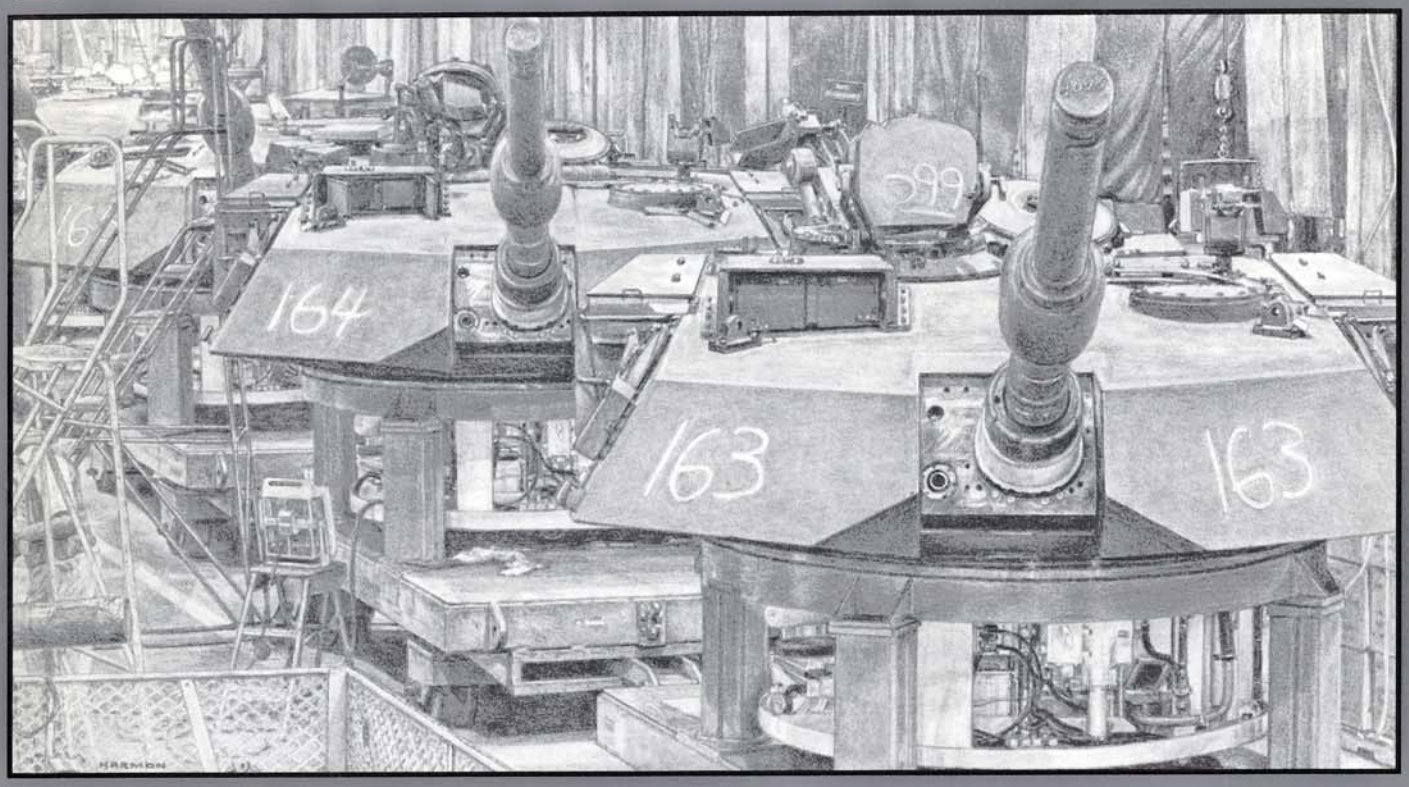
# ARMOR

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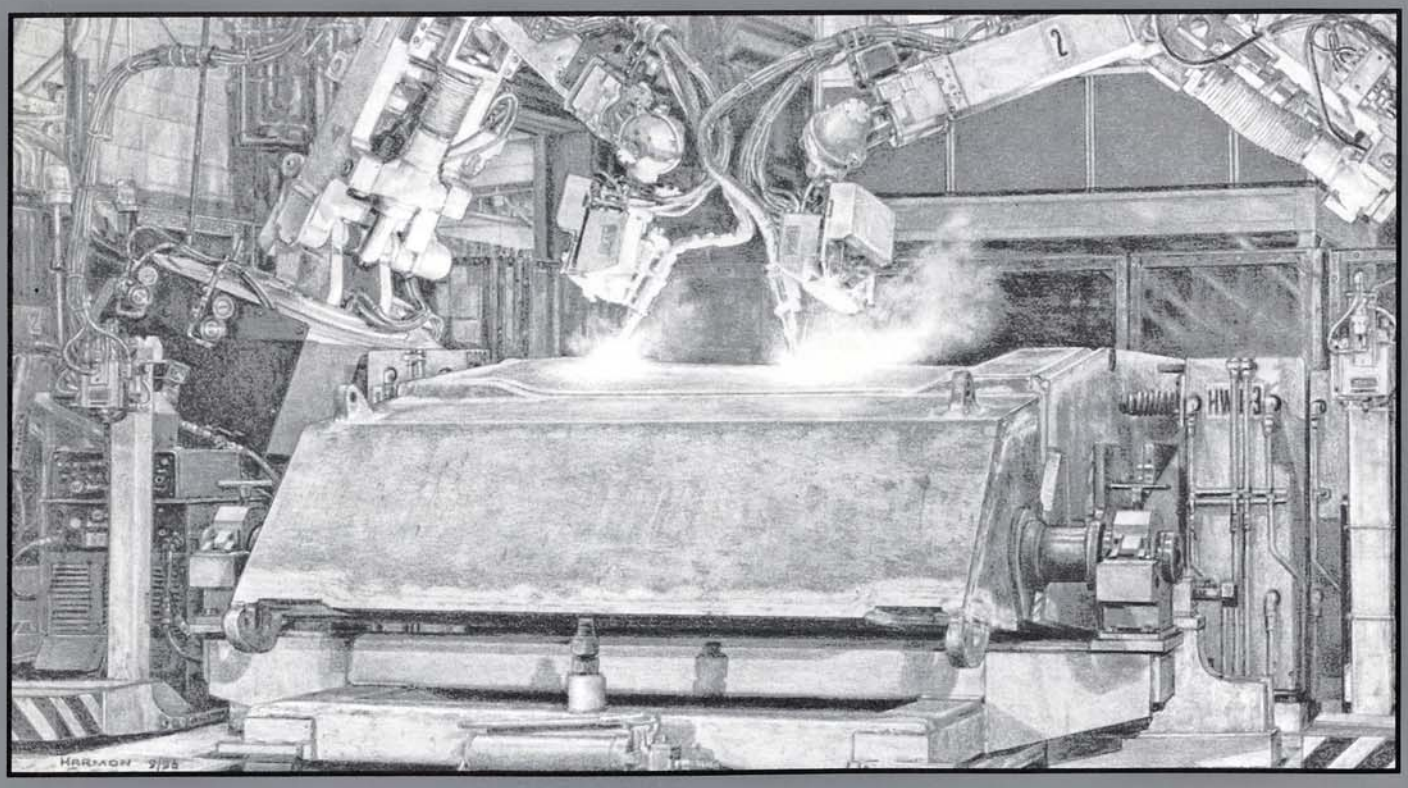

*PB 17-96-6*

*November-December 1996*


*"There is something rotten in the state of Russia."*

Through events that would make good theater if only they weren't so painfully real, we have seen the once-vaunted Red Army become its own worst enemy. The scene is the embattled and horribly scarred Chechen Republic. The protagonists and antagonists are — well, who really knows? The players are the soldiers of the Russian Army, troops from the Interior Ministry, and the Chechen natives who are outnumbered, out-gunned, and largely without external support.

Through the heavy door of censorship, we saw or heard tales of terrific gun battles and bombardments where the rebels consistently outmaneuvered and outshot a bigger and ostensibly better-organized foe.

What happened to the once respected Red Army which stood tall on the West German and Czechoslovakian border for so long? What happened to the army that learned its bitter lessons in the Afghan mountains? Why are armored and mechanized units making such basic mistakes as running into cities without scouts ahead?

Some say that we are finally seeing the real Russian Army which past propaganda — ours and theirs — built into a force more capable on paper than on the ground. Others say it is the logical by-product of a corrupt communistic society that is imploding like a star reaching critical mass. Those answers are too easy. I think the reasons are more understandable.

Like the Russians, we were faced with the monumental task of downsizing at the end of the cold war. Our nation's health demanded we reorganize, consolidate on the objective, and prepare for new missions. We did that, but thankfully our civilian and military leaders drew us down in as controlled a manner as possible.

What lessons should we learn from the Russian Army's Chechen humiliation? First, an army must learn from its mistakes and not repeat them. The Russians are relearning what they had already learned in Afghanistan: a dedicated home team has a tremendous battlefield advantage.

Second, that military measures only work in the long haul if the political directions guiding them are clearly understood. Recall the tragedy of errors in the relationship between Russian security chief Alexander Lebed and the onsite field commander. Negotiations with the opposition don't work well when the politician is saying peace is at hand and the general is already beginning another armored assault.

Third, we must never abandon the tactics, techniques, and procedures we've worked so hard to develop. Adapt them, yes, but reject outright, never.

Finally, we should never be so smug that we think our great army is immutable.

The army we have today is not the same army we will have in 2001, nor is it the same army we had in 1991, or 1972, or 1945. Those dates mark important times in our history, but they are only a part of what we are today. Yes, our core values remain constant. Doctrine is much the same. Leadership competencies are constant, but the skill and competency of individual soldiers, their units, and the larger units they comprise, is changeable. You want proof? Go around the staff table in a tank battalion, or walk down the motor pool line in a cavalry squadron, and find out how many of the soldiers and leaders are combat veterans in that unit, or in any unit at all. The numbers will be small, and this only five years removed from Desert Storm.

As we seem to be near the last step in downsizing, there are some other things to learn from the Russian experience. When funding cuts are the order of the day, when training opportunities decrease rapidly due to resource constraints, when leaders and soldiers alike feel alienated from the population whose bidding they are supposed to be executing, and when manning levels sink to levels that give too many junior guys too much responsibility too quickly, something very bad happens. In the business of warfighting, the first time your delusions of grandeur are exposed is when an enemy pops you between the eyes. That is much too late.

Is there any solace for us? Yes. As the Army's Chief of Staff, General Reimer, recently said, we are in good shape. I believe him. You should, too. We withstood a historical downsizing and emerged on the other end of it a leaner, meaner, and even more ready force than before. Feel good about it, because it sure didn't have to turn out that way. Look at our once able foe to see how fast and how far one can sink without a well-executed plan. Driver, move out. Gunner, continue to scan.

— TAB

By Order of the Secretary of the Army:

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*Chief of Staff*

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*Secretary of the Army*
02588

# ARMOR

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# LETTERS

## We Need to Invest In Peacekeeping Vehicles

Dear Sir:

I found COL Charles Lehner's "Bosnia Report" (May-Jun 96) and CPT Matthew Morton's "Balkan Report II" (Jul-Aug 96) to be informative and thought-provoking. My initial reaction was one of dismay, as both officers advocate the acquisition of non-standard vehicles, which would complicate the logistical and maintenance equations. After further contemplation, however, I have reached the conclusion that the authors are on the right track.

I am not sure how well suited the BV-206S would be to operation in other types of terrain — and I am more than a little uncomfortable with the articulated vehicle concept for general use — but for use in deep snow, the BV-206S seems to have proved itself. I am a bit puzzled by Tom Buonaugurio's letter in the July-Aug 1996 issue, wherein he states, "If a requirement for the (armored) BV-206S...does emerge..." Inasmuch as these vehicles are used for scouting and patrolling — combat duties — isn't the need for armor protection somewhat obvious? Indeed, why was the unarmored (SUSV) version bought instead of the BV-206S? *(The SUSVs deployed to Bosnia were from U.S. stocks stored in Italy. -Ed.)*

The use of the USMC 8x8 LAV also makes a great deal of sense for peacekeeping operations, if only to minimize damage to the road nets. As was pointed out, mission accomplishment and troop safety depend, to a degree, on the good will of the local populace, which is likely to be adversely affected if tracked vehicles destroy the infrastructure.

I must disagree with CPT Morton's view that the LAV-APC should be used because it offers a kinder, gentler image than tanks or M113s. It must be remembered that in peacekeeping operations, our forces are functioning as police. As such, we are there to preserve peace and order and, like a police officer, we must have the means — and it must be readily apparent that we do have the means — to inflict death and destruction on any would-be attacker; the LAV-APC lacks this ability. As was noted in COL Lehner's article, the "overwhelming firepower image" of the 1st Armored Division's tanks effectively underscored U.S. resolve in implementing the peace accords. This "big gun" intimidation factor should be included in any peacekeeping force, but in the form of the LAV-105, rather than the Abrams. The LAV-105 would be much more infrastructure-friendly and possess greater in-country mobility (on those narrow roads and MLC bridges) than the M1A1, with little loss of intimidation value or combat power; it would also have commonality with the LAV-APC CPT Morton proposes for use by the infantry squads.

During the Cold War, the senior leadership tried to avoid involvement in OOTW, considering such operations as distractions from the Army's only valid reason for being: Warfighting! All of the budget and all of the training was dedicated to preparing to fight a major war. With the demise of the Soviet Union, the U.S. Army was effectively without a mission. Now the leadership embraces participation in OOTW, but the budget is still being spent on equipment for a major war (a low-probability event), while spending almost nothing on equipment for OOTW (a certainty).

If U.S. soldiers are going to continue to play the role of international policemen in peacekeeping operations, they should be given the right tools for the job. Divert a small percentage of the funding for projects that may never be needed (MLRS, BAT, Crusader, etc.) and buy the BV-206S, LAV-APC, and LAV-105 vehicles that are needed right now by our peacekeeping forces; in the long term, the "major war" projects will not suffer excessively, and the peacekeepers will be properly equipped for their task.

STANLEY C. CRIST
San Diego, Calif.

## Mission Orders Concept Deserves More Than Lip Service

Dear Sir:

I appreciate the torrent of letters which followed my Jan-Feb 96 article, "Force XXI and the Death of *Auftragstaktik*." The response is exactly the sort of discourse I wanted to provoke. Personally, I really hope that the future which I postulated doesn't come to pass. On the other hand, is everything I suggested necessarily "bad"? As professionals, we should regularly reassess how we operate to determine (preferably BEFORE we make any changes) if we are executing to our fullest potential, and how we might improve still more. Different is not always bad. (I have to continually remind myself of that; I assume others do as well.) As a professional, I believe that my future, if not my life, depends upon the unrestricted and nurtured leadership abilities of our junior leaders. In my mind's eye, the Orwellian control by superiors displaced from the battle would equate to a death knell for our current primacy in military affairs. Independent action, the ability to make decisions, is the fuel which our Army thrives upon, especially in the combat arms. The *potential* future which I wrote about bodes ill for the development of the type of leaders I think we need. Yet I can also see that the same scenario could lead to quantum leaps in effectiveness. It remains for greater minds to determine how this tightrope should be walked.

My concerns were identified in the article; several others said, "This will never be," and I would like to agree. But we've also yet to take into account how the soldiers and leaders after us will fight. Perhaps more than other generation, those growing up now are unique in their abilities. They've been exposed to technologies which have, as a generation, made them almost a society apart. How will they fight? The uniquely Amerian Way of War has always taken advantage of our cultural biases and abilities. How will this new generation fit into our mold?

Right now, we preach *Auftragstaktik* (Mission Orders) to the exclusion of all other methods. We regularly claim to give subordinates the chance to use their initiative, especially in tactical matters. Yet at the same time, we produce 20-50 page OPORDS at the NTC and JRTC. In WWII, a Wehrmacht DIVISION OPORD was normally *verbal!!!* The best we can manage **might** be a five-page "matrix" order, and that is at the battalion level. Truth be told, while we say we want "Mission Orders," we practice "Orders Tactics" (*Behfelstaktik*). As an Army, we have yet to resolve this dichotomy. As much as we'd like to say that we promote initiative and subordinate control, how many have seen an attack at the NTC go off early, when the battalion commander saw an opportunity and thought he might get the jump on the OPFOR ahead of schedule? How about at company level? Platoon?

I am a strong believer in the concept of *Auftragstaktik;* I just have yet to see it in action. Perhaps when I do, I will also see true "maneuver" training at one of the training centers.

ROBERT L. BATEMAN
CPT, IN

## Maneuver Warfare: Change the Culture First

Dear Sir:

I am writing to address, actually add to, Captain Christopher D. Kolenda's excellent article, "Reconnaissance in the Offense 'Command Push' vs. 'Recon Pull'" (*ARMOR,* July-August 1996). As I write this letter, I hope to add flavor to Captain Bateman's article, "Force XXI and the Death of *Auftragstaktik*." Good try, Captain Bateman, but *auftragstaktik,* as it was truly defined and practiced in the German military culture from Gerhard Scharnhorst thru Helmuth von Moltke to Hans von Seeckt's creation of Blitzkrieg, has really never existed in our Army. Our promotion system

tends to punish officers of strong character, the very ones we need in battle.

I must address the cultural foundation our Army must adjust to prior to executing maneuver warfare techniques such as "Recon Pull." It is this institutional foundation which is disregarded or simply not understood when authors, such as Captain Kolenda, address facets of maneuver warfare or advocate borrowing from the Germans' well-tried approach to war. Because they fail to address the needed military culture, these authors leave their sincere attempts at making our Army even better open to simple critics on the attrition side of the Army. These critics refuse to change our French-based doctrine and antiquated personnel policies, such as "up or out," which deny us the experience needed to execute this facet of maneuver warfare or the warfare we envision in TRADOC Pamphlet 525-5, *Force XXI Operations.*

Now, more toward what "Recon Pull" really is. As Captain Kolenda states, the U.S. Army employs the opposite, command push. What we need to adjust to in Force XXI doctrine is where our reconnaissance is pulling the commander, in fact the whole force. When we begin an operation, we do not know where this will take us. We know only that we are going to destroy the enemy. Now the opponents have almost replied that one who practices maneuver warfare could carry this to the extreme and have a war that began in Kuwait going to China or somewhere, but we must pre-suppose we have a force of soldiers we can trust. It is not as if we have given them no guidance. It is not as if we have sent the mentally inept to risk their lives for us. If we do that, not only are we morally irresponsible, but we are naive if we expect success. If we are unwilling to enlist the most intelligent members of society, we will not have Force XXI operations. We will have victory only when lucky or against gross incompetence. The issue here is that war is uncertain. The enemy is not likely to do it our way. We need to be constantly exploring and exploiting.

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Our Army must encourage entrepreneurial soldiers as a revolutionary idea. Our Army must tolerate entrepreneurial officers — leaders, soldiers — as equally revolutionary. We did not have such an Army in Vietnam, Korea, or World War II, and we have slipped back into this mode now with the drawdown as an excuse. We won World War II and the Gulf War with the old kind of Army employing old "line up, tie in the flanks, and overwhelm with firepower" doctrine. Experience since then and against potential enemies shows that it does not work anymore.

Now, let me get back to "Recon Pull." The commander, being pulled along by his reconnaissance, is not some helpless figurehead at the mercy of his subordinates. On the contrary, it is he who makes the force act as one instead of many disparate and disconnected entities. It is paramount, as Major General Maggart has stated in many of his "Commander's Hatches," that leaders be up there — up front with the fighting infantry or the lead tank. The advanced technology we are now playing with in our Advanced Warfare Experiments, especially in information technology, will delude us. IVIS will be capable of fully informing a commander in a sophisticated command and control vehicle. Not only can he talk to nearly anyone he wants; today, he can see almost anything he wants on a television screen. Yet, this fully informed commander in his C3 vehicle suffers a number of disadvantages.

First of all, he will become removed from the atmosphere of the front. We are influenced every second of our lives by whatever atmosphere we are in. As the battlefront has its atmosphere, so does the advanced command vehicle.

The atmosphere is our surroundings - visual, audible, psychological, and moral. A commander cannot know *a priori*, the atmosphere at the front. It is unpredictable, fluid, and electronically untransmittable to that little box. That is, you have to be there to know it, or you will never know it. It only comes through years of experience doing it, making mistakes, and trying it again, something we do not allow. Instead, our officer management system has too many officers in line waiting for their turn in order to be fair. This level of experience is part of what makes warfare an art form, and not a technological solution, as many would like to believe.

The atmosphere of the battlefront may be unleashed aggression, comrades encouraging one another, helping those who are down, sometimes amazing patience for the sake of stealth, and recognition that every soldier counts. The atmosphere of the command vehicle may be anxious unreleased tension, impatience, and dominance by one individual. Influenced by the atmosphere of the command vehicle, the commander is out of touch. His subordinates at the front know it and feel it. At the front, he would make different decisions, more likely to be those his men on the front would make. At the front, he sees only a narrow slice, but it is a relevant slice. He has a staff that can dwell in the command vehicle and study the rest of it. He need not ignore them. Nor need he be held prisoner by them. For even their "board slice" of information is a narrow slice of atmosphere. So the commander seeks and probes, just as do the reconnaissance troops Captain Kolenda speaks of. He seeks to be at the decisive point. Accepting the uncertainty of combat, he is aware he cannot know in advance where that decisive point will be. Great commanders like Patton, or Rommel, who

*Continued on Page 51*

*MG Lon E. Maggart*
*Commanding General*
*U.S. Army Armor Center*


# Some Farewell Thoughts

As I complete my tenure as the Chief of Armor, I would offer these few thoughts for your consideration as you move on to positions of greater responsibility. After thirty years as a mounted soldier, they represent my perspective on what is important for the future of the mounted force.

Armor is the decisive force on the battlefield because of the skill, courage, intellect, creativity, and spirit of our soldiers. Equipment, no matter how sophisticated or deadly, will never replace the power that well-trained, well-led soldiers bring to the fight. We must train them to be aggressive, yet cognizant of the value of human life. We must teach them how to think, not what to think. And we must give the general guidance they need to accomplish the mission with the latitude to perform to their full potential. Nothing will smother the mounted force faster than centralized leaders who are afraid to operate with frag orders. Our job as leaders is to set the conditions for success. We must be technically and tactically competent, and we must be focused on selfless service to country, not on careers. It is far more important to end military service as a focused, dedicated, enthusiastic major than to be a colonel bitter over not getting brigade command.

While information age technology is both necessary and appealing, we are paid to close with and destroy the enemy. Technology will help us do that better, but it is no substitute for the warfighting spirit of our soldiers and leaders. In the future, leaders will have to work hard to instill in their soldiers the intense desire to move to the sound of the guns. Armor and infantry soldiers are a unique breed. They have to go where no one else wants to go. They must go where the battle rages, where danger and death are real, where fear has to be controlled just to survive. Mounted soldiers have to think quickly while fighting their vehicles, which are moving at high speeds over rough terrain, sometimes in the dead of the night, through blowing sands and/or driving rain storms. They have to do all this knowing that, in the end, they may face serious wounds or death.

Decisive battles in the future will not be fought by technologists in white lab coats using precision guided munitions to attack targets that are miles away. The preliminaries to decisive operations may be fought that way, but the ability of the U.S. Army to dominate the enemy will hinge on close combat, just as it always has. Closing with and destroying the enemy will depend on mounted soldiers and leaders who have the courage, skill, and desire to look the enemy in the eye and take him down. In the flood of technology, and the many advantages it brings, we must not lose the warfighting spirit that has characterized the mounted soldier throughout history.

While leaders today have many warfighting skills to master, some of which we are now just beginning to understand, leaders of the future will have to be as comfortable working with advanced technology as they are with a radio or a compass. The decisive battlefield will require leaders who are creative, innovative, and versatile. Yet we have no institutional or unit training that teaches these subjects. We will have to find ways to teach ourselves those skills. Leaders will find it necessary to be masters of digital architecture, tactical internets, and a host of other equally complicated applications. Tactics, techniques, and procedures for digital operations will be different from those in practice today. Therefore, while mastering the present, leaders must keep one eye trained on the current developments that will transition to future capabilities. Leaders must read, talk, and think about the implications of future warfighting now to be ready later.

The ability to communicate thoughts, ideas, concepts, and instructions will separate truly great leaders and units from the rest. In the final analysis, success will depend on your ability to formulate a vision (end state, concept, or intent) and communicate it on a personal level while setting the conditions which make open communication among the members of your unit not only possible, but imperative. Cohesion and team building are impossible in an environment where communications are restrained. A centralized leader will certainly achieve short term results, probably very quickly. But ultimate success rests on the contributions of everyone in the organization. Everyone won't contribute unless they feel free to speak their minds without fear of retribution or reprisal. A high perform-

*Continued on Page 51*

*CSM Ronnie W. Davis*
*Command Sergeant Major*
*U.S. Army Armor Center*


# Retention — A Need for Concern

"The Army enlists soldiers but retains families."

"Be all you can be, because we need you in the Army."

"We do more by 9 o'clock than most people do all day."

"From the hills of Bosnia to the rice paddies of Korea, the Armor/Cavalry soldier sets the example."

All of these themes have encouraged good soldiers to reenlist. In the midst of downsizing and the NCO downgrade program, slogans like these could become increasingly valuable to us in the near future. They can break the ice, provide a rallying point, or further a discussion of retention.

- How do we retain quality soldiers?
- How is the Armor force doing in the area of retention?

A noncommissioned officer's responsibility is to maintain the integrity and quality of the Armor force. We do this by putting quality soldiers in the right positions and providing them with career advancement opportunities that not only challenge them, but stimulate their desire to continue an Armor career. We need to emphasize retention opportunities and include the soldier's family in the decision to stay Armor or Cavalry.

This is too critical a task to be shouldered by the unit retention NCO alone. We must all stay abreast of current retention policies and options available for our soldiers. The intent is not to undercut the retention NCOs, but to supplement their expertise with sound career counseling.

This counseling can be formal, in the manner taught in PLDC, BNCOC, ANCOC, or in FM 22-101 (Counseling), but a number of other methods exist — back deck counseling, foot locker counseling, motor pool counseling, or shooting the breeze, just to name a few.

Whatever method you use, the desired outcome should be the retention of quality Armor/Cavalry soldiers. Only through open lines of communication can we make the soldier and his family aware of all the information necessary for a sound, intelligent, and informed decision on the advantages of staying Armor/Cavalry. It is better to retain one quality soldier than to allow two less-than-adequate soldiers to reenlist.

Now, how is the Armor force doing on the retention of quality soldiers? The chart is a snapshot of the retention picture in CMF 19. As you can see, we are below the Army average on initial reenlistments across the CMF, and slightly below the Army average in 19D mid-career reenlistment. The remainder of the Armor force is in line with the Army average.

So, the answer to the problem is relatively simple. We must work harder to maintain quality soldiers during their initial enlistment assignments and improve on our retention of 19D mid-career soldiers. We do this by caring for our soldiers and their families, educating them early on about their options, so when reenlistment time occurs there are no surprises, and placing them in the best possible position for promotion and advancement through schooling, Soldier/NCO of the Quarter/Year Boards, enrollment in the Excellence in Armor program, and induction into the Sergeant Morales or Audie Murphy Clubs.

I challenge all of you to heighten your awareness of retention, and to work diligently to retain those soldiers who will someday replace us as leaders.

| | 19D | | 19K | |
|---|---|---|---|---|
| | ARMY RETENTION RATE | MOS RETENTION RATE | ARMY RETENTION RATE | MOS RETENTION RATE |
| INITIAL | 35.6% | 31.2% | 43.5% | 39.2% |
| MID-CAREER | 75.3% | 75.0% | 73.1% | 73.1% |
| CAREER | 78.2% | 78.2% | 73.1% | 73.1% |

# Building Tanks at Lima

*For more than 50 years, this Ohio plant has forged the Army's heavy metal*

**by Captain Todd Tolson**

As World War II approached, the U.S. Army developed a plan to utilize industrial firms to manufacture armored vehicles. The urgent need for these vehicles was not fully recognized until the Germans' Blitzkrieg across Europe in 1939 and 1940. This situation presented a staggering mission for the Army Ordnance Department's new (1941) Tank and Combat Vehicle Division. In one year, over one million vehicles, including 14,000 medium tanks, were to be produced and ready for shipment.[1]

The Lima Army Tank Plant traces its 55-year history back to May 1941, when the Ohio Steel Foundry began building a government-owned plant to manufacture centrifugally-cast gun tubes. The site was chosen for its proximity to a steel mill, five railroads, and national highway routes.[2] Before construction was completed, the Ordnance Department redesignated the site as an intermediate depot for modifying combat vehicles, to include tanks.

In November 1942, United Motors Services took over operation of the plant to process vehicles under government contract. The plant prepared many vehicles for Europe, including the M-5 light tank, the T-26 Pershing tank, and a "super secret" amphibious tank intended for use on D-Day.[3] During World War II, the Lima Tank Depot had over 5,000 employees, including many women, and processed over 100,000 combat vehicles for shipment.

Activity slowed during the post-WWII period, and the plant temporarily became a storage facility. In 1948, tanks were dismantled and deprocessed there. Numerous tanks were "canned" and stored in cylindrical gas containers with dehumidifiers.

When the Korean War broke out, the depot expanded and industrial operations resumed. Over the next few years, the facility rebuilt combat vehicles and fabricated communication wiring harnesses. The Korean truce led to the depot's eventual deactivation in March 1959 with little other activity taking place over the next 16 years.[4]

A technician guides the giant crane that marries the hull and turret of an M1A1 tank. The two major components move down separate assembly lines — and the hull is test driven as a "convertible" —before this final assembly step.

In August 1976, the government selected Lima Army Tank Plant (LATP) as the initial production site for the XM-1 tank, and Chrysler Corporation was awarded the production contract. The method of production differed from previous armor programs; the hull and turret sections were to be fabricated from armored plate, rather than castings, allowing Chrysler to produce a lighter, stronger tank.[5] Since this was a government-owned, contractor-operated (GOCO) manufacturing facility controlled by the Army's Tank-Automotive and Armaments Command (TACOM), the installation was expanded and specialized industrial plant equipment purchased. A sister plant was established in Michigan, the De-

| TANKS | QUANTITY | | PRODUCTION DATES |
|---|---|---|---|
| M1 Tanks | 2,374 | | 1979-1985 |
| IPM1 Tanks | 894 | | 1984-1986 |
| M1A1 Tanks | 4,753 | (U.S. Army) | 1985-1993 |
| M1A1 Tanks | 221 | (U.S. Marines) | 1989-1991 |
| M1A2 Tanks | 62 | (New) | 1991-1992 |
| M1A2 Tanks | 206 | (Upgraded) | 1993-Present (Oct 96) |
| M1A1 Tanks | 18 | (AIM XXI) | 1996-(Jan 97) |

**Figure 1**

troit Tank Plant, to assist with the assembly of M1 sections fabricated at Lima.

On February 28, 1980, the first M1 tank rolled out of LATP. It was designated the M1 Abrams, in honor of General Creighton W. Abrams. The name, Thunderbolt, recalled the name Abrams gave to each of his seven tanks in WWII.

One of the original XM-1 prototype tanks is permanently on display in front of the Patton Museum of Armor and Cavalry at Ft. Knox.

In 1982, General Dynamics Land Systems (GDLS) bought Chrysler Defense Corporation and began producing the M1 at a rate of 30 tanks a month. By January 1985, the last M1 had rolled off the assembly line, and production began on the improved M1 (IPM1) the following October. The plant later transitioned to manufacture the M1A1, with the first pilot vehicle built in August 1985.[6] By the end of 1986, the plant's equipment was increased to meet a maximum monthly production capability of 120 M1A1 tanks. At that time GDLS employed over 4,000 workers in Lima with over 100 TACOM personnel monitoring the production and facilities contracts.

In June 1990, all government contract administration services at Lima were placed under the Defense Logistics Agency, Defense Contract Management Command, with TACOM as the procuring activity. During this period, the Marines received over 200 M1A1 tanks, and the first Abrams foreign military sales occurred. The plant supported Desert Storm by sending technical experts to Saudi Arabia for M1A1 fielding to units previously equipped with M1s.

The 1990 DOD base closure plan ordered the Detroit tank plant to reduce its operations, and in August 1991, the Lima Army Tank Plant became the only facility in the U.S. that is a hull/chassis/turret fabricator and final systems integrator of the M1.

The first M1A2 tanks rolled out of LATP in 1992 with upgrade versions produced in 1994.

## LATP Facilities

The commander of the Lima plant, a government-owned, contractor-operated facility, is an Army lieutenant colonel. The installation includes 370 acres and 47 buildings, it's own railroad network, and two government-owned railroad locomotives. There is also is a 2-mile test track, steam plant, deep water fording pit, 60% and 40% test slopes, and an advanced armor technology facility. The main manufacturing building has over 950,000 square feet of enclosed space, equivalent to approximately 30 football fields. The government owns all of the real property and over 96% of the plant equipment, to include computerized machines, robotic welders, plate cutters, large fixtures, and special tooling. General Dynamics is under contract to operate the facility and produce the Abrams with government oversight.

## U.S. Production

Abrams production originally occurred at the earlier mentioned two sites with over 9,000 Abrams having rolled off the assembly lines of these facilities, including those produced for domestic and foreign sales. Currently, GDLS is under a multi-year Army contract to upgrade approximately 600 M1/IPM1 tanks to M1A2. The plan is to upgrade 10 tanks a month over a five-year period. The cost of a new M1A2 tank is approximately $4.3 million.[7] Listed at Figure 1 is the current status of U.S. M1 tank production/distribution.

## Foreign Military Sales (FMS)

The M1's technological and tactical successes in Desert Storm made the tank the envy of the world armor community and generated foreign interest. Both Saudi Arabia and Kuwait now own M1A2 tanks produced at LATP. In a co-production program, M1A1 tank kits (hulls, turrets, components, etc.) are manufactured at LATP and shipped to Egypt for final assembly. Commercially, GDLS also produces "special armor" packages for the South Korean K1 tank. Abrams current foreign military sales are listed in Figure 2.

| COUNTRY | QUANTITY | PRODUCTION DATES |
|---|---|---|
| Saudi Arabia | 315 M1A2 | 1993-1995 |
| Kuwait | 218 M1A2 | 1994-1996 |
| Egypt | 100+ M1A1 (kits) | 1990-Present |
| South Korea | 1000+ Special Armor Packages | 1984-Present |

**Figure 2**

## Personnel

The government and contractor managerial staffs work together monitoring monthly production requirements while maintaining quality control. A partnership environment ensures the highest quality equipment is produced at a fair cost to the government. General Dynamics currently has over 400 employ-

ees at LATP to produce the M1. There are four military and over 60 civilian personnel assigned to Defense Contracts Management Command-General Dynamics, Lima (DCMC-GD, Lima). Government duties range from contract administration to production surveillance, quality control, and facilities management. The commander's vision is that DCMC-GD, Lima is committed to being a national center of excellence through innovative methodology implemented by motivated, qualified, empowerment teams.

### M1A2 Manufacturing, Machining, and Assembly

Rolled homogeneous steel plates go in one side of the plant, and 92 days later, a new M1A2 comes out the other.

The tank starts out as metal plates that are 3/8 to four inches thick and 8 by 12 feet in length and width. Two different machines cut the plates into tank parts. The oxyacetylene cutter uses a mixture of oxygen and propane gas burning at 3000 degrees Fahrenheit to cut metal plates. The machine is capable of cutting up to six-inch plates at about one foot a minute. There are two triple-head burners that have the ability to make 60-degree angle cuts and rotate 360 degrees.

Another machine, a plasma cutter, uses nitrogen gas to cut steel plates up to two inches thick at ten feet a minute. The cutter's flame burns at over 18,000 degrees Fahrenheit, which is over twice as hot as the sun's surface. Plates are flame cut underwater to disperse the heat of the flame and to reduce noise. Both the oxy fuel and plasma cutters are computer controlled, and templates verify that the cuts are made within tolerance. After cutting, the plates are ground to remove oxide prior to welding.

The turret is fabricated on a precast race ring. A hydraulic fixture aligns the six interior steel plates for welding. Three different types of welding are used for the turret: high deposition, pulse, and stick. Welders fill the gaps between the plates with enough weld wire to make the weld as strong as the adjoining steel.

The turret must be rotated vertically and horizontally to weld each joint on a horizontal surface. Normally, it takes several passes of weld wire to meet ballistic specifications. Overall there is

*"Rolled homogeneous steel plates go in one side of the plant, and 92 days later, a new M1A2 comes out the other."*

Above, stacks of steel plates, ranging from an inch to four inches in thickness, will eventually be cut and formed into M1-series tanks.

At right, the oxyacetylene cutter, which slices through steel with its 3000-degree torch.

Below, turrets have now been fabricated and sent to a secured area where the special armor has been installed.

New M1s negotiate the 60-degree slope and the 40-degree side slope during final testing. At left, an M1's seals are tested by fording in 4 feet of water. More than 600 checks are made by the contractor even before the government's final acceptance tests.

approximately 500 lbs. of weld wire in the turret.

The turret then goes to the secured armor technology building for special armor. Every M1A2 tank, foreign or domestic, has a brand new turret manufactured from "scratch."

The M1A2 hull is created similarly to the turret, except it starts upside-down. The side plates are locked into a fixture and the floor plates, nose and tail sections are welded in place. The nose section already has special armor enclosed. There is over 1000 lbs. of weld wire used in hull manufacturing. The hulls are placed in rollover fixtures and rotated horizontally to flame cut the openings for the final drive, torsion bars, driver's hatch, and floor holes.

Currently, the plant is only upgrading old M1/IPM1 hulls to M1A2, so hull manufacturing no longer occurs. The M1 hulls arrive by rail from Anniston Army Depot "sanitized" with all components and suspension removed. LATP cuts off the left side hull sponson to install the new sponson that is capable of supporting the improved NBC system. The original hull structure and serial numbers remain unchanged. Although all hull structures were fabricated at LATP, your tank was assembled in Detroit if the tank serial number starts with a D, and assembled in Lima if it starts with an L.

### Machining

Nine large milling machines drill, tap, and cut the top and sides of the manufactured hull. The torsion bar windows, final drives, and driver's hatch openings are all machined to a smooth surface. The hull race ring has 48 holes drilled and tapped to connect it to the turret.

The 15-ton turrets are machined in an upright position and held by a fixture transported on air pads (hovercraft-like) so they can be moved by one person. The turret's top, underside, and race ring are all machined in this fashion.

Appurtenances are the small metal brackets that attach components to the tank. These appurtenances are tacked and stud welded to the inside of the turret and the hull (sub-turret) floor. There are over 800 appurtenances used in the Abrams: 500 in the hull and 300 in the turret.

Prior to initial painting, the turrets and hulls are shot-blasted with metal particles to remove rust, markings, dirt, and oil. Shot blasting gives texture to the steel, creating a better surface for paint adhesion. The hulls and turrets then receive a primer coat, are dried in an oven, and finally receive a base coat of paint.

### Assembly

The hull and turret assembly lines move parallel to each other. Turrets begin assembly on fixed stands, where the ammo doors are installed. The 120mm cannon has already been fired three times at Aberdeen Proving Ground, Maryland, prior to installation. The turret is then placed on a mobile dolly, which is pulled down the line by an in-ground conveyor system. Components, cables, and the assembled turret basket are added during this period. Fully assembled, the turret is a completely/functional separate unit. The turret is then independently boresighted to align the sights and check the functions of the turret components.

The hull begins assembly on a fixed stand, where the torsion bars, roadwheel arms, and roadwheels are installed. Then the hull rolls down the assembly line on its own roadwheels. Rear fuel tanks, hydraulic lines, cables, slip ring, engine, and the track are

# LIMA VIEWS

ABOVE: The entrance to the new tank plant in 1942.

ABOVE RIGHT: In a 1952 view, bare cast hulls await installation of suspension components. Today's tank hulls are not castings, but are made up from plates of steel armor.

RIGHT: An impressive aerial view of the sprawling plant.

BELOW: In a 1950s photo, several divisions' worth of stored tanks form an almost abstract composition in this view of a large storage area at the Lima plant.

added next. Skirts are then attached and the hull is driven as a "convertible" to ensure that all components are working properly, and that there are no oil or fuel leaks.

Upon completion of the separate hull and turret tests, the structures are "married" with 48 bolts connected through the hull and turret race rings. With the connection of the slip ring, the component that communicates all electronic and hydraulic functions between the hull and turret, the vehicle is ready for testing.

### M1 Abrams Test and Final Acceptance

Before the government begins inspection, General Dynamics takes each M1 through extensive testing. The contractor makes over 600 checks to ensure safe operation. Each tank is driven 30 miles on an oval test track with a radar gun to verify vehicle speed. The tank then negotiates a four-foot water ford, drives over a bump course, travels on a 40% side slope, stops and starts on a 60% vertical slope, and completes prep-to-fire checks. A three-hour NBC test then verifies that the tank will maintain an overpressurized condition for long periods of time. After General Dynamics testing, the contractor turns the vehicle over to the government for acceptance.

On a full government inspection, over 180 checks are made to guarantee conformance to specifications. Normally, the government conducts between 40 and 60 checks, based on historical data and recent vehicle faults. Each M1 is driven an additional ten miles and tested by the quality specialist. If there are no deficiencies, the government accepts the tank. The vehicle then receives its final coat of paint, has decals added, and is loaded on railcars for transport within the U.S. or to overseas terminals.

## New M1A2 Developments

The pulse-jet air propulsion system (PJAS) was added to February 1996 M1A2 production vehicles. This system cleans the three air filters (V-Packs) automatically while moving through dust/sandy terrain. With the PJAS system, there is no longer a need to manually clean the V-Packs after a hard day of fighting at the National Training Center (NTC); PJAS will have cleaned the filters for you.

Several efforts have been made to reduce the weight of the M1A2. Aluminum has successfully been used to replace steel in the bustle rack, oil cooler cover, and other parts. Titanium is the latest metal introduced to the M1A2. Titanium is approximately 40% lighter than steel at five times the cost. Plans are to substitute titanium for the NBC sponson covers, turret blow-off panels, and Gunner's Primary Sight (GPS) covers in M1A2 tanks by the end of the year.

## The Future of Abrams

Modernization is essential for the Army; a smaller force requires increased lethality, and replacement of obsolete equipment. The Army will spend dollars saved by cutting selected programs on developing and improving critical systems, to include the Abrams tank. The technological advantage displayed in Desert Storm will be maintained by supporting soldiers with modern, advanced weapons.[8]

### M1A2 Domestic

There are two programs that will produce more M1A2s for field units. The Abrams upgrade program has received funding for five years to upgrade an additional 600 M1/IPM1 tanks to M1A2s for completion in 2001. The Abrams Integrated Management 21st Century program (AIM XXI) will modernize over 1,200 M1A1 vehicles starting in 1998. By 1999, the M1A2 Systems Enhancement Program (SEP) will upgrade the M1A2 fleet to a single enhanced configuration, horizontally integrating the Abrams within the Force XXI community with common hardware/software. Specifically, the M1A2 (SEP) will:[9]

- Enhance target detection with 2nd-generation FLIRs
- Store terrain maps and improve navigation
- Upgrade vehicle displays to color
- Improve communication within Force XXI
- Add a thermal management system to keep electronics cool
- Add an under-armor auxiliary power unit for extended surveillance operations with the engine off, reducing fuel and battery use.
- Provide growth potential for future technologies

### Future Abrams Family of Vehicles

The Army has pushed the common component chassis approach, using the same or similar M1 components for all Abrams variants. Current vehicle initiatives include the Wolverine Heavy Assault Bridge (HAB). This vehicle is capable of deploying a temporary bridge in combat, and is strong enough to support the Army's heaviest equipment. Production of over 599 vehicles will start in the year 1999 with the hulls possibly built at LATP. The Corps of Engineers is considering an Abrams chassis Combat Mobility Vehicle (CMV-Breacher). The Crusader, the Army's advanced field artillery system, and the Air/Ground Dual Role Defense System (AGDS, the Sergeant York replacement), may both be built with a modified Abrams hull.

In June of 1996, the Navy awarded GDLS the contract for the demonstration and evaluation phase of the Marine Corps' Advanced Amphibious Assault Vehicle (AAAV), a 37-ton armored personnel carrier designed on an Abrams chassis. This vehicle has a three-man crew and is capable of transporting 18 marines from 25 miles out at sea to shore in one hour.[10] Production of over 1,000 vehicles is projected to start in 2005. These initiatives capitalize on the benefits of chassis commonality, reducing developmental, production, and sustainment cost.

### Future Foreign Military Sales

Future foreign M1A2 sales are dependent on how the Abrams stands up to the competition. Our Allies all make modern battle tanks, but none compare to the current M1A2. Primary tank competitors to the Abrams are the Challenger II (Britain), Leo 2 Step II (Germany), Leclerc (France), and the Type 90 (Japan). The M1A2 outshines all armored rivals with its many unique capabilities and demonstrated superior performance.

Overseas opportunities for sales of over 1,200 new Abrams tanks look bright in the near future. In addition to its 315 M1A2s, Saudi Arabia has asked for pricing on another 150 tanks. Egypt recently contracted for 31 co-production M1A1 tank kits and asked for pur-

chasing data on another 100 vehicles. Kuwait has the potential for 38 M1A2 follow-on orders. During 1995, GDLS demonstrated the M1A2 in Turkey with stellar results. Turkey is expected to purchase more than 800 tanks initially in a co-production arrangement, and the Abrams is aggressively competing for the contract.[11] There is a potential for upgrading an additional 500 M1 tanks to M1A1 for sales abroad. Five European nations have expressed interest in obtaining upgraded M1A1s for their countries.[12] The Abrams may soon be the standard tank seen all over the world.

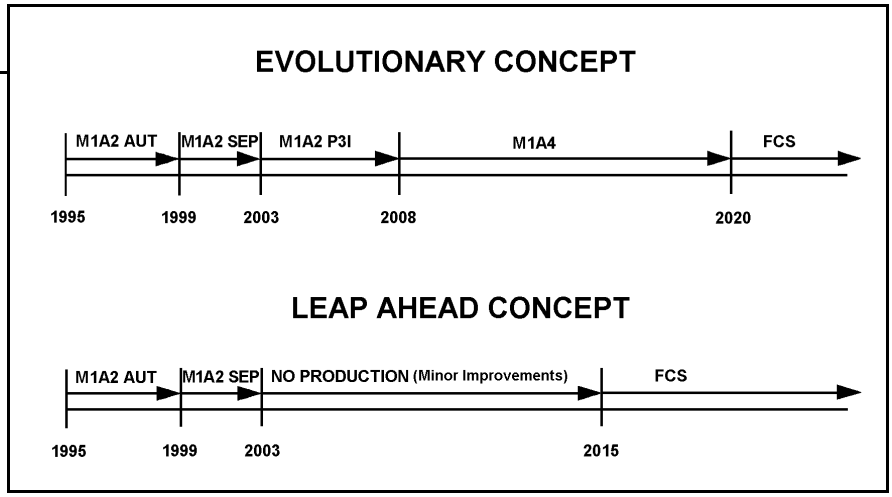


**Figure 3. Tank Modernization Options**

### Future Combat System (FCS)

The Future Combat System will be a tank radically different from the current Abrams design. The goal is a vehicle that weighs no more than 43 tons when fully combat loaded, operable by a two-man crew from a safe compartment. Other initiatives are an electromagnetic gun with an eight kilometer effective range, high-power-density engines, voice-activated system, and indirect vision technologies, giving the commander a 360-degree "virtual" vision system while sitting inside the tank. Many of these technologies are going to be fueled by the commercial industry; however, there is a concern on how quickly these complex systems will be available to produce a functional combat system at a reasonable cost.[13]

There are two competing "trains of thought" inside the Army on how to move to the next-generation tank (Fig. 3). The first school of thought is the "evolutionary" concept backed by the Army Science Board (ASB). The ASB wants to make incremental improvements to the Abrams until the technology is available to produce the FCS. Their concerns are that while a search for new technologies could bring improvements to the Abrams family, no such technology is currently on the horizon that would make it necessary and cost-effective to opt for a new tank prior to 2020.[14] Additionally, if the tank production line stays idle for about a decade, renewing production activities would be both very difficult and expensive. A "warm" production line must be maintained or defense contractors and sub-contractors will lose technological expertise and production capability in this critical sector of the defense industrial base.

ASB officials want to initiate two, successive interim Abrams improvements after the SEP and prior to introducing the FCS. The next tank could be a three-man-crewed M1A2 SEP preplanned product improvement (P3I) model, which could be fielded in 2003. The P3I package would include extended-range fire control systems, automatic target detection, helmet mounted displays, battlefield combat identification systems, autoloaders, and speech recognition systems, increasing the tank's lethality by 30 percent. In 2008, industry recommends an Abrams block upgrade (M1A4), which may include a an improved main gun, hit avoidance countermeasures system, top attack protection, countermine system, and engine upgrades. Another 30 percent improvement in combat effectiveness would result from those changes.[15]

A second school of thought is the "leap ahead" concept backed by Ft. Knox's Armor Center. The Center drafted an armor modernization plan that called for a FCS to be developed by 2015 and recommends that no further M1A2 Abrams production beyond 2003. All future research and development funds would be funneled to the new tank, making the M1A2 SEP the most advanced tank the Army will field until 2020, before the FCS is fielded in numbers.[16]

Ft. Knox has recommended that the Army initiate two studies to examine operational and industrial-based concerns. The armor community's tactical concerns are that units trained on M1A2s may be required to deploy overseas and operate pre-positioned M1A1s. Also, the aging of the Abrams fleet could reduce U.S. deterrent credibility in the world. Industrial concerns are the possibility of ceasing Abrams production at LATP and the adverse impact on the U.S. production base for armored systems.[17] General Dynamics builds tanks with the support of 146 contractors and 400 vendors in nearly 40 states. The "leap ahead" option has higher risk, but is potentially the lower cost option and allows for using all available armor funds to achieve a next generation battle tank in the earliest amount of time. A Congressional Budget Office (CBO) report stated that canceling the M1A2 production and preserving the production facilities in a "mothballed" status could save the Pentagon significant dollars over the next six years.

Recently the Armor Caucus, composed of the Army's senior leadership, concurred with Ft. Knox's "leap-ahead" recommendation to start development on the FCS. However, the program executive officer for armored systems modernization (PEO ASM) has supported the ASB results and advocated to the Army's Vice Chief of Staff, an incremental "evolutionary vs. revolutionary" approach to an FCS through continuous improvements to the Abrams tank. The belief is that the Army should continue to produce tanks at a rate of 120 per year until the force is ready to begin procurement of the FCS. Additionally all M1A1s and M1A2s should be refurbished through the AIM programs with continuous technology improvements for the Abrams fleet through 2010. Financially, the Army will eventually have to commit to either the Abrams improvement or an FCS development: the service cannot afford two tank systems.[18]

Ft. Knox is crafting a modernization plan in cooperation with PM Abrams, TACOM, and the Army acquisition executive's office to address the future

needs of the armor force.[19] Technology studies are occurring now to support this effort. No matter which path the Army take towards tank modernization, the FCS will undoubtedly be the most lethal ground vehicle the world has ever known.

## Conclusion

From 1941 to the present, the Lima Army Tank Plant has established a record of mission readiness and accomplishment through teamwork with employees, contractors, and the surrounding community. This effective partnership has built a critical industrial base for national security in Lima, Ohio, including a reservoir of skilled and flexible workers. These workers — Army, contractor, and civilian — produced the M1 Abrams tank along with some of its predecessors in U.S. tank lineage and contributed directly to military victories from WWII to Operation Desert Storm. They are capable of meeting new challenges in an equally successful fashion.[20]

You now have insight on the past, present, and future production of the M1 tank and Abrams family of vehicles. Although there is talk of new technology, unmanned machines, and light armored vehicles, the M1 tank will be around for at least the next 20 years and presumably will be manufactured in Lima. The contractor and government personnel at the Lima Army Tank Plant are dedicated to providing you with the highest quality tank products as we move into the 21st century. If you are in the Midwest, try to take a detour to the birthplace of the modern Armor Force, the Lima Army Tank Plant.

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[12]Briefing made by Mike Dupree, GDLS, at an Abrams Program Review, 19 June 1996, information approved for release by Pete Keating, GDLS.

[13]Ross, pp. 27, 30.

[14]Sherman, Jason, "Science Board Study Recommends Continued Upgrades to Abrams Tanks," *Inside the Army,* May 20, 1996, p. 8.

[15]Ross, p. 24.

[16]Sherman, Jason, "Army Commits Funds for Future Tank Development," *Inside the Army,* April 22, 1996, p. 13.

[17]Sherman, "Armor Caucus blesses Future combat System, Directs Technology Review," *Inside the Army,* June 17, 1996, p. 12.

[18]Sherman, Jason, "Longhouser Presses for Continued Tank Production and Improvements," *Inside the Army,* July 29, 1996, pp. 11-13.

[19]Sherman, p. 13.

[20]Houshower, p. 9.

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## PART II - THE OFFENSE

# M1A2s, Smart Ammunition, And Time and Space Theory

**by Captain Mike Pryor**

Photo by Greg Stewart

In the January-February 1996 *ARMOR*, I offered the theory that M1A2s with smart ammunition in the defense could destroy enemy armored vehicles at an amazing **11.5:1** ratio. This theoretical capability is the result of increased space and corresponding time provided by the Smart, Target Activated, Fire and Forget (STAFF) round's range, combined with enhanced digital battle command. These factors increase our lethality and situational awareness on the modern battlefield.

But what happens when we are not defending? Can we still see a quantitative increase in our ability to destroy enemy vehicles offensively? The answer again is, yes. An attacking, pure M1A2 company can potentially halt an attacking Threat motorized rifle regiment (MRR) in a meeting engagement/battle. This is proven in time and space when we consider several assumptions.

### METT-T Assumptions

**MISSION:** An M1A2 company attacks in order to halt enemy offensive operations in its zone.

**ENEMY:**

- The attacking MRR is BMP-2 and T-80 equipped, is at 100% strength and executes standard Threat meeting battle doctrine.
- The MRR deploys a Combat Reconnaissance Patrol (CRP), a Forward Security Element (FSE), and a motorized rifle battalion (MRB) as its Advance Guard main body.
- Threat forces move at a constant speed of 20 kph (50m every nine seconds).
- Threat forces maintain maximum doctrinal intervals for their formations.
- For the purposes of this article, enemy air is not introduced.

**TIME AND SPACE:**

- All tanks in our company fire at a constant rate of one round every nine seconds.
- On the move, we travel at a constant speed of 20 kph.
- We open engagement of the enemy at the STAFF round's **4km** maximum effective range.
- We want to maintain the maximum distance possible from the enemy in order to enhance force protection.

**TROOPS and EQUIPMENT:**

- We lead an M1A2 tank company at 100% strength.
- Each tank has a combat load of 40 STAFF rounds.
- All tanks have a proper boresight.
- No tanks experience a weapon system malfunction.
- No tanks in the company are lost to enemy fire during the engagement.
- STAFF rounds kill with a constant 40% probability of kill (**.4Pk**) over any distance out to 4000 meters.
- Enemy locations are constantly reported and updated on our IVIS system.

**TERRAIN:** We fight on terrain that is gently rolling, open and wide enough for the Threat and our forces to maintain formations.

### Calculations

The assumptions above lead us to several key facts. First, attempting to prove the theory in the context of an attack/meeting battle provides us with the least battlefield time and space. In the defense, our static position coupled with the Threat's constant 20 kph speed gave us a closing distance and time of 50 meters every nine seconds.

When our tank company is also moving at a constant 20 kph speed in the offense, we close at 100 meters every nine seconds. In order to buy back the balance of time and space lost between defensive and offensive operations, we

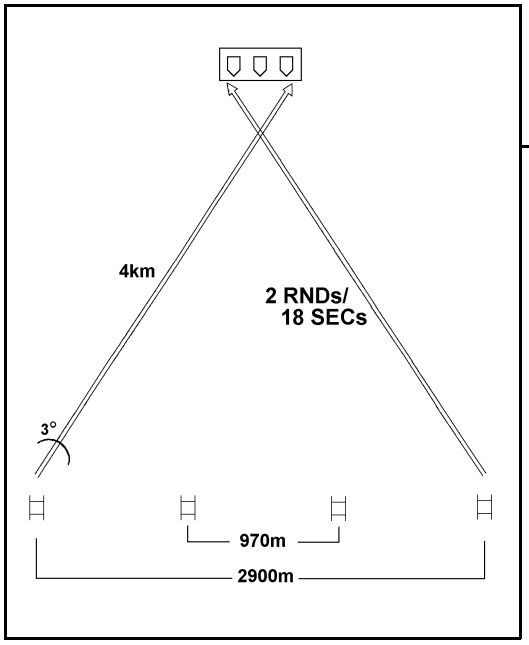



**Fig. 1**

must increase our firepower. Hence, a company-sized attack.

A second key point concerns targeting. A .4Pk means we must fire 2.5 rounds (in 22.5 seconds) to destroy a target. Even though STAFF rounds seek out their victim, at least to some extent, we cannot blindly fire downrange believing we will kill targets — enemy vehicles must fall within the round's footprint. (For the CRP, we have three degrees of aiming arc at 4km in which to find a target; for the FSE and main body, six degrees per MRC-sized element.)

So, once enemy positions are downloaded onto our IVIS, we need a means of orienting our main gun in the proper direction.

Finally, our closing distance and time coupled with the .4Pk yields the following calculations:

• **Engaging the CRP.** (See Fig. 1.)

+ This element closes with us at 100 meters every nine seconds.

+ It will take one of our platoons two rounds per tank and 18 seconds/200 closing meters to destroy them.

+ Since only one platoon is needed for this engagement, the rest of the company can disperse. For near flanks of the other two platoons to remain "tied-in" to the center, engaging platoon, the company can maintain a 500 meter distance between elements. This dispersion only allows the commander virtual battle command of his company. He cannot "see" his entire element at all times, but force protection is increased. So dispersed, our company frontage is approximately 11 kilometers.

+ For all tanks in the platoon to range across the (doctrinal) space occupied by the CRP, we cannot maintain a frontage greater than 2900 meters.

• **Engaging the FSE.** (See Figure 2.)

+ In approximately nine minutes, the FSE closes to within effective range of our company.

+ To achieve company mass for engaging the FSE, we must shrink our 11 kilometer frontage. A five kilometer frontage allows us to "see" all of our elements, maintain proper battle command, and mass our fires. Maneuvering to this point, flank platoons must move at an inward, approximately 45-degree angle for five kilometers while maintaining their constant speed. This closes the company at 4500 meters from the FSE. It also provides us 45 seconds for company/platoon/crew fire commands.

+ We must initially be able to range half-way across the FSE and 100 meters deep with our far, flank tanks to provide appropriate mass. To do so, the company is in a loose Vee formation, 600 meters deep, with 350 meters between tanks.

+ It will take our company three rounds per tank and 27 seconds/300 closing meters to destroy the FSE.

• **Engaging the Advance Guard Main Body.** (See Figure 3.)

+ In up to another nine minutes, the Advance Guard main body comes into engagement range.

+ Our frontage is the same as when attacking the FSE. Each platoon engages one MRC of the Advance Guard in a frontal or cross pattern of fire. All tanks can range across MRC formations and 100 meters deep to open the engagement. Our formation depth, however, shrinks to 300 meters.

+ Our company must fire nine rounds per tank (in one minute, 21 seconds/900 closing meters) to destroy this element. We close to within 3100 meters of the enemy. While this does not favor force protection against ATGMs, it is still outside of maximum effective T-80 main gun range.

+ By doctrine, inability of the Advance Guard to halt our attack dictates a hasty defense by the enemy and provides us with mission success. We must now execute a sequel to our plan that meets the higher commanders' intent.

• **End State** (based on assumptions and the scenario above). From the first round fired, none of our tanks have expended more than 14 rounds, leaving us with enough to destroy about 140 more enemy vehicles. Our attack traversed almost 12 kilometers in just under 20 minutes.

By comparison, we have just about equaled the destruction wrought by H.R. McMaster's cavalry troop in the Battle of 73 Easting during Desert Storm. However, our round expenditure, engagement distances, and situ-

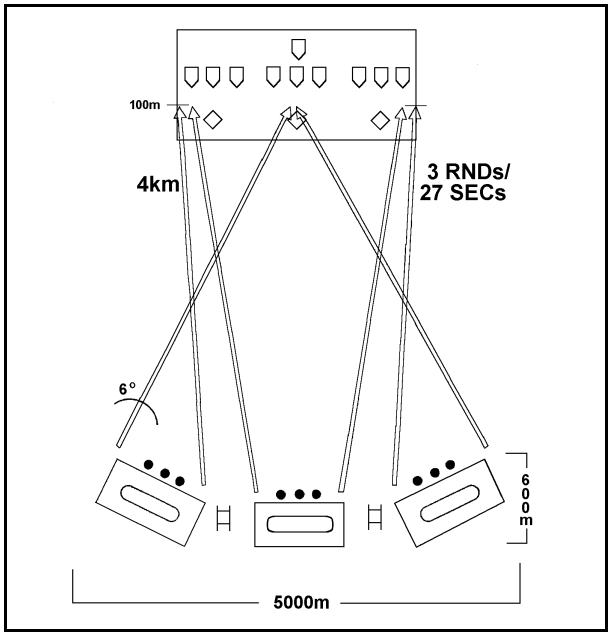



**Fig. 2**

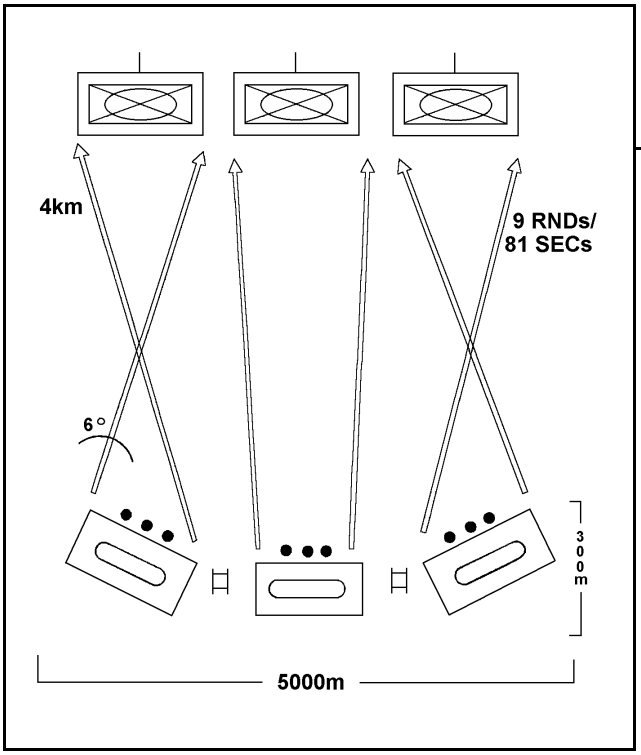



**Fig. 3**

ational awareness are quantitatively improved.

### Capabilities

The above shows us it is possible to launch a tank company at a much larger, moving enemy force and destroy them bluntly in head-to-head confrontation. This is a non-maneuver warrior's dream. But what if commander's intent stated that our goal is to maximize dispersion for force protection and attack the enemy throughout the depth of his formation simultaneously within the capabilities of the company?

We know that the M1A2 company has the ability to destroy the Advance Guard. We are aware that we have more space and time when using the STAFF round's maximum effective range to open engagements. We also understand that the M1A2 provides us the means to both maneuver with greater speed and exercise battle command with greater precision.

It is therefore possible for one platoon to attack the CRP, two platoons to attack the FSE, and, with artillery support, for the company to place fires on the Advance Guard main body simultaneously. After destroying the CRP and FSE, we then mass the company to attack the Advance Guard main body. Time and space figures for maneuvering elements in this manner are a bit more complicated to calculate. However, the conditions surrounding our task are no different.

Our problem then, is one of battle command because of platoon dispersion. The company commander's battlespace is now tens of kilometers deep and wide for the initial attack. But without constant scrolling, his five-by-five kilometer IVIS screen does not allow him to "see" more than the platoon with which he maneuvers. A radical rethinking of the tools we provide the commander for his trade may be in order.

### Digital Thoughts

The ability to attack and destroy an MRB(+) with one M1A2 company in 14 rounds/under 25 minutes/approximately 16 kilometers is revolutionary. This revolution, as with the platoon in the defense, raises both observations and questions about our digital force:

- A first, arrogant thought might be, "Who needs to task organize?" However, a thinking man would call for equipping the infantry with a faster antiarmor projectile (LOSAT?) that can be carried in greater quantity than TOW missiles. (We will not always fight entirely armored forces on prime tanker ground.)

- A distinct depth and frontage correlation is evident in offensive calculations: the wider the enemy's frontage and greater his depth, the narrower (to some extent) and shallower our company formation must be.

- Capabilities of an M1A2 platoon underscore the need to train that echelon and their leaders to proactively identify when and where to engage in combat and determine the time and space needed to complete the task.

- What is the proper training goal for our company or its parent battalion? Our rapid tempo can regularly close engagements and battles faster than ever before. Theoretically, it is also possible that a battalion(-) has the ability to ATTACK to halt an enemy division's unwanted incursions. Does this mean company and battalion commanders conduct operational maneuver for strategic objectives? How and when do we begin to teach them to think that big?

- As illustrated above, we can spread elements over vastly greater distances. Would a company commander then not need the ability to "see" all of his elements in order to properly command and control them? If he is to "see" everyone, he needs a screen that shows more than a five-by-five kilometer box. Or, to take a walk on the far side, is a traditional, fighting company commander no longer needed? (It is evident that the above attack did not need to end with the Advance Guard. The company still has the ability to destroy enemy forces in great number. The commander of this element needs to see deeper before this fight is over in order to continue the attack and may not be able to do so if involved in the direct fire fight. For a commander to be successful in this enhanced role, will he have to remain a platoon leader for a much greater period of time?)

- While simultaneously attacking the enemy throughout his depth, we disregard traditional notions of a company formation. Two platoons forward and one back constitutes a company Vee formation. But does it remain a viable formation when we spread out over tens of kilometers with platoons alternating in defensive and offensive posture? Do we want to do this at so low an echelon simply because we can?

- How do we test these (and defensive) theories other than in the virtual world? We need a MILES-like system upgrade that replicates our direct fire time and space capabilities. Additionally, the size of the Combat Training Centers OPFOR must be increased appropriately. The current family of TADDS also needs modification to replicate our true capabilities.

# *Last Original M1s Retired from Active Duty*

The last original model of the M1 tank has been retired from duty in the active Army, an event marked by a brief ceremony at the Burke Motor Pool, Fort Knox, on September 16.

HHC, 2-81 Armor of the 1st Armor Training Brigade used this early model of the M1 to train National Guard and Reserve units. It was the last active duty unit to carry this model in its inventory.

The original M1 revolutionized the Army's combat capabilities and marked a turning point in U.S. tank development. Its most impressive feature was its special armor, a composite "sandwich" of steel and other materials capable of defeating HEAT rounds in addition to kinetic energy penetrators. The M1 was faster and more maneuverable than its predecessors in the M60 series, while offering a lower, smaller silhouette. It was constructed of flat armor sections welded together, rather than armor castings, the method used in earlier U.S tanks (see the Lima Army Tank Plant story on page 7, this issue).

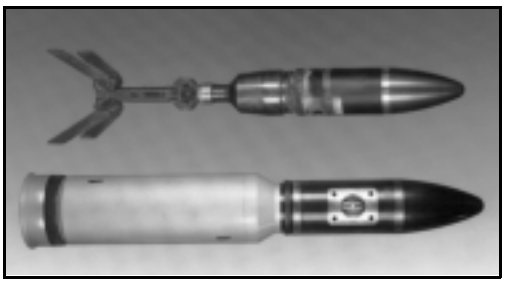
The earliest M1s were armed with the M60's 105mm rifled cannon, a British design first adopted to the final versions of the old M48 series. Subsequent M1s were upgunned with the German Rheinmetall smoothbore cannon of 120mm.

Another revolutionary feature of the first M1 tanks were their turbine engines, replacing the diesels that powered the M48 and M60 series tanks. The engine change, despite a penalty in fuel consumption, resulted in much quieter operation, so much so that soldiers encountering the tank in early maneuvers dubbed it "Whispering Death."

The Fort Knox armor unit's 10 M1s being retired from active duty will be rebuilt as M1A2s. Meanwhile, the unit was to receive M1A2s as replacements.

## SMART AMMUNITION, *Cont'd*

• We know our speed, shock effect, and stand-off capabilities can carry us through the direct fire fight. However, the advent of smart mortar and artillery rounds presents a real threat to our force. Consequently, counterbattery fires are needed to provide true force protection. Could it then be that a fire support element complete with FIRE-FINDER Radar and a DS artillery battery is attached down to the company level?



**XM943 STAFF ROUND**

• In (defensive or) offensive operations, the enemy's numerical advantage and subsequent ability to mass fires is functionally dislocated by our battle command enhancements and STAFF round effective range. The enemy's best way to counter this is to either seek out our technology for himself or tactically maneuver his current force to close direct fire distance faster. He also needs to consciously attack our ability to conduct information operations. If he cannot execute any of these options, a very temporary fix may be to seek more combat support fires. With no other options, might he use either weapons of mass destruction or directed energy weapons to meet his goals?

• Our CSS assets need the ability to cover more distance at a faster speed with larger quantities of CLASS III in order to support offensive operations. Based on this (and the earlier defensive theory), we should use less CLASS V than we do now.

### Conclusion

I believe an M1A2 tank company can theoretically attack and destroy an enemy Advance Guard battalion (+), halting an MRR attack. Our ability to conduct offensive operations at greater than a **1:3** ratio in quantitatively increased battlespace is quite revolutionary. However, it calls into question many of our long held notions about battle command, organization, and doctrine. We must now proactively seek answers to these questions if we are to fully exploit digitization. I urge all soldiers to stress digital capabilities to their actual and theoretical limits. In so doing, we can make this warfighting leap a very long one.

*I would like to acknowledge appreciation for the critique and comments on this article by COL (Ret.) Joe Strickland and 1LT Pete Robertson.*

Captain Mike Pryor was commissioned in Armor from New Mexico Military Institute's Early Commissioning Program in 1984. He completed his bachelor's degree in political science from the University of North Texas. He is a graduate of AOBC (Cavalry), $SC^3$, $TC^3$, (M60A3 and M1), TLIC, NBC Defense, IMPC, the III Corps MOUT Trainer's Course, AOAC, and $CAS^3$. He has served as a cavalry platoon leader, troop XO, S3 (Air), adjutant, and troop commander with 1-124 Cavalry, TXARNG, and as an S3 (Air) and company commander with 1-156 Armor, LAARNG. He is currently the S3, 1-156 Armor, LAARNG.

# Proof Positive

*Joint Live Fire Testing Assesses the Lethality And Protection Of Our Own Equipment And Foreign Materiel*

**by Thomas Julian and Robert Wojciechowski**

A typical target, the BMP 2 is to be tested against the Javelin antitank missile. (Story photos supplied by U.S. Army Test Center, Aberdeen Proving Ground, Md.)

The Joint Live Fire (JLF) program was initiated by the Office of the Secretary of Defense (OSD) in March of 1984 because there was no formal process to test fielded U.S. systems against realistic threats.

The cold war was intense at the time. There was great interest in assuring effective capability, and a need to accurately determine the effectiveness of U.S. systems against the Soviet threat.

The U.S. had been successful in acquiring a significant stock of threat systems; we knew what they had, but we did not know how well their systems stood up against ours, and vice versa.

The Joint Live Fire program was chartered to focus, through live firing of real munitions, on the vulnerability of fielded armored vehicles and combat aircraft against actual threat systems, and the lethality of U.S. munitions against those threats.

OSD provides the program funding, buys the test articles, and provides technical oversight. The Joint Technical Coordinating Groups (JTCG) for Aircraft Survivability and Munitions Effectiveness administer the programs. The JTCGs, under guidance from OSD, directly coordinate test planning and program direction while the individual services execute and support the tests.

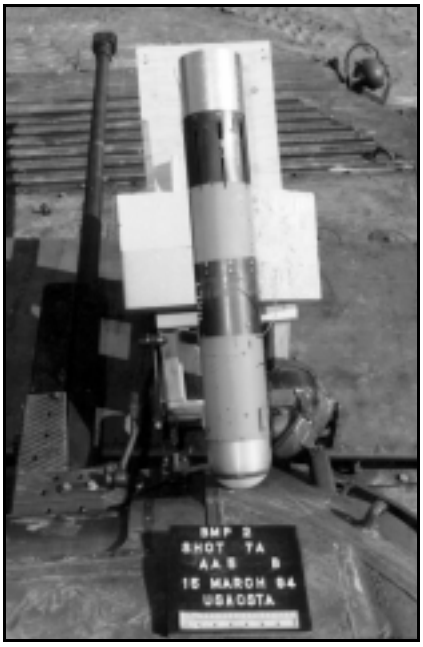
There are two distinct divisions of the JLF program, Aircraft Survivability and Armor/Anti-armor. The program has four primary objectives:

- Establish actual test data on the vulnerability of fielded U.S. systems to actual threat weapons, and the lethality of fielded U.S. munitions or missiles against threat targets.
- Provide insights into necessary U.S. system design changes, such as moving ammunition storage racks to provide greater protection to the crew members.
- Develop Battle Damage Assessment and Repair (BDAR) information to enhance equipment repair in the field for restoration into the battle.
- Provide insights into lethality and vulnerability modeling and simulations that are used in live-fire testing of new systems. The information also helps train soldiers, for example, by enhancing crew training to better report the results of firing engagements at threat systems.

Initially, JLF was a program covering a selected set of front-line U.S. systems. However, there are numerous systems which might be involved in combat beyond those selected or initially imagined, plus the potential new threats that are always evolving, so the program has continued to meet a never-ending need. Initially, the Navy was not involved in the JLF program, but the program has been expanded to include testing of surface ships.

There have been tests of numerous aircraft and armored systems since the program started. Much of the Army's current helicopter fleet (AH-64, UH-60, AH-1S), many Air Force and Navy front-line aircraft (F-15, F-16, F-18, A-6, AV-8A/B) and several Soviet attack helicopters and fighters (MI-24, MIG-21, MIG-23) have been tested. Additionally, most of the Army and Marine Corps armored combat vehicles (M1/M1A1, M60, M48, M2/M3, M113, AAVP-7, LAV-25) and several Soviet armored systems (T-62, T-72, BMP, BRDM) have been tested to determine the vulnerability of U.S. systems to threat systems, or the lethality of U.S. weapons and ammunition (M829, M919, M791, TOW, Hellfire, etc.) against threat systems.

While the JLF program conceptually may have spawned interest resulting in the Congressionally mandated Live Fire Test (LFT) program, each has its own area of applicability. The LFT program focuses on new systems in development, or systems that have product changes or improvements that involve vulnerability or lethality. The driving interest in LFT is to include live-fire testing early in the system acquisition processes, complete the testing, and identify appropriate design changes prior to a decision to proceed beyond low rate initial production. The JLF program focuses on fielded systems which have raised questions involving




Javelin missile is placed at preplanned impact point prior to test.

The BMP at moment of Javelin warhead ignition. Note armor plate shields around test area to ensure safety.

live fire exposure, or where threat weapon systems change.

JLF often discovers small changes that have large impacts on survivability. These items have developed as a result of JLF, for example:

- Jam-resistant actuators for aircraft which are both lighter and more survivable
- Shielding of critical components of a system
- Adding extra wire to improve redundancy
- Moving detectors to improve warnings
- Modifying software to enhance operations
- Revising stowage to save lives
- Shock mounting soft components to provide durability
- Changing fasteners to create better access
- Fuel management changes to improve efficiency
- Changing trigger pull thresholds so soldiers can better use their equipment.

These and many other beneficial improvements have been the large payoffs from small changes brought about from the JLF program.

The program offers many benefits not available from other sources. As mentioned above, funding for the program is provided from the OSD budget, and administered by the Joint Technical Coordinating Groups. OSD also provides the target materials, if the encounter is a U.S. system lethality investigation. In practice, the service involved provides test support from its own resources as well. The service may also provide the U.S. system employed in the test, its ammunition, its operating crew, and the range facilities and range support.

As new systems arrive on the battlefield, threats change. Fielded systems are developed, based on the threat envisioned during early development of the system, and no matter how accurate the attempt at threat definition, the actual threat is always going to be different from that envisioned. Political alignments also change as the world situation evolves, as evidenced by the multiplicity of new U.S. interests since the breakup of the Soviet Union. The end of the cold war has brought new realignments, and potential involvements for U.S. forces not previously anticipated, either as combatants or in a peacekeeping role.

Coupled with the changing political scene, the reality is that weapon systems placed in the hands of troops now will be in use for several decades. The current U.S. Army truck fleet is running an average life of about 30 years, and counting. The UH-1 helicopter continues to be a robust system. While technology makes great strides, the service life of our deployed systems will continue to be extended.

Even though the system must undergo its mandated live fire testing before it can be produced in quantity for issue, it is likely that the threat facing the system during its operational life will be different from that it was designed for, or the need for improvements may become obvious under actual employment conditions. Questions of survivability and lethality always arise, which need to be answered by joint live-fire testing.

JLF also tests foreign vehicles or munitions, to determine the effectiveness of non-U.S. munitions and systems and to discover the pros and cons of a system's attributes that make it survivable. An example of this concept might be the M1 tank series, which has completed its live fire test, but, if a new threat develops, JLF will test that threat against the M1.

In a test in Nevada in 1995, a focus was on battlefield damage assessment of threat armored vehicles fired on by U.S. tank guns. The test determined what crews could expect to infer from through-the-sight observation of an impact. Aggregated Desert Storm data, from both Army and Air Force sources, based on BDA supplied by U.S. system operators, scored more than twice the number of Iraqi tanks killed than were present in the theater. This was a clear overestimation of the kills that actually occurred. In last year's JLF test, two

Mannequin representing BMP crewman after test.

different tanks, a T-62 and a T-72, plus a BMP armored personnel carrier, were fired on, using actual combat munitions and gunners. The targets were observed through the gunner's sight of the firing vehicle and through the sight of a companion vehicle during the firing. Even when it was clear the target was hit, it was not possible to determine whether a target perforation (hard kill) had occurred. Data was collected, however, to suggest state-of-the-art signature processing technologies could be employed to provide the crew a positive indication of perforation (hard kill) vs. nonperforation (damaged, but not a kill) in real time. If a kill determination was dependent upon the occurrence of a perforation, the JLF test confirmed that other sensing techniques would be needed. In addition to the daylight sights, use of thermal sights were also evaluated and, although what was seen was different from the daylight sights, the perforation conclusion still held. It was also determined, by placing an earth berm in front of the target, that a hit on the berm looks very similar to a hit on the tank when viewed through the sights, and a hit determination is likely to result, even when there actually is none. These JLF test results are a very useful source of data in BDA sensing, considerations for future developments of fire control systems and simulators, and training for tank crews.

Another potential benefit from the JLF program is the opportunity for live fire test exposure of systems categorized at levels less than major systems. LFT is mandated for those systems which are considered major systems based on the individual unit cost, or the aggregated cost of the production run (as in the case of munitions). In addition to these, there are many systems which have potential exposure to combat conditions, but which are not required to conduct full-up, full-scale live fire testing by the LFT criteria. Ground systems, like trucks used to move personnel and supplies, have a potential exposure to combat conditions, even when their primary use is not to perform a combat mission. This is especially important in the case of employment of U.S. forces in operations other than war. A recent example is the generation of casualties from vehicle exposure to mines in Bosnia. Truck design changes and/or modifications can be tested by exposure to potential threat mines, and the JLF program can serve as a helpful means for the production of data to assist in the design of these modifications.

Another potential use of the JLF program is in obtaining data on the use of so-called "gray" systems — U.S. or foreign manufactured systems either obtained through foreign military sales, or other sources, and employed against U.S. forces. The political changes mentioned above, and others like them, could conceivably result in changed loyalties leading to such a result. Thus the traditional engagement concept of "Blue-on-Red" may well be supplemented with "Blue-on-Gray," or even "Blue-on-Blue." There is, therefore, a need for data with which to plan employment of U.S. systems against such targets, and to consider the possible need for protection from them. This is potentially in the JLF program scope, and should be considered a possibility.

Another important aspect of JLF is to determine the limits of munitions lethality and vehicle vulnerability regardless of the "design requirements." Some of the most interesting results have been related to system performance outside the design envelope. For example, tests demonstrated that hits by overmatching munitions on the Bradley by no means guaranteed a "kill." Further, the crew and system would have survived many direct hits on stowed ammunition.

JLF has led to many changes that have directly affected the safety of U.S. crews, the fightability of systems, tactics for utilization in battle, and the designs of future systems. The JLF program continues to be highly relevant to the determination of system vulnerability and confirmation of system lethality.

If you have questions about the lethality or vulnerability of fielded systems that can be answered by data from live fire tests, the Joint Live Fire test program may offer answers. The OSD office overseeing the program is happy to discuss previous test data and considerations for future testing. The office is eager to assist the armed services and the defense industry in assuring the most capable defense for this country. For additional information, contact:

**Deputy Director, Operational Test & Evaluation Live Fire Testing**
**1700 Defense, Room 1C730, The Pentagon**
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Robert Wojciechowski, a lieutenant in the USAR, is a staff assistant to the deputy director, Operational Test and Evaluation (Live Fire Test). He is on a one-year special assignment to OSD from the Army Research Laboratory (ARL), where he has been involved in the conduct of numerous armor and anti-armor tests. He is being assigned to the Operational Test and Evaluation Command (OPTEC).

# From the External Gun To the Hybrid Tank

**by Robin Fletcher**


TACOM's Tank Test Bed Vehicle

Designs for armored fighting vehicles are now being put forward which are to be operated by only two crewmen seated down in the hull.

Both the German E.G.S.[1] and the British VERDI 2[2] experimental vehicles employ this new system of crewing. It has been proposed for a further development of the German Leopard 2 Main Battle Tank (MBT)[3], and in the United States, General Dynamics Land Systems (GDLS) is proposing a low profile Future MBT to be operated by only two hull-seated crewmen.[4]

Some of the reasons given for this change in crewing are the need to reduce the vehicle's presented frontal area — particularly that of its turret — so as to reduce the size of target exposed to enemy fire; the need to increase the passive protection provided for the crewmen; and the desire to put the fewest crewmen at risk when the MBT goes into action. A further reason, often not sufficiently appreciated, is that by seating the MBT's two principal crewmen side-by-side in duplicate forward-facing hull crew stations, either one of them would be able to drive.

This would eliminate the third crewman, the dedicated driver, conventionally seated at the front of the vehicle. The resultant vehicle would have smaller dimensions and the possibility of better protection. The three functions of driving, gunning, and commanding would then be exercised by only two crewmen, working together. They could exchange functions as the tactical situation developed. The fact that only two crewmen would then be involved in the operation of the vehicle, rather than a crew of three or even four, should result in an enhanced speed of reaction.

Image intensification and thermal imaging night vision devices have been introduced into many fighting vehicles over the past two decades, so that it has now become possible to maneuver and fight 24 hours a day. Whether a hand-loaded MBT is manned by four crewmen, or whether the introduction of automatic loading allows the number of crewmen to be reduced to only three (e.g. Russian T-80 and French Leclerc MBTs), the vehicle's crew members will all have to remain on duty continuously and all will become equally exhausted. A two-man crew is likely to suffer even more severely during round-the-clock operations, reducing the time a two-man crew can keep going.

If a two-man crew is to be adopted, back-up crews might be one answer, with the off-duty crewmen, transported and protected in some form of light armored vehicle (LAV) for adequate rest and sleep. These LAVs will then have to meet up with the MBTs so that crew exchange can take place, something not easily arranged in a war of maneuver in which vehicles will be well dispersed.

An alternative solution would be to carry a third crewman, resting and sleeping within the hull of the MBT. The three crewmen, who would all be trained to undertake any task in the vehicle, could take turns manning the two principal hull crew stations. Changeovers every four hours, on an agreed schedule, would ensure that the MBT would always be manned by two alert crewmen. The size of the hull would have to increase to accommodate the third resting crewman so, for a given weight of vehicle, there would be less protection.

### Loss of Direct "Top Vision"

The MBT's main armament would then be traversed above the hull-seated crewmen, either in an unmanned turret or on an external overhead mounting. An unmanned turret will — like the manned turret preceding it — carry the gun trunnions over the front of the turret ring so the breech can descend into the hull when the gun is put into elevation. An unmanned turret will provide protection for the gun and its recoil system, and rounds will be supplied to the breech within the same armor protection. Examples are the American Tank Test Bed vehicle of the 1980s[5] and Western Design Corporation's winning entry in *ARMOR*'s 1993 Tank Design Contest[6] (See *ARMOR*, July-August 1993).

On the other hand, with an external overhead mounting, the gun trunnions can be above or even to the rear of the mounting's center of traverse so that the breech will not descend into the hull on elevation. Instead, it will move in elevation and depression to the rear of the mounting. Although the external overhead mounting is likely to present a smaller target than the unmanned tur-

ret, it offers less protection to the gun and its recoil system, and rounds supplied externally to the breech are likely to be vulnerable. Examples are the German VTS experimental vehicle of the 1970s, which carried a 105mm tank gun externally above a Marder hull, and the Swedish UDES-19 proposal of the 1980s, in which individual rounds were moved to the breech externally from rear hull stowage while the gun remained pointing at the target.[7]

In the case of a conventionally turreted vehicle, whether hand or automatically loaded, the commander has been able to look all around directly from the highest point of his vehicle, head out, with raised hatch or through his vision cupola, using a wide field of view through the unity periscope.

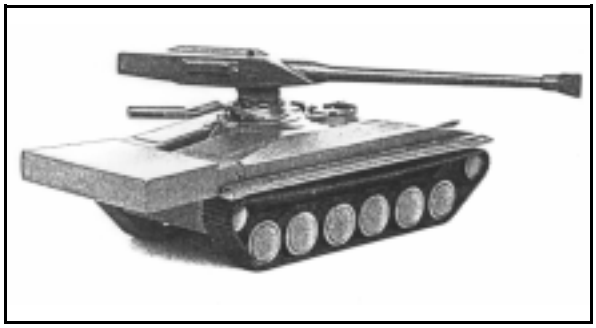
At the same time, he is likely to be provided with a high powered panoramic instrument with which to search for and identify targets, and he may then be able to make use of that same instrument for target engagement. While using this high powered instrument, he will be fully aware that he will be unable to maintain watch all around his vehicle and that there will be a danger that it will be surprised and destroyed.

A major disadvantage of allowing the main armament to traverse above the hull-seated crewmen is that the commander will no longer be able to exercise direct "top vision." He will only be able to look around from the hull roof below the level of the gun.[8] When moving over rolling country with the gun in an unmanned turret or on an external overhead mounting, the gun is likely to be spotted by the enemy before our vehicle commander is in a position to see him.

In the January-February 1996 issue of *ARMOR*, Don Loughlin, in his article, "The External Gun Turret: Often a Bridesmaid, Never a Bride," points out this considerable disadvantage. He notes that such external mountings have often been proposed but have never as yet been adopted, principally because of the absence of commander's direct "top vision."

### Reinstatement of "Top Vision"

One way of overcoming this disadvantage is by restoring the vehicle commander's all-around vision to the highest point of his vehicle, if not on a permanent basis then at least temporarily. When the articulated UDES-XX-20 tank destroyer was under development in Sweden[9] in the 1980s, the disadvantage was recognized and steps were taken to overcome it — the vehicle commander, complete with his vision cupola, could be raised and lowered in an armored "capsule." In this way, he could reestablish direct all-around vision above the level of the gun. But the capsule could be only lightly armored, and had to be lowered again for the gun to regain its all-around traverse.



Two Swedish concept vehicles, the UDES-19, at left, seen in model form, and the articulated UDES-20, above, were external gun designs. The arm seen at the base of the UDES-19's gun pedestal was the device used to transfer ammunition from the hull to the rear of the gun.

A sensor head offers another approach to obtain commander's "top vision" indirectly. It would be carried on top of the mounting. But this change from direct to indirect vision may not be entirely satisfactory. As Don Loughlin writes in his article, "thermal imaging ... can't replace the human eye in three respects: resolution, field of view (and the combination of both) and its marvelous working with the brain."

It may be possible to use a tall optical periscope, set in the hull roof, to obtain adequate resolution for target identification, but it will be difficult to use such an instrument to lay the gun. Sighting would probably have to be done by television or thermal imaging from a sight head carried on the gun mounting. This would supply a sight picture to the screens in front of both crewmen. It might also be possible to employ a continuously rotating panoramic head, carried above the mounting, to record the 360-degree scene around the vehicle, but it would be difficult to show a wide portion of that scene to the crewmen if space restrictions limited each man to a single display screen.

A Helmet Mounted Display (HMD) system, worn by all crew members, might allow a 40- to 60-degree field to be obtained from the sensor head above the gun mounting. It would be directed entirely by head movement — a restricted field perhaps, but quickly and instinctively traversed.

It can be argued that such indirect vision will soon become essential if Directed Energy Weapons (DEW) are introduced. If that becomes the case, similar indirect vision will then have to be provided for all classes of fighting vehicles, whether they are turreted or carry their guns in fixed mountings. If this were to occur, the indirect vision of an MBT-equipped with an external overhead gun mounting, while not wholly satisfactory, would certainly not be inferior to any other gun mounting configuration. In that event, the loss of commander's direct "top vision" would no longer be the chief reason to reject the external overhead mounting, and criticism would then be transferred to two other disadvantages.

The first of these is that the external mounting, being above and distinct from the hull of the vehicle, will be easily spotted and identified by the enemy. The second criticism will be the vulnerability of the gun, its recoil system, and the mechanism transferring rounds externally from rear hull stowage to the breech. As Don Loughlin writes in his article, "Elevated gun position decreases survivability due to high silhouette and exposed mechanisms." Clearly, steps will have to be taken not only to counter the vehicle commander's loss of direct "top vision," but also the external mounting's vulnerability. Fortunately, it is possible to overcome all three of these disadvantages simultaneously by the adoption of an unconventional system of mounting the gun.

The low position of the hull-mounted gun in the S-Tank required the tank to be almost fully exposed when firing over cover.

### Creating the Hybrid Tank

If we lower the MBT's long tank gun into a depression running the full length of the roof of the hull, the vehicle commander would regain his direct "top vision" and the mounting's vulnerability would be corrected. Moreover, if such a vehicle were then able to be traversed on its tracks and inclined back and forth on a controllable suspension system, it would be able to engage targets with its gun held in its lowered position. Such a vehicle would have to incorporate two very different vehicle configurations, each having very different attributes. Both should now be examined individually in some detail before they are put together to form the hybrid.

The first configuration is the Swedish "S" Tank, developed in the 1960s and only now being withdrawn from service. Traversing was difficult in this fixed gun tank because of the need to employ the differential action of the tracks to turn the whole vehicle. This MBT concept has not been accepted by other nations. Yet the commander's direct "top vision" is available from the hull's highest point, the vehicle is compact and is in no way prominent and, with the gun and its recoil system contained within armor, they cannot be considered vulnerable. The "S" Tank's front engined layout provides good protection for the crewmen at the front and for the ammunition at the rear, but just like a conventional turreted tank, the S" Tank displays a large target to enemy return fire when engaging over cover.

Like the "S" Tank, an MBT carrying its gun on a permanently raised external overhead mounting would be likely to accommodate the crewmen in a front engined hull, with ammunition carried at the rear. The gun would have 360-degree traverse for the rapid engagement of flank targets, but commanders' direct "top vision" would no longer be available. As already noted, the gun on its mounting would be bound to be prominent, and it would also be vulnerable as would the transfer mechanism needed to bring rounds from rear hull stowage to the breech. The mechanism's most difficult task would be to reload the gun while it remained directed at a flank target, although this was, in fact, the solution adopted by the Swedish UDES-19 experimental vehicle. The mechanism's task would be eased considerably if the gun were to return momentarily to the 12 o'clock position after each shot, as the rounds would only need to be raised and rammed forward, and would not also have to be traversed around into alignment with the gun.

When moving in open country, the vehicle carrying an external mounting is likely to present the same size target as the "S" Tank, but when engaging from behind a crestline or rise in the ground, the size of target exposed would be very much reduced.

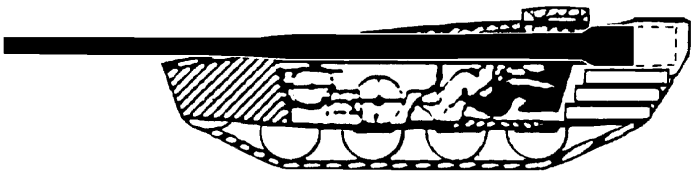
If the permanently raised external overhead mounting were replaced by a mounting which could be moved up and down, or rather by a "lift-and-turn" mounting which could both raise and traverse the gun, the vehicle could engage targets in any direction once the gun was raised. After firing, the gun would not only be returned to the 12 o'clock position, but would also be lowered down into its hull top depression where it would be reloaded by the automatic loading system carried in the rear of the vehicle. Once reloaded, the gun could again be raised and traversed.

While the gun is raised, the vehicle commander's direct "top vision" would no longer be available and the gun, now well above the hull, would be vulnerable. But this would be so only momentarily, while the gun was actually being fired, and the commander would surely minimize the time during which the gun remained raised and exposed.

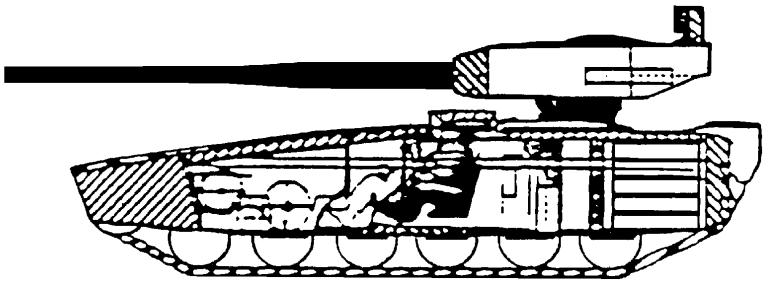
### Operating the Hybrid Tank

The Hybrid Tank would be capable of two different modes of operation, employed according to the prevailing tactical situation. It would normally be operated with its gun lowered, giving its commander his vital "top vision" from within his well-protected vehicle. The principal use of the raised gun would be for the engagement of emergency flank targets, but it would also be used for firing on the move, or to display a much reduced target when engaging from behind cover.

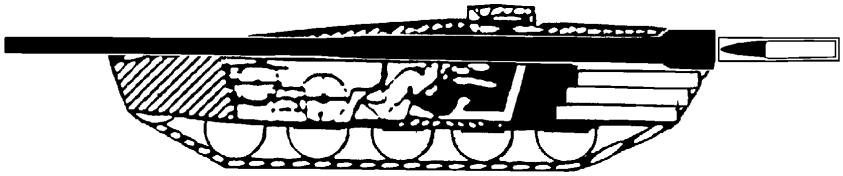
One set of attributes would then be in use when the gun was raised and another when it was lowered, but what amounts to a third set would become available due to the actual raising and lowering of the mounting. Thus, when engaging from behind a crestline, not only would the size of target exposed be minimal, but exposure time would also be short. This makes it difficult for the enemy to hit the much smaller target, gives him little time to do so — the latter depending on his gunner's speed of reaction and the time of flight of his projectile. Moreover, there would be no need for the Hybrid Tank to move forward to put its gun into action or reverse to break off the engagement, as is the case with a conventionally turreted vehicle. It would simply remain



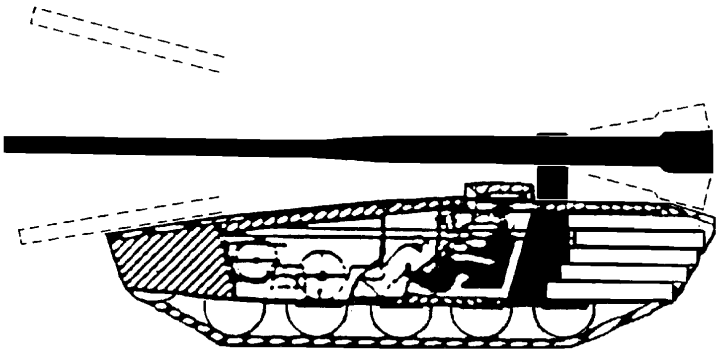
**"S" Tank configuration.**



**External overhead gun configuration.**



**Hybrid Tank — gun lowered — loading.**



**Hybrid Tank — gun raised — traversing.**

stationary behind the protective crest and raise and lower its gun as necessary.

A Hybrid Tank would have two different means of traverse, on its tracks and by the use of its raised mounting, and also two different means of elevation and depression, by means of its controllable suspension system and again by the use of its raised mounting. This would allow engineers to reduce the scope of either system as the other would be available to supplement it. For instance, a lengthened hull might be difficult to turn on its tracks, but the gun could be traversed on its mounting if necessary, and if the raised mounting was unable to provide enough depression, the suspension could be "knelt" to supplement it. In the extreme, the complete failure of one system need not lead to the Hybrid Tank becoming unserviceable; the other system could be used temporarily, although no doubt with reduced efficiency.

The "lift-and-turn" mounting would be installed behind the crew stations but forward of the stowed ammunition and, just like the vehicle's power pack, should be able to be removed from the hull as a single unit for maintenance or modification. With the breech at the extreme rear of the vehicle, recoil would take place behind it and rounds would be moved out of the rear of the hull before being moved over onto gun centerline to be loaded. The decreased inertia of the gun in traverse would allow the rapid engagement of flank targets and, while lowered, the gun would be supported in the hull top depression to ensure its correct alignment with the automatic loader. Thus the same loading system would reload the gun in whichever mode it happened to be operating with the breech being held close to, or actually being brought to, the ready rounds rather than rounds being conveyed to a distant breech.

An alternate that has been suggested[10] calls for the lowered gun to be carried on one side of the hull, or over one of the vehicle's tracks, rather than in a hull top depression. It would be protected from flank fire by armor carried on the sides of the vehicle. The two crewmen operating the vehicle would then no longer be separated by the gun tube depression in the hull roof between them. They would be able to sit shoulder to shoulder for improved cooperation, and would be able to use

*Continued on Page 50*

# *The British Tank Detachment at*
# Cambrai
## *Lessons Learned and Lost Opportunities*

**by Major David P. Cavaleri**

*"And therefore I consider that we were not beaten by the genius of Marshal Foch, but by 'General Tank,' in other words, a new weapon of war..."*

General der Infanterie A.D.H. von Zwehl, *Die Schlachten im Sommer, 1918, am der Westfront*.

On September 15, 1916, the British Expeditionary Force under the command of General Sir Douglas Haig employed tanks in support of infantry operations during the Battle of the Somme. In a previous article (*ARMOR*, November/December 1995), I discussed the decision-making process behind Haig's commitment of tanks at that time. This article analyzes the British development of mechanized doctrine leading up to the November 1917 Battle of Cambrai and the impact of the lessons learned from that operation. In the final analysis, the British selectively applied certain lessons to immediate tactical problems, but failed to grasp the implications of mechanized operations for the future.

At the end of September, 1916, Lieutenant Colonel Hugh Elles took command of the British Tank Detachment. He was described by his primary staff officer, Major J.F.C. Fuller, as "boyish and reckless in danger; perhaps a better soldier than a strategist, yet one who could profit from the cooperation of his advisors, and one who was universally loved and trusted by his followers."[1] Historian Douglas Orgill looked beyond Elles' personality and wrote that Elles represented a "bridge between the new military knowledge and the old soldierly virtues."[2] Despite Elles' personal leadership qualities, however, Major Fuller was the one responsible for developing doctrine and training programs.

At their first meeting in late 1916, Elles stated that "this show [the Tank Detachment] badly wants pulling together; it is all so new that one hardly knows which way to turn."[3] Elles charged Fuller with creating a sense of discipline and *esprit de corps* in the detachment. Fuller regarded this mission as a three-part problem. First, he had to instill a sense of discipline, which he pursued via a series of lectures on the subject. Second, he had to instruct the officers in new doctrine. And third, he had to reorganize the detachment so as to maximize the use of its equipment.

Fuller was an infantry officer with a reputation for being a highly efficient staff officer. In February 1917, he published a training manual entitled "Training Note #16," designed to standardize all training practices in the detachment.[4] Fuller organized the manual in nine sections: detachment organization, operations, tactics, cooperation with other arms, preparations for offensives, supply, communication, reinforcements, and camouflaging. Calling the tank "a mobile fortress, which could escort the infantry into the enemy's defenses, and from behind which they could sally forth and clean up his trenches,"[5] he believed that tanks were capable of a more offense-oriented role than had been demonstrated during the Somme operation.

In June, 1917, Fuller produced a document entitled "Projected Bases for the Tactical Employment of Tanks in 1918." In this study, he drew on the results of ineffective tank employment during the battles of the Somme (September 1916), Arras (April 1917), and Messines (June 1917). Fuller advanced three points based on his analysis. The first was that the tank's effectiveness was related directly to the terrain over which it operated. The second was that, if properly employed, tanks were capable of executing a penetration which could allow for a breakthrough by follow-on cavalry and infantry forces. The third principle was that the success of any tank penetration required a surprise artillery bombardment not to exceed forty-eight hours in duration.[6] Fuller expanded on Ernest D. Swinton's concepts in his belief that tanks were capable of more than strongpoint and wire obstacle reduction. "He soon became the leading advocate," wrote B.H Liddell Hart, "of the tanks' wider potentialities — as a means to revive mobile warfare, instead of merely as a modernized 'battering ram' for breaking into entrenched defenses.[7]

Later in 1917, Fuller proposed an operation to British General Headquarters designed to test the validity of his ideas. Fuller's initial recommendation proposed a raid of no more than a few hours duration, designed to penetrate enemy defenses, capture prisoners, and shake up the defenders. In an August 1917 paper entitled "Tank Raids," he summarized the objectives of just such a limited raid as "Advance, hit and retire; its objective being to destroy the

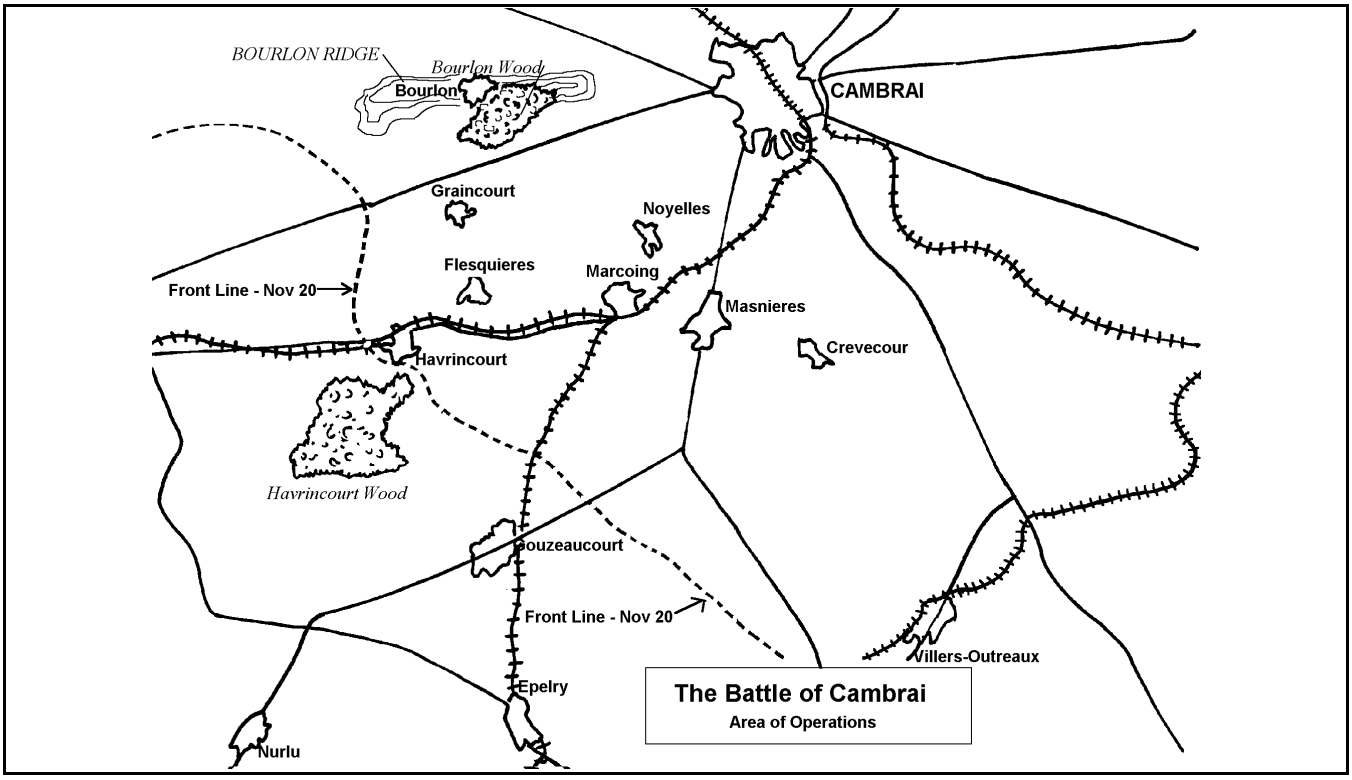

enemy's personnel and guns, to demoralize and disorganize him, and not to capture ground or hold terrain."[8]

Unfortunately, such a plan had little to recommend it to GHQ; the limited tactical gains were outweighed by the potential loss of surprise and vehicles. However, the Third Army Commander, General Julius Byng, read the proposal and recognized its potential. He developed a plan which incorporated Fuller's basic concepts but which had much larger objectives, especially regarding the capture of territory.

Byng wanted the focus of the operation to be the communications center at Cambrai; once that town was captured he could then release his cavalry to the northwest to raid behind German lines. Byng's plan relied on the tanks to penetrate the defense and assumed that such a break-in would automatically result in a cavalry breakthrough. His plan meticulously prepared for the initial break-in, but discounted the fact that at that stage of the year, he lacked adequate reserves to follow through. Even if the operation was successful in effecting a break-in of the "outpost" and "battle" zones, he would not be able to penetrate into the "rearward" zone to launch his cavalry.[9]

Haig ultimately decided on an advance with limited objectives in the vicinity of Cambrai, but not necessarily focused on the town itself. He revised Byng's plan to concentrate on the Bourlon Ridge which, if captured, would provide British forces with excellent observation of the "battle" and "rearward" zones. Unwilling to discount completely the possibility of a breakthrough, Haig nevertheless retained the option to terminate the operation at the end of forty-eight hours unless clear progress was evident.[10] By October, 1917, Fuller had revised his original "Tank Raids" proposal to incorporate Byng's and Haig's guidance. These new plans featured the tank in a spearhead-type role.

By mid-November 1917, the staff at GHQ had finalized the plans for the Cambrai attack. The sector was constricted by two canals, the Canal du Nord on the left and the Canal de l'Escaut on the right, six miles apart. The initial attack area included a number of small villages and two dominant ridgelines, the Flesquieres and Bourlon. The




Hindenburg trench system in this sector was over five miles deep, complete with dugouts, machine gun posts, wire obstacles, antitank ditches in excess of twelve feet wide, and supporting artillery batteries.[11]

The Hindenburg Line proper ran in a northwesterly direction for almost six miles from the Scheldt Canal at Banteux to Havrincourt. The line then turned north for four miles to Mouvres. Roughly one mile behind this first line lay the Hindenburg Reserve Line, and an additional three and a half miles behind that lay the Beaurevoir, Masnieres and Marquian Lines.[12]

The final plan called for the tanks to penetrate the Hindenburg Line between the two canals, pass the cavalry through the gap, then continue forward and assist the infantry in seizing Bourlon Wood and the town of Cambrai. The tanks and infantry would continue to expand the penetration while the cavalry raided support units in the "rearward" zone and beyond.[13] Fuller expressed concern over the suitability of the terrain beyond the "battle" zone and over the lack of reserves available to exploit any breakthrough, but the plan stood as written.[14] The Cambrai plan was a mixture of traditional operation and innovative thinking. The plan of attack dispensed with the traditional long duration artillery bombardment and instead, the 1,003 supporting artillery guns were to conduct a brief suppressive bombardment, concentrating on counter-battery and smoke-screen fire. Once the assault began in earnest, the artillery would shift to the creeping barrage pattern similar to that designed by General Rawlinson for the 1916 Somme operation. The tanks were assigned the mission of breaching the trenches and wire obstacles and leading the attack, precluding the need for an intense preparatory bombardment.

Byng anticipated a breakthrough which would allow the cavalry to pass through to the "rearward" zone in order "to raid the enemy's communications, disorganize his system of command, damage his railways, and interfere as much as possible with the arrival of his reinforcements."[15] The final plan reflected the level of development which British mechanized doctrine had reached under Fuller; Haig was willing to commit the tanks to a crucial role and expected them to accomplish more than obstacle reduction. At the same time, the exploitation and disruption role stayed with the cavalry who remained vulnerable on a battlefield replete with machine guns and artillery.

Fuller divided the six-mile-wide offensive sector into a series of objectives, each of which was further subdivided, based on the number of strongpoints, into "tank section attack areas." He assigned a three-tank section, along with an infantry section, to each attack area. Each tank carried a bundle of wood three or four feet in diameter and weighing over one ton. These were affixed to the front of each vehicle with chains. The wood was carried to fill in antitank ditches, thereby allowing the tank-infantry teams to negotiate three ditches as they leapfrogged through the defenses.[16]

On November 20, 1917, at 0620 hours, British artillery commenced a suppressive barrage along the six-mile-wide front. Unlike previous preparatory barrages, this forty-five minute barrage was predominantly smoke and high explosive. The artillery concentrated on suppressing the defenders' artillery and masking the tanks' advance. After less than one hour, the artillery began the creeping barrage and the tanks moved forward. The absence of a traditional preparatory bombardment probably contributed to the defenders' surprise and to the tanks' success in breaching the first defensive lines.

GHQ allocated 476 tanks to Byng's Third Army for the Cambrai attack. Out of this total, 378 were fighting tanks; 44 were devoted to communications, command and control; and the remaining 54 were assigned resupply duties. These last tanks each carried two tons of supplies and hauled an additional five tons on sledges over the breached obstacle networks. Fuller estimated that it would have required over 21,000 men to carry a similar resupply load, which represents a significant

savings in fighting troops who were not diverted from actual combat duties.[17] The tanks were accompanied and followed by elements of six infantry divisions. Waiting behind the safety of the British trenches were the five divisions of cavalry which Byng hoped to launch forward.

The opening stages of the attack were successful. Masked by smoke and the creeping barrage, the tanks tore holes through the wire obstacles and filled in ditches with the wood. Less than two hours after the attack began, the British captured the Hindenburg Main Line over the six-mile front between the two woods. By 1130, the Hindenburg Support Line, with the exception of the ridge at Flesquieres, was in British hands as well. By the end of the day, the BEF had penetrated to a depth of just over four miles, capturing over 5,000 prisoners, with a loss of just over 4,000.[18] The first day's operation demonstrated the effects of coordinated tank, infantry, and artillery tactics over suitable terrain within the parameters of a well thought-out tactical plan.

But the success of November 20 was mitigated by several failures. The British lost 179 tanks that day to a combination of enemy fire and mechanical breakdown. The tank/infantry teams penetrated to a depth of over four miles, but not deep enough to qualify as a breakthrough into the "rearward" zone. The cavalry divisions in most sectors never even made it into the battle, and the few cavalry units committed failed to accomplish anything significant in terms of rear area exploitation. In addition, the operation experienced several instances of degraded coordination between the tanks, infantry, and artillery. The 51st Infantry Division fell so far behind the assaulting tanks that, when the tanks reached the Flesquieres Ridge, the infantry could not detect the breaches in the wire.

A short while later, 16 tanks, without the protection of their own infantry teams, were destroyed by a battery of German field guns which were out of range of the tanks' weapons.[19] This incident illustrates clearly that Fuller's tactics needed refinement. While he had proven that tanks were capable of rapid penetration, they were by no means capable of independent operations.

Haig terminated the Cambrai attack on November 22, just as he had promised if the offensive failed to result in a breakthrough. He recognized that the BEF lacked the reserves needed to continue the attack because of the previous diversion of five divisions to the Italian Front at Caporetto.[20] One week after the attack began, he wrote, "I have not got the necessary number of troops to exploit our success. Two fresh divisions would make all the difference and would enable us to break out...."[21] This lack of reserves, combined with the cavalry's inability to achieve a breakthrough on their own, convinced Haig to end the attack after only limited gains. It is clear that no one, with perhaps the exception of Fuller himself, anticipated the extent or rapidity of success. Swinton reacted to the initial reports on November 20 with this comment: "I'm pleased all right, but I'm wondering. I bet that GHQ are just as much surprised by our success as the Boche is, and are quite unready to exploit it."[22]

The lack of available reserves resulted in the loss of British momentum at Cambrai. The Germans were able to fall back, regroup, and on November 30 launch a counterattack to eliminate the new British salient. The Germans began their attack at 0700 with an intense one-hour-long artillery bombardment, similar to the one used by the BEF on November 20th. Using proven *sturmabteilung* tactics, they succeeded in reducing the salient on an eight-mile front in just over three hours. Several minor successes followed, but they were unable to execute a rapid or violent breakthrough due to inadequate reserves, British reinforcements, and general troop exhaustion. The counterattack forced the BEF to withdraw partially to stabilize the lines, resulting in practically no net gain based on the success of November 20th. By December 7, the lines had stabilized. The Germans had, between November 20 and December 7, lost 41,000 men and 138 guns. The British had lost 43,000 men, 158 guns, and 213 of their available tanks.[23]

In strategic terms, the BEF had gained nothing. But from a tactical and developmental viewpoint, the battle of Cambrai represents a transition in BEF operations. Because of the complete tactical surprise and significant gains made in less than 12 hours, several contemporaries mark November 20, 1917, as a landmark of sorts in the history of warfare. Lloyd George later said that the battle "will go down to history as one of the epoch-making events of the war, marking the beginning of a new era in mechanized warfare."[24] Haig credited the use of tanks at Cambrai with making it possible "to dispense with artillery preparation, and so to conceal our intentions from the enemy up to the actual moment of attack,"[25] and stated that the tanks' penetration of the Hindenburg Line had "a most inspiring moral effect on the Armies I command... the great value of the tanks in the offensive has been conclusively proved."[26] Swinton, not surprisingly, claimed some credit for the success of November 20th. "It has an added interest," he wrote, "in that it was upon the lines here laid down [reference made to his February 1916 'Notes on the Employment of Tanks.'] that the epoch-making Battle of Cambrai was fought...."[27]

The combination of surprise, suitable terrain, adequate numbers of tanks, coordinated artillery bombardment, resourceful preparation and, most importantly, comprehensive planning resulted in a major penetration of enemy lines. The lessons learned in the areas of economy in men per weapon, in men per yard of front, in casualties, artillery preparation, cavalry personnel, ammunition, and battlefield labor were important.[28] While there was no denying the significance of the event, the British failed to convert the early success of November 20th, and Fuller set out to determine exactly why. Fuller and the General Staff of the Third Army developed a list of lessons learned based on the Cambrai operation.[29] Six of the most significant lessons, several of which remain applicable to present-day combined arms operations as well, appear below:

1. "Tank units and infantry units must maintain close liaison during offensive operations." Haig used the incident at Flesquieres Ridge as an example of this lesson: "This incident shows the importance of infantry operating with tanks and at times acting as skirmishers to clear away hostile guns...."

2. "Keep large reserves of tanks to replace unexpected losses in any sector."

3. "The present model tank is mechanically unable to deal with enemy parties in upper stories of houses."

4. "Tanks must not outdistance supporting infantry — this allows enemy to hide and reappear." This was a contributing factor in the cavalry's failure on November 20th.

5. "Infantry must not expect too much from tanks — they must assist the tanks with protection — this requires continuous combined arms training."

6. "Tanks used in small numbers are only 'frittered' away. If it is desired to continue the advance with tanks on the second day, a completely new formation of tanks should be earmarked."[30] Historian John Terraine alluded to this when he stated "the tanks [at Cambrai] had shown their effectiveness for breaking into even a very elaborate and strong trench position. Breaking through was another matter."[31]

In May, 1918, Fuller published an important doctrine study entitled "The Tactics of the Attack as Affected by the Speed and Circuit of the Medium D Tank," more commonly referred to as simply "Plan 1919."[32] His analysis called for the initial penetration of the "outpost" and "battle" zones by tanks. Once into the "rearward" zone, the tanks would seek out the enemy's command and control systems and artillery support, thereby assuming the role of the cavalry.[33] This plan represented a further innovation on tactics beyond those employed in September 1916 and November 1917. Fuller advocated the destruction of systems, rather than the elimination of enemy troop concentrations, and believed the end result would be the same: the crippling of the enemy's will and capacity to fight. His futuristic concept was based on the speed, maneuverability, and firepower capabilities of the Medium D tank, and he assumed, mistakenly, that the military establishment would agree with him. In order to execute his plan, Fuller required a force of over 5,000 tanks, an increase in Tank Corps personnel from 17,000 to 37,000, and a willingness on the part of the military to replace the horse-mounted cavalry with tanks.[34]

Despite the success of November 20, 1917, Fuller's "Plan 1919" was too radical for the leadership to endorse, and it never progressed beyond the theoretical stage. What "Plan 1919" represents is the continuing development of mechanized doctrine. The limited success of November 20th demonstrated the capabilities of tanks; in July 1918 at the Battle of Hamel, and later, in August, 1918, at the Battle of Amiens, the British Tank Corps had opportunities to demonstrate the potential for tank operational success on an increasingly greater offensive scale.

The Battle of Cambrai provides a picture of the tanks' development from infantry support weapons with limited offensive potential to weapons employed on the point of the offensive. They had proven capable of clearing a path for the infantry into the main defensive zone and demonstrated the potential to advance further. During the inter-war period, mechanized doctrine would vacillate between those who believed tanks should remain auxiliary to the infantry and those who were willing to take the doctrine to a higher level. Interestingly enough, it was the British who elected to revert back to the early philosophy, while the Germans, under General Heinz Guderian, explored the potential for expanded mechanized operations. In retrospect, the decision by both sides is logical. The British had won the war using traditional strategies augmented by innovative equipment and tactics, and therefore had little inclination to change. The Germans, on the other hand, had lost; their tactics had proven ineffective on the large scale of the Western Front, and they had everything to gain by adopting new equipment and strategies.

## Notes

[1]J.F.C. Fuller, *Memoirs of an Unconventional Soldier,* (London: I. Nicholson and Watson, 1936), p. 88.

[2]Douglas Orgill, *The Tank: Studies in the Development and Use of a Weapon*, (London: Heinemann Publishing Co., 1970), p. 31.

[3]Fuller, *Memoirs of an Unconventional Soldier*, p. 87.

[4]*Ibid.*, p. 96ff.

[5]*Ibid.*, p. 97.

[6]*Ibid.*, pp. 129-130.

[7]B.H. Liddell Hart, *The Memoirs of Captain Liddell Hart, Vol. 1,* (London: Cassell and Company, Ltd., 1965), p. 87.

[8]Fuller, *Memoirs of an Unconventional Soldier*, pp. 172-175; see also Trevor Wilson, *The Myriad Faces of War,* (New York: B. Blackwell, 1986), p. 488.

[9]Orgill, pp. 35-36; see also Wilson, p. 488.

[10]Wilson, pp. 488-489; see also J.H. Boraston, *Sir Douglas Haig's Despatches, Dec 1915-April 1919,* (New York: Charles Scribner's Sons, 1927, pp. 152-153.

[11]*Ibid.*

[12]Boraston, pp. 153-154.

[13]Fuller, *Memoirs of an Unconventional Soldier*, pp. 181-182.

[14]*Ibid.*

[15]Boraston, p. 153.

[16]J.F.C. Fuller, *Tanks in the Great War*, (London: John Murray, 1920), pp. 136-153; see also Wilson, p. 489.

[17]Fuller, *Memoirs of an Unconventional Soldier*, p. 198.

[18]Boraston, p. 157; see also Wilson, p. 490.

[19]Fuller, *Memoirs of an Unconventional Soldier*, p. 209.

[20]Robert Blake (ed.), *The Private Papers of Douglas Haig, 1914-1919,* (London: Eyre and Spottiswoode, 1952), p. 265.

[21]*Ibid.*

[22]Ernest D. Swinton, *Eyewitness: being personal reminiscences of certain phases of the Great War, including the genesis of the tank,* (New York: Arno Press, 1972), p. 266.

[23]Wilson, p. 492; see also David Eggenberger, *A Dictionary of Battles* (New York: Thomas Y. Crowell Company, p. 1967), p. 73.

[24]David Lloyd George, *War Memoirs of David Lloyd George,* (Boston: Little, Brown and Company, 1933), p. 102.

[25]Boraston, p. 157.

[26]*Ibid.*, p. 173.

[27]Swinton, pp. 171-172.

[28]Arch Whitehouse, *Tank*, (New York: Doubleday and Company, Inc., 1960), p. 93.

[29]Fuller, *Memoirs of an Unconventional Soldier*, pp. 218-219.

[30]Blake, p. 269.

[31]John Terraine, *White Heat: The New Warfare 1914-1918,* (London: Sidgewick and Jackson, 1982), p. 242.

[32]Fuller, *Memoirs of an Unconventional Soldier*, pp. 332-335.

[33]Robert H. Larson, *The British Army and the Theory of Armored Warfare, 1918-1940,* (New York: University of Delaware Press, 1984), p. 90; see also Orgill, p. 89; see also Fuller, *Memoirs of an Unconventional Soldier*, p. 321.

[34]Orgill, p. 89; see also Fuller, *Memoirs of an Unconventional Soldier,* Appendix I, pp. 334-335.

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# Counterreconnaissance

## *Taking the Fight to the Enemy*

**by Captain Doug Boltuc and Captain Scott Efflandt**

The outcomes of most battles — at the National Training Center or in a real war — are usually decided before a unit ever crosses the Line of Departure (LD). In nine out of ten cases, a unit's success in the preceding counterreconnaissance fight is an impressively accurate indicator of who will win the upcoming battle.

According to the Ft. Irwin Mobile Training Team, "90% of the units that win the counterrecon fight win the subsequent battle."[1] Few who have been involved in the practical application of such maneuvers can argue empirically about the truth behind this statement.

Despite the importance of a successful counterreconnaissance fight, many units fail in their effort. We believe this is because of the friction generated in the planning, preparation, and execution of the mission.

To start, we must recognize the nature of the beast, and the source of the difficulties. The essence of the problem lies in the lack of definition in how to conduct the counterrecon fight. There exists no direct method to succeed in this fight, as evident by the limited published tactics, techniques, and procedures on the subject.

The armor manuals (FM 17-95 and FM 17-97) describe the concept of several types of screens, but not the mechanics of a counterrecon fight. The infantry school acknowledges the mission's importance (FM 7-10 and FM 7-20, FM 71-2), but glosses over the mechanics of the mission (FM 71-123). The battle against enemy reconnaissance is a mission in and of itself, which ties together the diverse missions of subordinate units. The task of conducting a counterrecon fight incorporates a screen, hasty attack/defense, zone recon, and the unique execution of tactical logistics, to name a few.

Units grapple with the counterrecon fight because of the complex conditions under which they conduct it. First, the counterrecon fight immediately follows the completion of another violent, intensive mission, such as an attack or a defense. This means that the tasked units are at a reduced strength, with a non-standard chain of command, and at some level of physical exhaustion.

Second, since units normally fight the counterrecon battle during the planning process for a subsequent mission, it is underway without the benefit of the staff conducting a full mission analysis. Factors such as these increase the burden on the unit commander conducting the mission.

Our intent here is to lay out some techniques and procedures that have proven effective for the authors. The goal is to incorporate the following into training so that SOPs can be developed to facilitate the efficiency of counterreconnaissance fights. The article is organized to address the "mission" by Battlefield Operating Systems in three separate phases: plan, prepare, and execute. Finally, remember that this article seeks to amplify existing manuals with refined and proven techniques and procedures. It almost goes without saying that the following should be overlaid against published doctrine and methods available.

### Assumptions

Before continuing, let us identify the parameters and assumptions of this article. First, these techniques are applicable in conducting a counterrecon mission for the frontage of a company through regiment; while the numbers involved may change, the principles remain the same.

Second, the anticipated adversary is a mechanized/motorized enemy using various Krasnovian tactics; in other words, he does what he must to accomplish his mission.

Third, the unit conducting the counterrecon mission is *not* the main effort for subsequent missions, and the focus of the higher headquarters is on generating combat power for the following mission's main effort. The counterrecon unit is organically formed from, and protecting, a mechanized/heavy force (to include HMMWV-mounted scouts as applicable). During the execution of the mission, the tasked unit has priority of fires and logistic support. Further, mission execution will be primarily during hours of limited visibility.

Last, the applications explained utilize two separate maneuver elements. These two components are, to borrow an effective term, hunters and killers, and represent a refinement of the concept discussed in *ARMOR* (See "Hunter-Killer Operations," July-August 1993 *ARMOR*. - Ed.) The most effective ratio found to date is one tank section (killer) per scout or surveillance platoon (hunter).[2] The lethality of the killers has proven to be higher when employed in pairs, across a platoon frontage, under the control of a headquarters rather than as an individual tank in support and control of a specific scout section. When more than this one surveillance platoon (hunter) is used in conjunction with one tank section (killer), a third component is required from outside these two forces, a mission commander. A command and control element (CP) directs and manages all systems and synchronizes the fight, freeing the platoon leader to concentrate on detection and destruction.

### Plan

**Maneuver:** First, all participating forces should identify the front and rear boundaries of the security zone. These borders constitute limits where the fighting forces have the latitude to conduct operations without the need to further deconflict terrain. It is imperative that this front and rear limit be disseminated to friendly elements which operate behind the counterrecon force. This prevents friendlies from straying too far forward and, during the execution phase, delineates where subsequent units assume responsibility for destroying "leakers." As soon as possible, establish the rear boundary of the coun-

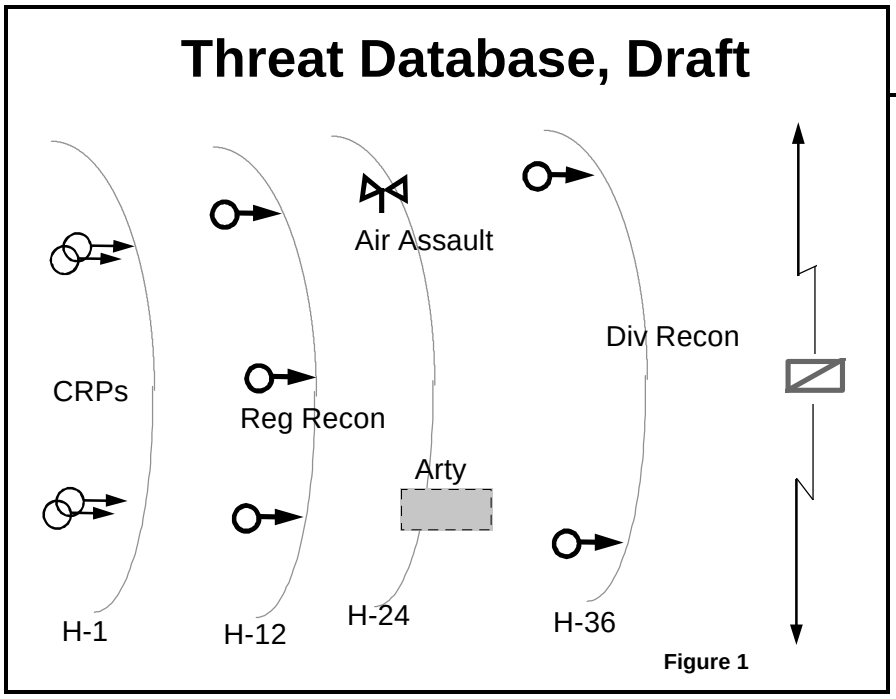


Figure 1

terrecon force. This will allow methodical clearance of the sector and provide control for the subsequent movement of friendly forces. The identification of subsequent and alternate positions is imperative. Instinctively, scouts will seek alternate screen lines during their occupation, but additional attack and assault positions for the tanks, as well as extra ambulance exchange points (AXPs), logistics release points (LRPs), and other CSS sites for related activities need to be included during development of the plan.

**Intelligence:** The commander of the counterrecon force needs to develop a "Threat Database" during the planning phase (FM 34-130). This tool is made up of three components: an enemy order of battle (OOB), overlaid on the current mission timeline, referenced against the enemy's objectives. To start, establish the order of battle with the number of enemy recon elements and from which echelon, for example: two divisional recon patrols followed by three regimental recon patrols in our sector with a possible air insertion of a 15-man patrol on hills in our northern sector (see Figure 1). Next, overlay the OOB onto the enemy's mission timeline. Depending on when the security mission begins, some enemy recon elements may already be in your area of operations. This obviously impacts movement techniques and affects the actions of those conducting operations to the rear. Finally, evaluate these two items in terms of the enemy's objectives. Just because the enemy has four recon patrols doesn't mean he will assign one in each quarter of the sector. This is particularly important when friendly assets are stretched thin; a unit cannot do **ALL** things well, and a tool such as this can help one decide where to assume risk.

While still in the planning phase, consider a deception plan for Ground Surveillance Radar (GSR). GSR can be a powerful tool, and it can also be an artillery magnet. When planning, specify its activation times as well as varying and changing the sectors it covers, and the positions from which this is done. If used during the day and not moved during the night, it could easily fall victim to the enemy's suppression of air defense.

**Fire Support:** Establish day and night indirect fire trigger points for the area of operation. There is no magic for this procedure; use the same criteria and thought process that goes into building an engagement area (see FM 17-95-10). Also establish mortar and artillery trigger points separately, based on the time needed to process a mission and the desired effects from each system.

Additionally, adjust the mortar basic load for the mission. Since we assume the task will occur during night, increase the number of illumination and HE rounds at the expense of smoke.

**Battle Command:** Establish good commo, establish good commo, establish good commo! Enough said about this subject? Probably not, but we'll move on.

The observation plan is the heart of the whole counterrecon fight. It is from this block (the actions of the hunter) that the rest of the mission evolves. Start developing this as soon as possible, beginning at the lowest level. Consider what terrain must be seized and what may be secured against the anticipated threat.

Determine what can be observed and what advantage dismounted patrols can bring to the sector. As each position is manned, require a completed sketch card (similar to a range card) depicting both observation and direct fire capabilities. Platoon leaders ensure coordination with adjacent units and attachments. Each platoon leader compiles these and draws a platoon sector sketch, forwarding a copy to the unit CP. The CP completes a unit observation plan from all platoon sketches and includes all combat multipliers (GSR, countermobility, patrol routes and times). The extra work spent doing this early will make for a less confusing and hectic fight later.

**Mobility/Countermobility:** During the planning phase, address this BOS by defining with higher when the main supply routes (MSR) in sector will be opened and closed. This is especially true when an engagement area is developing to your rear. Nobody wants to be sealed forward or forced to travel a circuitous route back. Also define from higher what engineer assets are available and when. Frequently, the answer is "none" since the engineers are already supporting the main effort of the subsequent mission.[3]

**Combat Service Support:** If the unit's SOP does not specifically address support during the counterrecon fight, then throw it away for this mission. Begin by task-organizing early for the mission. Second, recognize (and force others to recognize) this is a unique mission and requires some nonstandard actions. Move the aid station forward, and synchronize it with the MSR. Consider having Class III bulk attached to the unit for the duration of the mission. Depending on what the follow-on mission requires, and the length of time needed to conduct LOGPAC, it may be simpler (and thus more likely to succeed) if effort isn't wasted with link-up times and compressed time schedules used in traditional re-

supply methods. Identify and request the mission-specific extras needed, such as; night vision device batteries, engineer class V, flares, etc. Simultaneously request CSS for expected attachments, and ensure that the attachments are aware of locations of AXPs, LRPs, etc.

**Air Defense Artillery:** Besides considering the standard parameters of ADA, look specifically at the likely enemy landing zones (LZ) that are in the sector, or could influence the sector if they were used for an enemy airmobile operation. Then reposition ADA elements to cover air avenues of approach and deny the use of these templated LZs.

### Prepare

**Maneuver:** As the unit begins its preparation for the counterrecon fight, it conducts a survivability move, ideally at the end of End Evening Nautical Twilight (EENT). For maximum deception, have the hunters bound forward to set the screen line. If time did not permit a covert leader's recon of a forward position, then fall back to a subsequent screen line that was reconnoitered during the advance into sector. The observation plan is compiled for the final position.

When does the counterrecon fight end and the subsequent mission begin? If you, as the force commander don't know, then ask; different criteria for each mission can exist. It could be based on time, identification of an enemy main body, or destruction of specific enemy forces. Decide which routes and movement techniques to use when it is time to reposition for subsequent missions. Above all, disseminate this criteria.

**Intelligence:** During the preparation, refine the "Threat Database," similar to the way a doctrinal template is developed to a situation template. At this point, it should evolve from a schematic into an enemy plan. Overlay the enemy's timeline to your current locations and define his frontages to specific avenues of approach (see Figure 2). Then take this and refine the observation plan. Are the patrols synched to when we expect the enemy? Are the sectors of observation (both visual and electronic) appropriate? If not, fix it.

**Fire Support:** Consider registering mortars **and/or** artillery. Consult with your favorite artillerist to see if this is appropriate for you. For brevity, the doctrinal diatribe on this subject is omitted.

The leader of the counterrecon fight must determine the commander's intent for fires, both for artillery and mortar systems. The two weapons are obviously not the same, and can be arranged to complement each other, such as mortar illumination for artillery adjustments. Prioritize the mortars for the element without priority of FA fires and allocate the artillery for the main effort of the counterrecon force. At the same time, utilize the observation plan and establish applicable no-fire areas for OPs, patrols, AXPs, etc.

**Battle Command:** Work to have alert leaders during the critical times by ensuring rest. No other component of a BOS is so selectively ignored as this. To start, as stated in the assumptions, the counterrecon fight is part of a larger operation, and thus it cannot be conducted in a vacuum. Given this, leaders need rest to be a viable component of the follow-on mission. Allot time during the preparation for leader rest — however little it may be. Likewise, since there will be a follow-on mission, the commander of the counterrecon fight will have to leave sector to be briefed on following missions. Thus, plan for his absence during a portion of any of the phases. The commander is important to this fight, but do not allow him to be irreplaceable.

The requirement for the commander to enter and return to sector will affect his location on the battlefield. His position should provide redundancy in commo and complement the CP's placement. Some situations may require the two of them to co-locate.

**Mobility/Countermobility:** Application of engineer assets will pay its highest dividends if done during the preparation phase of the mission. Maneuver forces should utilize vehicle basic load Class IV to emplace hasty obstacles (cheap tricks). These obstacles, in addition to their doctrinal applications against the enemy, can serve several other uses such as: movement control from the rear by closing unneeded MSRs, blocking lateral routes, and as a form of deception. If further engineer assets are available, always employ them. Engineers typically work long into the night, and fratricide becomes a concern since they quickly become indiscernible as friendlies in a thermal sight. Applying silver duct tape can provide a field expedient "CIP" panel; it's especially effective on the sides of M113s.[4]

**Combat Service Support:** Consider pre-positioning Class V, either for the upcoming fight or in anticipation of rearming for follow-on missions. For example, extra HE mortar rounds for the evening, and a main gun cache vicinity of the unit's battle position for the subsequent mission.

Use all daylight to rehearse movement of medics and recovery vehicles

## Threat Database, Refined

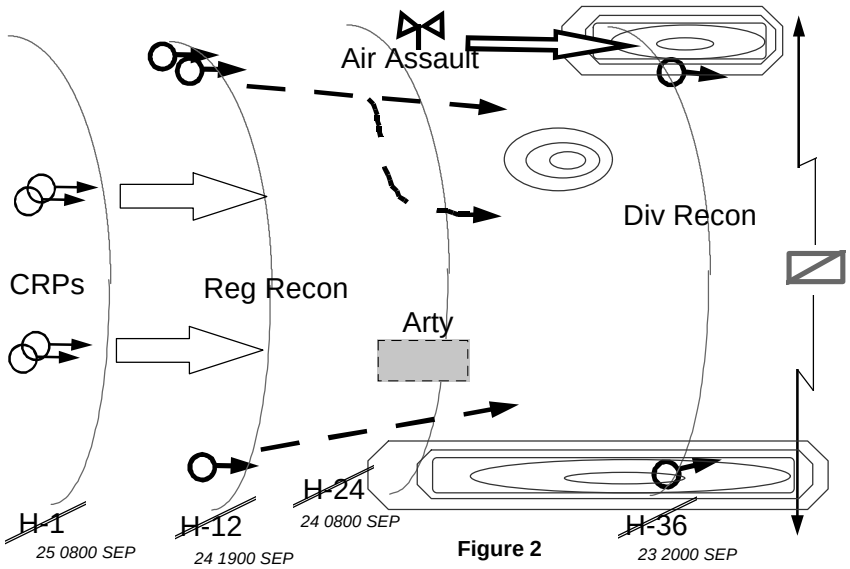



**Figure 2**

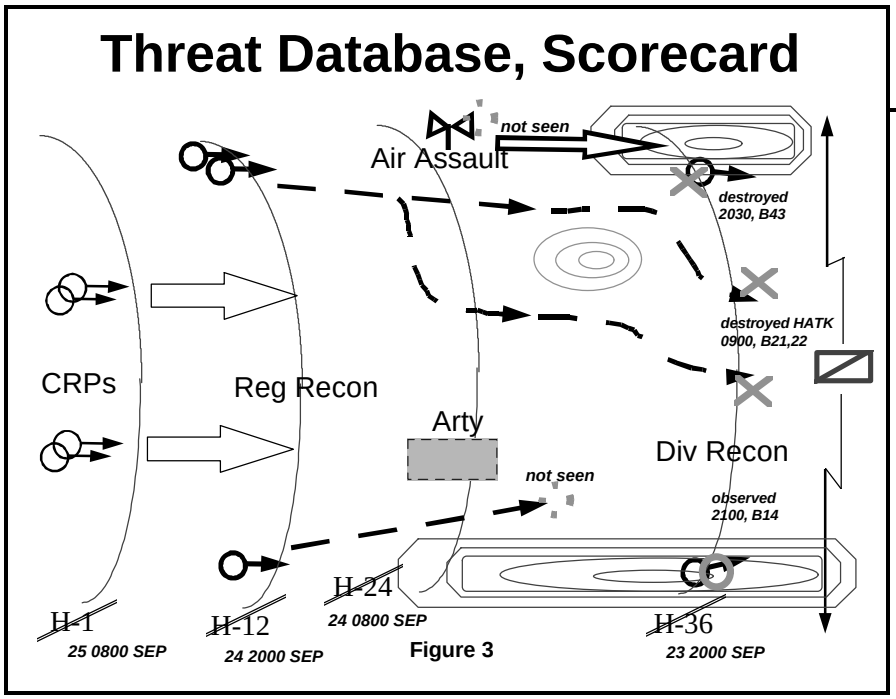


Figure 3

if available. Start with the most difficult position (as opposed to the most likely) and rehearse ending with the easiest position. Include in these rehearsals the evacuation of attachments (GSR, ADA, engineers). No one wants to waste time during the fight chasing a misoriented medic instead of hunting an enemy scout.

From the aforementioned paragraph, one can see that LOGPAC will be anything but standard. Configure it not for what is immediately needed but to carry the unit until its next window for resupply. MREs instead of upcoming "A" rations is nothing new for a cavalry unit. Likewise the standard timeline or LOGPAC window may not work for this mission. The distance required and the inability to conduct a service station may mean the LOGPAC for the counterrecon fight must leave the trains ahead of others and remain forward with the force for an extended period of time. Accept this and adjust. If the SOP won't work, then it's better to adjust the "standard" timeline than to attempt to meet it by conducting an incomplete LOGPAC and coming up short later. Develop the CSS timeline from an assessment of the impact of the event, as compared to the higher's standard logistic timeline.

**Air Defense Artillery:** During the hustle of mission preparation, things in the periphery are often not assimilated. Do not let this happen with ADA. By the nature of their mission, ADA assets often work as general support to a higher unit, regardless of whose sector they operate in. Despite the clear responsibility for terrain management, and delineated reporting requirements, the movement of ADA is frequently not clearly understood by the maneuver force, and vice versa. Take the time to find out what ADA assets are in sector. Then physically identify them and, as a minimum, make FM coordination.

## Execute

**Maneuver:** It's almost a given with the quality of today's soldiers and troopers that each will understand the mission. Not as clearly understood are the "On Order" and "Be Prepared" missions additionally assigned. Define these and the criteria for each. This, in turn, will make command and control easier.

As the mission unfolds, seek to further refine NAIs. Based on the "Threat Database," adjust or move these in regard to the enemy sought. Hand in hand with this, adjust the TAIs. Ideally, we should be able to use the tenets of FM 17-97/98 to walk the enemy from the point of acquisition to destruction using the depth of our sector. Using multiple combat and combat support mechanisms is integral to having a successful counterrecon battle; doing this maintains the integrity and security of the screen by not requiring the hunters to engage with direct fire. The pieces used in the elimination of the enemy (the killers) reposition as necessary behind the surveillance unit (the hunters) to maintain flexibility and their security.

Here it is, the high payoff task for the counterrecon fight: **"go to ground."** At about the time when the screen is established, but certainly not later than EENT, have *everyone* go to ground, and stop moving in the sector of the counterrecon fight; this includes CSS, engineers, etc. Use this time the way a dismounted patrol uses a listening halt, after crossing the LD, to adjust to the battlefield. At the time of the freeze, identify what elements are still moving and get control of them. This also serves as a backstop to find forces in sector you are not aware of. From this point on, all movement in sector is controlled by the CP. It approves all movement (mounted and dismounted) and ensures its dissemination throughout the sector. Movement from higher is monitored by the CP and passed to all attachments and subordinates.

**Intelligence:** During the execution, keep score off of the "Threat Database." Use this to identify periods when contact can be expected and maximum vigilance is important. Using the "Threat Database" as a score card, the CP can have a pretty solid idea where the enemy forces are, and then focus the hunters to find them (see Figure 3). In a worst case, the counterrecon commander can use this matrix to template when an enemy element might have penetrated, and accordingly alert subsequent forces of the possibility of the "Threat" in their sector. For example, a "negative report" during a templated event time may indicate a successful enemy infiltration.

**Fire Support:** As the mission wears on and fatigue develops, remember to update no-fire areas as patrols begin and end, and when maneuver and support forces reposition in sector.

The second nugget of learned information is "**shoot it**" with indirect! The criteria for engagement during a large caliber mission is different from the criteria of a counterrecon fight. Let's face it, at the time of this fight, it's probably the only game in town, hence the indirect assets are not heavily tasked. Assuming the fires are cleared, shoot the target, even if the conditions for target effects are not ideal. Regardless of the precise results, this action will take the initiative from the enemy

and can force him to a premature action. This sequence, was known formerly as harassment and interdiction fires (H & I fires).

**Battle Command:** Delineating if two spot reports are in fact two separate spottings or two sightings of the same enemy is one of the hardest leader tasks of the counterrecon fight. Then factor in darkness and the potential for a spot report to be a sighting of a friendly vehicle moving in sector and the task becomes horrendous. Ground burst illumination can be a tool to sort out these situations. Have our indirect friends fire an illumination round with "burst illum" at impact. Then have observers give their spot reports with a declination from the illumination marking (or have friendly attachments update their position from the source of the illum). Plot these updates on the observation plan and confirm or deny the spot reports.

The counterrecon fight is like deer hunting; it is a contest of patience and vigilance. A highly useful tool in maintaining vigilance is to have the troop/unit CP act as a stimuli throughout the night. To do this, the CP keeps subordinates busy by asking questions and directing activities throughout the night, keeping each one alert and reporting. For example, have observers switch NAIs, or activate other NAIs for specified periods. Regardless of the techniques, the CP keeps all on the net (back to the good commo piece) throughout the mission.

**Mobility/Countermobility:** If engineers are available at mission execution, consider incorporating them in the dismounted patrol plan, as a counter-obstacle force in preparation of upcoming missions (METT-T dependent). Also, ensure that the engineer element reports the status of tasked obstacles to the unit CP, as well as to higher. Additionally, if a FASCAM is to be fired in support of an upcoming mission, have the engineers adjust and observe it rather than distract an element on surveillance.

**Combat Service Support:** Because of competing demands across the sector, and the added complexity of darkness, obstacles, and friendlies moving in sector, all CSS tasks will not be possible or equal. Accept this up front and be prepared to assume risk in the CSS arena. When a decision is made to execute a logistic action, lead that asset to the point of execution. Our CSS assets simply are not authorized the density of NCOs and commo equipment that many of us take for granted. When the counterrecon fight begins, it is too late to wonder if the moving vehicle is the enemy or a wayward fuel HEMTT. Don't take the chance; lead them to where they need to go.

**Air Defense Artillery:** Although not doctrinal, if available, consider using the Avenger's radar in the ground surveillance mode. It can provide a field expedient back-up to confirm or deny a spot report. During the battle, ensure the ADA assets in sector are kept abreast of the tactical situation and changes in friendly air activity.

ADA assets are often in a position where they must share responsibility for their own security. Notice the word "share;" the force conducting the counterrecon fight must work to protect ADA assets in sector, especially from enemy recon units who see ADA systems as a high payoff target.

## Conclusion

Ideally, the application of these procedures coupled with integration of proven tactics and doctrine will serve to ensure future successes in the counterrecon fight and, consequently, subsequent battles. As a minimum, we hope that this article spurs thought towards better ways to win this fight. It is through similar discourse and discussion that direct fire planning and EA development has evolved to what we enjoy today (see "Direct Fire Planning," *ARMOR*, Nov-Dec 93). All comments and improvements are welcome, for we share the same goal — to win. Above all else, good hunting.

Doug Boltuc is a 1989 graduate of the U.S. Military Academy, and Scott Efflandt is a 1985 graduate of MMI. They currently command Dragon Company and Bandit Troop respectively within the 1st Squadron, 3d U.S. Cavalry.

## Notes

[1]As noted by scout platoon leaders attending the course at Ft. Bliss in May 1995.

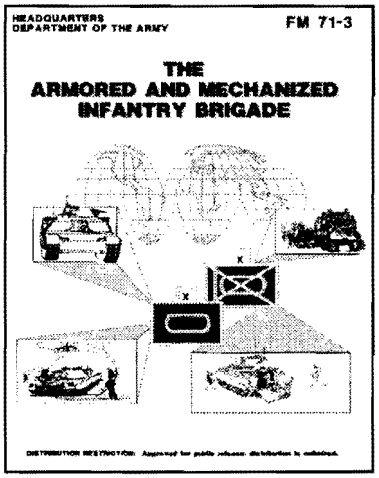
[2]True at the NTC and similar open terrain, but arguable at CMTC or forested areas where there are many avenues of approach.

[3]As a minimum engineer assets, as part of the main effort, must coordinate with the counterrecon commander before coming forward to prevent fratricide.

[4]Used effectively during the 3d ACR's Troop ARTEPs, squadron maneuver exercise, and NTC 95-12.

## FM 71-3 Scheduled for revision in January 1997

*Battalion/Brigade Doctrine Branch seeks your comments*




FM 71-3, *The Armored Mechanized Infantry Brigade,* is scheduled for revision in January 1997. We would appreciate your comments and recommendations to improve the final product. Please address specific issues in a "problem, discussion, and recommendation" format. Include page numbers from the current FM 71-3 if necessary.

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# Heavy-Light Operations At the National Training Center

## *Getting the Most Out of the Light Force*

**by Colonel Frank Stone**

*"Combat experience from World War II onward compels the increasingly complex integration of combined arms. There is no pure "heavy" or light scenario; the surest way to achieve success is to balance the array of tactical forces in accordance with METT-T. The combined arms concept requires teamwork, mutual understanding, and the right recognition by everyone involved of the critical roles performed by other arms. There is no place for parochialism or ignorance; success of the mission and the lives of our soldiers will depend upon the ability to understand and synchronize the light-heavy force."*

**-MG Blackwell, March 1993**

Several times each year at the National Training Center (NTC), we attach a light battalion to a heavy brigade to conduct a heavy-light rotation. The addition of a light battalion to the brigade adds significant capabilities to the brigade combat team, providing the brigade commander tactical flexibility he would not otherwise have. However, along with the added capabilities and increased flexibility comes the challenge of integrating the light battalion into the heavy brigade. In this article, I examine some of the challenges associated with integrating the light battalion, review some potential employment options, and highlight some additional considerations for employing a light battalion with a heavy brigade.

Brigade commanders: as the following vignettes based on recent rotations portray, prudent employment of the light battalion will increase your options and enhance your brigade's combat power. In the offense, the light battalion can infiltrate by ground to seize and hold restrictive terrain, allowing the brigade to move faster, or air-assault deep into the enemy's rear, disrupting his defenses to create an exploitable weakness. Additionally, it can execute tasks that your heavy infantry may not be manned or trained to perform, like attacking in restrictive terrain to defeat enemy infantry in prepared positions.

At the NTC, brigades face some of their greatest challenges in the defense. The light battalion can help here too, by defending in restrictive terrain and allowing you to mass the brigade's heavy systems along the primary mounted avenue of approach. Let's look at some examples.

### Clearing Restrictive Terrain

In this example, the brigade conducted a movement to contact in zone (as shown in Figure 1). The brigade staff's analysis indicated initial contact with enemy reconnaissance elements would most likely occur at Phase Line (PL) FORD, but that the brigade would have the advantage if it moved beyond FORD and established a hasty defense on the high ground overlooking PL BARSTOW. The brigade commander agreed with his staff's assessment and assigned the light battalion the task of infiltrating the night before the brigade attack to seize and hold the restrictive terrain along PL FORD at Objective DOG. Success by the light battalion would mean the brigade could cross PL FORD rapidly and be postured to mass fires against the enemy as it crossed PL BARSTOW.

Timely warning orders followed by close coordination among the brigade and battalion staffs throughout the brigade planning process facilitated parallel planning and saved time. Within a few hours after receipt of the brigade order, the light battalion commander met with the brigade commander to discuss his battalion's plan.

These were some key elements in the battalion's plan: first, since intelligence indicated that Objective DOG was occupied by at least one enemy division reconnaissance team (DRT), the battalion planned to infiltrate by company. Infiltration would help the battalion avoid detection and engagement until it could mass on the objective. Second, the distance from the battalion assembly area to Objective DOG exceeded 20 km. Since helicopters were not available for air infiltration, and the enemy force-to-space ratio in the objective area was low, the battalion would infiltrate by ground vehicle to a concealed point about 10 km from the objective. After dismounting, the battalion planned to infiltrate by companies to a linkup point. Infiltration by companies would allow the battalion to continue should one of the companies be compromised enroute. Following linkup, the battalion would seize the objective, clear the restrictive terrain, and prepare for the brigade's forward passage.

The battalion had divided the objective into three intermediate objectives and planned to seize each sequentially. Sequential seizure would ease command and control, allow the commander to rapidly mass the battalion if required, and simplify clearance of indirect fires. The battalion commander estimated the dismounted infiltration would take 10 hours.

The battalion departed the assembly area at 1500 and arrived at the detrucking point shortly after EENT. Company infiltration to the linkup point was challenging but successful. During the infiltration, enemy reconnaissance elements detected the movement of one company and called indirect fire; however, it was not effective because of the darkness. When attempts to report the contact to brigade were unsuccessful, the battalion relayed the report through another task force. The companies linked up at 0300, and by 0600 had attacked and destroyed

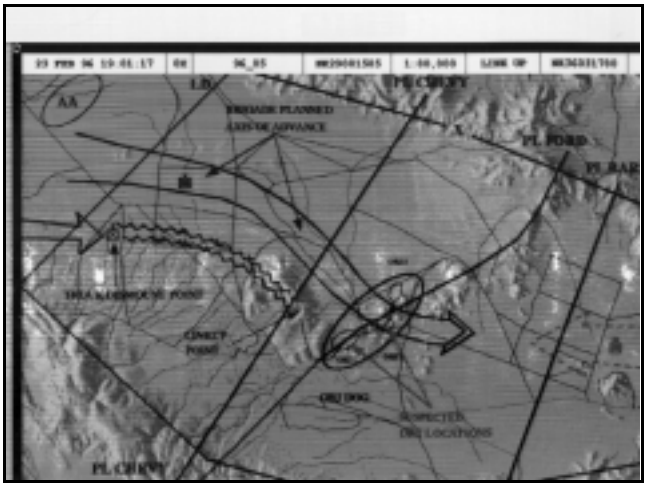

Fig. 1

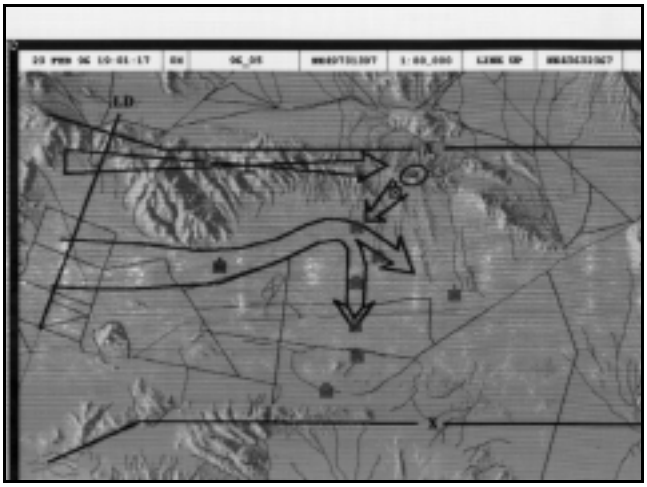

Fig. 2

two division reconnaissance teams in the objective area. During the attack, efforts to call indirect fires on the enemy were not effective and resulted in a near fratricide. The battalion cleared Objective DOG before BMNT, and by first light, the battalion was establishing hasty defensive positions and preparing for the brigade's forward passage. Shortly after 0630, the battalion made initial contact with the advancing brigade elements when the lead platoon from the mech task force took elements of the battalion under direct fire in another near fratricide. Once that was resolved, linkup was completed, and the brigade rapidly passed through and prepared to mass fires against the enemy as he crossed PL BARSTOW.

In this example, several factors contributed to the success of the light battalion and the brigade. First, effective IPB and rapid course of action development by the brigade staff allowed them to provide timely warning orders to the battalion. Second, because of their level of training, the light battalion was able to successfully infiltrate at night, initially by truck, then dismounted by companies, and link up to seize the objective. Finally, the battalion commander clearly understood his task and purpose — to clear the pass to allow the brigade unimpeded movement through the restrictive terrain along PL FORD.

### Some Key Points to Consider

- As outlined in FM 7-20, infiltration is a preferred form of maneuver used by light battalions in the offense. At the NTC, light battalions often infiltrate by ground or air to seize key terrain to deny its use by the enemy. Prior to your rotation, consider having the brigade staff review FM 7-20 to become familiar with how to most effectively employ the light infantry battalion in the offense.

- If you intend for the light battalion to infiltrate the night before the heavy elements of the brigade attack, the time available for them to plan and prepare for the mission will be 12 to 18 hours less than for the remainder of the brigade. This makes timely warning orders, parallel planning, and close coordination between the brigade and the light battalion staffs critical throughout planning and preparation for the mission.

- Truck moves in the desert are difficult, particularly at night, and a light battalion is especially vulnerable if they cross the LD mounted — think about overwatching their movement from the LD with tanks or Bradleys. Have a plan to react should they come in contact while mounted.

- The light battalion's rate of movement during a dismounted night infiltration will probably not exceed 1 kph.

- Communicating over long distances with dismounted moving elements requires detailed planning. (Transmission distance for an AN/PRC 119A is 8 km.) You may have to put the brigade retrans out early to ensure communications with the light battalion as they infiltrate.

- Clearance of indirect fires is always a challenge — particularly at night. It is even more difficult if the battalion infiltrates by company or platoon. Anyone who could potentially call or clear indirect fires must understand the control measures and clearance procedures.

- Recognition signals must be briefed down to the lowest level to avoid fratricide during linkup or passage. Often, the lead tank or Bradley platoon doesn't get the word.

### Air Assaulting to Destroy Enemy Forces

In this example, the brigade conducted a deliberate attack against an enemy battalion. Intelligence indicated that the enemy battalion was defending with two motorized rifle companies (MRC) forward and one back with a frontage of 11 km as depicted in Figure 2. Because the terrain leading up to the brigade's tentative point of penetration afforded no concealment, the brigade commander believed that once the brigade crossed the LD, he could not deceive the enemy about where he intended to attack.

His preferred course of action then was to create a weakness in the enemy defenses with the light battalion that the brigade could exploit. To create the weakness, he planned to air assault the light battalion the night before the brigade attack. The light battalion's mission was to air assault behind the enemy defenses to attack and destroy the northern Motorized Rifle Platoon (MRP) of the northern MRC. Following destruction of the MRP, the battalion would establish a hasty defense. The brigade commander intended to attack at first light, link up with the light battalion, and then attack the enemy battalion from north to south.

Conducting a night air assault at the NTC is always a challenge and can be high-risk; for this light battalion it was both. The battalion had not conducted an air assault during the rotation, and had never conducted a battalion level air assault at night. Additionally, the

light and lift battalion commanders and staffs were unfamiliar with each other's SOPs, having come to the NTC from different posts. To further complicate matters, there were not enough helicopters available to move the battalion in one lift, and illumination at the time of the air assault would be zero. Finally, the brigade staff was not experienced in planning air assault operations, which slowed the planning and coordination effort.

Planning this mission was a challenge. As the Air Assault Task Force Commander (AATFC), the light battalion commander and his staff worked carefully along with the lift commander and his staff to put together the five basic plans necessary to conduct the operation. (Five basic plans: ground tactical plan, landing plan, air movement plan, loading plan, and staging plan). The planners from the two battalions held an air mission coordination meeting to ensure the details necessary for the air assault were coordinated and would support the ground tactical plan. When planning and coordination were complete, the key leaders and the staffs from both battalions attended the Air Mission Brief to ensure the details of the plan were finalized and understood. In the end, with much hard work, the two battalion commanders and their staffs pulled the plan together in time for execution.

The air assault did not go without a hitch. In the darkness, as aircraft were lost due to maintenance and ground fire, the battalion discovered it had no plan to prioritize loads — no bump plan. In the ensuing confusion, the S3/air lost control of the PZ which resulted in loads being lifted in the wrong order and with the wrong equipment. Loss of communications between the Pickup Zone (PZ) and LZ, and between the battalion and brigade TOCs, added to the confusion on the LZ as the battalion commander and S3 tried to figure out what was where, and to report progress to the brigade commander. Loss of communications with the brigade also hindered battalion efforts to get indirect fire support. Finally, failure to coordinate for evacuation of casualties on lift aircraft caused casualties to stack up on the LZ and resulted in a high died-of-wounds rate. Darkness and confusion affected the OPFOR as well. Instead of reacting vigorously, the OPFOR commander misread the threat, allowing the light battalion to execute its ground tactical plan and defeat the northern MRP, creating the weakness the brigade needed to penetrate.

### Some Key Points to Consider

- The light battalion and the lift battalion cannot plan and execute a battalion air assault alone — it must be a brigade effort. Have your staff review *FM 90-4 Air Assault Operations* before the rotation, then develop a brigade air assault planning and execution SOP.

- When the light battalion air assaults, the brigade staff must consider how long they will be on the ground before linkup with the heavy forces. Consider how they will be resupplied if necessary and how casualties will be evacuated.

- Air assault communications planning deserves your personal attention. Plans must be detailed and provide for redundant communications means. The enemy will react to the air assault and you will have to adjust your plans — tough to do without good communications.

- Plans for artillery support, to include Suppression of Enemy Air Defense (SEAD) and radar zones, require detailed planning and rehearsals.

- If the light battalion and the lift battalion have not worked together before the rotation, take advantage of the time you spend in the "Dustbowl" to conduct air assault training and review planning procedures.

### Performing Infantry Intensive Tasks

At the NTC, your brigade may have to execute missions for which the mechanized infantry battalion has insufficient dismounted infantry, or for which their dismounted infantry is not trained. Clearing a trench in live fire might fall into this category. As I will describe in the following vignette, a light battalion is usually trained to perform this task, and can enable your brigade to move through an enemy position prepared in restrictive terrain and continue the attack.

In this example the brigade had the mission to attack along Axis SILVER to destroy an MRB (-) located at Objective BIRD. As depicted in Figure 3, intelligence indicated an enemy MRP; with 3 BMPs, 30 infantry, and reinforced with a tank, occupying a security position in the trenchline at Objective ALPINE, astride the axis of advance. The S2 believed the enemy would withdraw if it sustained 50 percent casualties.

Further mission analysis by the brigade highlighted several additional points. First, although the terrain leading to the enemy position was too restrictive for a mounted attack, the Bradley battalion did not have sufficient infantry to attack dismounted and defeat the entrenched enemy. Second, division would not allow the brigade to bypass the platoon position. The plan to have the light battalion infiltrate to attack and defeat the platoon, and then pass the brigade through, appeared to be the most viable course of action.

The light battalion commander and his staff studied the mission and developed a plan. Twenty-four hours before the battalion crossed the LD, the scout platoon would infiltrate to the objective area to confirm routes, find a position for the light COLT, and position guides at the dismount point. Later, the battalion would infiltrate by truck under the cover of darkness along Route BLACK (no air lift assets were available), then dismount and infiltrate two companies on foot over the ridge to a point overlooking the flank of the objective. The third company, the battalion TOWs, the sapper platoon, and the battalion mortars would infiltrate along Axis SILVER, clearing the restrictive terrain as far as Point C. The light COLT would accompany these elements to observe Copperhead and HE fires on the objective.

The battalion planned a 30-minute artillery preparation, concluding with 60mm mortars firing WP as the signal to shift artillery and 81mm fires to the rear of the objective. Once the artillery preparation began, the support elements on each axis would move forward to establish support-by-fire (SBF) positions. Sixty millimeter mortars and M-60 machine guns would fire final suppressive fires from SBF positions before the assault. After the objective was secure, tactical obstacles in the objective area could be reduced unopposed, and the brigade heavy forces could pass through.

The brigade commander planned to have a tank-heavy company team, with a heavy engineer platoon, move forward once the assault was complete to assist in obstacle reduction and lane marking to facilitate the passage.

The attack went well. Led by scouts, the battalion moved well throughout

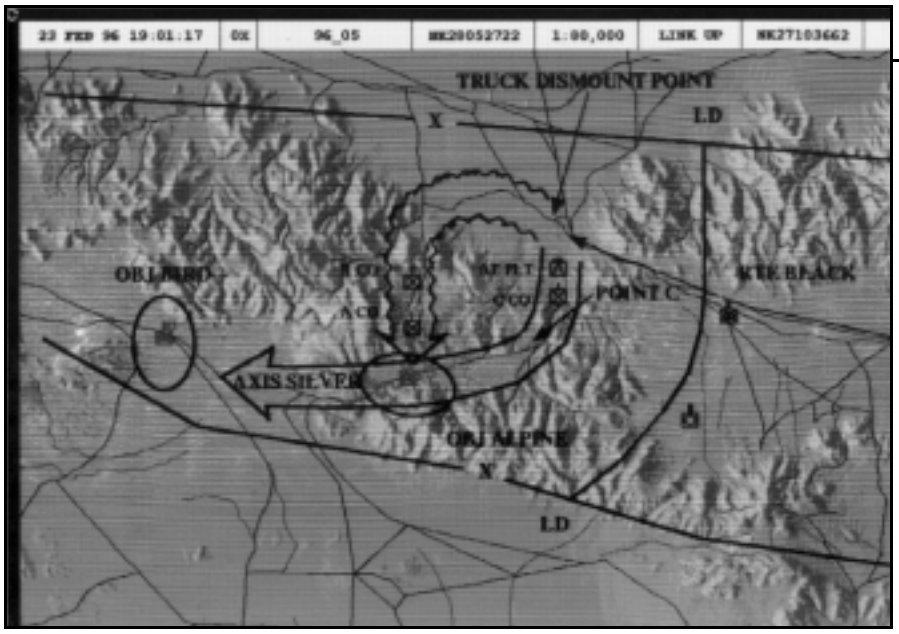


**Fig. 3**

the night and at dawn was positioned to observe the artillery preparation of the objective. The preparation began with Copperhead, which destroyed the tank, and continued for 30 minutes. On the WP signal from the 60mm mortars, artillery and 81mm mortar fires shifted to the rear of the objective. The 60mm mortars continued to suppress the objective to allow the SBF elements to take up their positions. Once in position, the support elements began firing on the objective with M-60 machine guns and TOWs. When TOWs destroyed two more BMPs, the remaining armored vehicle withdrew. As the support element continued to suppress, the assault element attacked and cleared the trench works. Once the objective was secure, heavy engineers moved forward to assist the light engineers in the unopposed breaching, clearing and marking lanes through the obstacle for the brigade's heavy forces.

### Some Key Points to Consider

- The light battalion may need help getting to the objective area. The brigade staff should complete a detailed terrain analysis of potential mounted and dismounted routes, and calculate estimated mounted and dismounted movement times.

- Attacking an entrenched enemy is a difficult task requiring detailed planning and coordination. For the brigade to support the light battalion, the brigade staff must be thoroughly familiar with the light battalion's plan.

- In restrictive terrain, the light commander's C2 will be stretched as he tries to maintain stealth and position support, breach, and assault elements. Avoid the temptation to augment them with elements that may make their stealthy movement more difficult.

- The brigade FSCOORD must know how the battalion's 81mm and 60mm mortars fit into the plan.

- Make sure your staff understands the light battalion's breaching capability and how it intends to breach and mark lanes for passage of the heavy force. Most light battalions have never breached lanes for a heavy force and light engineers have limited breaching and marking capability.

- If you give the light battalion a heavy team it should be OPCON rather than attached. And remember, the light battalion commander may not have experience at controlling the fires or movement of a heavy team.

- FM communications between the light battalion and the brigade TOC will be difficult in restrictive terrain. The brigade signal officer must be involved in the placement of retrans assets.

### Allowing the Brigade to Mass: Heavy Systems in the Defense

Defense in sector is one of the most difficult missions your brigade will face. As described in the following vignette, the light battalion can contribute by defending in restrictive terrain and allowing you to mass the brigade's heavy systems along the primary armor avenue of approach.

In this example, the brigade defended in sector with two balanced heavy task forces and a light battalion, as shown in Figure 4. The sector was 14 km wide, and included both open and restrictive terrain along multiple avenues of approach. The multiple avenues available to the enemy and his potential courses of action presented a significant challenge for the brigade commander and the staff. Having been successful against the enemy's reconnaissance efforts, the brigade expected him to attack in regimental advance guard formation with the lead motorized rifle battalion (MRB) providing combat reconnaissance patrols (CRP) and a motorized rifle company (MRC)-sized forward security element (FSE). The remainder of the lead battalion would

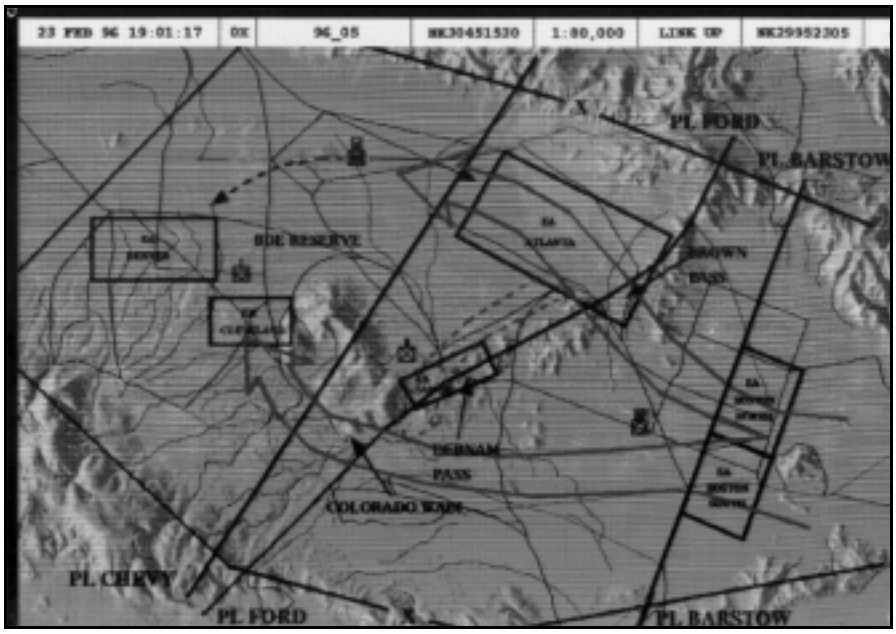


**Fig. 4**

form the advance guard main body (AGMB). Two MRBs would form the regimental main body, and the fourth MRB would trail as the regimental reserve. In all, the brigade expected to face over 150 enemy armored vehicles.

The brigade commander's concept was to defend in depth. The tank task force, organized with two mech and one tank company, would defend along PL BARSTOW to destroy the advance guard and cause commitment of the regimental main body. The mech task force, organized with two mech and two tank companies, was the brigade main effort and defended west of PL FORD to destroy the main body whether the enemy attacked north or south. The light battalion, with a tank platoon OPCON, would defend the restrictive terrain at Debnam Pass, denying the enemy this cross-mobility corridor. The brigade reserve, a tank company, would be positioned in depth at the center of sector, oriented on EA CLEVELAND. The brigade combat power was just under 90 percent — about 100 armored vehicles.

On the day of the attack, the brigade's forward task force destroyed the regimental advance guard in EA BOSTON but was penetrated by the main body. At this point, the regimental commander sent one MRB north through Brown Pass and one MRB as an enveloping detachment south through the Colorado Wadi. He intended for the regimental reserve to follow in the north.

The MRB attacking in the north moved well until it entered EA ATLANTA, where the mech task force destroyed two of its MRCs. Because the enveloping detachment was moving unhindered in the south, the regimental commander directed the surviving elements of the MRB in the north (remnants of two MRCs) and the regimental reserve to move south through Debnam Pass to join them.

As the two companies moved south, extensive obstacle work, including MOPMs, and aggressive AT ambushes with Dragons and TOWs, along with fires from the tank platoon, were effective in destroying both MRCs in EA TAMPA. By the time the enemy realized the light battalion had denied the Debnam Pass cross-mobility corridor, it was too late; he had committed his force piecemeal.

The brigade reserve and repositioned companies from the mech task force destroyed the remaining elements of the regiment in EAs CLEVELAND and DENVER. The light battalion had successfully defended the restrictive terrain, denied the cross-mobility corridor to the enemy, and allowed the brigade commander to mass the fires of his heavy systems along the primary mounted avenue of approach.

### Some Key Points to Consider

- The light battalion will require help digging in. They will normally come with a sapper platoon to aid in the engineer effort, but it has no heavy digging assets. If you OPCON a tank platoon or heavy team, the light battalion will need to get their fair share of the heavy digging assets.

- The light battalion can be a great help in the construction of wire and mine obstacles. Normally, they will have more soldiers to throw into the effort than a tank or mechanized task force. However, because they have limited capability to move barrier material, even a short distance, it must be delivered to the obstacle site.

- Discuss in detail your concept, and the brigade SOP for constructing and fighting engagement areas with the light battalion commander so you both have a common understanding of what is expected.

- Detailed fire support rehearsals will enhance the light battalion's appreciation for space, time, and triggers in open terrain.

- Light battalions have few long range tank-killing systems; normally four HMMWV-mounted TOWs. And their Dragons normally have little effect on the battlefield unless they mass their fires.

- When properly employed, the modular pack mine system (MOPMS) can be effective against the OPFOR. Coordinate early with the battalion to ensure they train on this system and bring the remote control units.

### Additional Considerations

- The light battalion that joins you probably has little corporate knowledge about what to expect at the NTC. Most of the key leaders, and very likely their parent brigade commander, have not been to the NTC on rotation. They will arrive eager to learn, and anxious to demonstrate their capabilities, but don't expect their leaders or soldiers to know as much as you and yours about how the NTC operates. In this regard, don't underestimate the value of the NTC Leader Training Program (LTP). LTP offers a great opportunity to get your team together, and to seriously consider the capabilities of the light battalion and how they will fight as part of the brigade.

Additionally, consider following up your LTP rotation with several video teleconference sessions to keep each other abreast of preparation for the rotation.

- The light battalion may not know your brigade SOP, or understand your lingo. Consider exchanging LNOs with the light battalion. In addition to a light battalion LNO in your TOC, send an LNO from brigade to work with the light battalion during the rotation. The LNO from brigade will help the light battalion understand how you intend to fight and facilitate parallel planning.

*"Hey, face it. Heavy-light is hard; that's why we have to do it."*

**- NTC OC**

Heavy-light rotations at the NTC are challenging, both for the heavy brigade and the light battalion. However, the brigade commander and staff that meet the challenge of integrating the light battalion into the brigade combat team and employ it prudently based on a good understanding of its unique capabilities and limitations will enjoy a rewarding training experience. As I described in the preceding vignettes, a light battalion integrated into the brigade scheme will have a significant impact on the NTC battlefield, both in force-on-force, and live fire. Brigade commanders: "Getting the Most Out of the Light Force" means understanding that, with teamwork and mutual understanding, heavy and light battalions on a brigade team represent a significant combat capability and afford you capabilities and tactical flexibility you would not otherwise have.

Colonel Frank Stone is a Distinguished Military Graduate of North Georgia College. Commissioned Infantry, he is a graduate of Airborne, Ranger, IOBC, IOAC, CGSC, and the National War College. He has served in various command and staff assignments, including commander, 1-16 Infantry (1st Infantry Division). He is currently the Senior Light Task Force Trainer at the National Training Center.

# New Training Aids Help Soldiers Recognize Dangerous Ordnance

**by the TRADOC Munitions System Manager's Office**



Two examples of the new ammunition and mine recognition boards now being produced to help soldiers identify and avoid these battlefield killers. While the ordnance looks remarkably real, the vacuum-formed boards are actually thin, lightweight, and easily shipped.

During Operation Desert Storm (ODS), 148 Americans were killed in action. Fatalities due to hostile action resulted from a variety of causes, the least of which was direct enemy fire where opposing forces were engaged in combat. Tragically, unexploded ordnance (UXO) and mines proved more deadly than Iraqi guns. In fact, some 20% of GI casualties were caused by mines and unexploded munitions.

After the Gulf War, soldier reaction to unexploded ordnance on the battlefield was identified as a battlefield deficiency. General Frederick Franks directed the Army to develop and implement an Army-wide UXO training program. As a result, the U.S. Army Ordnance Missile and Munitions Center and School (USAOMMCS) developed instructional video tapes, a plastic ordnance training aid kit, common soldier tasks, field manuals, and graphic training aids to support UXO training.

A new training item was suggested by SGM Gary Sampson of the Explosive Ordnance Disposal Training Department, USAOMMCS. His inexpensive suggestion was to fabricate plastic, vacuum-formed, two-dimensional ordnance recognition boards that show the actual dimensions and ordnance color codes of mines likely to be encountered. The U.S. Army Missile Command (MICOM) Corporate Information Center's (CIC) Training Support Division developed the prototype. The Army Training Support Center (ATSC), Ft. Eustis, Va., approved a Training Device Fabrication Request and authorized production and distribution throughout the Army. Production of 229 sets of Ammunition Recognition Boards (DVC-T 05-50) began in December 1995.

While the Ammunition Recognition Board Sets effectively address many soldier UXO training needs, they do not include specific regional mine awareness training. Mine awareness prevents mine casualties. Operation Joint Endeavor, in Bosnia, has provided clear evidence of the hazards of mines and reinforces the requirement for mine awareness during peacekeeping and peace enforcement operations and all operations throughout the spectrum of war. Land mines, used by all warring parties in the conflict, are among the biggest dangers facing U.S. forces — there may be 4-6 million antitank and antipersonnel mines randomly laid in mountain roads, fields, forests, and villages in the area.

USAOMMCS and CIC-MICOM collected regional mines, mine fuzes, delay-firing and booby trap devices from U.S. and foreign sources to make a set of Mine Recognition Boards appropriate to the area.This set, called the Mine Recognition Board Set (DVC-T 05-51), was funded for production, and manufacture of 160 sets began in February 1996.

Quantities of both DVC-T 05-50 and DVC-T 05-51 have already been produced and shipped to some Army Training Support Centers (ATSC). Production and shipments of both sets continues.

## Points of Contact

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# Enhanced Mine Detection For Limited Visibility Operations

**by Sergeant First Class Paul E. Thompson Jr.**

When clearing routes, mine rollers are among our most important pieces of equipment. They help detect the leading edges of minefields and complete the mission in a timely manner. But to complete the mission, the roller must survive. This article suggests some ways to enhance the roller tank's survivability.

### An Enhanced Lighting System

At the Joint Readiness Training Center at Fort Polk, we have experimented with a field expedient lighting system to improve operations in hours of darkness. The Driver's Thermal Viewer is not fully fielded yet, and when the infrared headlights are used, much of the infrared light is directed back into the driver's AN-VVS-2, reducing his visibility, and making an already bad situation worse. Current, traditionally-mounted, infrared lights do not aid the tank commander in early visual detection of potential minefields.

We have come up with a simple interim fix, which might easily be made into a permanent modification, that could save lives and equipment. Referring to Figure 1, follow these steps:

- Remove headlights, exposing wiring harness.
- Mount headlights to left and right trunnion pin appendages using 100 mile per hour tape.
- Using split WD-1 wire, attach a ground wire and the bright light wire from the wiring harness to the corresponding connections on the headlight. (The bright light wire is marked "D" on the harness, and the ground is marked "A"). Use electrical tape and plastic to waterproof both the wiring harness and the point where the wire is connected to the headlights. Secure the WD-1 wire to the frame of the roller using zip strips or tape. Leave enough slack wire hanging at the headlight assembly to compensate for roller movement, but don't leave too much, or the WD-1 may be cut during movement.
- Using an infrared light easily found in most motor pools, or ordered through the supply system, (light, infrared NSN 6220-00-984-5180), run WD-1 wire from hot and ground on the rheostat assembly of the TC's domelight. Attach the light to the turret in such a manner that the beam can be directed to the front of the roller or, better yet, be handheld (Figure 2). (Author's note: On the M1A2, the tank fire suppression system is on the same wiring harness as the headlights. We wired the ground directly to the hull, as opposed to using the "A" ground, and had no problems.)

This addition makes it much easier to drive, allows surface laid mines to be spotted earlier, and picks out areas where mines may have been buried. As a bonus, the tank commander does not have to spend as much time directing the driver, because the driver has much better visibility. An enemy observing from an overwatch position will also have a hard time using night vision equipment because of the brightness of the infrared light.

This configuration has been used successfully by units on rotation at the Joint Readiness Training Center through use of the "Coach, Teach, Mentor," technique. We believe it to be a viable, field expedient modification to assist in route clearance operations in periods of darkness.

### Improved Detection And Margin of Safety

Many units get a false sense of security when using the mine roller to clear or proof a route. There is a margin of safety of only 9.5 inches on each side of the track on an M1-series tank. (Refer to Figure 3.) There is a distance of 71 inches that is completely uncleared in the center of the two roller assemblies. When you factor the differing track vehicle widths (Figure 4), not to mention wheeled vehicles, there is quite a bit of room for error, and subsequently for disaster.

### What about the Dogbone?

The current dogbone and chain assembly between the rollers is designed to defeat tilt-rod fuzed mines. The dogbone has insufficient mass to pre-detonate magnetically fuzed mines. Recently, the Army fielded the Improved Dogbone Assembly (IDA), designed to defeat tilt rod and magnetically fuzed mines. The IDA projects a magnetic signature while rolling or plowing. We still have multiple impulse pressure fuzes to worry about, but these can be defeated by running more than one roller tank in tandem if the unit's intelligence preparation of the battlefield says that this type fuze is expected or suspected.

Mine rollers are an asset that are not easy to replace, and are best used to detect the leading edges of minefields and to proof lanes in obstacles breached by other means, such as the MICLIC. The Joint Readiness Training Center believes these techniques used to employ the mineroller will ensure its survivability as well as the survivability of all combat vehicles in the column.

Sergeant First Class Paul E. Thompson Jr. is an Armor Observer Controller with the Joint Readiness Training Center at Fort Polk, La. His assignments include 2/325 Airborne, 1/320 FA in the 82nd Airborne Division; 428th FA Brigade, 2/64 AR in the 3rd Infantry Division; Recruiting Command; and 4/67 AR in the 1st Armored Division.

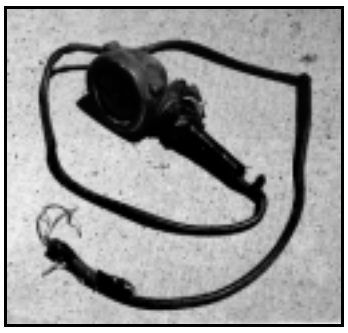

Fig. 2

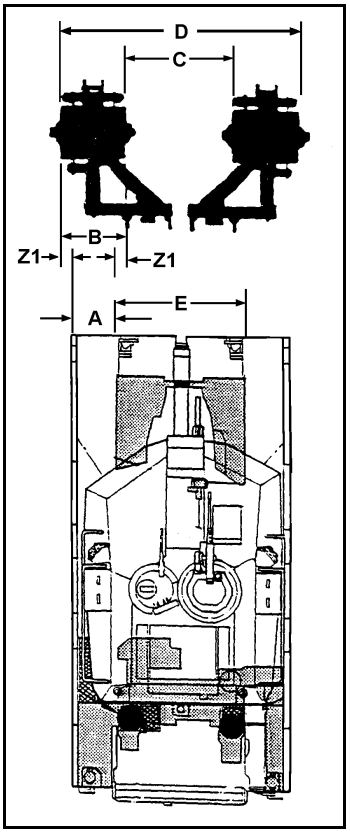


Fig. 3

A - TRACK WIDTH
25 in. (.7112m)

B - MINE ROLLER WIDTH
44 in. (1.1176m)

C - DISTANCE BETWEEN ROLLERS
(Inside) 71 in. (1.8034m)

D - DISTANCE BETWEEN ROLLERS
(Outside) 159 in. (4.0386m)

E - DISTANCE BETWEEN TRACKS
89 in. (2.2098m)

Z1 - DIFFERENCE (Safety Margin)
9.5 in. (.2032m)

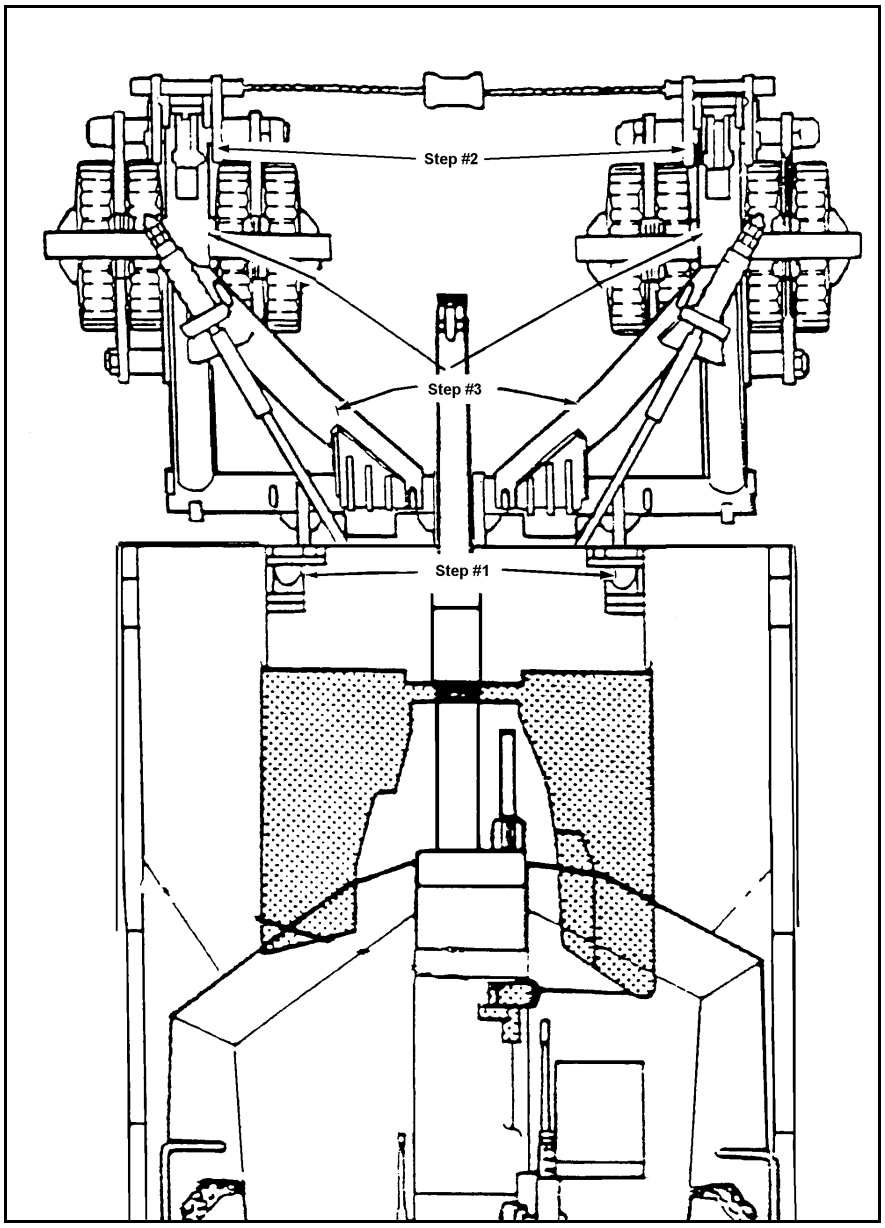


Fig. 1

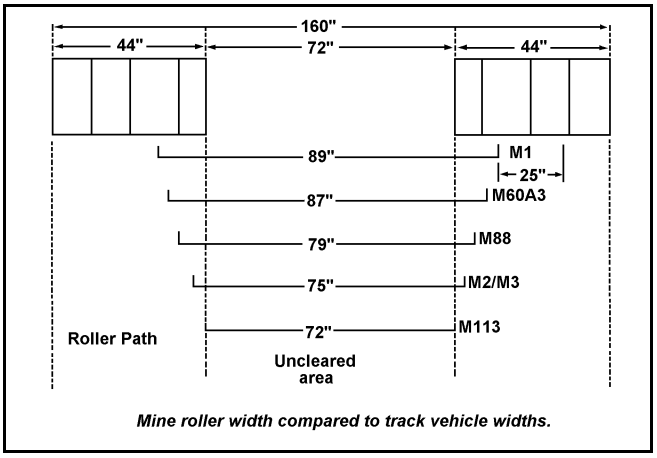


Fig. 4

*Mine roller width compared to track vehicle widths.*

## TWGSS/PGS:

# Combat Vehicle Gunnery Training Takes a Great Leap Forward

**by Brigadier General Philip L. Bolté, U.S. Army, Retired**

"Gunner! Sabot! Tank!"

"Identified!" I responded, somewhat rustily, to the tank commander's fire command.

"Up!" shouted the loader.

"Fire," from the TC.

I had indexed the ammunition, lased to the target, and laid the crosshairs, almost like old times.

"On the way!" I announced as I fired. There was a blast and my sight was obscured. The obscuration caused me to miss the tracer, but I saw the impact of the long rod penetrator on the target tank.

It all seemed real, but in fact I was in a maneuver area at Fort Hood, attending a demonstration of the TWGSS/PGS, acronyms for the Tank Weapon Gunnery Simulation System and Precision Gunnery System, designed for the Abrams tank and Bradley Fighting Vehicle, respectively.

Watching the demonstration, my mind went back over the years I had been associated with tanks and gunnery training. To "date stamp" me, I remembered the Cedar Run Range combat course at Fort Knox, where we student officer tank commanders had to respond to a balloon simulating an air attack by climbing out of the M4A3E8 Sherman turret and standing on the back deck to fire the .50 caliber machine gun. I remembered commanding a tank training company at Fort Knox later, when M48 tank crew trainees fired subcaliber rounds at small targets a few yards away to get the feel of laying the tank gun, making sure the final lay was always in the same direction to eliminate the effects of backlash. I remembered that a smart M60 gunner knew he could increase his chances of a hit with an inert HEP practice round by using the telescope, which allowed for projectile drift, rather than using the computer, which did not. I remembered the laser gunnery range used in the 1st Armor Training Brigade that allowed gunners to track moving targets and fire, but not much else. And I thought of the M1 tank Conduct of Fire Trainer that places great stress on the tank commander and gunner as they engage computer-generated targets in rapid succession.

Each generation of training devices was a step in the right direction, and each capitalized on new technologies, but none by itself met the standards of realism that the armor community wanted. Institutional trainers using computer-generated displays are effective, but the environment is an artificial one. Gunnery devices attached to a tank have been useful and provide a degree of realism to a crew in that soldiers use their own tank, but firing procedures are not complete.

Subcaliber devices have benefits, but they require at least small firing ranges and leave out many of the required crew duties. Also, each system that provides a partial replication of tank gunnery procedures has always included drawbacks that result in some degree of negative training.

At last, it seemed as if all the crew duties were accommodated, with the exception of the loader actually loading a round of ammunition. Dummy rounds can be loaded for additional loader training. The simulator cable, in fact, was routed outside the barrel to keep the breech free of obstructions.

The realism of the TWGSS was awesome. Here was a crew, using its own tank under field conditions, and any error in executing firing duties was reflected in a miss. Targets were at real ranges. There was blast and obscuration. Not only was I impressed, but, more importantly, the young tank crewmen, brought up on video games and computer technology, were enthusiastic about what they were experiencing.

My experience with the Bradley and the PGS was similar. Here I fired both the 25mm automatic cannon and the TOW missile. Again, the realism was almost unbelievable. I *saw* the TOW missile heading for the target and *saw* the hit.

### The Requirement

Technology has opened new possibilities in the past two decades to greatly improved training devices for tank crews. Laser substitutes for actual rounds, video disk training devices, and computers have all been incorporated in devices to train tank gunnery. At first, each device filled a particular void, but as technology broadened the horizons of those responsible for developing requirements for gunnery trainers, and tank crew training systems themselves, the potential to duplicate reality began to be realized. Generally, in tank crew training, two paths were followed, dictated by the limits of technology, cost, and imagination. Separate devices were developed to train gunnery and to conduct tactical training.

MILES was developed and fielded to bring greater realism to tactical training. Using laser projectors and detectors, MILES provides a means of inflicting real-time casualties on opposing forces. The result has been a major step in providing realism in tactical training.

Various gunnery training devices were developed for both the Abrams tank and Bradley Fighting Vehicle, culminating in the 1980s with a Conduct of Fire Trainer (COFT) for each weapon system. The COFTs provide

At left, a crew installs the TWGSS system to an M1A2 at Fort Hood. It takes 20 minutes. Above, a crew reviews the after-action record that is stored on a laptop computer.

Abrams and Bradley crews with highly effective training. Through the use of computers and instructor monitoring, crews can be faced with a wide variety of scenarios and challenges. Targets can be stationary or moving over varying terrain, the firing tank can be moving or stationary, weather conditions can be changed, fire control systems can be degraded, and the pace of engagements can be changed. The systems offer a true final exam before a crew proceeds to live firing. But the environment, although realistic in many ways, is artificial. The crew is in a simulator with computer-generated images. The crewmen are not in their tank, and they know it.

As early as the 1970s, while the Abrams tank was under development, the U.S. Army armor community was seeking a gunnery training device that could be applied to the tank itself. What the Army wanted was an eye-safe laser simulator, a strap-on device, that could be used for precision and degraded mode gunnery training on unit vehicles in all terrain and weather conditions.

In a search of industry ideas, the Army program manager for training devices (PM TRADE) contacted the Swedish company Saab for a report of its newly developed laser simulator BT41. The resulting "Hit/Kill Study" compared various methods for providing precision gunnery training to crews to sustain their skill levels between live fire opportunities.

In 1982, two Saab simulators were acquired by the Army for engineering tests at Fort Knox. These were later used in an Armor Center Concept Evaluation Program (CEP) in conjunction with the newly developed TWGSS concept. In 1984, the Infantry Center at Fort Benning acquired additional BT41 systems for a CEP associated with the PGS requirement for the Bradley Fighting Vehicle. Here the requirement was to simulate both gun and missile systems in training crews. With system requirements further defined, in 1986 an additional CEP was conducted at Fort Hood using these systems, as well as other simulators, including MILES. The main purpose was to evaluate the transference of gunnery skills from simulation to live fire. As the U.S. Army continued its progress toward the eventual acquisition of a solution to the TWGSS/PGS challenge, Saab was meeting with success with foreign armies. In 1988, the German Army selected Saab systems to meet its similar requirement. In September 1992, the U.S. Army selected the new generation Saab simulator, BT46, to meet its TWGSS/PGS requirement. British selection of the same system followed two months later. Thus, the major NATO armies were following a similar path for combat vehicle gunnery training.

A procurement contract was subsequently awarded to Saab. The Army approved an acquisition plan to procure 2,000 systems for the Abrams and Bradley by the year 2001, with the first unit equipped in 1995. The systems are eventually to be fielded at 25 locations. In addition, procurement and fielding is now planned for Marine Corps Abrams tanks. To date, the program is on schedule and within programmed cost, and the equipment exceeds required performance standards.

When the U.S. Army's 1st Armored Division deployed to Bosnia, it quickly became apparent that Abrams and Bradley crews would be unable to maintain weapon system proficiency in the environment there. The Army diverted delivery of more than 60 TWGSS/PGS systems to the deployed force, which should solve the problem.

It is significant to note that TWGSS/PGS also meets the U.S. Army's Tactical Engagement Simulator (TES) requirement by combining a precision gunnery and maneuver capability with provisions for extensive after-action review.

### System Description

TWGSS/PGS is an eye-safe laser simulator strap-on device that provides precision and degraded mode gunnery training, using unit vehicles, in all terrain and under all weather conditions. The system requires the vehicle crew to perform all gunnery tasks under field conditions, except actual ammunition loading, and provides accurate firing results. These are available immediately and for after-action review (AAR). Similar in concept, the TWGSS and PGS have common or generally similar components. In the following paragraphs, the TWGSS is discussed in detail, with major differences of the PGS discussed later.

TWGSS consists of three subsystems: the firing system, the target system, and the training data retrieval system.

The firing system, mounted on the tank, includes four main elements: the transceiver unit; the tracer, burst, obscuration simulator; the vehicle interface assembly; and the remote system interface. Other components include the control panel, loader's panel, and turret position sensor. The included target system, comprised of target processor, four retro reflectors, and four hull deflectors, allows the tank to participate in two-sided engagements, as well as independently assessing engagement results.

The transceiver unit, mounted in the main gun muzzle, uses conditionally eye-safe laser transmitters. A transmitter simulates projectiles in real time

with the correct ballistics and dynamics of real ammunition, based on actual firing tables, thereby allowing precision gunnery training. The tracer, burst, and obscuration system simulates in both the gunner's primary sight and auxiliary sight the effects of rounds fired with the main gun or coaxial machine gun. Tracers are simulated with realistic burn times and zooming effects. Bursts on the target or on the ground are simulated, with the size determined by the type of ammunition and range. Obscuration is shown for main gun ammunition and can be programmed by the instructor from 0 to 5 seconds.

The vehicle interface assembly is the link between TWGSS and the tank. It receives and distributes power, monitors and injects signals to and from the fire control system, monitors weapon status for use in the after-action review, registers the turret/hull relationship, and injects sound into the intercommunication system.

The remote system interface uses satellite data to determine the position of the tank, updating the position every 50 meters. The information is stored on the memory card for use in the after-action review. The unit is made up of two components, the antenna that receives satellite signals and the assembly that determines vehicle position.

The entire TWGSS assembly can be mounted on a tank in 20 minutes. The target system, which can be mounted independently on targets, includes four retro detector units, four hull defilade detector units, and the target computer unit. It determines whether a projectile hits or misses the target. If the target is hit, the system simulates the effect the projectile would have on the vehicle. The effect is indicated with strobe lights and sound cues in the intercommunication system. Each round is individually evaluated, with no consideration of cumulative effects. If there is a hit, based on the received coordinates and a random generator incorporating actual vulnerability to the round fired, the unit determines whether it is a no-kill hit or a weapon, mobility, or catastrophic kill. It then triggers the appropriate visible and sound signals.

The training data retrieval system includes equipment necessary to perform the after-action review of TWGSS training. It is used to evaluate the effectiveness of tank weapon firing engagements, whether in a tank weapon gunnery exercise or in a tactical training environment. The system consists of a laptop computer unit and memory cards.

Here, the TWGSS system is mounted on a Marine M1A1 at Camp Lejeune, N.C. The Marines use the system for both tactical and gunnery training.

Each TWGSS tank has a memory card installed at the beginning of an exercise. Using the TWGSS control panel, the crew or instructor downloads information such as ballistics and target templates, as well as ammunition allowances, obscuration times, etc. The memory card then stores the data on training events for use in the after-action review. Three days of data can be recorded on one card.

The laptop computer unit provides the centerpiece of the after-action review. Each memory card is loaded into the computer, and graphics for gunnery or map views can be displayed. Gunnery results are also available in the map view so that gunnery and maneuver training results can be integrated. For firing engagements, crew member names and vehicle type are displayed, along with detailed data on time, motion, engagement ranges, hit points, and damage assessment.

PGS is essentially the same system as TWGSS. It is designed for compatibility with both the 25mm chain gun and the TOW missile system. For the 25mm gun, wide misses can be measured for area fire evaluations. TOW missile engagements can be simulated out to the 3,750 meter maximum range of the missile system.

As noted earlier, a number of gunnery training devices have been introduced in the last two decades, each offering advantages, generally related to realism, over other devices. Continued proliferation of such devices, however, is not an acceptable solution to the training challenge. Thus, it is important to examine how TWGSS/PGS fits into the overall training environment.

Most important are the relationships of the Abrams and Bradley conduct of fire trainers (COFT) and MILES with TWGSS/PGS. COFT and MILES are both widely fielded and have proven to be effective training systems.

The Abrams and Bradley COFTs, like TWGSS and PGS, are similar in nature and provide excellent gunnery training. Crews can be faced with a wide variety of scenarios and firing engagement challenges over a short period of time, making the use of COFTs efficient. They have been used since introduction to prepare crews for live fire from their vehicles. Nevertheless, training experts have recognized the missing bridge between the COFT full simulation and live fire with full-caliber ammunition. Fielded subcaliber devices, while contributing to training, lack realism and include at least a degree of negative training.

While live firing of full-caliber ammunition is critical to full-up training, the cost of ammunition, the availability of ranges, and safety restrictions are, among other factors as well, severe limitations. TWGSS/PGS can be especially useful for night firing training where live fire at night may be restricted because of the proximity of civilian communities. At Grafenwöhr, the U.S. Army's major training area in Germany, night firing has been curtailed, but TWGSS/PGS can provide

the means to conduct night training, including gunnery, without disturbing the local population.

TWGSS/PGS provides the missing bridge between COFT training and live fire. The system is flexible enough to offer a range of simulated gunnery training that provides a smooth transition to live firing. Realism can be achieved, with the operational tempo of live fire, without the need to travel to distant ranges and fire service ammunition.

TWGSS/PGS can perform gunnery in four progressive modes: tracking training, scaled gunnery, panel gunnery, and combat gunnery.

Tracking training teaches crews to lay on targets and track moving targets using the actual vehicle fire control system.

In the scaled gunnery mode, targets can be placed at close-in ranges, but the system can be set so that longer ranges are simulated. Thus, using one-half scale, a target placed at 500 meters will appear to the crew and the fire control system to be at 1,000 meters. This mode allows the use of areas restricted in size, such as many local training areas.

The panel gunnery mode allows crews to prepare realistically for situations similar to those faced on typical live fire ranges. TWGSS/PGS provides an accurate assessment of the quality of performance of the crew.

Because of safety restrictions associated with live fire, in the combat mode the crew is faced with situations more real than those faced on live fire ranges. Gunnery tasks must be accomplished, with the exception of actual ammunition loading, just as they must be in combat. Targets react as they do in combat. It is this mode, of course, that can be used in two-sided exercises, with the firing vehicle vulnerable to fire from opposing target vehicles.

MILES has provided the Army with the ability to train realistically in two-sided maneuvers. How does the TWGSS/PGS fit with MILES? This is an important question, for much of the cost of TWGSS/PGS is associated with qualities that are similar to MILES.

Fortunately, the answer to the question is that TWGSS/PGS is compatible with MILES. Thus Abrams tanks equipped with TWGSS and Bradley Fighting Vehicles equipped with PGS are able to participate in maneuvers with, for example, dismounted troops or HMMWVs using MILES components. The TWGSS/PGS transceiver transmits MILES firing information after a completed TWGSS/PGS simulation in order for the laser target interface device (LTID) and MILES target systems to function. MILES information is transmitted at the impact point of the simulated round. TWGSS/PGS equipped vehicles use the retro reflector mounted strobe lights to simulate hits instead of the yellow lights of MILES.

What this all means is that Abrams and Bradley crews can participate in MILES-based exercises using TWGSS/PGS instead of add-on MILES components. It means that Abrams and Bradley crews, in addition to gaining the tactical training of a MILES-based exercise, can practice their gunnery skills at the same time. Thus, there is much less difference between training and the reality of combat.

TWGSS/PGS has been adopted for the Abrams and Bradley, but it is equally applicable to other combat vehicles, such as the Marine Corps light armored vehicle (LAV).

On the subject of compatibility, not only is TWGSS/PGS compatible with MILES, but there is international compatibility. As mentioned earlier, the British Army and the German Army have both adopted Saab systems, as has the Swedish Army, and Saudi Arabia is procuring TWGSS/PGS through the U.S. FMS program. Other countries can be expected to follow. These systems, modified to meet certain national requirements, are all similar in operation and are compatible. International exercises will be greatly enhanced by this situation.

The potential for growth of any complex training system is important. The U.S. Army cannot afford to field a system that may become outdated in several years. At the aforementioned demonstration at Fort Hood, Saab included the application of its Gunnery and Maneuver Exercise (GAMER) system. GAMER is an add-on system that integrates the capabilities of existing systems such as TWGSS/PGS and MILES to provide realistic two-sided combat training at the small unit level in local training areas. A portable system that can be carried in a HMMWV and set up in an hour, GAMER's add-on components to existing systems use commercial components, including a laptop computer and mobile data cellular hardware. GAMER allows the integration of simulated artillery, mine fields, and obstacles into the play. It maximizes the capability of the small unit leader to plan, conduct, and review the training exercise. In effect, in about an hour, a local training area can be converted into a miniature National Training Center.

## Summary

TWGSS/PGS is bringing to the U.S. Army a major improvement in its ability to effectively train combat vehicle crews in gunnery. Moreover, it provides training establishments and combat units the ability to integrate gunnery and maneuver training. The benefits include training time and cost savings, as well as greater realism in training. TWGSS/PGS is as close to live fire training as possible, without incurring the disadvantages and costs associated with such training.

Compatibility with the existing MILES equipment and interoperability with other nations' systems are benefits that enhance the attractiveness of TWGSS/PGS. It is a modern training system that offers current capability and growth potential for the U.S. Army of the twenty-first century.

Brigadier General Philip L. Bolté was commissioned in Cavalry from the U.S. Military Academy in 1950. He served in a number of cavalry units, including 3rd and 14th Armored Cavalry Regiments and the 11th Airborne Reconnaissance Co., and commanded the 1st Squadron, 1st Cav in Vietnam. He is a graduate of the Armor School, Canadian Army Staff College, and the Army War College. He retired in 1980 from his final assignment as program manager, Fighting Vehicle Systems.

# Research Pays Off For the Guard:

## *A Device-Based Strategy For Training Tank Gunnery*

**by Dr. Joseph D. Hagman and Dr. John E. Morrison**

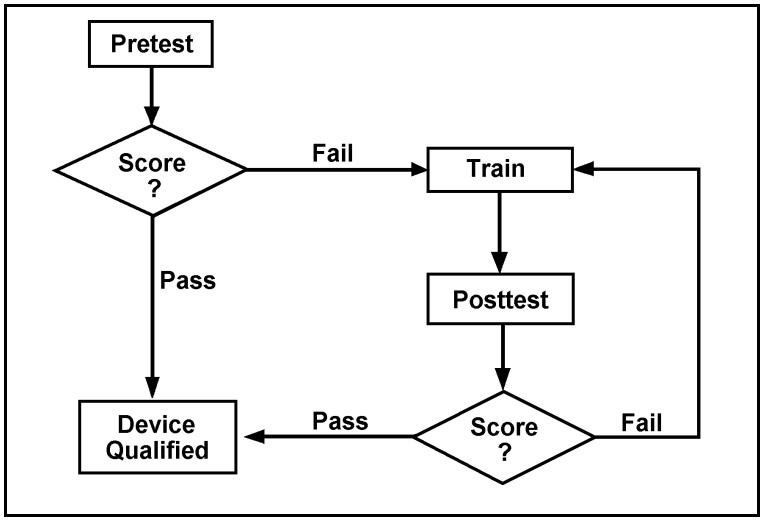


**Figure 1**

As a National Guard armor unit trainer, how often have you faced the question of how best to use training devices in preparing tank crews for successful first-run qualification on Tank Table VIII (TTVIII)? Sure, guidance is out there,[1,2] but time constraints always seem to force compromises.

Well, would you be interested if we were to show you how to complete the device-based portion of your tank gunnery training program in just three drill weekends, and afterwards be able to predict how many of your crews would be first-run TTVIII qualifiers? The Army Research Institute at Boise, Idaho, has developed a device-based tank gunnery training strategy that will allow you to do just that. In addition, this strategy will eliminate any guesswork in determining the crews to be trained, the devices to be used, the training and evaluation exercises to be conducted, and which device to use in order to maximize the payoff from your training time investment.

### THE PROPOSED STRATEGY

#### Pretesting

The strategy, as shown in Figure 1, begins with a 60-75 minute pretest on the Conduct-of-Fire Trainer (COFT) to determine each crew's gunnery proficiency.[3] The pretest involves the firing of four "gate" exercises (131-134) from the COFT's advanced matrix. You simply add up the scores from each (after subtracting "crew cuts") and divide by 4 to arrive at a total pretest score. This score is then plugged into Column 1 of Table 1 to find a crew's predicted average TTVIII score (Column 2) and associated probability of first-run qualification (Column 3). A crew firing 765 on the pretest, for example, would be predicted to fire an average score of 700 on TTVIII (if fired multiple times) and have a 50-50 chance of actual first-run qualification.

Depending on the commander's standard for his unit's first-run TTVIII qualification rate (from Column 3 of Table 1), some crews will pass the pretest (device-qualified crews) while others will not (device-unqualified crews). According to the strategy, you will only need to train the latter on devices. Thus, valuable time is not taken up training crews that are already device-proficient.

#### Training

Having identified which crews need to be trained, the next step is to determine which training device(s) to use, and which training exercises to conduct. According to the strategy, training can be conducted on either the COFT or the Abrams Full-Crew Interactive Simulation Trainer (AFIST),[5] and should focus on only the simulated TTVIII engagements not performed to pretest standard. This standard is determined by dividing the pretest score (for example, 765) by 10 (the number of engagements fired per exercise). Any engagements not fired to this standard (for example, 76.5) must be trained. To help you do this, Table 2 shows the training exercises on each device that simulate each TTVIII engagement.

Except for Engagement A2, the simultaneous engagement, which requires use of the Caliber .50 machine gun not simulated by AFIST, we recommend using AFIST whenever possible because it supports full-crew training. If AFIST is not available, we recommend alternating between or among the training exercises shown in Table 2 for the COFT. This will add variety and promote device-to-tank transfer.

| COFT Pretest SCORE | Predicted Average TTVIII Score | Probability of Scoring ≥ 700 on TTVIII |
|---|---|---|
| 620 | 562 | 10% |
| 669 | 609 | 20% |
| 706 | 644 | 30% |
| 737 | 673 | 40% |
| 765 | 700 | 50% |
| 793 | 727 | 60% |
| 824 | 756 | 70% |
| 861 | 791 | 80% |
| 910 | 838 | 90% |

**Table 1. Predicted Tank Crew TTVIII Score and Probability of First-Run Qualification for Selected COFT Pretest Scores[4]**

| TTVIII Exercises | COFT Training Exercises | AFIST Training Engagements |
|---|---|---|
| A1 | 113, 117 | 6AT1 |
| A2 | 101, 111 | — |
| A3 | 102, 106 | 6AT2 |
| A4 | 102, 106, 110 | 6AT3 |
| A5S | 102, 106, 110 | 6AT4 |
| A5A | 102, 106, 110 | 6AT5 |
| B1S | 103, 107, 119 | 6BT1 |
| B2 | 105 | 6BT2 |
| B3 | 110 | 6BT3 |
| B4 | 102, 106, 110 | 6BT4 |
| B5 | 113, 117 | 6AT1 |
| B5A | 105 | 6BT5 |

**Table 2. COFT and AFIST Training Exercises for TTVIII Engagements**

Regardless of which device is used, we suggest that an easy-to-difficult progression be followed when pretesting reveals that some crews need training on more than one simulated TTVIII engagement. Table 3 shows the difficulty rankings that we've found recently for live-fire Table VIII engagements.[6] So engagement B5, for example, would be trained before B2, A1 before A3, and so forth. To make sure that tank crews become device-proficient and, at the same time, don't pass a training exercise by luck, we recommend that the proficiency standard for training exercises be set at two successful, but not necessarily consecutive, criterion performances. On COFT, a criterion performance is reached when the crew receives an "advance" recommendation from the device in the areas of target acquisition, reticle aim, and system management. On AFIST, criterion performance is reached upon crew receipt of a "pass" recommendation from the device for the exercise(s) being trained.

## Post-testing

Just because a crew passes the training exercises doesn't necessarily mean that it is device-qualified. So, the last step in the strategy is to post-test your crews by having them retake the pretest. Those that pass the post-test are now device-qualified; those that fail the post-test must return for further training on devices, as outlined above.

We've designed this strategy to be used by units over three (preferably consecutive) drill weekends once pretesting is completed. The hour or so needed for pretesting should be included as part of the Tank Crew Gunnery Skills Test, with Readiness Management Assemblies used if drill time runs out.

Before the first scheduled drill after pretesting, pretest scores should be compared against the performance standard for first-run TTVIII qualification set by your unit commander (from Column 3 of Table 1). This will allow you to determine which crews are device-unqualified and which engagements they need to fire during training.

Similarly, the training results of this and the next two drills should be reviewed to select the right training exercises for those crews not ready for post-testing and to post-test those that have completed training. Once your crews are all device-qualified, by virtue of passing either the pre- or post-test, on-tank training should begin, probably with TTV[2,7] or with Combat Table I.[8] Regardless of where you start, on-tank training is important because it allows crews to experience the different aspects of gunnery not practiced or simulated on devices (for example, open-hatch target acquisition, tank movement, and weapon recoil effects) but important for successful TTVIII qualification.

## Conclusions

What will this strategy allow you to do in the future that you can't do now? For starters, you will be able to schedule your device-based training time more efficiently by targeting only crews in need of remediation. You will also know which devices to use and which exercises to conduct when training is needed. And lastly, because device performance standards are keyed to expected live-fire outcomes, you will know when crews have received enough device training to warrant transition to the tank, and what the expected result will be on your unit's first-run TTVIII qualification rate.

After all, tank gunnery training on devices takes time. Although this time is scarce, we think that the strategy just described provides the tools you need to use it wisely. Let us know what you think.

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## Notes

[1]U.S. Army Armor School. (1990). *Armor Training Strategy* (ST 17-12-7). Fort Knox, Ky.: Author.

[2]Department of the Army (1993). *Tank Gunnery Training (Abrams)* (FM 17-12-1-2). Washington, D.C.: Author.

[3]Use of AFIST for pretesting must await development of validated performance standards similar to those now available for COFT (see Note 4).

| | Engagement | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A3 | B3 | A2 | A1 | B2 | A4 | B4 | B5 | A5S | A5A | B5A | B1S |
| | Most | | | | | | | | | | | Least |
| Difficulty Ranking | 1 | 2 | 3 | 4 | 5 | 6.5 | 6.5 | 8 | 9 | 10 | 11 | 12 |

**Table 3. Difficulty Rankings of TTVIII Engagements**

common displays and controls mounted between the two crew stations. Also, the roof of the hull, not having a central depression, could be better protected against top attack weapons.

## Conclusions

- The relocation of two crewmen to fixed hull crew stations will separate them from their main armament, which will then either be carried on an unmanned turret or on an external overhead mounting.
- As pointed out by Don Loughlin, the commander will then no longer be able to exercise direct "top vision" from the highest point of his vehicle, and the external overhead mounting will be both prominent and vulnerable. No wonder that it has been often proposed and just as often rejected.
- But, if the introduction of a 'lift-and-turn' mounting were to allow the characteristics of the fixed gun "S" Tank to be combined with those of a similar front-engined vehicle carrying its gun on an overhead mounting, the resultant hybrid would be able to employ the characteristics of either of these configurations according to the prevailing tactical situation. Such a Hybrid Tank would also only display a small target, for only a short time, and without any vehicle movement when engaging from behind a crestline.
- With the three main disadvantages of the external overhead gun mounting thus corrected, and with advantages gained when engaging from behind cover, the Hybrid Tank might well form the basis of our future main battle tank.

## Notes

[1]Robin Fletcher, "The Arming of Crew-in-hull AFVs," *Military Technology*, 7/1995, p. 32 for a photograph.

Hermann Sitterberg, Division K.G., B.W.B., *Military Technology*, Special Issue "B.W.B. - Defence Procurement in Germany," 1994, p. 41 for a description.

[2]Robin Fletcher, "Crew-in-hull A.F.V. Concepts," *Military Technology*, 10/1994, p. 27 for a photograph.

Christopher F. Foss, *Jane's Armour and Artillery*, 1994-95, p. 220 for a description.

[3]Rainer Glass and Rolf Hilmes, "Shaping Germany's Leopard 2 Tank for the Future," *International Defense Review*, 5/1995, p. 62.

[4]Barbara Starr, "GDLS briefs U.S. Army on low-profile tank," *Jane's Defence Weekly*, 28 February 1996, p. 5.

[5]Richard M. Ogorkiewicz, *Technology of Tanks*, Jane's Information Group, 1991, p. 398 for a photograph.

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[6]Western Design Corporation, "We have a winner!," First Place in *ARMOR's* Tank Design Contest, *ARMOR*, July-August 1993, p. 7.

[7]Ogorkiewicz, p. 124 photograph and description.

[8]Rolf Hilmes, *Main Battle Tanks - developments in design since 1945*, translated by Richard Simpkin and published by Brassey's Defence Publishers, 1987, scope and limits of future tank development, p. 108.

[9]Ogorkiewicz, pp. 119 and 274 for photographs and p. 395 for a description.

[10]Board on Army Science and Technology of the National Research Council (U.S.) in their report, "STAR 21: Strategic Technologies for the Army of the Twenty-First Century," National Academy Press, 1992, pp. 80-81.

[4]From "Device-Based Prediction of Tank Gunnery Performance," by J.D. Hagman and M.D. Smith, *Military Psychology, 8, 59-68*. Copyright 1996 by Lawrence Erlbaum Associates, Publishers. Reprinted with permission.

[5]Snyder, S.J., "The Guard Unit Armory Device Full Crew Interactive Simulation Trainer (GUARDFIST-1)," *ARMOR*, March-April 1996, pp. 40-43.

[6]Hagman, J.D. (1994). *Performance analysis of Table VIII tank gunnery engagements* (Res. Rep. 1669). Alexandria, Va.: U.S. Army Research Institute for the Behavioral and Social Sciences.

[7]Shaler, M.D. (1995). *Compressed gunnery program for Abrams Tank battalions: Trainer's handbook*. Project SIMITAR.

[8]U.S. Army Armor Center (1995). *Enhanced mounted brigade training strategy*. Fort Knox, Ky.: Author.

Dr. Joseph D. Hagman is a senior research psychologist at the U.S. Army Research Institute's field office at Gowen Field, Idaho (208-334-9390). He received a Ph.D. in engineering psychology from New Mexico State University. His research interests are in human learning and memory, and more recently, in soldier performance on armor-related simulation and training devices.

Dr. John E. Morrison is a research staff member at the Institute for Defense Analyses (IDA) (502-366-5836). He received a Ph.D. in experimental psychology from Tulane University. Before joining IDA, he worked for 11 years at HumRRO's Radcliff office and before that for 5 years at ARI's Fort Knox field office. His current research interests are in the application of cognitive psychology principles to applied training problems.

Robin Fletcher was commissioned in the Westminster Dragoons in 1941 and later served in the Special Operations Executive and 2d Special Air Service Regiment. After the war, he attended the technical staff officer's course at Shrivenham, spent two years on tank design at Chobham, and returned to Shrivenham to lecture on tank armament. After leaving the service, he raised crops in Kenya and cattle in Ireland. His articles on armor have been published in *International Defense Review, Soldat und Technik, Military Technology,* and other journals.

## Commander's Hatch (Continued from Page 5)

ing unit works at the speed of every brain in the organization. Active listening is very difficult, especially so for young leaders eager to be in charge. Take a moment to listen to your NCOs and soldiers. They often have something important to say.

The final point has to do with an understanding of the resource environment in which the Army will operate for the next several years, barring an unforeseen war. It is wishful thinking to believe that the Army will return to a time where there are enough soldiers and dollars to accomplish every task. The future will be full of hard choices. One of them will be the decision to either bunker in and wait for better times or to plan for success. Choose the latter. The key to planning for success is first to define it in writing, then to build the steps necessary to achieve it. No matter what the process is, and I think Army Performance Improvement Criteria (APIC) is better than the others, each of you will have to spend an enormous amount of time figuring out what it costs to perform each element of your mission. Unless you know specifically what each activity costs, you will never be able to trade off inefficient or unnecessary activities for those that are critical.

These are interesting times. There is much to learn and much to do. Exciting things. Take a second along the way to enjoy life. Your time in the military will be over all too soon, and none of you will want to look back on your service and say it wasn't a fun, productive, pleasant time in your life. There is more to the Army than constant work and worry. Find the time to discover what those things are.

### *MG Harmeyer Selected As New Chief of Armor*

Major General George Harmeyer, a Vietnam and Desert Storm veteran with more than 30 years service in Armor and Cavalry units, was to assume command of the U.S. Army Armor Center on 29 October. Previously the commander of Seventh Army Training Command, he has also served as V Corps chief of staff and as assistant commander of the 3d ID (Mech).

He commanded 1st Brigade, 1st Cavalry Div. during Desert Storm, and was a troop commander and S3 Air in the 4th ID during the Vietnam war. Much of his career has been focused on training, as commander of the Operations Group at the NTC and at the training support division of the ODCSOP, the Pentagon.

His introductory "Commander's Hatch" will appear in the January-February 1997 issue of *ARMOR*.

## LETTERS (Continued from Page 4)

always seemed to know where the decisive point would be, and appeared there as if by a sixth sense, spent more of their time searching, realizing they were not at the decisive point, then moving on, exploring the front until they found it (this ability was only gained through commanding long enough to gain it).

A second disadvantage suffered by the commander in the rear command vehicle is that he loses time, despite what we are attempting to do by overwhelming him with instant information from hundreds of sources. (We feel this will take the place of experience.) Precious time! Information takes time to get to him accurately! More time is lost while he and his staff, doing things by consensus as we practice daily in peacetime, make a decision. Now, unless he has made his command vehicle and himself irrelevant by telling his soldiers to act without waiting (which is probably the best thing to tell them if he is going to remove himself from the fighting), more time is lost while they wait for his perfectly-formatted orders to be transmitted via IVIS.

A third disadvantage is the loss of confidence he will surely suffer if he is not seen by the soldiers who bear the real burden of combat. The commander may be the most noble man in the world, the hardest worker, the most intelligent, the bravest, but if they do not see him, they will not trust him, and they will gripe about his indolence. We mistrust what we do not see.

The soldiers doing the fighting need to know their commander is there, sharing the risks. A close camaraderie like no other known in the world is formed by those who fight and bleed together. The commander has a choice, becoming a part of that brotherhood or staying apart from it.

The bottom line in "Recon Pull," or just executing the style of warfare Force XXI is calling for, is trust. We must go back and define our culture which creates trust and not subtle dangers which exist in our evaluation systems and promotion boards. Trust is important in any style of fighting. But Force XXI, which calls for decentralization in a multitude of engagements, will depend on it. Without trust there can be no Force XXI operations. It simply will not work. The concepts that both Captains Bateman and Kolenda touch upon, Commander's Intent, *Auftragstaktik*, and Recon Pull, are impossible without it!

MAJ DONALD E. VANDERGRIFF
OEC
Alexandria, Va.

### Synopsis: Senior Officer Logistics Management Course

The Senior Officer Logistics Management Course (SOLMC) is specifically designed to update battalion and brigade commanders, primary staff officers, and DA civilians working in the logistic field. The course encompasses maintenance, supply, readiness, transportation, as well as hands-on experience with vehicles, unit level logistics computer, ammunition, medical, communication, NBC, missile and quartermaster equipment. The course is open to officers of all branches in the rank of major or higher in the Active, Reserve, and National Guard components, U.S. Marines Corps, and Allied Nations. DA civilians in the grade of GS-11 or higher are also eligible to enroll. The one-week course is conducted 10 times each fiscal year at Fort Knox, Kentucky. Class quotas may be obtained through normal U.S. Army Training and Doctrine Command channels. Any problems encountered obtaining class quotas or information about the course should be directed to the SOLMC Branch Chief, DSN 464-8152/3411 or commercial (502) 624-8152/3411. Class schedules for Fiscal Year 97 are shown below.

| Class # | Class Dates | Class # | Class Dates |
|---|---|---|---|
| 97-01 | 18-22 Nov 96 | 97-06 | 12-16 May 97 |
| 97-02 | 27-31 Jan 97 | 97-07 | 16-20 Jun 97 |
| 97-03 | 24-28 Feb 97 | 97-08 | 21-25 Jul 97 |
| 97-04 | 17-21 Mar 97 | 97-09 | 18-22 Aug 97 |
| 97-05 | 14-18 Apr 97 | 97-10 | 15-19 Sep 97 |

# BOOKS

## Of "Warrior-Studs" and "Perfumed Princes"

**Hazardous Duty** by David H. Hackworth (COL, USA, Ret.) with Tom Mathews. William Morrow and Company, Inc., New York. 328 pages. $25.00.

This book claims, "America's most decorated living soldier exposes the real truth about the U.S. military." I will not dispute Colonel Hackworth's personal valor, nor the number of his decorations. But the "truth" he presents is heavily flavored by his own "unique" perspective.

This book is a rambling collection of war stories, heavily flavored with profanity (because that's how soldiers talk), interspersed with barbs against "The System," the Military-Industrial-Congressional Complex, and anyone who generally does not fit into his idea of a soldier. COL Hackworth has visited every operation and fight in the last decade, from the Gulf War to Bosnia. He has talked with the leaders and the troopers involved. He lavishes praise on his idea of "real warrior-studs" and heaps disdain on "Perfumed Princes," soldiers who do not measure up to his idea of selfless service.

But this book does perform a service to the Army and the Defense Department. He did make me think, although I had to choke back my disdain for his operating procedures and his repeated "concern" for the troops — concern repeated so often as to make you wonder about its sincerity.

The really unfortunate thing about this book is that when COL Hackworth does make a worthwhile observation, for example the problem of mines in Bosnia, he leads his worthwhile point with, to use his vernacular, profane horses#$% which effectively disguises his point. One thing I've learned in the 20 years I've served is to make a point with selective profanity, but once you've proven you're a hard-core warrior, let the profanity go. The book is saturated with the words and phrases we use in the motor pool and the TOC. So what, Colonel, make your point based on experience, which I do not doubt you have.

COL Hackworth also makes "new" suggestions for the restructuring of the Defense Department, which are by and large revarnished trite ideas from the extreme liberal wing of the Democratic Party. The author's new ideas are: do away with the U.S. Air Force and combine the Army and Marine Corps. These sad, old ideas obscure some very salient ones he gathered in his interactions with our troopers, like putting money into R&D for new body armor, lightweight commo gear, and streamlining of the acquisition procedure.

COL Hackworth also points out that our civilian leadership's dearth of military experience, in either political party, requires military planners and leaders to more fully explain the depth of the commitment to military operations other than war, in addition to the real gun fights of the future. We all understand his examples, like the fact that a battalion on MFO duty really ties up one brigade of troopers in the preparation, execution, and recovery/retraining cycle. I am a planner right now, and believe me, I spend sleepless nights thinking about the battalions we have in Bosnia, Kuwait, and the Sinai, and how we'll get those troopers out when we have to fight. Good point, Colonel; we owe it to our civilian leaders to make them understand the application of military power.

So, should you buy this book? My answer is a qualified yes. The point of reading is to expand your range of thought, and this book does make you think. It is really unfortunate that COL Hackworth obscures his points with "barracks talk" and rambles on about meeting with former Vietnamese enemies, then shifts back to his travelogue of trouble. His "truth" is not so clear to me; it sounds at times like a rehash of Gabriel and Savage's *Crisis in Command,* from the late 1970s, and I know we are not that bad off, yet. I really think COL Hackworth needs to write a book on how to fight the dirty little wars he believes we will be facing in the future — and by the way, I believe he is correct here. This would be a real contribution to the Army, more important than chasing generals and looking for faults where there might not be any.

Just so COL Hackworth does not think I am one of those who has sold his soul to become a "Perfumed Prince," I'll note here that I probably won't command a battalion and, therefore, will not be promoted any higher. But Colonel, I still call them like I see them.

LTC KEVIN C. BENSON
Third U.S. Army

**A Quick and Dirty Guide to War, Third Edition** by James F. Dunnigan and Austin Bay, William Morrow and Company, Inc., New York, 1996. 690 pages. $27.50, hardback.

This is not a book to be read from cover to cover, rather one to have close at hand while watching the evening news or reading the daily paper. It covers the world in major geopolitical pieces going into just enough detail to provide the reader the background (geography, history, local politics) and agenda of all the key players. It certainly does not disappoint readers interested in numbers and predictions. Each chapter provides charts with empirical data the authors have developed from wargaming. The authors use this data as a major component of their predicted outcomes; the first edition was 80 percent accurate and the second edition 72 percent correct.

The book would be better served with the addition of more maps in greater detail. The index provides quick access to more information on today's third page story before it becomes *Newsweek's* cover story. The only major deficiency is the lack of any documentation to explain where the authors got their information. The unstructured bibliography provides a few clues, but coupled with the lack of documentation, it is impossible for the reader to find out more information on some of the more interesting lines like "...some Brazilians fear that the United Nations intends to 'internationalize' control of the Amazon...." Which Brazilians? The authors cheat readers out of the opportunity to evaluate the quality of the research material and, more importantly, the ability to further their understanding of a situation by picking up the trail of knowledge where the authors left off.

The book meets its stated goal to provide readers a brief synopsis of the world's wars and possible situations that could easily become wars, and explains what we should expect from them in the future. Armor and cavalry officers should consider this book for their professional libraries. With luck, there will be a fourth edition around the turn of the century with an accompanying CD ROM diskette filled with the magazine and newspaper articles the authors used in their research, not to mention more maps and pictures.

CPT MATTHEW MORTON
Ft. Polk, La.

**Arrogant Armies: Great Military Disasters and the Generals Behind Them** by James M. Perry, John Wiley and Sons, Inc., New York, 1996. 314 pages. $27.95.

James Perry's *Arrogant Armies* is a journalist's survey of military catastrophe. His subjects are General Braddock, famous for the Braddock Massacre; Charles V.F. Townshend, who surrendered a British Army in

Iraq during World War I; and other foolish, vain, and arrogant officers who led armies to catastrophe in the last two hundred years. Perry's style is pithy and reveals some predisposition to regard soldiers as arrogant and empty headed. Perry makes no pretensions about his qualifications or his motives. A political writer, he is expert in his field, but argues that understanding the history of these kinds of events is critical and important not only for journalists, but to be well informed. He expresses the hope that this book might encourage young people that history is worthwhile and exciting. In this attempt, he is successful.

Perry recounts the unfortunate results of 11 failed military campaigns clearly and concisely, and tells the story in such a way as to develop a sense of foreboding, even if the reader is familiar with the campaign. Perry also lays out the policymakers' role in these outrageous affairs. Sending troops to salvage failed policy has a long tradition. Because most of these campaigns involved operations overseas, logistics failures also contributed to the disastrous events Perry describes.

Flawed policies and operations at the end of enormously long supply lines contributed to failure in campaigns from 18th century North America to Morocco in the early 20th century; but Perry's central thesis is that "arrogance, contempt for the enemy, bad intelligence...and incompetent political leadership," were the chief causes of military catastrophe from Braddock to Mogadishu. Mogadishu! — Yes, Mogadishu. Perry uses the events in Mogadishu to remind us that the elements of military catastrophe remain with us today. His conclusion is irritating, because it is compelling and chilling, and because it could happen again. Arrogance, contempt for the enemy, bad intelligence, and flawed policy are not the province of history alone. All of us who would lead troops should read Perry and consider the implications of his argument.

COL GREGORY FONTENOT
Cdr, 1st Bde Combat Team
1st Armored Division
Dubrave, Bosnia

**Inside the Blue Berets: A Combat History of Soviet and Russian Airborne Forces, 1930-1995** by Steven J. Zaloga, Presidio Press, Novato, Calif., 1995. 339 pages. $24.95.

Steven Zaloga is the author of numerous books on the Soviet and Russian military. Additionally, he writes regularly for *Jane's Soviet Intelligence Review* and has written and produced several video documentaries on military technology. His look at the Soviet, and now Russian, airborne demonstrates his expertise and provides tremendous insight for the military scholar.

The value of this book is stated clearly in the book's introduction: "The Russian Army may no longer be 'The Threat,' but the Blue Berets [Russian Airborne soldiers] are likely to figure prominently in the headlines over the next decade. The Blue Berets are Russia's power projection muscle in these [current] conflicts. This book aims to establish Russia's legitimate claim as one of the pioneers of airmobile forces and to explain how the tradition is changing the face of today's Russian Army."

In the early 1930s, the Soviets led the world in the development of paratroopers and airborne tactics. Zaloga goes to great detail in recounting the early Soviet experimentation in this futuristic style of war. Most of these tests and trials, to include their use during World War II, were disastrous, but the author's descriptions reveal numerous lessons. They add detail to an area little studied or written about.

Zaloga explains how the Soviets developed their airborne forces as a strategic asset, working directly for the Soviet General Staff. This fact, and the fact that all airborne forces were mechanized in the 1950s and 1960s, demonstrates differences between the Soviet paratrooper and his U.S. Army counterpart.

The author's description of the development of the Soviet airborne force as a rapid deployment or shock force is outstanding, and it allows the reader to understand why the Soviets maintained such a large airborne force, and why they mechanized it. An entire chapter discusses airborne armor tactics and armor systems. The Soviets, from the inception of the airborne concept in the 1930s, planned to use armor forces as part of the airborne operation. Usually, these forces were airlanded following the seizure of an airfield. This leads to a discussion of the development of an airborne armored vehicle and airlift to move these and other armor assets.

The author also includes brief discussions about the other Soviet special operations units: Spetnaz, Soviet Naval Infantry, and Naval Spetnaz. This, and the discussions of the use of airborne and special forces during the war in Afghanistan and the Moscow coup attempts in the early 1990s, bring the reader up to the present day and also bring this work into focus. Zaloga's entire development shows that the new Russian airborne units are the ones with which U.S. Army forces will most likely interact as either friend or foe. The work also takes on current significance as the author traces the careers of several prominent individuals through their time in the airborne corps, to include General Alexander Lebed (Russian "National Security Advisor") and General Pavel Grachev (ex-Russian Defense Minister).

This book is well written, providing for easy and enjoyable reading. An extensive bibliography is included. The information presented has importance, not simply to scholars, but to Armor/Cavalry soldiers as well. The men and units discussed are "players" on the world military stage. Additionally, the Russian airborne's use of armor in rapid deployments poses interesting questions in light of the recent decision to cancel acquisition of an Armored Gun System. I recommend this book to anyone interested in the Russian (Soviet) Military and Airborne/Special Operations.

CPT BRIAN L. STEED
Fort Knox, Ky.

**Sheridan: A History of the American Light Tank, Vol. 2** by R.P. Hunnicutt, Presidio Press, Novato, Calif., 340 pages. $80.

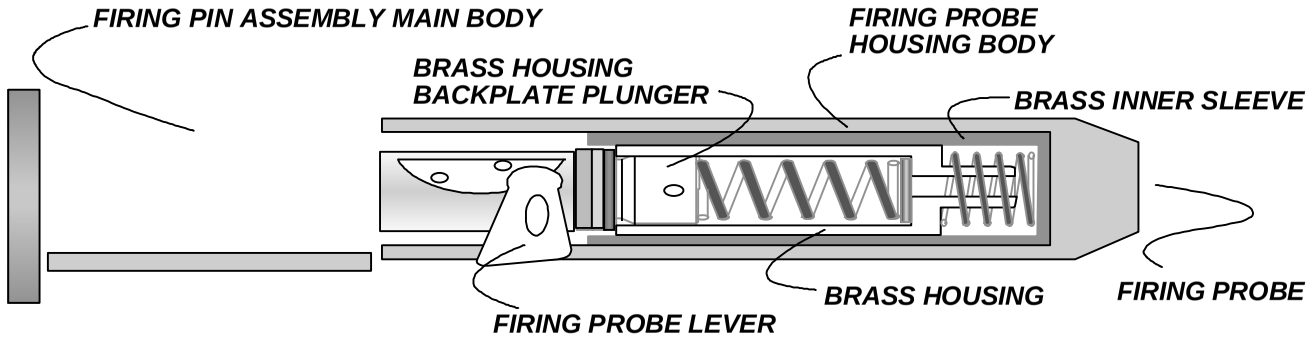
Dick Hunnicutt's series of books on American armor are well known to armor professionals as authoritative, heavily illustrated, and of extremely high quality. Together, they offer the definitive coverage of the development of U.S fighting vehicles.

What makes them so special is the level of detail. The author not only covers the major tanks that have been in the Army's inventory, but also the many test projects and prototypes that led up the final design, along with the variants that followed. The text is accompanied by many outstanding pictures that make it easier to follow. Many of these pictures have never been published before, a tribute to Hunnicutt's incredible effort in contacting sources and gathering truly unusual photos.

His latest title is a bit misleading. Actually, the book is not so much a history of the Sheridan's development, but of all light armor projects in the post-WWII era, including the M41, experimental T71 and T92 designs, the Sheridan, and the Armored Gun System, may it rest in peace. This volume picks up where his earlier, *Stuart: A History of the American Light Tank, Vol. 1,* left off.

Despite the price in an era of overpriced books, this one is a bargain. Paper and printing are of the highest quality, and the binding is definitely reference-book class. These qualities set off a really first-rate effort.

JON CLEMENS
*ARMOR* Staff




***FIRING PIN ASSEMBLY***

# The Firing Pin Assembly — An Inside Look

**by Staff Sergeant Stephen A. Krivitsky**

The above illustration is a cutaway view of the firing pin assembly for the M256 gun. It is not drawn to scale. Currently, the disassembly of the firing pin assembly is 20 level (Unit Maintenance). It is critical, however, for the tank crew to be extremely proficient at disassembly, cleaning, inspection, assembly, and function check of the firing pin assembly. This process should be accomplished monthly at a minimum.

This illustration shows the firing pin assembly and how each of its components interact, and how they are placed correctly in the assembly. This drawing is extremely handy when training new crewmembers the basics of the firing pin assembly and firing circuit test. A copy in the gunner's or tank commander's position will prove very helpful during gunnery densities and live-fire exercises.

*Staff Sergeant Stephen A. Krivitsky has served as an armor crewman in Friedberg, Germany; Ft. Hood, Texas; and Ft. Carson, Colo., and has been assigned as a battalion master gunner at Ft. Carson and Camp Casey, Korea. He is currently a tank commander with C/1-68 Armor at Ft. Carson.*

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