly have consequences for the TNDM.

Here it is suggested that the German CEV superiority was higher than originally calculated. There are a number of flaws in the original calculations, each of which will be discussed separately below. With the exception of one issue, all of them, if corrected, tend to give a higher German CEV.

The Database on Italy 1943–44

According to the database the German divisions had considerable fire support from GHQ artillery units. This is the only possible conclusion from the fact that several pieces of the types 15cm gun, 17cm gun, 21cm gun, and 15cm and 21cm nebelwerfer are included in the data for individual engagements. These types of guns were almost exclusively confined to GHQ units. An example from the database are the three engagements Port of Salerno, Amphitheater, and Sele–Calore Corridor. These take place simultaneously (9–11 September 1943) with the German 16th Pz Div on the Axis side in all of them (no other division is included in the battles). Judging from the manpower figures, it seems to have been assumed that the division participated with one quarter of its strength in each of the two former battles and half its strength in the latter. According to the database, the number of guns were:

15cm gun	28
17cm gun	12
21cm gun	12
15cm NbW	27
21cm NbW	21

This would indicate that the 16th Pz Div was supported by the equivalent of more than five non–divisional artillery battalions. For the German army this is a suspiciously high number; usually there were rather something like one GHQ artillery battalion for each division, or even less. Research in the German Military Archives confirmed that the number of GHQ artillery units was far less than indicated in the HERO database. Among the useful documents found were a map showing the dispositions of 10th Army artillery units. This showed clearly that there was only one non–divisional artillery unit south of Rome at the time of the Salerno landings, the III/71 Nebelwerfer Battalion. Also the 557th Artillery Battalion (17cm gun) was present, it was included in the artillery regiment (33rd Artillery Regiment) of 15th Panzergrenadier Division during the second half of 1943. Thus the number of German artillery pieces in these engagements is exaggerated to an extent that cannot be considered insignificant. Since OLI values for artillery usually constitute a significant share of the total OLI of a force in the TNDM, errors in artillery strength cannot be dismissed easily.

While the example above is but one, further archival research has shown that the same kind of error occurs in all the engagements in September and October 1943. It has not been possible to check the engagements later during 1943, but a pattern can be recognized. The ratio between the numbers of various types of GHQ artillery pieces does not change much from battle to battle. It seems that when the database was developed, the researchers worked with the assumption that the German corps and army organizations had organic artillery, and this assumption may have been used as a "rule of thumb." This is wrong, however; only artillery staffs, command and control units were included in the corps and army organizations, not firing units. Consequently we have a systematic error, which cannot be corrected without changing the contents of the database. It is worth emphasizing that we are discussing an exaggeration of German artillery strength of about 100%, which certainly is significant. Comparing the available archival records with the database also reveals errors in numbers of tanks and antitank guns, but these are much smaller than the errors in artillery strength. Again these errors do always inflate the German strength in those engagements I have been able to check against archival records.

These errors tend to inflate German numerical strength, which of course affects CEV calculations. But there are further objections to the CEV calculations.

The Result Formula

The "result formula" weighs together three factors: casualties inflicted, distance advanced, and mission accomplishment. It seems that the first two do not raise many objections, even though the relative weight of them may always be subject to argumentation.

The third factor, mission accomplishment, is more dubious however. At first glance it may seem to be natural to include such a factor. After all, a combat unit is supposed to accomplish the missions given to it. However, whether a unit accomplishes its mission or not depends both on its own qualities as well as the realism of the mission assigned. Thus the mission accomplishment factor may reflect the qualities of

the combat unit as well as the higher HQs and the general strategic situation. As an example, the Rapido crossing by the US 36th Infantry Division can serve. The division did not accomplish its mission, but whether the mission was realistic, given the circumstances, is dubious. Similarly many German units did probably, in many situations, receive unrealistix missions, particularly during the last two years of the war (when most of the engagements in the database were fought). A more extreme example of situations in which unrealistic missions were given is the battle in Belorussia, June–July 1944, where German units were regularly given impossible missions. Possibly it is a general trend that the side which is fighting at a strategic disadvantage is more prone to give its combat units unrealistic missions.

On the other hand it is quite clear that the mission assigned may well affect both the casualty rates and advance rates. If, for example, the defender has a withdrawal mission, advance may become higher than if the mission was to defend resolutely. This must however not necessarily be handled by including a missions factor in a result formula.

I have made some tentative runs with the TNDM, testing with various CEV values to see which value produced an outcome in terms of casualties and ground gained as near as possible to the historical result. The results of these runs are very preliminary, but the tendency is that higher German CEVs produce more historical outcomes, particularly concerning combat.

Supply Situation

According to scattered information available in published literature, the US artillery fired more shells per day per gun than did German artillery. In Normandy, US 155mm M1 howitzers fired 28.4 rounds per day during July, while August showed slightly lower consumption, 18 rounds per day. For the 105mm M2 howitzer the corresponding figures were 40.8 and 27.4. This can be compared to a German OKH study which, based on the experiences in Russia 1941–43, suggested that consumption of 105mm howitzer ammunition was about 13–22 rounds per gun per day, depending on the strength of the opposition encountered. For the 150mm howitzer the figures were 12–15.

While these figures should not be taken too seriously, as they are not from primary sources and they do also reflect the conditions in different theaters, they do at least indicate that it cannot be taken for granted that ammunition expenditure is proportional to the number of gun barrels. In fact there also exist further indications that Allied ammunition expenditure was greater than the German. Several German reports from Normandy indicate that they were astonished by the Allied ammunition expenditure.

It is unlikely that an increase in artillery ammunition expenditure will result in a proportional increase combat power. Rather it is more likely that there is some kind of diminished return with increased expenditure.

General Problems with Non–Divisional Units

A division usually (but not necessarily) includes various support services, such as maintenance, supply, and medical services. Non–divisional combat units have to a greater extent to rely on corps and army for such support. This makes it complicated to include such units, since when entering, for example, the manpower strength and truck strength in the TNDM, it is difficult to assess their contribution to the overall numbers.

Furthermore, the amount of such forces is not equal on the German and Allied sides. In general the Allied divisional slice was far greater than the German. In Normandy the US forces on 25 July 1944 had 812,000 men on the Continent, while the number of divisions was 18 (including the 5th Armored, which was in the process of landing on the 25th). This gives a divisional slice of 45,000 men. By comparison the German 7th Army mustered 16 divisions and 231,000 men on 1 June 1944, giving a slice of 14,437 men per division. The main explanation for the difference is the non–divisional combat units and the logisitical organization to support them. In general, non–divisional combat units are composed of powerful, but supply–consuming, types like armor, artillery, antitank and antiaircraft. Thus their contribution to combat power and strain on the logistical apparatus is considerable. However I do not believe that the supporting units' manpower and vehicles have been included in TNDM calculations.

There are however further problems with non–divisional units. While the whereabouts of tank and tank destroyer units can usually be established with sufficient certainty, artillery can be much harder to pin down to a specific division engagement. This is of course a greater problem when the geographical extent of a battle is small.

Tooth–to–Tail Ratio

Above was discussed the lack of support units in non–divisional combat units. One effect of this is to create a force with more OLI per man. This is the result of the unit's "tail" belonging to some other part of the military organization.

In the TNDM there is a mobility formula, which tends to favor units with many weapons and vehicles compared to the number of men. This became apparent when I was performing a great number of TNDM runs on engagements between Swedish brigades and Soviet regiments. The Soviet regiments usually contained rather few men, but still had many AFVs, artillery tubes, AT weapons, etc. The Mobility Formula in TNDM favors such units. However, I do not think this reflects any phenomenon in the real world. The Soviet penchant for lean combat units, with supply, maintenance, and other services provided by higher echelons, is not a more effective solution in general, but perhaps better suited to the particular constraints they were experiencing when forming units, training men, etc. In effect these services were existing in the Soviet army too, but formally not with the combat units.

This problem is to some extent reminiscent to how density is calculated (a problem discussed by Chris Lawrence in a recent issue of the Newsletter). It is comparatively easy

to define the frontal limit of the deployment area of force, and it is relatively easy to define the lateral limits too. It is, however, much more difficult to say where the rear limit of a force is located.

When entering forces in the TNDM a rear limit is, perhaps unintentionally, drawn. But if the combat unit includes support units, the rear limit is pushed farther back compared to a force whose combat units are well separated from support units.

To what extent this affects the CEV calculations is unclear. Using the original database values, the German forces are perhaps given too high combat strength when the great number of GHQ artillery units is included. On the other hand, if the GHQ artillery units are not included, the opposite may be truc.

The Effects of Defensive Posture

The posture factors are difficult to analyze, since they alone do not portray the advantages of defensive position. Such effects are also included in terrain factors.

It seems that the numerical values for these factors were assigned on the basis of professional judgement. However, when the QJM was developed, it seems that the developers did not assume the German CEV superiority. Rather, the German CEV superiority seems to have been discovered later. It is possible that the professional judgement was about as wrong on the issue of posture effects as they were on CEV. Since the British and American forces were predominantly on the offensive, while the Germans mainly defended themselves, a German CEV superiority may, at least partly, be hidden in two high effects for defensive posture.

When using corrected input data on the 20 situations in Italy September–October 1943, there is a tendency that the German CEV is higher when they attack. Such a tendency is also discernible in the engagements presented in *Hitler's Last Gamble*, Appendix H, even though the number of engagements in the latter case is very small.

As it stands now this is not really more than a hypothesis, since it will take an analysis of a greater number of engagements to confirm it. However, if such an analysis is done, it must be done using several sets of data. German and Allied attacks must be analyzed separately, and preferably the data would be separated further into sets for each relevant terrain type. Since the effects of the defensive posture are intertwined with terrain factors, it is very much possible that the factors may be correct for certain terrain types, while they are wrong for others. It may also be that the factors can be different for various opponents (due to differences in training, doctrine, etc.). It is also possible that the factors are different if the forces are predominantly composed of armor units or mainly of infantry.

One further problem with the effects of defensive position is that it is probably strongly affected by the density of forces. It is likely that the main effect of the density of forces is the inability to use effectively all the forces involved. Thus it may be that this factor will not influence the outcome except when the density is comparatively high. However, what can be regarded as "high" is probably much dependent on terrain, road net quality, and the cross–country mobility of the forces.

Conclusions

While the TNDM has been criticized here, it is also fitting to praise the model. The very fact that it can be criticized in this way is a testimony to its openness. In a sense a model is also a theory, and to use Popperian terminology, the TNDM is also very testable.

It should also be emphasized that the greatest errors are probably those in the database. As previously stated, I can only conclude safely that the data on the engagements in Italy in 1943 are wrong; later engagements have not yet been checked against archival documents. Overall the errors do not represent a dramatic change in the CEV values. Rather, the Germans seem to have (in Italy 1943) a superiority on the order of 1.4–1.5, compared to an original figure of 1.2–1.3.

During September and October 1943, almost all the German divisions in southern Italy were mechanized or parachute divisions. This may have contributed to a higher German CEV. Thus it is not certain that the conclusions arrived at here are valid for German forces in general, even though this factor should not be exaggerated, since many of the German divisions in Italy were either newly raised (e.g., 26th Panzer Division) or rebuilt after the Stalingrad disaster (16th Panzer Division plus 3rd and 29th Panzergrenadier DIvisions) or the Tunisian debacle (15th Panzergrenadier Division). ⊕

List of Engagements Checked

Port of Salerno	9–11 Sept 1943
Amphitheater	9–11 Sept 1943
Sele–Calore Corridor	11 Sept 1943
Vietri I	12–15 Sept 1943
Battipaglia	12–15 Sept 1943
Tobacco Factory	13–14 Sept 1943
Eboli	17 Sept 1943
Battipaglia II	17–18 Sept 1943
Vietri II	17–18 Sept 1943
Grazzanise	12–14 Sept 1943
Capua	13 Oct 1943
Triflisco	13–14 Oct 1943
Monte Acero	13–14 Oct 1943
Caiazzo	13–14 Oct 1943
Castel Volturno	13–15 Oct 1943
Dragoni	14–17 Oct 1943
Monte Grande I	16–17 Oct 1943
Canal I	17–18 Oct 1943
Canal II	18–20 Oct 1943

Response to Niklas Zetterling's Article

by Christopher A. Lawrence

Mr. Zetterling is currently a professor at the Swedish War College and previously worked at the Swedish National Defense Research Establishment. As I have been having an ongoing dialogue with Prof. Zetterling on the Battle of Kursk, I have had the opportunity to witness his approach to researching historical data and the depth of research. I would recommend that all of our readers take a look at his recent article in the *Journal of Slavic Military Studies* entitled "Loss Rates on the Eastern Front during World War II." Mr. Zetterling does his German research directly from the Captured German Military Records by purchasing the rolls of microfilm from the US National Archives. He is using the same German data sources that we are. Let me attempt to address his comments section by section:

The Database on Italy 1943-44:

Unfortunately, the Italian combat data was one of the early HERO research projects, with the results first published in 1971. I do not know who worked on it nor the specifics of how it was done. There are references to the Captured German Records, but significantly, they only reference division files for these battles. While I have not had the time to review Prof. Zetterling's review of the original research, I do know that some of our researchers have complained about parts of the Italian data. From what I've seen, it looks like the original HERO researchers didn't look into the Corps and Army files, and assumed what the attached Corps artillery strengths were. Sloppy research is embarrassing, although it does occur, especially when working under severe financial constraints (for example, our Battalion–Level Operations Database). If the research is sloppy or hurried, or done from secondary sources, then hopefully the errors are random, and will effectively counterbalance each other, and not change the results of the analysis. If the errors are all in one direction, then this will produce a biased result.

I have no basis to believe that Prof. Zetterling's criticism is wrong, and do have many reasons to believe that it is correct. Until I can take the time to go through the Corps and Army files, I intend to operate under the assumption that Prof. Zetterling's corrections are good. At some point I will need to go back through the Italian Campaign data and correct it and update the Land Warfare Database. I did compare Prof. Zetterling's list of battles with what was declared to be the forces involved in the battle (according the Combat Data Subscription Service) and they show the following attached artillery:

Engagement Number	*Engagement Name*	*Attached Corps Artillery*
1	Port of Salerno	1/4 XIV Corps Artillery
2	Amphitheater	1/4 XIV Corps Artillery
3	Sele–Calore Corridor	1/2 LXXVI Pz Corps Artillery
5	Vietri I	1/2 XIV Corps Artillery
6	Battipaglia I	1/2 LXXVI Pz Corps Artillery
4	Tobacco Factory	1/2 LXXVI Pz Corps Artillery
9	Eboli	None
8	Battipaglia II	1/2 LXXVI Pz Corps Artillery
7	Vietri II	1/2 XIV Corps Artillery
10	Grazzanise	1/8 XIV Corps Artillery
11	Capua	1/4 XIV Corps Artillery
12	Triflisco	2/5 XIV Corps Artillery
13	Monte Acero	1/5 VI Corps Artillery
14	Caiazzo	2/5 VI Corps Artillery
15	Castel Volturno	1/8 XIV Corps Artillery
16	Dragoni	1/4 XIV Corps Artillery
20	Monte Grande	1/8 XIV Corps Artillery
17	Canal I	1/8 XIV Corps Artillery
18	Canal II	1/8 XIV Corps Artillery

It is clear that the battles were based on the assumption that there was Corps–level German artillery. A strength comparison between the two sides is displayed in the chart on the next page.

The Result Formula:

CEV is calculated from three factors. Therefore a consistent 20% error in casualties will result in something less than a 20% error in CEV. The mission effectiveness factor is indeed very "fuzzy", and these is simply no systematic method or guidance in its application. Sometimes, it is not based upon the assigned mission of the unit, but its perceived mission based upon the analyst's interpretation. But, while I have the same problems with the mission accomplishment scores as Mr. Zetterling, I do not have a good replacement. Considering the nature of warfare, I would hate to create CEV's without it. Of course, Trevor Dupuy was experimenting with creating CEV's just from casualty effectiveness, and by averaging his two CEV scores (CEVt and CEVl) he heavily weighted the CEV calculation for the TNDM towards measuring primarily casualty effectiveness (see the article in issue 5 of the *Newsletter*, "Numerical Adjustment of CEV Results: Averages and Means"). At this point, I would like to produce a new, single formula for CEV to replace the current two and its averaging methodology. I am open to suggestions for this.

Supply Situation:

The different ammunition usage rate of the German and US Armies is one of the reasons why adding a logistics

	US	(Allied)	British	German
Ground Forces				
Armies	1			1
Corps	1		1	2
Divisions				
Infantry	2		2	
Mechanized				3
Armored			1	3
Airborne	1			
Division Totals	**3**		**3**	**6**
Personnel Totals		***103,500***		***97,300***
Aircraft				
Bombers		870		
Fighters		670		
Transports		300[2]		
Aircraft Totals[3]		***1,840***		***502***
Artillery[4]				
75mm Howitzer (incl SP)	53		27	104
105mm Howitzer (incl SP)	216		24	
155mm Howitzer	76			
155mm Gun	24		12	
3-in Tank Destroyer	156			
25-pdr (incl SP)			192	
3-in Howitzer			18	
4.5-in Gun			8	
7.2-in Gun/Howitzer			16	
5.5-in Gun/Howitzer			24	
88mm Gun				42
105mm Gun/Howitzer				21
105mm Gun/Howitzer				129
150mm Howitzer (hvy or inf)				34
150mm Gun (hvy)/Howitzer				55
170mm Gun				4
210mm Howitzer				5
Artillery Totals	***525***		***321***	***394***
Armor				
Light Tank	181		55	85
Medium Tank	294		194	290
Armor Totals	***475***		***249***	***375***

[1] Does not include Eighth Army divisions advancing from the "toe" that arrived too late to take part in the Salerno actions.
[2] Plus 400 gliders.
[3] German figures are for estimated serviceable aircraft. This figure is 75% of total German and Italian planes in southern Italy. The Italian craft were actually of little use and the figure is therefore probably high.
[4] Figures are not available for coastal artillery. Stamps and Esposito, *A Military History of World War II*, on p. 120 states: "included in the mobile defense was a railway battery of 132mm guns, usually kept on a track just north of Agripoli. Observation from such dominating terrain features as Mount Soprano would enable the enemy to direct fire on the gulf, the beaches, and the plain."

module is high on my list of model corrections. This was discussed in Issue 2 of the *Newsletter*, "Developing a Logistics Model for the TNDM." As Mr. Zetterling points out, "It is unlikely that an increase in artillery ammunition expenditure will result in a proportional increase in combat power. Rather it is more likely that there is some kind of diminished return with increased expenditure." This parallels what I expressed in point 12 of that article: "It is suspected that this increase [in OLIs] will not be linear."

The CEV does include "logistics." So in effect, if one had a good logistics module, the difference in logistics would be accounted for, and the Germans (after logistics is taken into account) may indeed have a higher CEV.

General Problems with Non–Divisional Units
Tooth-to-Tail Ratio

Point taken. The engagements used to test the TNDM have been gathered over a period of over 25 years, by different researchers and controlled by different management. What is counted when and where does change from one group of engagements to the next. While I do think this has not had a significant result on the model outcomes, it is "sloppy" and needs to be addressed.

The Effects of Defensive Posture

This is a very good point. If the budget was available, my first step in "redesigning" the TNDM would be to try to measure the effects of terrain on combat through the use of a large LWDB–type database and regression analysis. I have always felt that with enough engagements, one could produce reliable values for these figures based upon something other than judgement. Prof. Zetterling's proposed methodology is also a good approach, easier to do, and more likely to get a conclusive result. I intend to add this to my list of model improvements.

Conclusions

There is one other problem with the Italian data that Prof. Zetterling did not address. This was that the Germans and the Allies had different reporting systems for casualties. Quite simply, the Germans did not report as casualties those people who were lightly wounded and treated and returned to duty from the divisional aid station. The United States and England did. This shows up when one compares the wounded to killed ratios of the various armies, with the Germans usually having in the range of 3 to 4 wounded for every one killed, while the allies tend to have 4 to 5 wounded for every one killed. Basically, when comparing the two reports, the Germans "undercount" their casualties by around 17 to 20%. Therefore, one probably needs to use a multiplier of 20 to 25% to match the two casualty systems. This was not taken into account in any the work HERO did.

Because Trevor Dupuy used three factors for measuring his CEV, this error certainly resulted in a slightly higher CEV for the Germans than should have been the case, but not a 20% increase. As Prof. Zetterling points out, the correction of the count of artillery pieces should result in a higher CEV than Col. Dupuy calculated. Finally, if Col. Dupuy overrated the value of defensive terrain, then this may result in the German CEV being slightly lower.

As you may have noted in my list of improvements (Issue 2, "Planned Improvements to the TNDM"), I did list "re–validating" to the QJM Database. As part of that revalidation process, we would need to review the data used in the validation data base first, account for the casualty differences in the reporting systems, and determine if the model indeed overrates the effect of terrain on defense.

Artillery Effectiveness versus Armor

by Richard C. Anderson, Jr.

The effectiveness of artillery against exposed personnel and other "soft" targets has long been accepted. Fragments and blast are deadly to those unfortunate enough to not be under cover. What has also long been accepted is the relative—if not total—immunity of armored vehicles when exposed to shellfire. In a recent memorandum, the United States Army Armor School disputed the results of tests of artillery versus tanks by stating, "...the Armor School nonconcurred with the Artillery School regarding the suppresive effects of artillery...the M–1 main battle tank cannot be destroyed by artillery..."

This statement may in fact be true,[1] *if the advancement of armored vehicle design has greatly exceeded the advancement of artillery weapon design in the last fifty years*. However, if the statement is not true, then recent research by TDI[2] into the effectiveness of artillery shellfire versus tanks in World War II may be illuminating.

The TDI search found that an average of 12.8 percent of tank and other armored vehicle losses[3] were due to artillery fire in seven cases in World War II where the cause of loss could be reliably identified. The highest percent loss due to artillery was found to be 14.8 percent in the case of the Soviet 1st Tank Army at Kursk (Table II). The lowest percent loss due to artillery was found to be 5.9 percent in the case of Dom Bütgenbach (Table VIII).

The seven cases are split almost evenly between those that show armor losses to a defender and those that show losses to an attacker. The first four cases (Kursk, Normandy I, Normandy II, and the "Pocket") are engagements in which the side for which armor losses were recorded was on the defensive. The last three cases (Ardennes, Krinkelt, and Dom Bütgenbach) are engagements in which the side for which armor losses were recorded was on the offensive.

Four of the seven cases (Normandy I, Normandy II, the "Pocket," and Ardennes) represent data collected by operations research personnel utilizing rigid criteria for the identification of the cause of loss. Specific causes of loss were only given when the primary destructive agent could be clearly identified. The other three cases (Kursk, Krinkelt, and Dom Butgenbach) are based upon combat reports that—of necessity—represent less precise data collection efforts. However, the similarity in results remains striking.

The largest identifiable cause of tank loss found in the data was, predictably, high–velocity armor piercing antitank rounds. AP rounds were found to be the cause of 68.7 percent of all losses. Artillery was second, responsible for 12.8 percent of all losses. Air attack as a cause was third, accounting for 7.4 percent of the total lost. Unknown causes, which included losses due to hits from multiple weapon types as well as unidentified weapons, inflicted 6.3% of the losses and ranked fourth. Other causes, which included infantry antitank weapons and mines, were responsible for 4.8% of the losses and ranked fifth.

Curiously, at Kursk, in the case where the highest percent loss was recorded, the German forces opposing the Soviet 1st Tank Army—mainly the XLVIII Panzer Corps of the Fourth Panzer Army—were supported by proportionately fewer artillery pieces (approximately 56 guns and rocket launchers per division) than the US 1st Infantry Division at Dom Bütgenbach (the equivalent of approximately 106 guns per division)[4]. Nor does it appear that the German rate of fire at Kursk was significantly higher than that of the American artillery at Dom Bütgenbach. On 20 July at Kursk, the 150mm howitzers of the 11th Panzer Division achieved a peak rate of fire of 87.21 rounds per gun. On 21 December at Dom Bütgenbach, the 155mm howitzers of the 955th Field Artillery Battalion achieved a peak rate of fire of 171.17 rounds per gun.[5]

Table IX shows the distribution of cause of loss by type or armor vehicle. From the distribution it might be inferred that better protected armored vehicles may be less vulnerable to artillery attack. Nevertheless, the heavily armored vehicles still suffered a minimum loss of 5.6 percent due to artillery. Unfortunately the sample size for heavy tanks was very small, 18 of 980 cases or only 1.8 percent of the total.

[1] The statement may be true, although it has an "unsinkable Titanic," ring to it. It is much more likely that this statement is an hypothesis, rather than a truism.

[2] As part of this article a survey of the Research Analysis Corporation's publications list was made in an attempt to locate data from previous operations research on the subject. A single reference to the study of tank losses was found, Group 1 Alvin D. Coox and L. Van Loan Naisawald, *Survey of Allied Tank Casualties in World War II*, CONFIDENTIAL ORO Report T-117, 1 March 1951.

[3] The percentage loss by cause excludes vehicles lost due to mechanical breakdown or abandonment. If these were included, they would account for 29.2 percent of the total lost. However, 271 of the 404 (67.1%) abandoned were lost in just two of the cases. These two cases (Normandy II and the Falaise Pocket) cover the period in the Normandy Campaign when the Allied armies broke through the German defenses and began the pursuit across France.

[4] The US artillery at Dom Bütgenbach peaked on 21 December 1944 when a total of 210 divisional and corps pieces fired over 10,000 rounds in support of the 1st Division's 26th Infantry.

[5] Data collected on German rates of fire are fragmentary, but appear to be similar to that of the American Army in World War II. An article on artillery rates of fire that explores the data in more detail will be forthcoming in a future issue of this *Newsletter*.

The data are limited at this time to the seven cases.[6] Further research is necessary to expand the data sample so as to permit proper statistical analysis of the effectiveness of artillery versus tanks.[7]

[6] An eighth case was considered, but was not included in this article. This was the report of tank losses by the 1st US Army from June 1944 through April 1945. The data were incomplete, reporting all indirect fire and direct fire losses as caused by "gunfire." However, internal evidence implies that of the 898 losses reported in the study, as many as 250 (27.8 percent) may have been caused by indirect artillery fire.

[7] There is strong evidence that extensive data on armored vehicle losses are available in the captured German Army records from World War II. Most of this data would cover the German experience on the Eastern Front versus the Soviet Army.

Table I. Kursk, Soviet 1st Tank Army Strength and Loss by Unit, 4-18 July 1943[8]

Unit Tank Type	Participated	Lost	Artillery	Air	Burned	Breakdown
3rd Mechanized Corps						
T-34	195	145	20	0	108	17
T-70	35	16	3	0	10	3
6th Tank Corps						
T-34	155	146	13	5	106	22
T-70	32	30	5	2	19	4
31st Tank Corps						
T-34	175	146	32	3	102	9
T-70	42	32	7	0	10	15
180th Tank Brigade						
T-34	43	37	2	0	33	2
T-70	23	18	0	0	16	2
T-60	6	3	0	0	1	2
86th Tank Brigade[9]						
T-34	41	27	0	0	27	0
T-70	3	1	0	0	1	0
T-60	9	3	0	0	3	0
203rd Heavy Tank Regiment						
KV-1 and KV-2	11	8	1	1	5	1
192nd Tank Brigade						
Grant	31	25	1	0	21	3
Stuart	24	11	0	0	9	2
Total	***825***	***648***	***84***	***11***	***471***	***82***

[8] The data were found in reports of the 1st Tank Army (Fond 299, Opis' 3070, Delo 226). Obvious math errors in the original document have been corrected (the total lost column did not always agree with the totals by cause). The total participated column evidently reflected the starting strength of the unit, plus replacement vehicles. "Burned" in Soviet wartime documents usually indicated a total loss, however it appears that in this case "burned" denoted vehicles totally lost due to direct fire antitank weapons. "Breakdown" apparently included both mechanical breakdown and repairable combat damage.

[9] Note that the brigade report (Fond 3304, Opis' 1, Delo 24) contradicts the army report. The brigade reported that a total of 28 T-34s were lost (9 to aircraft and 19 to "artillery") and one T-60 was destroyed by a mine. However, this report was made on 11 July, during the battle, and may not have been as precise as the later report recorded by 1st Tank Army. Furthermore, it is not as clear in the brigade report that "artillery" referred only to indirect fire HE and not simply to both direct and indirect fire guns.

Table II. Kursk, Soviet 1st Tank Army Strength and Losses, 4-18 July 1943

Unit Tank Type	Lost	Artillery	Air	AP Shot	Breakdown	Other	Unknown
T-34	501	67	8	376	50	0	0
T-70	97	15	2	56	24	0	0
T-60	6	0	0	4	2	0	0
KV-1 and KV-2	8	1	1	5	1	0	0
Grant	25	1	0	21	3	0	0
Stuart	11	0	0	9	2	0	0
Total	***648***	***84***	***11***	***471***	***82***	***0***	***0***

Percentage Loss by Type and Cause (Excluding Breakdowns)

Type	Lost	Artillery	Air	AP Shot	Other	Unknown
T-34	451	14.9%	1.8%	83.3%	0.0%	0.0%
T-70	73	20.5%	2.7%	76.7%	0.0%	0.0%
T-60	4	0.0%	0.0%	100.0%	0.0%	0.0%
KV-1 and KV-2	7	14.3%	14.3%	71.4%	0.0%	0.0%
Grant	22	4.5%	0.0%	95.5%	0.0%	0.0%
Stuart	9	0.0%	0.0%	100.0%	0.0%	0.0%
Total	***566***	***14.8%***	***1.9%***	***83.2%***	***0.0%***	***0.0%***

Table III. Normandy I, German Armor Losses, 6 June-7 August 1944[10]

Unit Tank Type	Lost	Artillery	Air	AP Shot	Abandoned	Other	Unknown
Tiger	8	0	0	7	0	1	0
Panther	80	7	8	36	9	7	13[11]
Panzer IV	20	2	2	10	2	2	2
Total	***108***	***9***	***10***	***53***	***11***	***10***	***15***

Percentage Loss by Type and Cause (Excluding Abandoned)

Type	Lost	Artillery	Air	AP Shot	Other	Unknown
Tiger	8	0.0%	0.0%	87.5%	12.5%	0.0%
Panther	71	9.9%	11.3%	50.7%	9.9%	18.3%
Panzer IV	18	11.1%	11.1%	55.6%	11.1%	11.1%
Total	***97***	***9.3%***	***10.3%***	***54.6%***	***10.3%***	***15.5%***

[10] From ORS Report No. 17.

[11] Five of the 13 counted as unknown were penetrated by both armor piercing shot and by infantry hollow charge weapons. There was no evidence to indicate which was the original cause of the loss.

Table IV. Normandy II, German Armor Losses, 8-31 August 1944[12]

Unit Tank Type	Lost	Artillery	Air	AP Shot	Abandoned	Other	Unknown
Tiger	27	0	0	1	26	0	0
Panther	96	1	3	11	74	1	6
Panzer IV	96	3	7	11	68	0	7
Panzer III	3	0	0	0	3	0	0
Total	***222***	***4***	***10***	***23***	***171***	***1***	***13***

Percentage Loss by Type and Cause (Excluding Abandoned)

Type	Lost	Artillery	Air	AP Shot	Other	Unknown
Tiger	1	0.0%	0.0%	100.0%	0.0%	0.0%
Panther	22	4.5%	13.6%	50.0%	4.5%	27.3%
Panzer IV	28	10.7%	25.0%	39.3%	0.0%	25.0%
Panzer III	0	0.0%	0.0%	0.0%	0.0%	0.0%
Total	***51***	***7.8%***	***19.6%***	***45.1%***	***2.0%***	***25.5%***

[12] From ORS Report No. 17.

Table V. The Falaise Pocket, German Armor Losses, August 1944[13]

Unit Tank Type	Lost	Artillery	Air	AP Shot	Abandoned	Other	Unknown
Tanks	90	2	6	8	65	0	9
SP Guns	31	2	5	2	16	2	4
AC & APC	56	5	25	1	20	1	4
Total	***177***	***9***	***36***	***11***	***101***	***3***	***17***

Percentage Loss by Type and Cause (Excluding Abandoned)

Type	Lost	Artillery	Air	AP Shot	Other	Unknown
Tanks	25	8.0%	24.0%	32.0%	0.0%	36.0%
SP Guns	15	13.3%	33.3%	13.3%	13.3%	26.7%
AC & APC	36	13.9%	69.4%	2.8%	2.8%	11.1%
Total	***76***	***11.8%***	***47.4%***	***14.5%***	***3.9%***	***22.4%***

[13] From ORS Report No. 15. The "Pocket" was the area west of the line Falaise-Argentan and east of the line Vassy-Gers-Domfront in Normandy that was the site in August 1944 of the beginning of the German retreat from France. The German forces were being enveloped from the north and south by Allied ground forces and were under constant, heavy air attack.

Table VI. Ardennes, German Armor Losses, 16 December 1944-16 January 1945[14]

Unit Tank Type	Lost	Artillery	Air	AP Shot	Abandoned	Other	Unknown
Tiger II	5	0	1	1	3	0	0
Panther	47	3	3	16	20	0	5
Panzer IV	5	0	0	1	1	1	2
SP Gun	18	1	1	10	4	1	1
AC & APC	26	4	1	8	11	0	2
Total	**101**	**8**	**6**	**36**	**39**	**2**	**10**

Percentage Loss by Type and Cause (Excluding Abandoned)

Type	Lost	Artillery	Air	AP Shot	Other	Unknown
Tiger II	2	0.0%	50.0%	50.0%	0.0%	0.0%
Panther	27	11.1%	11.1%	59.3%	0.0%	18.5%
Panzer IV	4	0.0%	0.0%	25.0%	25.0%	50.0%
SP Gun	14	7.1%	7.1%	71.4%	7.1%	7.1%
AC & APC	15	26.7%	6.7%	53.3%	13.3%	7.7%
Total	**62**	**12.9%**	**9.7%**	**58.1%**	**3.2%**	**16.1%**

[14] From ORS Joint Report No. 1. A total of an estimated 300 German armor vehicles were found following the battle.

Table VII. Krinkelt, German Armor Losses, 17-20 December 1944[15]

Unit Tank Type	Lost[16]	Artillery	Air	AP Shot	Abandoned	Other	Unknown
Tanks	77	8	0	44	0	25	0

Percentage Loss by Type and Cause (Excluding Abandoned)

Type	Lost	Artillery	Air	AP Shot	Other	Unknown
Tanks	77	10.4%	0.0%	57.1%	32.5%	0.0%

[15] Data from 38th Infantry After Action Report (including "Sketch showing enemy vehicles destroyed by 38th Inf Regt. and attached units 17-20 Dec. 1944"), from 12th SS–PzD strength report dated 8 December 1944, and from strengths indicated on the OKW briefing maps for 17 December (1st [circa 0600 hours], 2d [circa 1200 hours], and 3d [circa 1800 hours] situation), 18 December (1st and 2d situation), 19 December (2d situation), 20 December (3d situation), and 21 December (2d and 3d situation).

[16] Losses include confirmed and probable losses.

Table VIII. Dom Bütgenbach, German Armor Losses, 19-21 December 1944

Unit Tank Type	Lost	Artillery	Air	AP Shot	Abandoned	Other	Unknown
Tanks	51	3	0	35	0	6	7

Percentage Loss by Type and Cause (Excluding Abandoned)

Type	Lost	Artillery	Air	AP Shot	Other	Unknown
Tanks	51	5.9%	0.0%	68.6%	11.8%	13.7%

[17] Data from Combat Interview "26th Infantry Regiment at Dom Bütgenbach" and from 12th–SS PzD, *ibid.*

Table IX. Percentage Losses by Type (Excluding Abandoned)

Type	Lost	Artillery	Air	AP Shot	Other	Unknown
Heavy	18	5.6%	11.1%	77.8%	5.6%	5.6%
Medium	643	13.1%	4.8%	75.0%	1.7%	5.4%
Light	137	17.5%	20.4%	54.0%	0.7%	7.4%
Other[18]	182	8.8%	6.6%	54.4%	18.7%	11.5%

[19]

[18] Heavy armor includes the KV-1, KV-2, Tiger, and Tiger II.[20]

[19] Medium armor includes the T-34, Grant, Panther, and Panzer IV.

[20] Light armor includes the T-60, T-70, Stuart, armored cars, and armored personnel carriers.

Table X. Summary of Armor Losses, Tables II-VIII

Engagement	Lost	Artillery	Air	AP Shot	Breakdown/ Abandoned	Other	Unknown
Kursk	648	84	11	471	82	0	0
Normandy I	108	9	10	53	11	10	15
Normandy II	222	4	10	23	171	1	13
Falaise Pocket	177	9	36	11	101	3	17
Ardennes	101	8	6	36	39	2	10
Krinkelt	77	8	0	44	0	25	0
Dom Bütgenbach	51	3	0	35	0	6	7
Total	**1384**	**125**	**73**	**673**	**404**	**47**	**52**

Percentage Loss by Cause (Excluding Abandoned and Breakdown)

Type	Lost	Artillery	Air	AP Shot	Other	Unknown
Kursk	566	14.8%	1.9%	83.2%	0.0%	0.0%
Normandy I	97	9.3%	10.3%	54.6%	10.3%	15.5%
Normandy II	51	7.8%	19.6%	45.1%	2.0%	25.5%
Falaise Pocket	76	11.8%	47.4%	14.5%	3.9%	22.4%
Ardennes	62	12.9%	9.7%	58.1%	3.2%	16.1%
Krinkelt	77	10.4%	0.0%	57.1%	32.5%	0.0%
Dom Bütgenbach	51	5.9%	0.0%	68.6%	11.8%	13.7%
Total	**980**	**12.8%**	**7.4%**	**68.7%**	**4.8%**	**6.3%**

Calculating an OLI Score for Armored Fighting Vehicles

by José Perez

The calculation of an OLI score for Armored Fighting Vehicles (AFVs) has undergone some changes since the TNDM was first created. These changes were the result of work done by Richard Anderson and Chip Sayers. The work was concluded in October 1994.

The changes made by Richard Anderson appeared in version 1.6 (22 September 1991). They consisted of adding the Visibility, Low–Light Capability, Power Traverse, Stabilization, Range Finding, and Ballistic Computer factors for the calculation of AFV OLI scores. The primary reason for adding these factors was to clarify the superiority of the latest generation tanks. Anderson's analysis of AFV OLI scores made it clear that modern tanks like the US's Abrams M1 were not getting scores that reflected the updated fire control and low–light capability systems in these tanks.

In general, the addition of these factors did little to change the OLI scores of most AFVs. However, those with Low-Light Capability, Stabilization, and the latest fire control systems received a boost. For example, a typical AFV might have increased its score by as little as 10% with the addition of these factors, but an AFV with a thermal imager, powered traverse, main gun stabilization, laser range finder, and ballistic computer correction for cant, ammunition, crosswind, and barrel got an OLI score that was 94% higher.

Chip Sayers' work was based an analysis of the engines, weight, size, and armor of newer tanks. His analysis indicated that the OLIs for these weapons did not reflect improvements in armor and engines. Changes were made to the Vehicle Supply, Vehicle Punishment, Radius of Action (multiplier became 0.06), and Battlefield Mobility Factors. Also, Height, Length, Ground Pressure, and Horsepower were added as factors in calculating the Battlefield Mobility Factor.

The values for the Armor Types range from 1.0 for Unimproved Armor to 1.3025 for Super–Hard Armor with Reactive Armor. This meant that a tank could receive as much as 30% more if it had the appropriate armor type. However, the resulting score did not reflect the result of increased weight: the reduced radius of action and the need for an engine with more horsepower.

The Vehicle Supply Factor calculation was changed from:

Equation 1

6.0 * Load / ((6.0 * Load) + Firing Rate of Primary Weapon)

to:

Equation 2

SQRT[6.0 * Load / ((6.0 * Load) + Firing Rate of Primary Weapon)]

where SQRT = square root of
Load = rounds of ammunition for the main gun.

The original equation generally gives a result that is less than 1.0. The greater the firing rate, the smaller the result. Applying a square root to the equation reduces the effect of the firing rate. For example, if equation 1 produces the result 0.98, then equation 2 gives 0.9899.

The Vehicle Punishment Factor was originally a value entered by the analyst. Chip Sayers changed it by creating an equation to calculate it:

Equation 3

1.2 * Armor Type * Weight / (2.0 * Height * Length)

The effect of this equation is that the Vehicle Punishment Factor increases as the Armor Type is improved and the Weight increases. But it decreases if the Height or Length of the AFV increase.

The equation for the Radius of Action Factor is:

Equation 4

0.6 * SQRT(Range)

Equation 4 produces a Radius of Action Factor that increases slowly as the Range increases. The consequence of applying the square root operation to the Range also means that short–ranged AFVs are penalized, but AFVs with a longer range must have an enormously greater range in order to benefit substantially.

The Battlefield Mobility Factor equation is:

Equation 5

0.04 * SQRT[(Horsepower/Weight) * Speed / Ground Pressure]

As the weight increases, the Battlefield Mobility Factor (BMF) decreases. If Ground Pressure increases, the BMF decreases. But if Horsepower or Speed increase, so does the BMF.

Many of these factors are indirectly related. For example, increased horsepower usually results in higher speeds, if all other factors remain constant. However, the horsepower is usually increased because of an increase in weight. Armor improvements can result in greater weight. Increased weight normally results in a higher ground pressure and a shorter range.

The benefit of these changes is that improvements to an AFV, such as an engine with greater horsepower or better armor, can be reflected in its OLI score.

AFV Values in the TNDM

"Old (QJM) Method versus Chip Sayers' "Improved Method"

by David L. Bongard

For some time, I have been aware of a potential problem in the TNDM over the calculation of Armor, or rather Armored Fighting Vehicle (AFV) OLIs. This has arisen in large measure because Col. Dupuy replaced the original, QJM–derived, calculation of Armor OLIs with a newer, more technology–oriented calculation method provided by Chip Sayers, a defense analyst with whom he had professional contact.

The "original" or "old" method for calculating Armor OLIs was, or is, comparatively simple. First, the individual OLIs of the on–board weapons are added together, modified by the multi–barrel multipliers for additional weapons after the second, so that a tank with a main gun (OLI of 90), a heavy AA machinegun (OLI of 0.984), and two light machineguns (OLIs of 0.420) would have a combined on–board OLI of 90 + 0.984 + (0.5 * 0.420) + (0.333 * 0.420) = 91.334. This sum is multiplied by the Battlefield Mobility Factor (or BMF, 0.15 times the square root of the vehicle road speed in kilometers per hour, or kph), and that product in turn multiplied by the Radius of Action Factor (or RAF, 0.08 times the square root of the vehicles operational range on roads, in kilometers). To that product is added the vehicle's Punishment Factor, calculated by multiplying one–quarter (0.25) of the vehicle weight in metric tons, by the square root of twice the vehicle weight.

That resulting sum is multiplied by the Rapidity of Fire Effect (RFE), the Fire Control Effect (FCE), the Ammunition Supply Factor (ASF), and the Amphibious Effect Factor (x 1.05 if the vehicle can ford, x 1.1 if it can "swim"). The RFE and the ASF were both determined by consulting graphs, resulting in factors ranging from 0 to 0.99. The result of all of these multiplications yields the AFV OLI.

[(Tot OLIs x BMF x RAF) + PF] x RFE x FCE x ASF x AmphF = AFV OLI

The newer method for calculating Armor OLIs is that developed by Chip Sayers in summer 1990. This was later modified, partly upon some suggestions provided by Rich Anderson, to produce the following methodology. The main weapon OLI is added to the OLIs for other on–board weapons, after those OLIs have been modified to account for ammunition supply. This total sum is multiplied by the BMF and RAF, as before, and then **multiplied** by a Punishment Factor (rather than having the Punishment Factor added to the existing sum), an Armor Factor, a Vehicle Mobility Factor (a modified version of the old Amphibious Factor). The PF is modified by the vehicle's side cross section, determined from its length and height, on the assumption that bulkier vehicles utilize a smaller portion of their full mass for armor than do more compact AFVs. The VMF is modified by the vehicle's ground pressure, this last expressed in kg per square cm.

Finally the result is multiplied by the Vehicle Attack Factor (VAF). The VAF is determined by taking the square root of a sequence of nine sub–factors, all of which are multiplied together. These nine factors are: (1) Visibility Factor (0.9 for enclosed vehicles, 1.0 for open–topped); (2) Low–Light Capability Factor, varying from 1.0 to 1.1; (3) Turret Traverse Factor (0.9 for fixed mount, 1.0 for manual traverse, 1.1 for powered traverse); (4) Stabilized Main Gun Factor (1.0 for unstabilized, 1.1 for stabilized); (5) Range Finder Factor, ranging from 1.0 (stadiametric) to 1.2 (laser); and (6) through (9), four capabilities for on–board ballistic or fire–control computers, correcting for cant, ammunition type, crosswind, and barrel condition, worth 1.05 each if the capability is present, and 1.0 if not. The maximum multiplier from the nine VAF components is 1.7473, the square root of which (and therefor the maximum VAF) is 1.3218.

Tot OLIs x BMF x RAF x PF x VMF x VAF = AFV OLI

VAF = SQRT (VisF x LLCF x TravF x SGF x RgFF x FCCFs)

It is worthwhile to examine how these two methodologies model the same two vehicles. Listed in the first table on the next page are about two dozen modern AFVs, designated by nation of origin, overall type (tank, IFV, recon vehicle), old OLI, and new OLI. The parenthetical numbers below reflect the numbers employed in the TNDM itself as the OLI values for the respective AFVs.

A few notes on these AFVs are warranted. The TAM is built in Argentina to a Thyssen–Henschel design; it mounts a 105mm gun on a 32.5 metric ton chassis. The Rooikat is an indigenous South African–designed armored car with advanced fire control and electronics systems, intended to replace its aging force of French–built AML-90 armored cars. The Rooikati105 is up–gunned with a low–recoil 105mm cannon. The U.S. FMBT–120 is based on a tank design which won a design contest in *Armor* magazine in 1993; it is armed with a 120mm smoothbore cannon, a coaxial 30mm chain gun, a 40mm automatic grenade launcher, and carries eight Stinger SAMs. The M8 AGS shown here carries the mode–two detachable armor suite, comprising composite–armor plates. The BMP–3 is the newest–generation Soviet/Russian infantry fighting vehicle, armed with a 100mm smoothbore gun (which can also fire ATGMs), and a 30mm autocannon co-axial with the larger gun.

Modern AFVs

Nation	Vehicle	Old OLI	New OLI
Argentina	TAM MBT	522	571
South Africa	Rooikat AC	178	64
	Rooikat-105	698	258
Germany	Leopard 2 MBT	743	1355
	Marder 2 IFV	177	63
	Luchs AC	112	13
	Fuchs TPz-1 APC	20	0.241
UK/Britain	MCV-80 IFV	222	200
	FV-101 Scorpion	114	83
	FV-107 Scimitar	52	33
	FV-432 track APC	19	0.79
	FV-4211 Fox AC	32	13
	Challenger MBT	517	1016
USA	FMBT-120	993	3035
	M1A2 MBT	639	1436
	M8 AGS	380	764
	M2A2 IFV	169	249
	M113A2 APC	14	1.08
USSR/Russia	T-80U MBT	577	1489
	T-72M1 MBT	635	990
	BMP-3 IFV	263	290
	BMP-2 IFV	190	124
	BRDM-2 AC	9.35	0.42
	MT-LB track APC	13	0.68
	BTR-70 whld APC	13	1.28

As an additional comparison, I present below twenty–one AFVs (mostly tanks) from the latter part of World War II (1943–1945). It is immediately apparent from comparing the OLI scores that the newer method sharply penalizes all World War II AFVs, by a factor of roughly 50%. Armored cars lose a much greater portion of the "old" OLI score, in most cases between 90% and 95%. Assault guns and a few other vehicles (the U.S. M–10 and M–36 TDs) lose less, between 18% and 40%. This is due largely to the fact that, excepting powered turrets, none of the VAF components apply to World War II–era AFVs, nor do they carry anything except plain ordinary steel armor.

It is worth noting here that the "old OLI" methodology relatively short–changed modern main battle tanks; even the relatively simple and lightweight TAM gained a 9.4% "bonus" from conversion to the "new TNDM" methodology. Similarly, the heavilyiarmed BMP–3 gains a 10.35% bonus in transition to the new methodology. The shift is even greater for heavier tanks, ranging from a factor of 2.0 to a factor of over 3.0 for the FMBT–120. Likewise, the M8 AGS (Armored Gun System) increased its OLI by a factor of just over 2.0.

On the other hand, lighter AFVs suffered notable declines in OLI values when translated into the "new TNDM" methodology. The MCV–80 Warrior IFV suffers a "less" of almost 10%, while the FV–101 Scorpion loses over 27% of its old OLI value, and the FV–107 Scimitar loses 35.4%. Likewise, the BMP–2 loses 34.5% of its value, almost the same proportion as the FV–107 Scorpion. Stunningly, the Rooikat lost 63.9% of its value through conversion to the "new" system, and the Rooikat–105 (with an admittedly near–ridiculously high OLI) dropped 64.1%, a nearly–identical proportion. The more lightly–armed British FV4211 Fox armored car lost only 58% of its "old QJM" value with conversion to the new format. The BRDM–2, though, lost a staggering 95.5% of its OLI score through conversion to the new method.

Slightly different distinctions are noticeable for World War II AFVs. Armored cars have generally suffered a 90–95% decline in OLI value when translated from the old methodology to the new, while tanks, even light ones like the M5A1, have dropped by 25–50%. The major exception to this is the enormous PzKw VIB King Tiger, which declined from 360 to 108, in part because of its size (over 10 meters long, just over 3.0 meters tall), low engine power (only 500 hp, the same as on the 20 ton lighter Panther), and high ground pressure figures, as well as its limited operational range and comparatively low speed.

World War II AFVs

Nation	Vehicle	Old OLI	New OLI
Germany	PzKw-IVJ	167	76
	PzKw-VG Panther	251	114
	PzKw VIB King Tiger	360	108
	StuG-IIIG	117	71
	SdKfz-234/2 AC	128	13
	SdKfz-250/1 Lt HT	4.454	1.267
	SdKfz-251/1 Hv HT	8.6	0.96
USSR	BA-32 AC	45	5.4
	T-34/C	193	133
	T-34/85	275	210
	SU-76	109	58
	SU-100	298	247
USA	M8 AC	73	4.63
	M4A2 Sherman	192	100
	M4 (76)	212	113
	M-10 TD	211	159
	M-36 TD	276	172
	M5A1 Lt Tank	55	36
	M3A1 Halftrack	10	3.35
	LVT(A)-4	117	38
UK	Bren carrier	2.953	0.2

Clearly, the "new TNDM" methodology strongly favors heavy and well–armed AFVs. Main Battle Tanks (MBTs) come off particularly well. More lightly–armored vehicles, excepting those that are especially heavily armed, come off poorly. Although not shown here, lightly–armed AFVs, such as APCs and recon vehicles armed only with machineguns, suffer particularly heavily, with scores between 10.0 and 19.0 under the "old QJM" calculations, and OLI scores in the 0.42 to 1.28 range under the "new TNDM" range.

Such light vehicles suffer in comparison with the older method of OLI Calculation because, under the old system, the additive PF comprised a major portion of the entire OLI. At low combat weights, the "new TNDM" method PF multiplier can be as low as 0.25, and coupling this to the generally low OLIs for machineguns, yield extremely low vehicle OLIs.

The real question in all of this is whether the model accurately assesses the battlefield, operational, and campaign value of light armored fighting vehicles and light armored vehicles generally. It certainly seems true that an APC armed with a machinegun is a more valuable combat asset than simply the machinegun alone, no matter how lightly armored the APC. Yet this nearly self–evident principle is clearly violated in the case of the BTR–70, whose 14.5mm heavy machinegun has an OLI of 1.165 on its own, while the BTR-70 is given only a 1.282. The situation with the BRDM–2 is even worse, as that vehicle is armed with a 14.5mm HMG and a PKT 7.62mm MG, yet has an OLI of only 0.424, or just 36.4% of the value of its heavy machinegun.

Something needs to be done here, either excepting "light AFVs and light armored vehicles" from the "new TNDM" methodology of OLI calculation, or developing an alternate method for OLI calculation in such cases so that the real combat value of these systems is not sold short.

How Would We Correct Armor OLIs?

by Christopher A. Lawrence

One of the problems that we are addressing in this issue is the difference between the old QJM armor OLIs and the new TNDM armor OLIs. The problem with armor in the QJM/TNDM is that one score is used to address two entirely different functions. Armor has a use in the battlefield as a weapon system against "soft" targets and for exploitation (what I refer to as its "general" combat value), and it has a tank/antitank role. Certain vehicle characteristics, like thickness of armor and muzzle velocity, are more important for the vehicle's tank/antitank role than they are for its other roles. In fact, some of the characteristics of the vehicle that make it good for its tank/antitank role hinder it in its other roles.

The old QJM OLIs tended to underrate the antitank functions of the AFVs, resulting in large scores for lightly armored and poorly gunned vehicles and scores that were clearly too low for main battle tanks. The current system may make the error in the opposite direction, overrating the "general" combat value of the main battle tank because of the emphasis on its antitank role, while underrating the "general" combat value of all other AFVs. If a correction is needed, then it would appear that the solution could take on one of three characteristics:

1. Find a new OLI score that produces a balanced score between the different combat uses.
2. Have two different OLI scores for tanks, one for its "general" combat value and one for its tank/anti-tank value.
3. Separate out the tank/anti-tank function into a separate engagement module, using something like SSPKs for resolution.

Of course, one could produce a "balanced" score by simply averaging the two OLI systems, but I am not really sure what we've done at that point. There are many advantages to a single scoring system, one of them being elegance of use.

Having two separate scoring systems, one for its "general" combat value and one for its tank/antitank role is a relatively easy correction to make to the model, *once one figures out how to score these two different functions.*

The third option, which is to use SSPKs for calculating armor/antiarmor subroutine would involve keeping an AFV OLI for "general" combat use, with the SSPKs used primarily to determine armor attrition and the who wins the "armor battle." This method is fraught with all the usual problems of building a bottom–up model using SSPKs, including how to determine how much engagement there is, who engages who, what are the conditions of the engagement, etc. Such a subroutine could grow to be bigger than the basic model.

If the scoring system is changed, then we would need to revalidate the model to a series of engagements where considerable armor was present. In fact, I would be very tempted to start the analysis of changing the scoring system by running the TNDM with the old QJM armor values through all the engagements, and then running it with the new values, and see which scoring system performs better for which battles.

No scoring system can be validated outside of the model in which it is used. Therefore one is left with developing a scoring system that one thinks feels good, and then validating the model with the new scoring system in place.

Use of Armor in the 76 Battalion–Level Engagements

by Christopher A. Lawrence

One of the items that was not included in the earlier listings of the engagements in the Battalion–Level Operations Database (BLODB) was the number and type of AFVs on each side. Most of the engagements had no significant armor resources, but several, were in fact heavy armor engagements. One of my concerns was whether the model has been having prediction problems due to armor being in the engagement. Therefore, in the last three columns of the table, I have identified those engagements in which we had a prediction problem with predicted winner/loser, attacker losses, or defender losses. All the engagements with armor are listed below:

World War I							Prediction Problem		
Engagement	Total Attacker AFVs	Total Defender AFVs	Attacker's % of OLI	Defender's % of OLI	Attacker's AFVs per 1000 troops	Defender's AFVs per 1000 troops	Winner/Loser	Attacker Losses	Defender Losses
Cantigny	12		0.1		1.4				
St. Amand Farm	5		18.5		4.3			Y (low)	
Beaurepaire Farm	12		1.1		2.7				Y (v. high)
Medeah Farm	3		0.8		1.6		Y		Y (v. low)
Essen Hook	3		0.7		2.1			Y (low)	Y (v. high)
Exermont	11		1.0		2.1		Y		
Mayache Ravine	13		1.2		2.4		Y		
La Neuville	13		1.6		2.4		Y		

World War II							Prediction Problem		
Engagement	Total Attacker AFVs	Total Defender AFVs	Attacker's % of OLI	Defender's % of OLI	Attacker's AFVs per 1000 troops	Defender's AFVs per 1000 troops	Winner/Loser	Attacker Losses	Defender Losses
Tenaru 2	4		6.3		2.2				Y (v. low)
Chougui Pass	13	25	79.5	76	28.0	133	Y	Y (v. high)	
Mte Maggiore		18		17.9		5.5			
Engebi I	55		8.0		13.3				Y (v. low)
Eniwetok	34		9.5		13.1				
Lausdell XRds	102	3	63.5	8.7	30.9	5		Y (v. low)	Y (v. low)
Assenois	33	6	28.3	61.1	18.3	12.3			Y (v. low)
Veritable 7BW	14		47.0		16.5				
Veritable 57G	14		41.6		18.9				
Veritable 1BW	14		42.7		18.9				
Veritable 1HL	14		47.3		18.9				
Veritable 4RW	14		43.4		18.9				
Veritable 10B	14		50.3		18.9				
Veritable 1GH	11		40		14.9				
Veritable 9C	11	3	48.7	28.8	15.2	19.5	Y		
Veritable 2AS	9		45.9		12.2		Y		
Veritable XHL	14		59		18.9		Y		
Veritable CH		3		19.4		7.5	Y	Y (low)	

Post-World War II							Prediction Problem		
Engagement	Total Attacker AFVs	Total Defender AFVs	Attacker's % of OLI	Defender's % of OLI	Attacker's AFVs per 1000 troops	Defender's AFVs per 1000 troops	Winner/Loser	Attacker Losses	Defender Losses
Tu-Vu		5		29.7		11.9	Y	Y (low)	Y (high)
Ninh Binh	17		25.5		20.0				Y (v. low)
Prek Klok II		4		0.0		2.5		Y (v. low)	
Buell II		4		12.6		10		Y (v. low)	
Ap Bau Bang II		6		13.2		40		Y (low)	Y (v. low)
Bir Gifgafa I	60	30	94.3	67.6	17.1	15			
Bir Gifgafa II	67	54	79.4	93.8	22.1	16.1			
Mt. Hermon	9	9	13.3	14.1	3.3	5.7			
Tumbledown	4		3.2		5.7				
Wireless Ridge	4		4.0		6.1				
Lomba River	38	28	46.2	43.6	34.0	12.4			Y (high)
Cuatir River	104	33	43.9	41.6	38.4	14.2			
Lipanda	41	23	44.1	27.7	33.8	10.2			
TF Bayonet	107	7	26.3	8.8	29.6	3			Y (high)

KEY:

v. low = For attacker, prediction is 10 to 25 percentage points below actual percent casualties.
For defender, prediction is 25 or more percentage points below actual percent casualties.

low = For attacker, prediction is 5 to 10 percentage points below actual percent casualties.
For defender, prediction is 10 to 25 percentage points below actual percent casualties.

high = For attacker, prediction is 5 to 10 percentage points above actual percent casualties.
For defender, prediction is 10 to 25 percentage points above actual percent casualties.

v. high = For attacker, prediction is 10 to 25 percentage points above actual percent casualties, except for Chouigui Pass, where the prediction is more than 25 percentage points above actual casualties.
For defender, prediction is 25 or more percentage points above actual percent casualties.

This table is a summation of all the engagements in the final battalion–level validation:

Summation of Data								
			All Engagements:	Problem Predicting Casualties		Engagements with Armor:	Problem Predicting Casualties	
Era	Total Engagements	Engagements with Armor	Problem Predicting Winner/Loser	A	D	Problem Predicting Winner/Loser	A	D
WWI	23	8	7	7	7	4	2	3
WWII	23	18	5	6	6	5	3	4
Post-WWII	30	14	1	12	14	1	4	5
Total	**76**	**40**	**13**	**25**	**27**	**10**	**9**	**12**
% of Total Engagements		53%				77%	36%	44%

As can be seen, while 53% of the engagements included armor, 77% of the engagements in which we had a problem predicting winner/loser included armor, whereas only 36% of the engagements in which we had a problem predicting attacker losses included armor, and only 44% of the engagements in which we had problems predicting defender losses included armor. It did not, therefore, appear that the presence of armor in an engagement was causing any prediction errors.

At this point, I ceased trying to do any further analysis. Quite simply, I could not see any pattern that would indicate that any of the prediction problems that I am having is related to the presence or absence of armor. If anyone sees a pattern, please let me know.

The Second Test of the Battalion–Level Validation

Predicting Casualties Final Scorecard

by Christopher A. Lawrence

While writing the article on the use of armor in the BattalioniLevel Operations Database (BLODB), I discovered that I had really not completed my article in the last issue on the results of the second battalion–level validation test of the TNDM, casualty predictions. After modifying the engagements for time and fanaticism, I didn't publish a final "scorecard" of the problem engagements. This became obvious when I needed that scorecard for the article on tanks. So the "scorecards" are published here and are intended to complete the article in the previous issue on predicting casualties.

As you certainly recall, amid the 40 graphs and charts were six charts that showed which engagements were "really off." They showed this for unmodified engagements and CEV modified engagements. We then modified the results of these engagements by the formula for time and "casualty insensitive" systems. We are now listing which engagements were still "off" after making these adjustments.

Each table lists how far each engagement was off in gross percent of error. For example, if an engagement like North Wood I had 9.6% losses for the attacker, and the model (with CEV incorporated) predicted 20.57%, then this engagement would be recorded as +10 to +25% off. This was done rather than using a ratio, for having the model predict 2% casualties when there was only 1% is not as bad of an error as having the model predicting 20% when there was only 10%. These would be considered errors of the same order of magnitude if a ratio was used. So below are the six tables.

World War I Attacker		
Predicted Casualties Off By:	Predicted	Time Modified CEV Predicted
-5 to -10	St Amand	St Amand
	Bouzancy Rdg	Bouzancy Rdg
	Medeah Farm	
	Essen Hook	Essen Hook
-5 to +5	15 cases	16 cases
+5 to +10	Remilly	Remilly
	North Wood II	North Wood II
+10 to +25	North Wood I	North Wood I
	Chaudun	Chaudun

World War I Defender		
Predicted Casualties Off By:	Predicted	Time Modified CEV Predicted
-25 or more	Cantigny	
	St Amand	
	Medeah Farm	Medeah Farm
	Essen Hook	
-10 to -25		
-5 to -10	Bouzancy Rdg	Bouzancy Rdg
-5 to +5	9 cases	11 cases
+5 to +10	West Wood I	West Wood I
	Mayache Rvn	Mayache Rvn
	La Neuville	La Neuville
	Hill 252	Hill 252
+10 to +25	Yvonne	
	North Wood I	North Wood I
+25 or more	Beaupre Farm	Beaupre Farm
	Chaudun	Chaudun
	Remilly	Remilly
		Essen Hook
		Yvonne

Seven of the World War I battles were modified to account for time. In the case of the attackers we are now getting results with plus or minus 5% in 70% of the cases. In the case of the defenders, we are now getting results of plus or minus 10% in 70% of the cases. As the model doesn't fit the defender's casualties as well as the attacker's, I use a different scaling (10% versus 5%) for what is a good fit for the two.

Two cases remain in which the predictions for the attacker are still "really off" (over 10%), while there are six (instead of the previous seven) cases in which the predictions for the defender are "really off" (over 25%).

World War II Attacker		
Predicted Casualties Off By:	Predicted	Time Modified CEV Predicted
-10 to -25	Tenaru River I	
	Edson's Ridge	
	Lausdell XRds	Lausdell Xrds
-5 to -10	Engebi I	
	Eniwetok	
	VER-CHx	VER-CHx
	Wake II	
	Makin Raid	
-5 to +5	13 cases	17 cases
+5 to +10	VER-RDMx	VER-RDMx
		Tenaru River I
+10 to +25		
+25 or more	Chouigui Pass	Chouigui Pass

World War II Defender		
Predicted Casualties Off By:	Predicted	Time Modified CEV Predicted
-25 or more	Makin Raid	
	Tenaru River II	Tenaru River II
	Engebi	Engebi
	Lausdell XRds	Lausdell XRds
	Assenois	Assenois
-10 to -25	Edson's Ridge	Edson's Ridge
	Eniwetok	
-5 to -10		
-5 to +5	11 cases	12 cases
+5 to +10	VER-1BWx	VER-1BWx
	VER-4RWx	VER-4RWx
	VER-2ASx	VER-2ASx
	VER-HXLx	VER-HXLx
		Makin Raid
+10 to +25	Wake II	
+25 or more		Wake II

Seven of the World War II battles were modified to account for "casualty insensitive" systems (all Japanese engagements). Time was not an issue in the World War II engagements because all the battles lasted four hours or more. In the case of the attackers, we are now getting results with plus or minus 5% in almost 75% of the cases. In the case of the defenders, we are now getting results of plus or minus 10% in almost 75% of the cases. We are still maintaining the different scaling (5% versus 10%) for what is a good fit for the two.

Now in only two cases (used to be four cases) are the predictions for the attacker really off (over 10%), while there are still five cases in which the predictions for the defender are "really off" (over 25%).

Post-World War II Attacker		
Predicted Casualties Off By:	Predicted	Time Modified CEV Predicted
-25 or more	Long Tan	Long Tan
	Prek Klok II	
	Ap Bau Bang II	
	Lo Giang I	
-10 to -25	Tu-Vu	
	Mapu	Mapu
	Buell II	Buell II
	Prek Klok I	
		Prek Klok II
-5 to -10	Lo Giang II	Lo Giang II
	Nui Ba Den	
	Mt Longdon	Mt Longdon
		Ap Bau Bang II
		Tu Vu
-5 to +5	17 cases	18 cases
+5 to +10	Salinas	Salinas
	Cau Lanh	
+10 to +25		Cau Lanh
+25 or more		Lo Giang I
		Prek Klok I

Post-World War II Defender		
Predicted Casualties Off By:	Predicted	Time Modified CEV Predicted
-25 or more	Tu-Vu	
	Ninh Binh	Ninh Binh
	Cai Nuoc	Cai Nuoc
	ZDB050	
	Hill 450	
	Prek Klok I	
	Ap Bau Bang II	Ap Bau Bang II
	Lo Giang II	
	Mt Harriet	Mt Harriet
	Mt Longdon	Mt Longdon
-10 to -25	Cau Lanh	
	Lo Gianh I	
	Nui Ba Den	
		Prek Klok I
		Lo Giang II
-5 to -10	Mapu	
	Bir Gifgafa II	Bir Gifgafa II
	Two Sisters	Two Sisters
	Lipanda	Lipanda
		Nui Ba Den
-5 to +5	9 cases	10 cases
+5 to +10		Lo Giang I
		Long Tan
+10 to +25	Salinas	Salinas
	Pearls AFB	Pearls AFB
	Lomba	Lomba
	TF Bayonet	TF Bayonet
		ZDB050
		Cau Lanh
		Tu-Vu

Only 13 of the 30 post–World War II engagements were not changed. Two were modified for time, eight were modified for "casualty insensitive" systems, and seven were modified for both conditions.

In the case of the attackers we are now getting results within plus or minus 5% in 60% of the cases. In the case of the defenders, we are now getting results within plus or minus 10% in around 55% of the cases. We are still maintaining the different scaling (5% versus 10%) for what is a good fit for the two.

We have seven cases (used to be eight cases) in which the attacker's predictions are "really off" (over 10%), while there are only five cases (used to be 10) in which the defender's casualty predictions are "really off" (over 25%).

Repetitious Conclusion

To repeat some of the statistics from the article in the previous issue, in a slightly different format:

World War I Engagements	*Actual Average Attacker % Losses*	*Predicted Average Attacker % Losses*	*Standard Deviation*	*Actual Average Defender % Losses*	*Predicted Average Defender % Losses*	*Standard Deviation*
23 Engagements	8.05	7.45	5.42	26.29	29.41	27.74
As corrected (total)	8.05	7.92	4.87	26.29	36.52	23.44
16 unmodified	8.58	9.90	5.09	18.38	31.59	25.66
7 modified	6.84	3.38	4.34	44.35	47.78	17.35

World War II Engagements	*Actual Average Attacker % Losses*	*Predicted Average Attacker % Losses*	*Standard Deviation*	*Actual Average Defender % Losses*	*Predicted Average Defender % Losses*	*Standard Deviation*
23 Engagements	7.36	5.62	8.49	26.58	14.25	29.38
As corrected (total)	7.36	7.93	7.56	26.58	22.41	27.81
less Wake II[1]				26.89	18.89	22.71
16 unmodified	5.06	5.87	8.44	15.77	9.95	22.65
7 modified	12.63	12.65	5.00	51.29	50.89	36.99
less Wake II				56.54	42.70	22.89

[1] At Wake II, the defenders (US Marines) surrendered after suffering 19.77% casualties. The revised predicition had them suffering 100%, which certainly would have been the case had they not surrendered.

Post-World War II Engagements	*Actual Average Attacker % Losses*	*Predicted Average Attacker % Losses*	*Standard Deviation*	*Actual Average Defender % Losses*	*Predicted Average Defender % Losses*	*Standard Deviation*
30 Engagements	12.26	4.55	14.63	26.84	11.94	25.75
As corrected (total)	12.26	11.77	12.30	26.84	22.49	21.45
13 unmodified	3.42	3.42	3.03	21.19	15.25	24.33
17 modified	19.01	18.16	16.10	31.16	28.05	18.97

Other Data Summations (this is a repeat from the last issue)	*Actual Average Attacker % Losses*	*Predicted Average Attacker % Losses*	*Standard Deviation*	*Actual Average Defender % Losses*	*Predicted Average Defender % Losses*	*Standard Deviation*
15 "cas. insensitive"	18.29	17.78	13.34	49.03	46.74	31.10
less Wake II				51.12	42.94	24.01
9 time corrected	5.84	2.70	4.05	35.77	37.46	15.50
7 time corrected and "cas. insensitive"	18.96	18.57	16.47	20.24	18.39	12.65

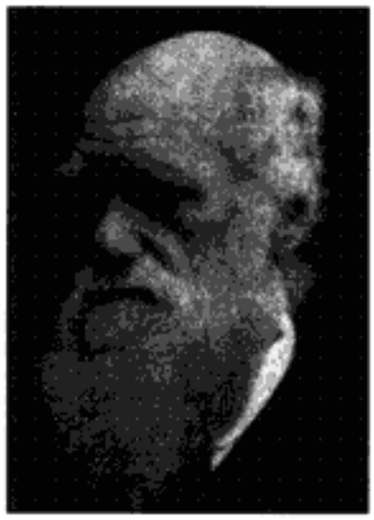
Final Fit on the Data (this is a repeat from the last issue)	*Actual Average Attacker % Losses*	*Predicted Average Attacker % Losses*	*Standard Deviation*	*Actual Average Defender % Losses*	*Predicted Average Defender % Losses*	*Standard Deviation*
World War I	8.05	7.92	4.87	26.29	36.52	23.44
World War II	7.36	7.93	7.56	26.58	22.41	27.81
Post-World War II	12.26	11.77	12.30	26.84	22.49	21.45
Total	***9.50***	***9.44***	***9.18***	***26.59***	***26.71***	***24.12***

TDI Profile: Jay Karamales

Robert Heinlein once wrote that specialization is for insects; another way of describing someone who subscribes to that credo could be "jack of all trades, master of none" and would be an appropriate introduction to this newsletter's production manager and contributing editor, Jay Karamales.

Jay was trained as a computer scientist, attending George Mason University in Virginia during the early 1980s. After stints as a White House consultant, data processing manager for a regional bank, and computer scientist for the USDA, Jay went to work for Trevor Dupuy's Data Memory Systems Inc. in 1987. Col. Dupuy hired him to design the Ardennes Campaign Simulation Database, and to be DMSI's general computer guru. Along the way, though, Jay's latent interest in history was piqued by the nature of the historical research and analysis going on around him. Then Chris Lawrence press-ganged him into helping with some of the research for the ACSDB, including the German unit location data. (Jay had taken five years of German in school, so that he could understand what the Germans were saying in the old war movies without relying on the subtitles.)

By 1989 DMSI had fallen on hard times because of the lack of defense funding for such frills as historical research. Fortunately Jay was able to secure a position at Science Applications International Corporation as half-historian, half-programmer/analyst, which suited his short attention span quite well. The highlight of his tenure at SAIC was producing the Anti-Armor Defense Data (A2D2) study for the US Army and British DOAE, under the aegis of noted British OR expert David Rowlands. A2D2 formed the basis for Jay's book *Against the Panzers*, co-authored by Allyn R. Vannoy and published in 1996 by McFarland & Co. of Jefferson NC. While at SAIC Jay also enjoyed designing databases, writing modeling and simulation software, installing and administering networks, and contributing to other small historical projects.



In early 1996 Jay left SAIC to form a software design company, C.K. Analytical Services Inc., with several childhood friends. So far, burdensome wealth has eluded them, so Jay has been sure to maintain ties with DMSI's successor organization, The Dupuy Institute. His consulting work for TDI has consisted primarily of assisting his old boss, Chris Lawrence, to compile and maintain the Kursk Database, and to oversee the physical construction of this newsletter via Jay's small computer graphics company, Olórin Press.

Jay lives in Vienna, Virginia, with his wife Maureen and two terriers, Darwin and Pixel. In his spare time, which amounts to about 20 minutes every other week, he paints Civil War miniatures, collects antique maps, designs computer wargames, listens to Celtic music, and works on the sequel to *Against the Panzers.*