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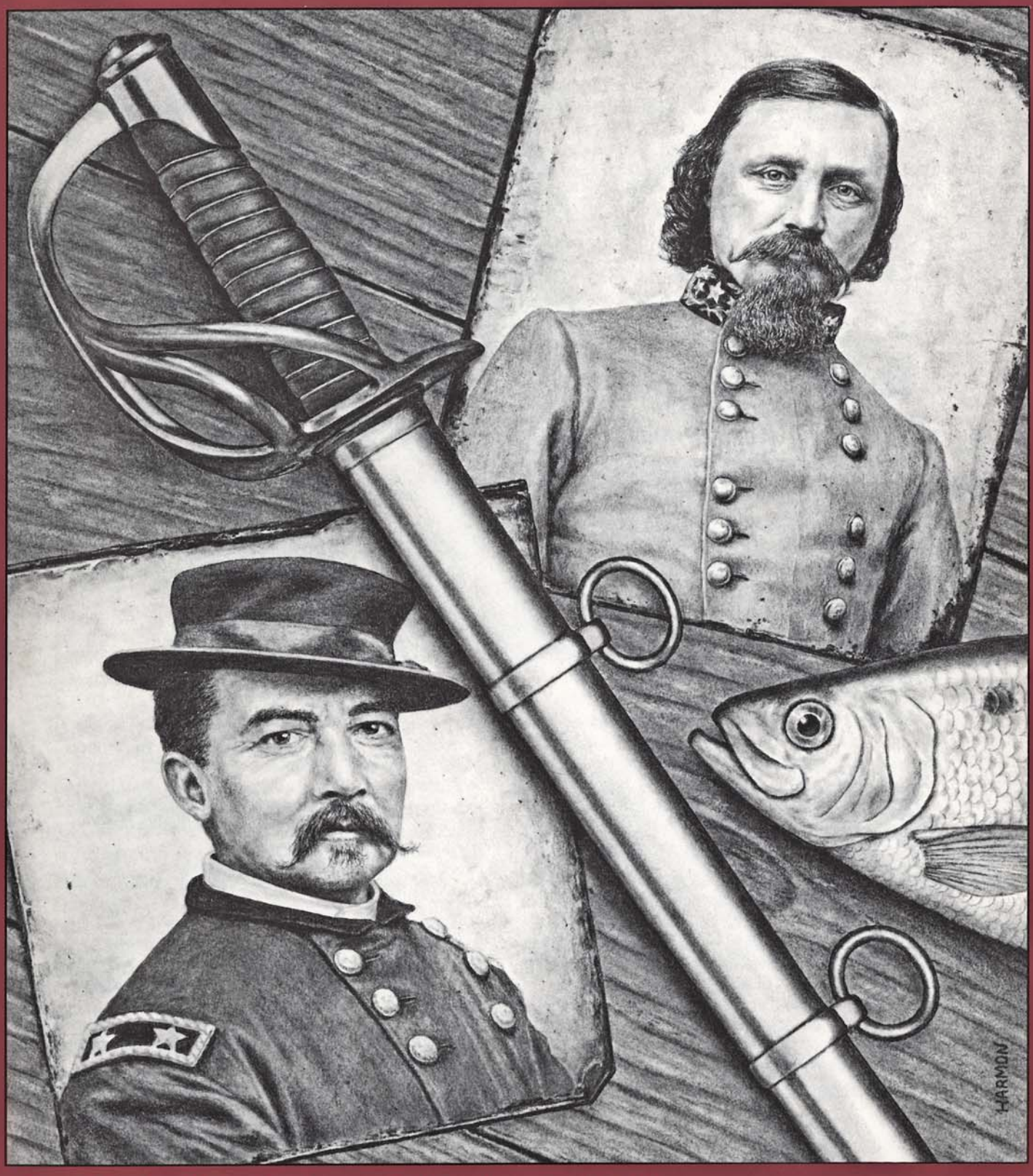
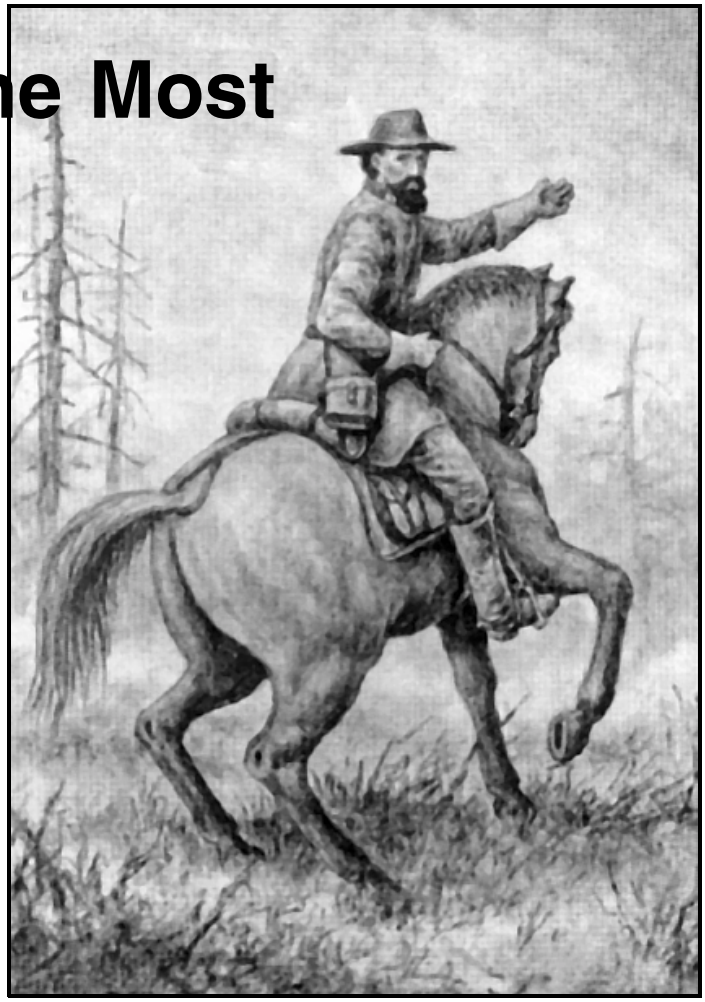


The Battle of Five Forks — 31 March-1 April 1865

PB 17-95-3

May-June 1995

First With The Most



Brewer's Axioms

Classic westerns end with the hero capturing the bad guys, kissing the girl, then riding off into the sunset. When I mount up and ride away in July, I will do so with mixed feelings. The Army has been good to me and to my family, and I am grateful for the opportunity to have served my country; however, I am equally excited about the possibilities for the future and I look forward to becoming a regular citizen once again. Yet retiring without offering some hard-learned lessons to my fellow soldiers seems to me the moral equivalent of keeping government equipment without at least attempting to settle-up with the supply system. Brewer's Axioms that follow are neither fully original observations nor absolute truths, and, in many cases, I don't recall specifically who taught which lesson, and even if I did, the chances are good that I wouldn't tell you. Just keep an open mind and absorb what is useful.

"You can have it as good as I've got it, but you can't have it any better." A platoon sergeant said that to me when I was a private, and, at the time, I didn't fully understand him. I now realize the statement was not a declaration of fact as much as a plea for equality of service within the service. People want to be treated with equal respect in the personnel, medical, housing, and other service-oriented areas of the Army. Sure, rank has its privileges. But basic human dignity should not be a function of the design one bears upon his collar. Our business forces us to recognize another person's rank and render the proper courtesies. But beware when you begin to look first at a person's right collar before determining how you will treat that person.

"You get more flies with honey than you do with vinegar." In-your-face, scream-at-the-top-of-your-lungs, intimidational leadership has its

(Continued on Inside Back Cover)

By Order of the Secretary of the Army:

GORDON R. SULLIVAN
General, United States Army
Chief of Staff

Official:

JOEL B. HUDSON
Acting Administrative Assistant to the
Secretary of the Army
00002

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LETTERS

Train Soldiers to Standard

Dear Sir:

I am a tank instructor at the III Corps NCO Academy, BNCOC. My letter regards the Tank Crew Gunnery Skills Test (TCGST) standards, but mainly Station 6, Boresight the Abrams Main Gun.

The 19K BNCOC Course is basically broken down into two areas: common leaders tasks (CLT) and tank related (MOS). One of the major tasks that soldiers fail is the TCGST tasks. And since we test to standard, as with Master Gunner Branch, we usually drop one to three soldiers a cycle on the retest.

I know this is nothing new for Master Gunner Branch. But the sergeants that come through this course usually have the same excuses. "My unit does not test us this way," or "I have not been on a tank for a long time."

Again, the two most troublesome tasks are Station 5A, Breechblock, and Station 6, Boresight. With the breechblock, the commanders at a lot of the units do not allow the tankers to drop them — mainly because too many soldiers do not know what they are doing and usually break something. So, when we get the tasked tanks, 75 percent of the breeches are either rusted or so dirty that you can hardly drop them at all.

Boresighting is an ongoing problem. Soldiers do not know the standards in FM 17-12-1-1. Too many tank commanders are using the shortcut method. And most of the sergeants do not do steps 36 through 44, adding the sight correction factors (SCFs). Someone has told them they are not important. And a lot of the sergeants say they still hit targets at gunnery. They must understand that on a gunnery range, when using the GAS, the ranges are usually under 1800 meters. And yes, you will probably hit the target. But, if you are in combat and have to use the GAS, at let's say 3100 meters and the correction factors are not recorded during boresighting and then placed on the GAS when firing from it, YOU WILL MISS at long ranges!

When I went to Master Gunner School, we were tested to standard. And I am sure that has not changed. Why are there so many units not testing to standard? When will master gunners, tankers, and leaders stop sending soldiers to schools not knowing if they know their JOB?

Taking care of soldiers is not just ensuring that they have clean socks or that they are being paid properly. Making sure they are trained to standard is also part of taking care of our soldiers.

SSG FLOYD C. McANALLEN
BNCOC 19K Master Gunner
Ft. Hood, Texas

Problems with Checkpoint Operations in Somalia

Dear Sir:

There are two totally unsound problems with "Checkpoint Operations in Somalia." First, there is no 360° security on either checkpoint. Moreover, everyone's attention is focused on the center of the checkpoint. Second, over 80 percent of the soldiers are on the checkpoint in the open when stopping a vehicle. Both of these problems make this operation very susceptible to enemy ambush/car bombing. Solutions: (1) Bring vehicle off road to an inspection area which is covered/concealed. (2) Put LP/OPs in four cardinal directions from checkpoint. (3) Use strict sectors of fire and fire control measures; maintain 360° security with the reinforcing element. (4) Whereas a 7-98 is good for LIC, a 7-8 and the *Ranger Handbook* will offer good advice to ensure you bring all your troops home.

1LT ANTHONY J. AQUINO
E/3/325 ABCT
APO AE

Communicate, Move, and Shoot Only When Necessary

Dear Sir:

I realized in reading MAJ Nowowiejski's article, "Achieving Digital Destruction..." (Jan-Feb 95 *ARMOR*), that some fundamental rethinking needs to occur.

When I was a student in AOBC (Cavalry) in 1984, I learned that the three missions of the cavalry (and by translation, the mechanized force) were "shoot, move, and communicate." This maxim found great use for me in teaching cavalry (and later scout) platoon tactics.

I used to tell scouts that "shoot, move, and communicate" was most helpful to remember in contact. You shoot to save your butt, move to a covered and concealed position to better develop the situation, and then communicate enemy compositions and dispositions and your proposed solution to the problem.

Of course, I would tell them before contact, that axiom was not used in that particular chronological order. For the cavalry, it was "move, communicate, and shoot," with the latter mission only to be conducted as necessary. Either way, proficiency in these three missions would guide them to proper tactical employment on the battlefield.

These three missions are still pertinent to Force XXI. However, MAJ Nowowiejski's article seems to suggest that the proper chronological order is "communicate, move and shoot:" communicate intelligence on the area of operations as it is gathered, move your force using this intelligence as your guide, and shoot proficiently when necessary to provide the outcome dictated by the commander's intent. This holds implications for future training.

First we must train our "communicate" mission. The digitized force must learn to work through the complexities of a receiving, discriminating, reconfiguring, and transmitting (RDRT) loop inherent to the volumes of intelligence that will come from the sky and on the ground. To me, this implies digitized command post exercises (DCPXs). These should be executed with the same intent as the UCOFT — to train proficiency in (digital) warfighting skills. I think not doing so would be tantamount to an aviator learning how to fly, but not how to work the radios to talk with air traffic control personnel.

Since intelligence gathered from the digitized system will drive force movement, field training exercises (FTXs), our "move" mission, should come next. Tactical training **MUST** be multiechelon in nature. This is of prime current importance with a one-way graphics update capability, as alluded to by the major's article (a critical vulnerability for a digitized force). Even when this software limitation is corrected, multiechelon training is still the way to go. As I understand it, information will flow from all over the battlefield. The only way to master the RDRT Loop is to use it the way it will come to us in the fight.

At the end of the training cycle, crews can begin gunnery training. This is not to say our "shoot" mission is of least importance. On the contrary, it is the ultimate expression of force. Simply deploying a joint task force (as we did this last October) to preempt a potential invader will not happen often in the future. But it would seem that the intelligence capabilities of a digitized force allow "shooting" to be more of an end state instead of the means we use to get there.

I have no idea how digitalization is going to change Tank Tables I-VIII. Perhaps it should not have any effect at all. But section- and platoon-level gunnery sounds like an opportunity to apply mass with acceleration (through velocity over a vectored route) to bring force to bear on the enemy. (It makes me wonder if gunnery ranges will be tens of kilometers long, or will we replicate the fight by maneuvering sections and platoons several kilometers through a training area onto the range?) It is not difficult to see digital possibilities for Tank Tables X-XII.

We should not forsake our traditional missions of "shoot, move, and communicate" as if electrons are **the** way to fight. Rather, we should apply electrons to bring us to

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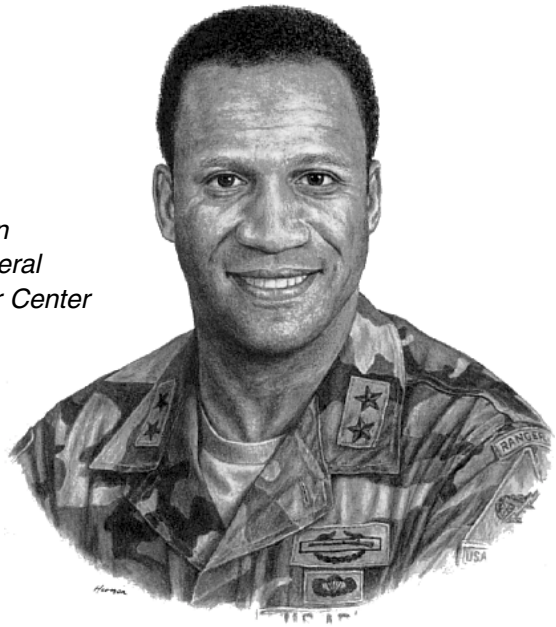
COMMANDER'S HATCH



MG Larry R. Jordan
Commanding General
U.S. Army Armor Center

Change in the Mounted Force

The most enduring characteristic of the Mounted Force is change. The theme of the 1995 Armor Conference, "Victory Then, Victory Now, Victory Tomorrow: The Mounted Force 1945-2005," spoke powerfully to that change. While the entire Army is in the midst of tremendous transformations as it moves towards Force XXI, it is perhaps the Mounted Force that most reflects fundamental shifts in the way we are organized, equipped, and trained. The Armor Conferences of 1993 and 1994 addressed issues of Force XXI and digitization of the battlefield. Central were presentations on digital equipment, expanded capabilities, Information Operations, and Advanced Warfighting Experiments. This year we sought to focus on training and leader development. We did this to highlight the fact that the real goal of Force XXI is to train more skilled and capable soldiers, and to develop and equip leaders who can make better, faster, more informed decisions and execute them superbly. Force XXI is using technology, innovation, and initiative to best leverage the skill and courage of our people. That is where we truly enhance our combat power and potential.

The change that enabled the Mounted Force to contribute to victory in World War II, to victory in the Cold War and DESERT STORM, and to victories yet played out, was or will be the result of leaders and soldiers who are willing to try new and innovative approaches. Success in this area depends on a dose of audacity, combined with a focus on warfighting, a healthy respect for the traditions and history of our Force, a willingness to take prudent risk, and thorough grounding in the fundamentals of our profession.

I am proud to have been a part of the tremendous changes that have involved the Home of Mounted Warfare for the past three years. First as Assistant Commandant, and then as Chief of Armor, I was privileged to serve with outstanding soldiers and leaders who made a lasting difference in the way we are organized to train, the way we conduct training, and the doctrine, tactics, procedures, and equipment that is the subject of that training.

In this last column I will pen for the Commander's Hatch, I would ask that you maintain the pride and esprit, the professional curiosity, the intellectual energy, and the standards of excellence that make ours the best Mounted Force in the world. Embrace change that is good and needed, hold fast those things from our past which define us, and keep both combat readiness and soldiers uppermost. Change at the leadership of the Home of Mounted Warfare is a part of the continued growth and progression. There are plenty of targets left to engage as we strive to enter the 21st Century. ON THE WAY!

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

BNCOC: A "Pit Stop" on the Road of Success

Sergeant Konrath has heen selected to attend his First Military Occupational Specialty (MOS) course, the Basic Noncommissioned Officers Course (BNCOC). He knows that with successful completion of BNCOC comes more responsibility and an increased chance for promotion. His equipment's ready but he wants to know more about the course; after all, it's his first "big" MOS course. He walks into your office and asks if you could tell him more.

This article gives a general understanding of how Career Management Field (CMF) 19 Armor BNCOC prepares junior-level noncommissioned officers for mid-level responsibilities, part three of a continuing series of articles highlighting the institutional training provided at the Armor Center and Noncommissioned Officers Academies.

FM 25-101, *Battle Focused Training,* states "NCOs also have responsibility to train sections, squads, teams, and crews." This statement accurately describes the capabilities of today's BNCOC graduate. His diploma is a testimonial to his demonstrated competence at training soldiers in a myriad of skills with an emphasis on warfighting.

BNCOC is an eight-week, intense CMF 19 course that is conducted in a combat simulated, tank or cavalry scout (depending on your MOS), environment using the Small Group Instructional (SGI) Model. Some of the common instruction shared by NCOs in both MOSs includes mine warfare; tactical movements; nuclear, biological, and chemical operations; maintenance procedures; safety procedures; gunnery, field training exercises; common leader and common military training. The course also provides in-depth instruction on topics that are either tank or scout specific, for example, demolition, patrolling and reconnaissance (intelligence gathering) operations for scouts, and tank weapon systems employment for tankers. The following is a discussion of some of the ways the two MOSs differ in the instruction received, beginning with the 19K armor sergeant.

The tactics portion of instruction sometimes is considered the most challenging for students. It exposes the student to the army warfighting doctrine. Here, the armor sergeant learns skills necessary to become a functional team member of a tank platoon, thereby increasing its killing capability.

Using terrain boards and local training areas, the armor sergeant is taught vehicle tactical movements, how to occupy tank fighting positions, tank battle drills, tank platoon displacements, preparing range cards, installing and removing hasty minefields, and how to prepare and send logistics reports. The student is tested on his proficiency and knowledge by the use of graded scenarios.

The armor sergeant's technical knowledge is also increased by detailed training on how to install and boresight the Multiple lntegrated Laser Engagement System (MILES) on the M1A1 tank. Then he moves on to a thorough training phase on the maintenance, installation, and boresighting of all tank weapon systems.

The armor sergeant then gets the opportunity to spend 16 hours in the Conduct of Fire Trainer (COFT) where he is required to negotiate the Advanced Matrix, Group I. This is in preparation for his eventual firing of a modified Tank Table VIIA and Tank Table IVA modified Tank Crew Proficiency Course (TCPC) on a stationary and moving tank range. He also takes a Tank Crew Gunnery Skills Test (TCGST).

Using terrain boards and local training areas, the cavalry scout is taught subjects such as adjusting indirect fires, evaluating and classifying bridges and vehicles, preparing and sending logistical reports, resupplying the section and platoon, how to conduct mounted and dismounted patrols, supervising security convoy operations, how to conduct reconnaissance and security missions, and how to conduct quartering party activities. Once taught, the student is tested on his proficiency by the use of graded scenarios.

Additionally, the cavalry scout is taught non-war subjects that might be employed during peacekeeping missions, such as how to establish and supervise a roadblock or checkpoint and how to perform a stand-up search or a frisk on a person or vehicle.

The cavalry scout receives additional training on weapons, MILES, and

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The Crewing and Configuration of the Future Main Battle Tank

by Robin Fletcher

General Sheridan's letter, "A New Tank: Time to Begin," in the September-October 1994 issue of *ARMOR* is a timely reminder that we cannot go on forever modifying and adding to the basic M1 Abrams main battle tank (MBT) and that we ought to start now to give serious thought to what sort of vehicle we wish to create as our future MBT. It should certainly be lighter than the MBTs that we have at present and there has been considerable discussion, not only in *ARMOR*, on the desirability or otherwise of reducing the number of its crewmen from four men to only two in order to reduce the size of the vehicle and so allow it to be better protected.

Captain Mike Newell set the ball rolling with his article, "Survivability Is the Best Argument For a Two-Man Tank" in the March-April 1992 *ARMOR*, and correspondence continued to Matthew Kristoff's letter, "The Two-Man Tank — Time for a Reality Check," which was published in the September-October 1993 issue. General Sheridan now draws our attention to J.B. Gilvydis' article, "A Future U.S. Main Battle Tank for the Year 2010 — A New Vision," published in the May-June 1994 issue, in which, in addition to commenting on the further development of the various systems which make up an MBT, he also advocates the reduction of the FMBT's crew to only two men.

But strenuous opposition to such a reduction is voiced in two letters in the September-October 1994 issue, one entitled "The Four-Man Crew Works — Don't Fix It" and the other "The Two-Man Crew — A Step in the Wrong Direction." But does the choice lie only between a conventional four-man crew and one composed of only two crewmen? Might not a three-man crew have a great deal to offer?

The introduction of automatic loading into Russian MBTs in the 1970s, and more recently into those now being built in France and Japan, has allowed the human loader to be eliminated and opposition to this particular move has been voiced in only one of the letters published in *ARMOR*. Moreover, if we are to move on from the 120-mm tank gun to guns using even larger rounds of ammunition, a human loader may be unable to handle these longer and heavier rounds, and automatic loading will become quite essential.

Having eliminated the human loader, attention has then been directed — certainly by Mr. Gilvydis — at the gunner and the possibility of laying the gun automatically, and this additional responsibility has then been given to the tank commander over and above his normal vital duties of commanding his vehicle. This time, opposition to such a change has been universal, as witness Major Warford's letter, in which he writes: "While reality may dictate the replacement of a human loader with a reliable automatic device, the replacement of the gunner is another matter. What Mr. Gilvydis has failed to recognize is that the addition of the gunner's responsibilities to the demands of the tank commander does not replace the gunner; it replaces the tank commander. That seems like a high price to pay."

What may have been overlooked in the discussion thus far is that the driver may be able to take over some of the additional duties placed on the tank commander, just as the commander of a two-man tank should also be able to drive the vehicle, should that become necessary. For these two crewmen to be able to cooperate closely together in the operation of their vehicle, it will be essential for them to be seated together — preferably shoulder-to-shoulder — either down in the hull, as specified by Captain Newell and as shown in the illustration in Mr. Gilvydis' article, or even together in the turret. What would not be acceptable, principally for reasons of loss of morale, would be for the commander to be the sole lonely occupant of the turret while the driver remained down in the front of the hull.

Figure 1.

The French AMX-ELC of the 1960s.

Although the FMBT is most likely to be operated from fixed hull crew stations, it is still conceivable that two crewmen might handle it from crew stations in the turret. In fact, this latter arrangement was actually adopted by a French experimental antitank vehicle during the 1950s.[1] (Fig. 1) Its turret was locked at 12 o'clock while it was being driven by one of its two turret crewmen. All-round traverse was only restored when the vehicle had become stationary in a selected fire position. Using modern technology, the driver — or rather both crewmen who might

now both have driving controls — could have television screens mounted in front of them, with cameras on the front of the hull. It would then be possible for a crewman to drive the vehicle with its turret partially traversed while the other man searches for targets and then engages and destroys them himself. But since the motion experienced by the crewman driving the vehicle would not be in agreement with what he expected from watching his screen, he would not be able to drive at high speed while his companion fired on the move.

Although this arrangement could use existing technology for the construction and control of the turret, the frontal area of the vehicle would still remain undesirably large, and it would be preferable to seat the two crewmen together in fixed crew stations down in the hull which, by presenting a smaller frontal area, could be better protected.

Two-Man Operation But Three-man Crewing

The adoption of automatic loading in turreted MBTs today has reduced the number of men in the turret but still requires the presence of a third crewman in the front of the hull to drive the vehicle. This can be seen in vehicles produced in Russia, Poland, Slovakia, and now in France and Japan. The American CATTB experimental vehicle[2] follows this same formula, as does the XM8 Armored Gun System[3] now being readied for production.

But so far — apart from the Sleep Support System hurriedly supplied for DESERT SHIELD[4] — no attempt has been made to alter these vehicles' crewing arrangements so that they can keep going 24 hours a day for continuous periods. All three crewmen are on duty together, and all will become equally exhausted over time as described in detail in Captain Chaisson's article, "Rest for the Weary," also in the September-October 1994 *ARMOR*. If best use is to be made of night vision devices now provided for all members of the crew, some system must be found for allowing a crewman to rest and sleep in the vehicle during 24-hour-a-day operations so that it can keep going for many days on end.

Fortunately, the transfer of the MBT's two principal crewmen from the turret into fixed crew stations down in the hull provides the opportunity for them to drive the vehicle, relieving the hull front crewman of his driving duties and allowing him to rest in the rear of the vehicle before coming on duty. If these three crewmen then rotate through the two principal crew stations, the vehicle will be able to keep going for continuous periods.

This new crewing system will require that all three crewmen be trained to the same high standard in the operation of all systems in their vehicle, but it will also provide crewing continuity, which the "2 plus 2" system of crewing does not. This is because a crewman coming on duty, probably after a four-hour period of rest, could be briefed on the tactical situation by his companion in the other crew station, who would already have completed half of his eight-hour duty. The vehicle commander would also take his turn in the crew rest space so he could keep going for many days on end. While he rests, the next senior crew member would command. Only the most junior crew member would not be called upon to command the vehicle.

Retaining three crewmen and adopting a "two-man operation and three-man crewing" system will give the tank the extended endurance that automatically-loaded, turreted vehicles do not currently possess. In addition, gathering the complete operation of the vehicle into the hands of only two crewmen is likely to lead to an increase in its speed of reaction when it goes into action. This can be contrasted with the three — or even four — crewmen needed to operate an MBT today, all performing different functions in different crew stations and dependent on good teamwork for successful operation. As mentioned above, overloading the commander of the FMBT can be relieved by giving his companion part of his load and the capability to rapidly exchange duties in duplicate fixed hull crew stations. Overall, the relocation of the crewmen from the turret into the hull will provide this opportunity for the FMBT to be operated by only two men.

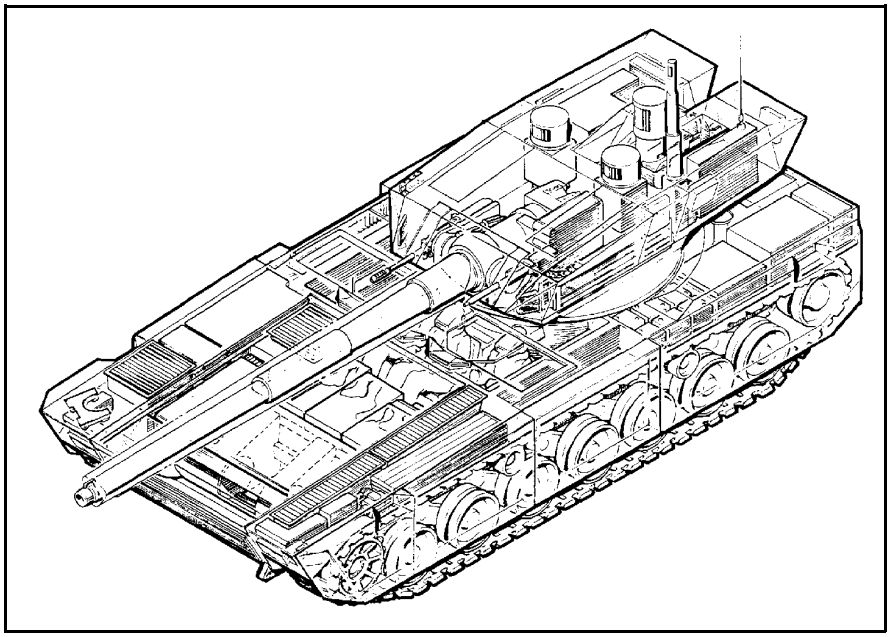

Figure 2. The Western Design winner of the 1993 Tank Design Contest envisioned three crew members sitting abreast in the hull.

If the above is accepted, and two-man operation provides such advantages, why does the Western Design winner of the Tank Design Contest,[5] (Figure 2) and also the Tank Test Bed vehicle,[6] which preceded it, both provide three crew stations abreast of one another in the hulls of these vehicles? Should it be assumed that the three crewmen would be designated as commander, gunner, and driver to operate as a team. Or, with driving and gunnery controls at all three stations, would the vehicle's endurance be extended with two-man operation while the third simply switches off his displays, disconnects his controls, and sleeps in his crew station? An advantage of this would be that no changing of places would be necessary,

because a crewman coming on duty after rest would simply switch on his displays and start work. An intriguing question then arises — whether or not the three crewmen would revert to being a team of a commander, gunner, and driver when action threatened. Or would two-man operation provide such an increased speed of operation that only two crewmen would handle all duties between them, while the third merely assisted when called upon to do so and kept watch to the rear of the vehicle?

It is possible to operate an automatically-loaded, turreted vehicle, such as the Russian T-72 or French Leclerc, while one crewman is absent but is not recommended because one man would then have to drive from the front of the hull while the other operated as a commander/gunner up in the turret. With the two men thus separated in different parts of the vehicle, it would be difficult to transfer part of the additional load from the commander to the driver down in the hull front. In the case of the FMBT, on the other hand, with two crewmen in fixed hull crew stations and a third man resting to their rear, the absence of this crewman would only affect the vehicle's endurance. So long as a replacement crewman could join the vehicle without too much delay, it could continue to operate at full efficiency, and his arrival would restore its ability to operate day after day. With the complete operation of the vehicle being handled by only two crewmen in duplicate fixed hull crew stations, it would even be possible for the vehicle to be maneuvered and fought by a single crewman in an emergency, though with greatly reduced efficiency.

Figure 3.
The Swedish S-Tank can be operated by only two crewmen at hull stations.

Two-man operation of an MBT has, of course, already been in use for many years in the fixed-gun Swedish "S" Tank (Figure 3), in which both men have driving and gun-laying controls in their fixed hull crew stations. This vehicle also carries a third crewman, seated to the rear of the other two, but he only watches over the operation of the automatic loader, drives when the vehicle is reversing, and keeps watch to the rear.

Front Engine, Rear Ammunition, and Rear Entrance

So far, the introduction of hull-seated crewmen has tended to place them in the front of the hull, more or less in the same position as that occupied by the driver of a conventionally-turreted vehicle. This was certainly the case with the Surrogate Research Vehicle and the Tank Test Bed, both of which were constrained by having to use hulls based on that of the Abrams MBT, and thus remained rear-engined.[7] However, the alternative front-engined hull layout is now receiving increased attention, principally because of the efforts of Teledyne Vehicle Systems in offering their Direct Fire Support Vehicle in the Armored Gun System contest[8] and their proposals for a heavier vehicle in the ASM Program having a similar front-engined layout.[9] Although these particular vehicles still have two crewmen traversing in low "pancake" turrets, they not only establish the employment of a front engine compartment but also make use of the rear of the hull to serve as stowage space for a large proportion of the ammunition. This configuration can be seen in the figure accompanying Frank Briglia's article in the July-August 1994 issue of *ARMOR* and in Jody Harmon's excellent illustration of such a vehicle on the front cover. Western Design's winning entry in the Tank Design Contest, which shows a full width front engine compartment combined with the stowage of reserve ammunition at the rear of the vehicle, has given added impetus to the changeover to a front-engined hull layout.

In the famous front-engined Israeli Merkava MBT, rear ammunition stowage is combined with a rear entrance and exit. Since the rounds are stowed in containers that can be removed from the vehicle whenever necessary, this space can accommodate tank crewmen who have been forced to abandon their vehicles, or, if thought to be appropriate, even infantrymen. Cadet Barrett's design, second place in the Tank Design Contest, includes a rear-hull escape door for added survivability.

If two crewmen are to operate the FMBT from fixed stations down in the hull, with a third crewman occupying a rest space behind them to extend the vehicle's endurance, the front engine compartment can extend across the full width of the vehicle and, in particular, the compartment's rear bulkhead can extend intact from one hull side plate to the other. Then, if a penetration should take place through the vehicle's frontal armor, there would be sufficient space for the debris to interact with the engine compartment components before being stopped by the rear armored bulkhead. Cooling air could be discharged at both sides of the vehicle, but might be discharged selectively on only one side when stationary in order to reduce its thermal signature. With direct driving vision being exercised from the top of the hull, a frontal roof slope of less than eight degrees might prove to be inadequate. This roof armor would have to be removable in order to allow power packs to be exchanged, and after being replaced, would have to be suitably secured to withstand heavy attack.

Rear ammunition stowage allows replenishment much more easily than if rounds have to be replaced in a carousel in the hull center, as in typical Russian vehicles. Moreover, should a penetration occur, rounds stowed at the rear of the vehicle can be vented upwards and rearwards in the same manner as those carried in the bustle of a turret. In addition, ammunition-handling systems already developed for installation in turret bustles should be transferable, at least in principle, to handle rounds in the rear of the hull. Rounds being supplied from a rear stowage magazine may either be moved internally through the hull crew space on their way to the breech or, alternatively, they may be moved externally without entering the crew space at all. Ideally, the breech of the gun would be located right at the rear of the vehicle, close to the ammunition magazine, which would not only

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How Manpower and Personnel Integration Was Applied to the Armored Gun System

by Captain Timothy Flanagan

To ease transition training, the AGS was designed to be as similar as possible to other tanks. It shares many components with existing U.S. Army systems.

We have all been frustrated at one time or another by a piece of equipment that just didn't live up to its expectations. Whether it was a weapon system, such as the Dragon, that promised a 90 percent hit probability and usually did not achieve that, or a radio, such as SINCGARS, that despite its tremendous technological leap forward has small buttons that make it difficult to operate with gloves in a cold weather environment and requires constant retraining. How many times have you sat in the TC's hatch of your M1, preparing to negotiate Table VIII, and asked yourself, "what kind of idiot is responsible for the traversing and elevating mechanism on this .50 cal?" Or did you ever think that the individual who designed the feeding system for the 25mm on the Bradley knew that he would never have to use it.

What is going to prevent these problems from happening again? Will the armor community be forced to accept the Armored Gun System (AGS) without these problems being considered? This article will look at the integration between man and machine, or MANPRINT, which is one of the checks and balances in the acquisition process, and how it affects the end product of our newest tank before it is delivered to the field.

As you sit there reading this article, I am sure you could name dozens of problems you have had or are having with Army equipment. Yet, we are constantly told that we have the best equipment in the world. After our success in DESERT STORM and the falling of the Iron Curtain, there are not too many people who could successfully argue that there is a nation out there with better tools to fight and win on the modern battlefield. Yet, we are not too arrogant to realize that we have some problems. These problems became extremely noticable during the '70s and '80s as the Army introduced many new systems and equipment.

Several major problems were encountered. New complex systems were fielded to soldiers who could not operate them to the standards that the manufacturer claimed that they could. A perfect example is the Dragon missile mentioned earlier.

The second biggest problem was that, in fielding the new system, we discovered that we needed smarter soldiers when compared with the previous system. Due to the more complex nature of the equipment, we also needed more maintainers and operators to keep these systems operational.

Fixing these problems required recruiting more highly skilled soldiers, putting more weapon systems in the field, and increasing training programs. These solutions were totally unsatisfactory. The Army could not afford to increase training programs or increase the size of the Army. This situation only led to more problems.

It wasn't until 1982 that the U.S Army Research Institute conducted a study that looked at previously fielded systems in an attempt to identify what could have been done differently to better integrate the manpower, personnel, and training issues. The study indicated that, if these issues are addressed early in the design process, money and time could be saved. In 1984, General Maxwell R. Thurman, as the Army DCSPER, directed that a MANPRINT program be started to maximize soldier-system performance.

MANPRINT is a comprehensive management and technical program to improve total system (soldier and equipment) performance by focusing on soldier performance and reliability. Constant integration of manpower, personnel, training, human engineering, system safety, health hazards, and soldier survivability considerations throughout the acquisition process improve total system performance. Each consideration is called a "domain." These domains are:

- **Manpower:** The number of human resources, both men and women, military and civilian, required and available to operate and maintain Army systems.
- **Personnel**: The aptitudes, experience, and other human characteristics necessary to achieve optimal system performance.
- **Training**: The instruction, time, and supporting resources (equipment, devices, technology) required to transfer to personnel the knowledge,

skills, and abilities that will enable and sustain efficient operation, maintenance, and support of the equipment.

- **Human Engineering**: The comprehensive integration of human characteristics into system definition, design, development, and evaluation to optimize the performance of human-machine combinations.
- **System Safety**: The inherent ability of the system to be used, operated, and maintained without accidental injury to personnel.
- **Health Hazards**: The inherent conditions in the operation or use of a system (e.g. shock, recoil, vibration, toxic fumes, radiation, noise) that can cause death, injury, illness, disability, or reduce job performance of personnel.
- **Soldier Survivability**: A combination of, but not limited to, actions taken to: reduce fratricide; reduce the detectability of the soldier; prevent attack on the soldier, if detected; reduce vulnerability, if attacked; prevent further medical injury, if wounded; and reduce physical and mental fatigue.

In looking at any system using the above domains, there is never going to be a system that is perfect. There are always tradeoffs. Some aspects, such as safety defects, are usually not compromised. Other areas, such as manpower, personnel, and training depend on the political and budgetary climate at the time the system is being developed, due to the costs associated with each.

Now that we have an understanding of the MANPRINT domains, let's look at the Armored Gun System from a MANPRINT perspective. We must remember that the AGS was not built to replace the M1A1 tank. It is unfair and foolish to compare survivability in the AGS with overall survivability in the M1-series vehicles. As we look at the Armored Gun System and how it stacks up under each domain, there is no choice but to compare it to its predecessor, the M551A1 Sheridan. The AGS operational requirements were identified early in the acquisition process. In order, they are: deployability, lethality, survivability, and sustainability. Under the manpower domain, the AGS is a clear winner over the Sheridan.

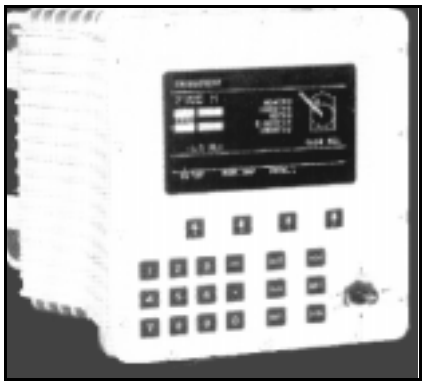
The addition of an autoloader negates the need for a fourth crewman. There are those who will argue that the loader does much more than load the main gun. Besides helping with maintenance, he acts as the tank's air guard and covers the left rear of the tank. The loader also helps provide dismounted security for the tank. The effect of one less person on the sleep plan of the tank crew cannot be denied.

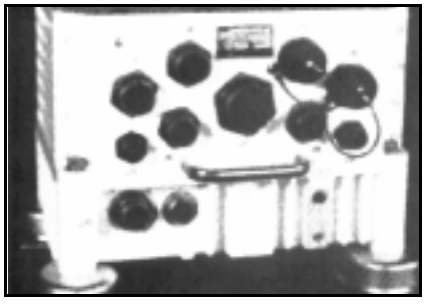
Using the AGS in a combined arms environment will offset the negatives of a three-man crew. The AGS will support dismounted infantry. Security concerns will have to be addressed with the help of those infantry. Reducing the vehicle crew size by 25 percent makes this vehicle attractive from a manpower perspective. There is also no indication that the AGS will cause an increase in the maintenance assets of the organic or support units. The engine and transmission can be rolled out of the vehicle within ten minutes, "ground hopped" while still on its rollout tracks, and then be reinstalled in about ten minutes. Compare this with any of our previous tanks! Two soldiers can also easily reload the AGS from outside the vehicle while the gunner tells the computer the type of round loaded.

Roll-out powerpack feature simplifies servicing.

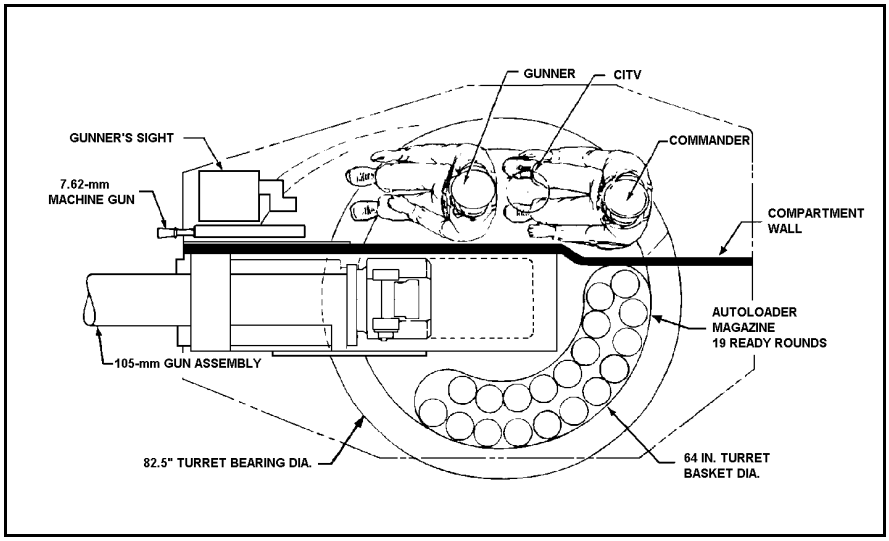
From a personnel standpoint, there appears to be no difference between what will be required of a 19K and what will be required of the AGS crewman. There is no need to increase either the education or physical requirements from what we are currently recruiting. From the start, this vehicle was designed with the intent to be as similar to our other tanks as possible while still fulfilling the operational requirements stated earlier. Since this was accomplished, personnel requirements have not changed.

Should we be concerned about the new training requirements that the AGS will entail? Apparently not. In fact, one of the comments made by a soldier during User Jury II testing was, "Nineteen Kilos will have an easy transition to AGS from the M1 tank." The driver's station was designed with a T-bar similar to the M1. The tank commander's station can accept either an M2, M240, or MK19. Although the fire control system is from the British Challenger series of tanks, it should not require too much of an adjustment for American tankers. The laser rangefinder is patterned closely on the M1, and the main gun will be the XM-35 105mm. As mentioned earlier, the pack can be easily removed and reinstalled. However, another big advantage of this system is the use of a HEMTT-type engine and Bradley transmission. Both are proven designs, and mechanics have been successfully maintaining these systems for several years. The obvious advantage of using these already developed components is that the developmental phase of the AGS is shortened considerably. This also carries over to the training domain. Training plans have already been developed and proven in training mechanics on other systems. Some modifications will





Computer control panel (top) and the fire control computer (above) are similar to the systems on the British Challenger 2, but U.S. tankers should have little problem learning to use them.



On the AGS, a compartment wall separates the commander and gunner from the autoloader magazine and the breech of the 105-mm main gun.

The AGS modular armor system defeats a HEAT round in this photo from a testing sequence at Aberdeen Proving Ground.

have to take place, but the core is already complete.

The domain of human engineering ensures we optimize the performance of human-machine combinations. The best tank in the world will be of little use to us if all its operators must be shorter than 60 inches. That is why testing is taking place to ensure that soldiers with physical characteristics of the 5th to 95th percentile male soldier can operate and maintain this vehicle. Are all aspects perfect on this vehicle yet? The answer is no. The testing allows problems to be identifed and corrections to be made prior to production and fielding.

The domain that is near and dear to all tankers' hearts is system safety. One of the primary safety concerns on the AGS is bound to be the autoloader. We have all heard the horror stories of the one-armed Russian tankers. A steel access panel separates the TC and the gunner from the autoloader, effectively eliminating this safety concern. If the door between the TC and autoloader is open because of a malfunction then the autoloader will not engage. All stations include a seatbelt.

One potential AGS drawback in the health hazards domain is the volume of noise produced by the main gun. The unique nature of the muzzle brake on the AGS directs the noise back toward the vehicle. Of particular concern is possible damage to the tank commander's hearing when more than 15 rounds are fired in one day. As of this date, only the 900-series rounds testing is complete. Training rounds for the AGS are not expected to cause a problem. Solutions to this problem are currently being examined and will probably be worked out. Shock, recoil, toxic fumes, and radiation have not presented any problems in testing thus far. Vibration, experienced in all tracked vehicles, is manageable, but improvements, such as different style trackpads, are still being examined.

Using modular armor allows upgrades to be made later on without building an entirely new vehicle. Commanders will have to use METT-T to determine how much armor they want to install.

Many of the lessons learned during the production of the M1 have been applied to the AGS. Ammunition is compartmentalized and "blow-out" panels similar to those on the M1, are installed. The fire suppression system utilizes Halon to extinguish fires in the crew compartment and a new powder extinguisher for the engine compartment.

In order to ensure the rapid deployability of the system, armor has been kept to a minimum to save weight. Additional armor can be added once the vehicle is on the ground. If the armor was built into the structure of the basic AGS, airlift capability would be jeopardized. Using modular armor allows upgrades to be made later on without building an entirely new vehicle. Commanders will have to use METT-T to determine how much armor they want to install. Like all new weapon systems, AGS is undergoing extensive, Congressionally-mandated live-fire testing.

In an attempt to keep procurement costs down and shorten the developmental process, the AGS uses much current, proven technology. This appears to be an extremely successful way of doing business. The AGS has already met or surpassed all that was required by the Operational Requirements Document (ORD). The developers of the AGS, by using the principles of MANPRINT, are going to deliver to our soldiers a light tank that is easily deployable, safe, and user-friendly.

Captain Tim Flanagan is a 1986 graduate of the United States Military Academy. He served as a tank platoon leader, scout platoon leader, and company executive officer with 1-70 Armor at Fort Polk, Louisiana. After being assigned to the 2d Infantry Division in Korea he served as assistant S3 in the Aviation Brigade, commanded HHT 5-17 Cavalry and A/2-72 Armor. He is a graduate of AOBC, AOAC, JOMC, ORSA MAC I, and the Airborne School. He is currently serving as an ORSA with the MANPRINT Division, Office of the Deputy Chief of Staff for Plans, Force Integration and Analysis (DCSPLANS), U.S. Total Army Personnel Command (PERSCOM), at Alexandria, Virginia.

PHOTO: Greg Stewart

NTC ROTATION 94-07

Digital Battlefield Training and Tactical Insights of a User

The Good, The Bad, and The Ugly

by Major O.T. Edwards III

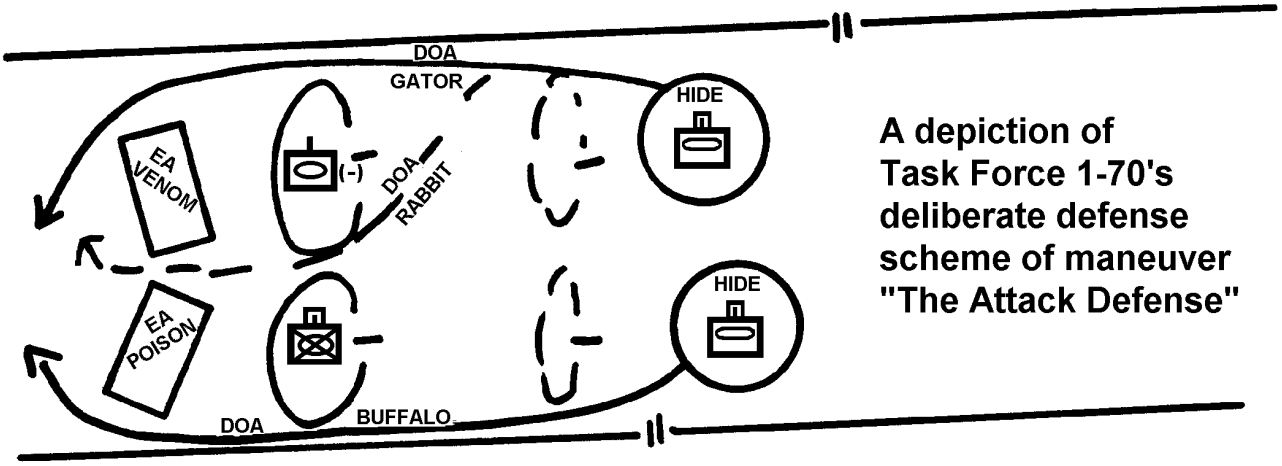
The views expressed in this article are the author's — not TSM positions.

NTC Rotation 94-07 provided the Army with a superb support-by-fire position from which to overwatch the final push on Objective Force XXI. We all learned a great number of lessons, many the hard way. If we're surprised again during future digital advances, it's our own fault. Danger lies in overlooking or disregarding some of those lessons learned.

I had the great fortune to serve as S3 of Task Force 1-70 during the preparations for and execution of 94-07. As such, I was privy to a close-up, hands-on opportunity to experience first-hand the CAPABILITIES AND LIMITATIONS of current digital combat technology. This article attempts to pass on those insights for consideration by future "digital" combat leaders. I should note that some of the views expressed within this summary run contrary to current doctrine and Army leadership positions. But I still believe it's worth the time and flak to point out some issues. I would also note that many of the recent articles focusing on digital operations and lessons learned were written by soldiers with second-hand or observer experience.

While such warfighter insights are significant in their contributions, none, repeat none have fought a digital tank while trying to facilitate the command and control of a task force. I've had that experience. That's why I've chosen to publish my views. It's time that experienced users speak out. Our Army is about to cross the line of departure from testing and experimentation to a real-world digital combat capability by fielding our first M1A2 battalion next summer. This makes it even more compelling to highlight digital capabilities and, even more importantly, limitations.

We need to cross that line of departure with our eyes wide open, our heads in the game, and "looking over the top," as a former boss of mine is fond of saying.



A depiction of Task Force 1-70's deliberate defense scheme of maneuver "The Attack Defense"

I've organized my user insights into two broad categories: key training and leadership implications and tactical observations.

Training and Leadership

- **In the event anyone has missed the point, tanking fundamentals at crew and platoon level still win battles!** Digital situational awareness leads to vastly increased levels of tempo and, potentially, to enhanced survivability. It's really almost impossible to fathom until you've experienced it in your tank. But accurate shooting is still king of the hill! Unless we can consistently put steel on target, improvements in command and control on the move are meaningless. It's easy for the task force and company leadership to become enamored and engrossed in the digital world at the expense of shooting and maneuvering fundamentals. Don't let it happen. **Steel on target is still the difference between winning and losing!**

- **Our soldiers can learn digital proficiency but require continual emphasis on default proficiency.** Soldiers default to their comfort zone in times of high stress. There's nothing new or startling in that concept, you might say, except that we cannot pay lip service to it! The bottom line is that digital command and control is a new task top loaded on an already full plate! Trainers must recognize this fact up-front and budget precious training time accordingly. This is where simulations can play a critical supporting role. Having said that...

- **Simulations are not a replacement for "old fashioned" maneuver training.** Say it again, simulation cannot replace the tough, dirty, and stressful field training environment. We hit the National Training Center without having conducted a full-up task force or company team maneuver exercise for over a year. We'd literally lived in a SIMNET world. At best, we were able to fashion a limited maneuver phase during our pre-rotation Table XII exercises. It showed. It took us the greater part of the rotation to catch up to the baseline. That adversely impacted on our ability to fully use our high tech battlefield force multipliers. Simulations just don't meet the full requirement for ground combat training. They play a supporting role. Get dirty!

- **Digital skills are relatively perishable!** Crews must practice continually to attain default proficiency. Crew Station Trainers are a major benefit in this aspect of training. Don't assume this challenge away. Incorporate digital proficiency training into all gunnery and maneuver training events. Have your tank commanders send digital contact and SITREPS during Table VIII runs and especially during Table XII. Consider incorporating a digital proficiency phase into your TCGSTs. It's **that** important!

- **Leaders still lead.** Task force commanders and operations officers still need a survivable, lethal combat platform that facilitates their presence in the close fight. Future battle command vehicles must be built around close combat systems that permit the commander to personally influence the close fight and continue to lead by personal example. We cannot confuse battle planning platforms with battle command machines. Task force commanders are not corps commanders! They lead their troops into harm's way, sharing the same dangers and perils. That has always been a cornerstone of our leadership philosophy. I have to believe that had Creighton Abrams' tanks been digitally equipped, he still would have led from the front.

- **It may be time to reexamine our leader development philosophy.** Digital combat may require enhanced stabilization of key leaders in order to attain and maintain levels of digital proficiency. This enhanced stability and readiness may have to come at the expense of diminished troop leadership opportunity but might prove essential to meet the mission of doing more with less and with exceptionally sophisticated combat machinery.

Tactical Insights and Implications

- **Old tactics plus new systems equal the same results.** Throwing a digital combat team into a forced deliberate breach still results in burning tanks in the enemy's fire sack! We've really got to find a better way to fight that fight in the absence of overwhelming fire support. Leaders need to live on the bold edge of audacity when it comes to the tactics, techniques, and procedures of fighting a digital force. Formations may be more of a hindrance than a help tomorrow. They may no longer be required. The tank company wedge may soon prove as obsolete as the flintlock. Think big and audaciously. Our most successful NTC fight came when we conducted a deliberate defense against a reinforced regiment. We employed a scheme of maneuver featuring two simultaneous counterattacking tank heavy teams, and coined it the "attack" defense. Ask yourself the question, why dig in the most lethal offensive tank in the world and reduce it to a pillbox? Perhaps we defend on the move, advancing vice delaying. Attacking the enemy's advancing formations on the move. Think big!

- **If the unit is not digital-pure with a seamless C^2 system, the task force battle staff and company team commander's work load is doubled.** Current systems do not permit seamless information flow of plans and orders. Separate systems are required to pass combat information to the maneuver and CS/CSS elements. When combined with a less than pure digital force, a high-low mix, this exacerbates the challenge as leaders must pass traditional graphics and orders to those without digital receptors. The effect is to double the workload and output requirements for the staff and company team commanders. You must incorporate this into your orders drill timelines.

- **User-friendly free text capability is a must!** Until we field a user-friendly (read tank and IFV/CFV commander), seamless, free text capability for the digital force, we're half-stepping it. While graphic plans are relatively simple to prepare and transmit to those interfaced with IVIS, free text is not available. When we get that capability, the frequency of FM voice transmissions will really plummet. To realize the full potential of digital battlefield tactical communications, we've got to easily transmit FRAGOs. We're not there yet by a long shot.

- **We need a dedicated digital net.** FM voice and digital traffic compete for air time as currently configured. Automated position updates emanating from moving tanks cause a near constant "digital" chirping which, over time, becomes extremely annoying. Both player participants and observer controllers highlighted the need for a dedicated third radio net reserved for digital traffic. We found that when a unit is in direct fire contact, FM voice remains the option of choice for contact reports,

PHOTO: Greg Stewart

etc. A dedicated digital net would permit continued digital traffic flow while maintaining the "human" element of voice contact.

- **Offensive digital combat operations.** The Armor Center is working on the development of a heads-up tactical display for IVIS. We desperately need it. A leader/tank commander now has two options. Either he maintains local situational awareness by disregarding his IVIS display while on the move or forfeits his close-in understanding by "riding down" to view the tactical display. We need a heads-up capability that, as a minimum, permits the leader to monitor the movement of friendly unit icons and recognize receipt of critical incoming digital reports. We won't get a true command and control on the move capability without a heads-up display.

- **Digitally enhanced tactical intelligence feed to the task force commander and staff.** A recurring theme heard during our rotation was that the commander needed a simple means by which to pull down needed intelligence data. But why should he have to pull anything down? Brigade and division staffs exist to provide the critical information the task force commander needs, and it's not where the enemy's second echelon division is! At the task force level, he needs more mundane data in real time, such as where the FD, FSE, and Main Body are, and how fast they're moving. Where are his long-range ATGMs? What's the time/space gap between first and second echelon MRBs, with continuous updates? Information like that will facilitate the kinds of lethal, fast tempoed, offensively-oriented operations described previously.

- **The M1A2 tank loader's contribution.** The leader tank loader, always a key player, has become even more critical. He now serves as a communications manager for the tank commander. Loaders must be selected for their ability to execute the traditional duties of gun replenishment and observation and for their ability to manage sophisticated digital communications systems. He's very much a digital copilot. Something to bear in mind as we develop our future main battle tank. Autoloaders don't perform these functions very well.

- **Digits "ain't" perfect, yet.** Caution is still critical to the digital leader! It's still vitally important to learn and teach terrain association, mounted land navigation, and the traditional orders process. Sophisticated communications and navigation systems are not failure-proof. When you lose your IVIS link, and with it your digital situational awareness, it's comforting to recognize terrain in your "AO" by old-fashioned association. Don't let these fundamental skills perish.

Let me close with a few "non-digital" observations:

- **Scout platoon leaders belong on the command net.** Eavesdropping, whether by digital or traditional FM voice technique, cannot be replaced as a combat multiplier. Situational awareness is greatly enhanced when the company team and other key leaders can monitor the recon/counterrecon fight. The task force intelligence officer is only one player who benefits from the reports of good scouts. Get the scout platoon leader on the command net and keep him there. Everybody benefits from it.

- **Counterreconnaissance requires command presence.** Everybody talks the counterreconnaissance battle. If I learned one thing from our rotation, it was that effective counterreconnaissance doesn't happen without either the battalion commander's or S3's direct involvement, not just in the planning phase but during the actual fight itself. One of these two leaders must be forward in the fight, making things happen and coordinating all the battlefield operating systems. This can't be done from the TOC.

- **The M1A2 tank is superb!** For all the advanced systems we used during our rotation, nothing matched or even came close to the effectiveness of the M1A2 tank as a fighting and command and control platform. Its ability to put steel on target, coupled with the enhanced "hunter-killer" system and onboard navigation system, make it the class of the modern battlefield. It proved itself to be reliable, maintainable, and extremely effective from an operational effectiveness standpoint.

These are just a few observations from a year's effort in preparation and execution of the Army's latest leap forward into digital combat operations. I hope this article stirs more candid discussion among professionals in the mounted force. Remember, we **field** the first digital battalion this summer! That battalion, along with its sister non-digital units, could very well be in hostile action soon thereafter. We need to be ready! Train to fight and win!

Major O.T. Edwards was commissioned in armor upon completion of Officer Candidate School in 1980. He served as a tank platoon leader, tank company XO, and scout platoon leader in the 2d Battalion, 77th Armor, and as aide de camp to the commanding general, 4th ROTC Region at Fort Lewis, Wash. His more recent assignments include command of two cavalry troops in the 2d ACR and as the armor lieutenant's and captain's assignment officer at PERSCOM. A 1993 graduate of the Command and General Staff College, he served as S3 for Task Force 1-70 Armor during its preparations for and execution of NTC Rotation 94-07. He currently is assigned as the Armored Gun System Development Officer with the TRADOC System Manager's Office for Abrams and the AGS, Fort Knox, Ky.

Lessons of Operation DESERT HAMMER VI: Materiel Could Be Improved

by Lawrence G. Vowels

The Advanced Warfighting Experiment (AWE) known as Operation Desert Hammer VI utilized a large number of digital materiel systems. Some of the digital hardware had not been completely developed and, in some cases, was still embryonic. The intention of this article is not to discuss all of these developmental items, but to enumerate the materiel lessons learned from this experiment and examine the corrections to be applied to materiel as the Army moves toward digitization.

Suggestions for improvements to the hardware used in this experiment were solicited from after-action reviews, questionnaires, and group meetings with the NTC observers/controllers (O/C), subject matter experts (SME) from TRADOC schools and battle labs, and the participants from Task Force 1-70, Fort Knox, Ky. The suggestions from these personnel will not be attributed to any specific group because the similarity of each group's suggestions makes it nearly impossible to assign authorship.

General

The recurring theme in all O/C, SME, and participant comments is that digital systems should make the task "no harder than it is to do now." If a system adds tasks or makes the job more difficult, it will not be used. All digital systems should be designed to save time and reduce workload so that leaders can spend more time thinking, analyzing, and perceiving the battlefield.

Clearly, the Army needs to standardize the digital equipment and software across Battlefield Operating System (BOS). Responses repeatedly expressed the need for reliable, user-friendly, compatible, and accurate systems. The requirement for interconnectivity between all parts of the force cannot be overstated, because this network provides situational awareness about the location of all friendly forces. These standardized systems should, to the maximum extent possible, use a common set of protocols with the same report formats.

These interconnected systems require user-definable routing or addressing flexibility to support the task organization often required in a combined arms force. During this experiment, inflexible routing matrices frustrated the commander's attempts to task-organize by causing loss of digital communications links when task organization occurred. Since changes in task organization are essential, routing matrices and addresses must be user-defined and flexible.

TF leaders had to devote significant effort to ensuring that key digital transmissions were received. As interconnectivity problems became known, it became commonplace for leaders to query their subordinates by voice after a key digital transmission, to ensure that the message was received. This additional workload should be avoided by use of an electronic "roger," similar to that used in many electronic mail systems, that provides immediate feedback telling who received the message. This could be combined with a feature allowing the recipient to acknowledge the message through one or two "keystrokes."

Digital systems must find a way to eliminate the duplication of having to use both digital systems and the "normal" method using acetate and markers. Leaders do not have enough time to develop overlays and conduct operations using both. Efforts should be made to develop digital systems that are as easy and reliable to use as the acetate overlay, the alcohol pen, and the paper map sheet.

Architecture

Leaders within TF 1-70 were sometimes unable to rapidly discern how many of their subordinates were linked digitally to their current operating network. This led to the participants, SMEs, and O/Cs to call for a "positive visual display of connectivity." By looking at a screen, a leader should be able to tell at a glance to whom he currently can digitally communicate.

The network architecture must be redundant to permit continuous information flow despite the loss of key vehicles due to maintenance failure or combat loss. The architecture must support the capability for the network to gracefully degrade. This means the architecture must support the re-routing of information by whatever means are necessary to get the information to the proper vehicles. To always ensure connectivity, there is a need for a re-transmission capability similar to that employed by the Enhanced Position Location Reporting System (EPLRS). This capability would attempt to send information to the proper vehicles repeatedly to make sure the information got through.

Digital message traffic was often competing with voice traffic over the SINCGARS radio. This resulted in a partial loss of both digital and voice messages. There is a very real need to eliminate the digital and voice competition, perhaps through a separate digital network. A separate network was endorsed by all groups of responders.

Continuous Communications

All respondents agreed that the digital systems must be rugged and reliable. They are required to operate under all battlefield conditions, including while the host vehicle is moving. In this experiment, some of the developmental digital systems did not prove to be consistently reliable.

There is a very urgent need for rapid log-on and reboot procedures for the digital systems. Leaders and soldiers can't be saddled with such time-consuming procedures (i.e., from 2-10 minutes) during operations or in combat. An automatic log-on when the vehicle is started is preferable. Additionally, the systems need to allow leaders to transfer easily and rapidly to another vehicle and take the setup of the digital system with them.

Combat vehicles cannot run continuously to provide a power source for digital systems. There needs to be a

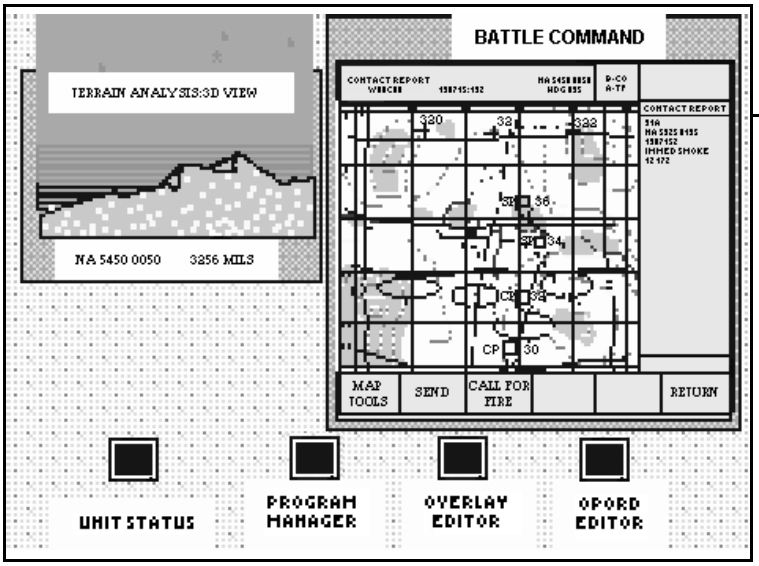


Figure 1. Digital System Display with Terrain Analysis Support System (Example)

way for the vehicle or network node to receive messages while the vehicle is shut down. This requires an advanced system and/or battery auxiliary power unit to provide electrical power to the vehicle's digital systems while it is powered down.

Display Configuration

Nearly every participant who commanded an M1A2 tank requested the IVIS display be moved so it could be viewed by glancing down while operating in open hatch mode. With the vehicle on the move, the tank commander prefers to operate head-out but occasionally needs to refer to the IVIS screen and doesn't want to keep dropping down to look at the IVIS screen or read an IVIS message. Several of the participants and SMEs suggested a Head-up Display (HUD) as a possible remedy.

Vehicle commanders and higher level leaders have a very limited time to view their screens and process information. The digital systems must, therefore, pack as much information as possible onto the screen. These displays should be tailorable and flexible, to the maximum extent possible, to allow for individual preference and ease of viewing under differing light conditions. The displays require variable contrast and intensity controls to permit use under light discipline and varying visibility conditions. The digital system display requires a flexible, tailorable, user-friendly graphical user interface like those available for personal computers and workstations. This flexibility is required to enable the operator to be able to operate concurrently in several different files and programs, with the added capability to rapidly shift between these files and programs.

The display should portray the battlefield in a form familiar to soldiers, with all symbols conforming to the conventions of Field Manual 101-5-1. The display must show terrain features in a manner similar to the current paper map. An example of this type of display is shown in Figure 1. The capability to view vegetation, urban areas, and roads via separate overlays is desirable. During this experiment, the Terrabase system was used to perform terrain analysis during and prior to operations. A self-contained terrain database/terrain analysis system is required to permit leaders from platoon to brigade level to analyze terrain, perform line-of-sight analysis, and select routes.

Warrior Requirements

The fighter at platoon, company, and battalion requires a movable display, so he can view it while operating inside the vehicle or in the hatch. The display should also be removable to support dismounted leader functions. Currently, leaders at all levels use the paper map in places they cannot take their digital system (e.g., coordination, operation order briefings, and rehearsals). We need to make the digital system display portable for use as an "electronic mapsheet." The portable display should portray the current map, look "just like a map," and be portable like a map case. An example of the portable display is shown in Figure 2. The leader should be able to draw, modify, or transfer graphics easily and quickly on the display via a light pen or touch screen. This display must have a convertible power source to support this portability. Disk transfer and data transfer capabilities could permit quick transfer of overlays and other information from one electronic mapsheet to another.

During this rotation, digital overlay preparation suffered because the process on the current digital systems was

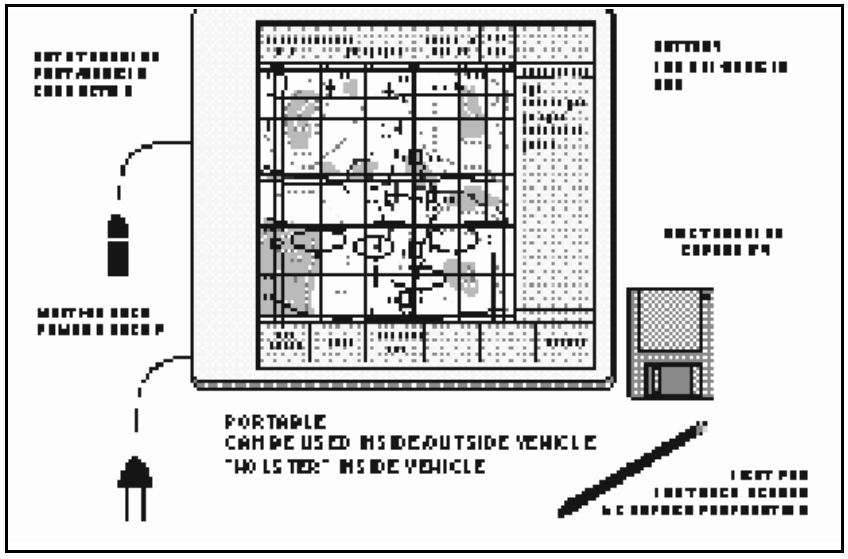


Figure 2. Portable Display (Example)

so cumbersome and time-consuming. Leaders succumbed to the temptation to continue to use acetate graphic overlays (despite instances of inaccuracy) because of the time required for digital overlay preparation. It is essential that digital systems offer easy graphics preparation and modification.

Leaders also need a "notebook" embedded in the software for maintaining unit status. They could store personnel information and status, quickly call up fuel/ammunition status, review key basic load status, and store sensitive item status and maintenance status.

Along with these changes, there should be audible and visual signals cueing the leader to the reception of high priority messages. The warrior should also be warned when the vehicle nears known obstacles or contaminated areas. Finally, a high resolution printing capability is necessary at the company level to print graphics and mapsheets for backup purposes, and for coordinating with non-digital units.

Battle Command Staff Requirements

Getting the battle command staff talking to one another while looking at the same map and graphics is the key to effective operations. Battalion and brigade staffs are concerned with large areas of terrain. Current computer display screens are much too small to permit several people to observe, and do not convey sufficient detail across a large enough area. A large flat screen capability could aid the staff to visualize the digitized battlefield.

Each key staff member and the commander require a personal console or workstation at times, especially during the planning phase. These consoles should have large screens and be capable of performing the work the individual requires. Additionally, the software should permit operators to trade or observe information from any of the other stations. The commander and staff should be able to get into any of the files or databases and call up any pertinent information. This would seem to call for a file server, where the working files can be stored and recalled by any staff member at any console.

One of the most difficult tasks a staff faces is the planning cycle and the need to synchronize more assets in less time. This experiment demonstrated the unit's need for additional planning aids. The O/Cs were most vocal in calling for a JANUS-like planning and wargaming tool that would allow comparative assessment of the available courses of action by the battle command staff. This tool could examine courses of action, not so much to measure which course of action is better, but to ensure that all available resources are synchronized. The tool should allow rapid modification of the scenario and provide a replay of the entire scenario.

On the digitized battlefield, leaders at the battalion and brigade level can easily become clearing houses for information. This was clearly shown during this experiment when the battalion S2 was inundated with intelligence information from the All Source Analysis System (ASAS). Software designed to minimize this problem would be of great benefit. Given the increased amount of information provided to leaders by the digital systems, it seems prudent to develop software that will filter or artificially manage the information before it is presented to the leader.

Software to aid in producing operations orders would be very helpful. Software that takes the selected course of action from the wargaming tool and develops the base order, the synchronization matrices, and the decision support matrices would relieve the staff from having to manually enter this during order production. This allows the computer to automate a personnel-intensive and time-consuming chore currently handled by the battalion and brigade staffs.

Wireless communications would be a significant enhancement to operation within vehicles, such as the Battle Command Vehicle (BCV), Command and Control Vehicle (C^2V), and the M577. Within a vehicle, wireless headsets allow unrestricted movement and continuous communication, allowing staff members to perform their function from any needed position within or around the vehicle. In a larger headquarters using multiple vehicles, wireless local area network communications permit extensive information sharing and coordination without requiring personnel to meet face to face.

Scout Platoon Requirements

The SMEs and O/Cs both noted that the systems used by the task force scout platoon provided an "observation standoff" badly needed to enhance scout platoon mission accomplishment and survivability. The hand-held Unmanned Aerial Vehicle (UAV) provides a view over the next terrain feature, permitting identification of enemy without direct exposure of scouts. Improved forward-looking infrared sights permit acquisition at increased ranges. Combined with navigation and position location devices, scouts can accomplish their mission and make better use of terrain. Most importantly, the scouts need to receive an integrated, operate-on-the-move, digital communication system with far-target designation capability. In this way, scouts can move through an area and digitally "paint" the battlefield for the task force, helping the task force see the battlefield in unprecedented accuracy and detail.

Scout platoons will also need a dismounted digital capability, to support dismounted reconnaissance and observation posts. At a minimum, the dismounted capability should allow digital reports and messages. Ideally, dismounted scouts should have superior sights and far-target designation capabilities.

Combat Service Support Potential

Nearly all agreed that digital technology of this experiment has only begun to impact the combat service support arena. Software on the M1A2 tanks that provide ammunition and fuel status to logistical personnel was reliable, but presently the information is by vehicle only. This needs to be expanded so that the information can be "rolled-up" by platoon, company, and task force.

This information, transmitted to the combat trains command post and posted on a large screen, would allow tracking of each unit's logistics status. With this information, the logistician can better anticipate needs and be prepared to deliver supplies where required. It might even be possible to set certain supply levels for each unit, with an alarm sounding when the critical

Continued on Page 34

The Battle of Five Forks

31 March-1 April 1865

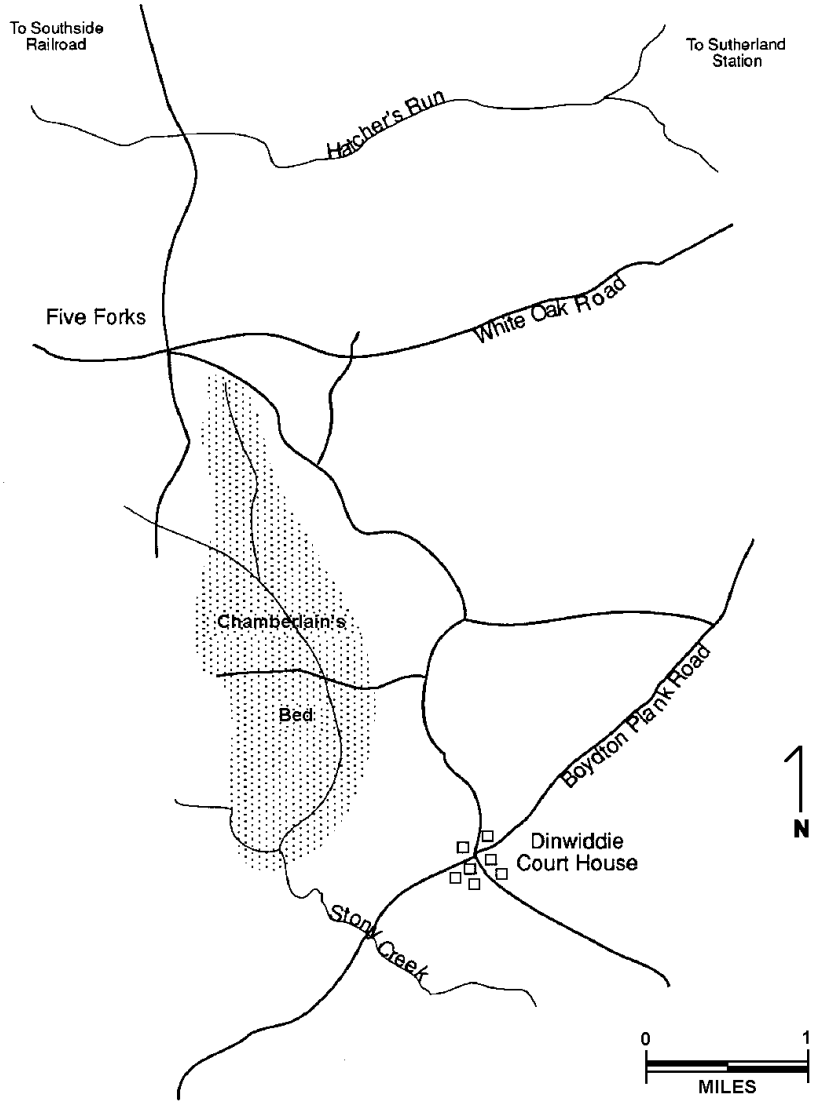
by Captain Kenneth C. Blakely

"I tell you, I'm ready to strike out tomorrow and go to smashing things!"

P.H. Sheridan

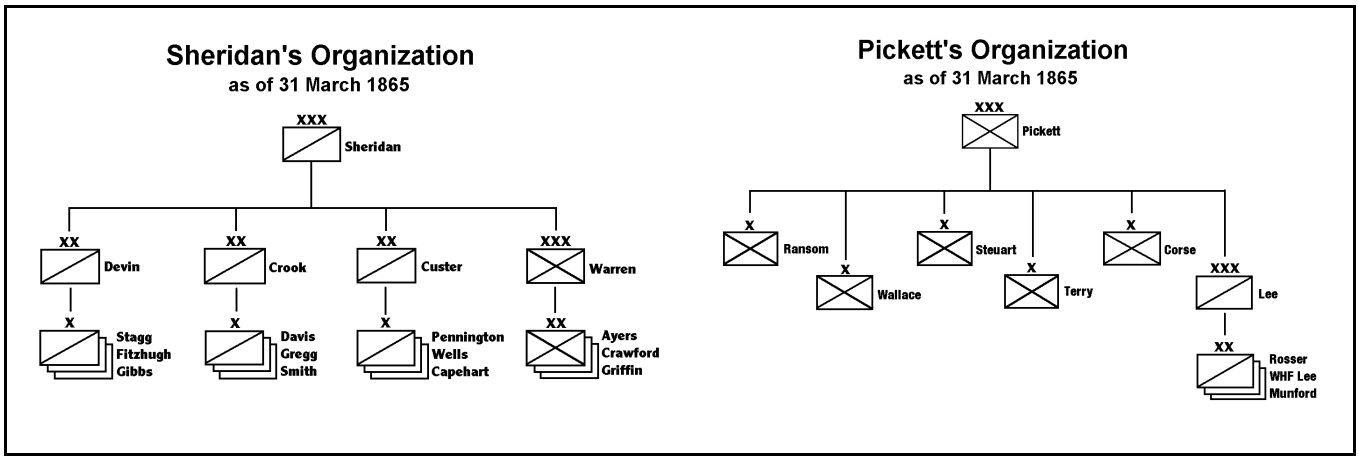
For two days in the spring of 1865, detachments of two great armies fought in the dark woods around Petersburg, Virginia. Like exhausted boxers, one army jabbed and the other countered. The resulting clash, the Battle of Five Forks, was barely a skirmish on the scale of most battles of the American Civil War. In terms of strategic impact, however, it arguably ranks with Gettysburg, Vicksburg, and Atlanta. On the ground Five Forks was a small battle, but to the Confederacy it signaled the end of meaningful resistance.

The two forces that met at Five Forks, Virginia, were detachments from the Union Army of the Potomac and the Confederate Army of Northern Virginia. For the Union, Major General Philip H. Sheridan led 10,000 hard-riding cavalry troopers. Fresh from decisive victory at the Battle of Waynesboro in the Shenandoah Valley, Sheridan's men were comparatively well rested, well fed, and well mounted. Sheridan himself seemed to smell victory, and his men were ready and eager for the fight. Supporting Sheridan was the V Corps of the Army of the Potomac, commanded by MG Governeur K. Warren. The hero of Little Round Top led a powerful corps of three divisions. His men had been manning the Petersburg trenches during the past winter and, while they were not quite as fresh as Sheridan's troopers, they trusted their general and they were ready to fight. All told, Sheridan commanded over 18,000 of the best cavalry and infantry the Union had to offer.[1]



Dinwiddie Court House and Five Forks, Va.

For the Confederacy, another cavalry-infantry force commanded by MG George Pickett was being fielded. Besides his own division, Pickett was given two brigades from MG Anderson's corps and three divisions of cavalry under General Fitzhugh Lee. These soldiers and troopers were battle-hardened veterans of every eastern campaign since the Peninsula in 1862. Arguably, they were the finest fighters of the entire Civil War. Like Warren's men, though, they had been in continuous contact since Grant crossed the Rapahannock the previous spring. The siege of Petersburg had taken its toll on them and their thinned ranks showed the result of desertions and battle losses. In spite of all this — hunger, disease, boredom, and almost constant combat — the 12,000 infantry and cavalry under Pickett still exhibited the spirit and determination that had made them famous at Gettysburg.[2]



At stake was the survival of Lieutenant General Robert E. Lee's Army of Northern Virginia. After a winter of siege in Petersburg, the Army of the Potomac had so encircled Lee's force that his only remaining link to the outside world was the Southside Railroad. This rail line stretched southwestward from Petersburg and was the only major means of supply or evacuation left. If it were cut, Lee would be trapped, and his surrender within a few weeks would be assured. If it were protected, however, Lee could move his army out of the trenches, link up with LTG Joe Johnston's Army of the Tennessee in North Carolina, and continue the fight. Within reach of Union forces, the only roads leading to the Southside Railroad came together just south of a creek called Hatcher's Run at an isolated trail intersection known as Five Forks. The army that controlled Five Forks controlled the Southside Railroad and, by extension, the course of the war.[3]

The area around Five Forks was similar to most of southern Virginia. Low, rolling hills and thick, heavy vegetation made off-road movement very difficult and slow, especially for units deployed for battle. The forest was sporadically broken by small clearings which, in some cases, extended line of sight, but for the most part 50-100 meters was the limit of observation in the woods. The few roads that crossed the area were unimproved dirt trails. The intersection at Five Forks was little more than an isolated crossroads with no buildings or settlements, made important only by its position at the western end of Lee's trench lines.[4] South of Five Forks was a small marshy area called Chamberlain's Bed and a stream called Stony Creek, both of which ran north-south and restricted east-west movement.

On 25 March 1865, U.S. Grant started the beginning of the end for Lee's army by instructing Sheridan to move his three divisions of cavalry out of bivouac at White House on the Pamunkey and proceed around the Union rear toward the Southside Railroad.[5] Having put his forces on the road, Sheridan arrived at City Point the next day for a personal interview with his commander. There is some controversy over which of the two generals, Grant or Sheridan, motivated the other, but the result was twofold. First, Sheridan was given status as an independent Army commander so that he reported directly to Grant, and second, Grant committed himself to the ultimate goal of capturing the Southside Railroad and turning Lee's right flank.[6]

Of course, the alert Confederate cavalry noted and reported these movements.[7] Lee, having identified this threat long ago, correctly interpreted the intelligence he received. To counter it, he sent three divisions of cavalry, one under General Rosser, and the others under his kinsmen, W.H.F. Lee and Fitzhugh Lee, to Five Forks. As the senior, Fitzhugh Lee commanded the group, and Colonel Munford took over command of Lee's division.[8]

Because this force totaled less than 6,000 sabres, General James Longstreet proposed to R.E. Lee that one of his divisions, George Pickett's, be designated a "special mobile force,"[9] and move with the cavalry. In desperation for more mass on his right flank, Lee acquiesced to this unorthodox tactic. At this point, Lee still did not know if the force heading for his flank was pure cavalry or if it had been reinforced with infantry.[10] This was to become a critical question in the next few days.

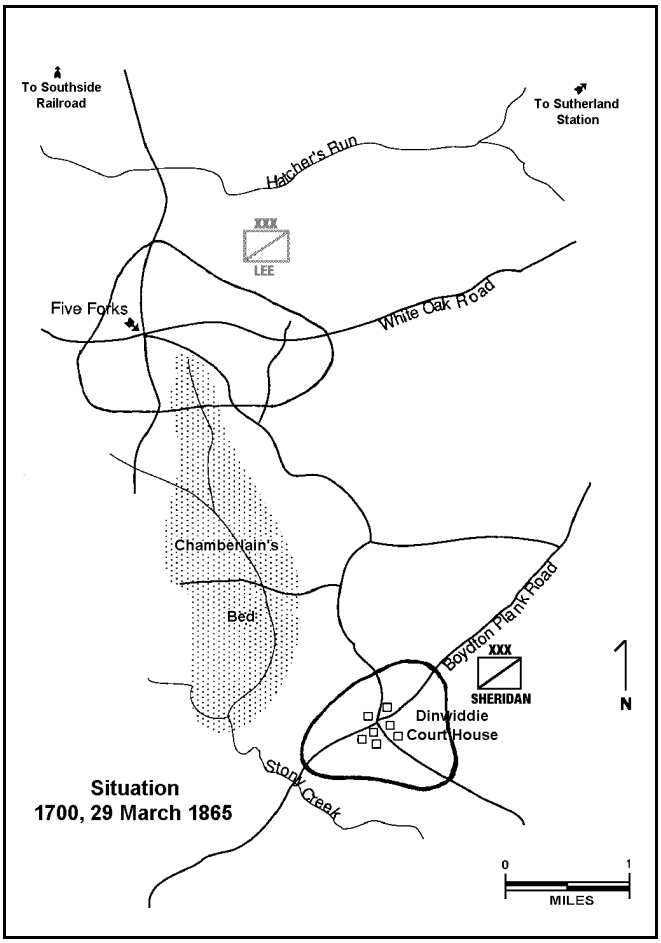
By 1700 on 29 March, Sheridan had arrived at Dinwiddie Court House, a tiny community some four miles south of Five Forks.[11] Dinwiddie was an excellent staging area to begin his assault through Five Forks to the Southside Railroad, and Sheridan paused to assemble his forces. By that evening, both Crook's and Devin's divisions had joined him at Dinwiddie, while Custer's division was occupied bringing up the trains through the clogged rear area.[12] Enthused by Sheridan's excellent progress, Grant changed his tactical focus somewhat and issued Sheridan new instructions.

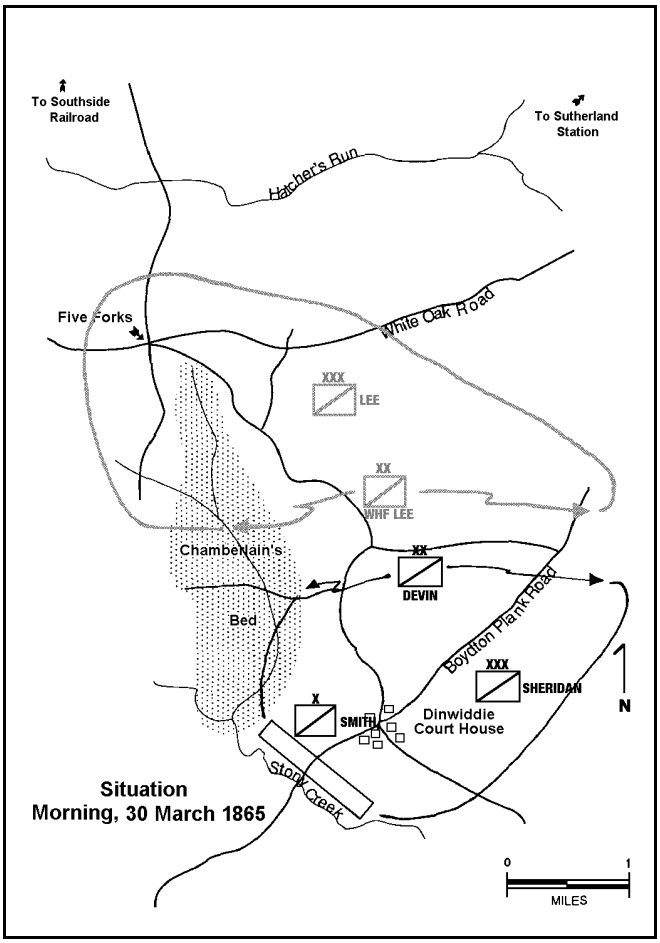
> *"I do not want you to go after the [rail] roads at present. In the morning, push around the enemy, if you can, and get in his right rear. I now feel like ending the matter, if it is possible to do so."*[13]

Pickett, meanwhile, had been instructed to move by rail to Sutherland Station, a tiny rail station on Lee's extreme right flank.[14] He made this move quickly and had detrained by the time Sheridan arrived at Dinwiddie. Fitzhugh Lee's cavalry force was already encamped at Five Forks and screening southward. It began to rain that night, first softly and then in torrents. It was not to stop for three days.[15]

By the next day, the rain had transformed roads in the Dinwiddie area from marginal to impassable. Thick, gooey mud clung to everything and threatened to swallow entire supply columns. Custer's men set to corduroying the roads with felled trees but the logs seemed to disappear under the bottomless mud.[16] Brevet Brigadier General Horace Porter, Grant's Chief of Staff, commented that "it looked as if the saving of the army would require the services, not of Grant, but of Noah."[17]

Despite the adversity, Sheridan lost no time on the 30th in deploying his forces for battle. He put a brigade of Crook's division in a blocking position





over the Boydton Plank Road at Stony Creek and pushed Devin's division north on the Five Forks Road to locate the enemy.[18] He was soon rewarded, as Devin almost immediately ran into a brigade of Confederate cavalry, probably from W.H.F. Lee's division.[19] A lively fight ensued and Sheridan was looking forward to a successful day when he encountered the first of several stumbling blocks.

Around midmorning, a courier from Grant's headquarters arrived at Dinwiddie and gave Sheridan this message from the commanding general.

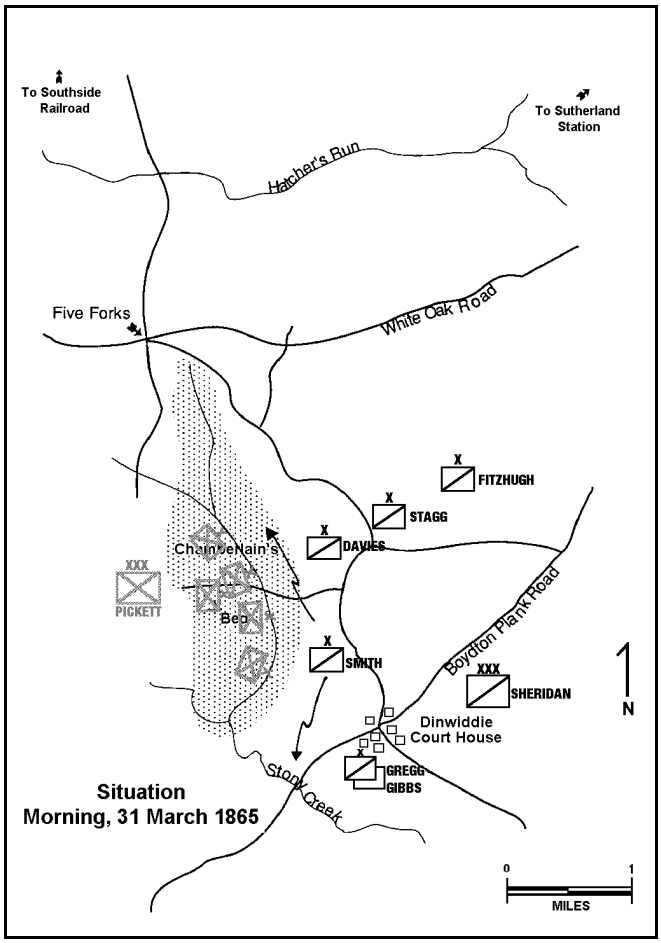
> *"The heavy rain of today will make it impossible for us to do much until it dries up a little or we get the roads around our rear repaired. You may therefore leave what cavalry you deem necessary to protect the left...and send the remainder back to Humphrey's Station where they can get hay and grain."*[20]

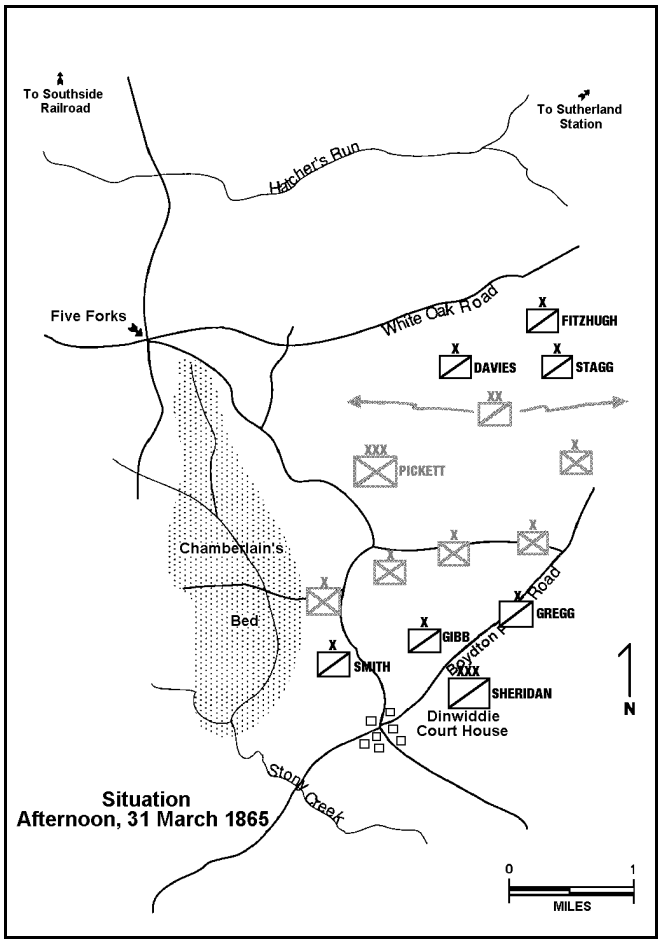
Sheridan was more than a little perturbed by this change in plans, especially after the optimistic instructions he had been given the previous day. After considering it for a few moments, he halted all offensive actions for that day, threw out a heavy screen, and then mounted his horse and set out for Grant's headquarters. As he said later in his memoirs, it seemed to him "that a suspension of operations would be a serious mistake," and he intended to see his commander personally so that he could "get a clear idea of what it was proposed to do."[21]

While Devin's and W.H.F. Lee's cavalry were clashing south of Five Forks that morning, the commander of the Army of Northern Virginia was holding a council of war at Sutherland Station.[22] Pickett was in attendance, as were other generals that occupied positions on Lee's right flank. Lee knew that Sheridan's force had occupied Dinwiddie, but it was still not known if he was accompanied by infantry. A pure cavalry force in such an exposed position, far to the left of Grant's trenches, was a tempting target. If it were destroyed, not only would Five Forks be safe, but the Confederates would be in a position to turn the entire Union line. Of course, Fitzhugh Lee was already in place at Five Forks with his three divisions of cavalry, but if the operation was to have any real chance of success, Lee had to be reinforced. Pickett's "mobile force" had been created just for such an occasion. The decision was made, and by noon Pickett's division, reinforced by two brigades from Anderson's corps, was marching westward toward Five Forks.[23]

The march was slow and agonizingly difficult because of the mud. Making it worse was the constant harassment of Pickett's column by federal cavalry. Every time his flanks were assailed by enemy horse, Pickett halted his column and deployed regimental battle formations and awaited an attack.[24] While this slow, cautious approach exasperated Fitzhugh Lee, it was understandable in light of Pickett's experience. Fortune had not been kind to George Pickett either at Gettysburg or since.[25] He now had an opportunity for fame and glory and he did not intend to lose it in an ambush.

Pickett finally reached Five Forks in the evening of 30 March 1865.[26] Once there, he located Fitzhugh Lee and, as senior officer, took command of the entire operation. While the rest of his force bivouacked, Pickett pushed out two brigades as local security. They





soon came in contact with Union cavalry under Devin, and Pickett was informed that the force to his front was equipped with repeating rifles.[27] What was still not known, however, was whether there was any Union infantry in the dark, wet woods to the south.

By this time Sheridan had returned to Dinwiddie with new orders from his commander. His trip to Grant's headquarters had been wholly successful. It had taken three hours of riding to reach Grant's encampment, three hours of forcing his horse through knee deep, sucking mud. When he arrived, Sheridan found Grant's staff standing on logs and planks around a roaring fire and the commanding general in his tent conferring with one of his corps commanders. While waiting for an audience with Grant, Sheridan was unrestrained and excited. He paced back and forth, pounding a clenched fist into his open hand and, as Porter put it later, "chafed like a hound on a leash." When another staff officer prodded him, Sheridan uttered his now famous statement, "I tell you, I'm ready to strike out tomorrow and go to smashing things!"[28]

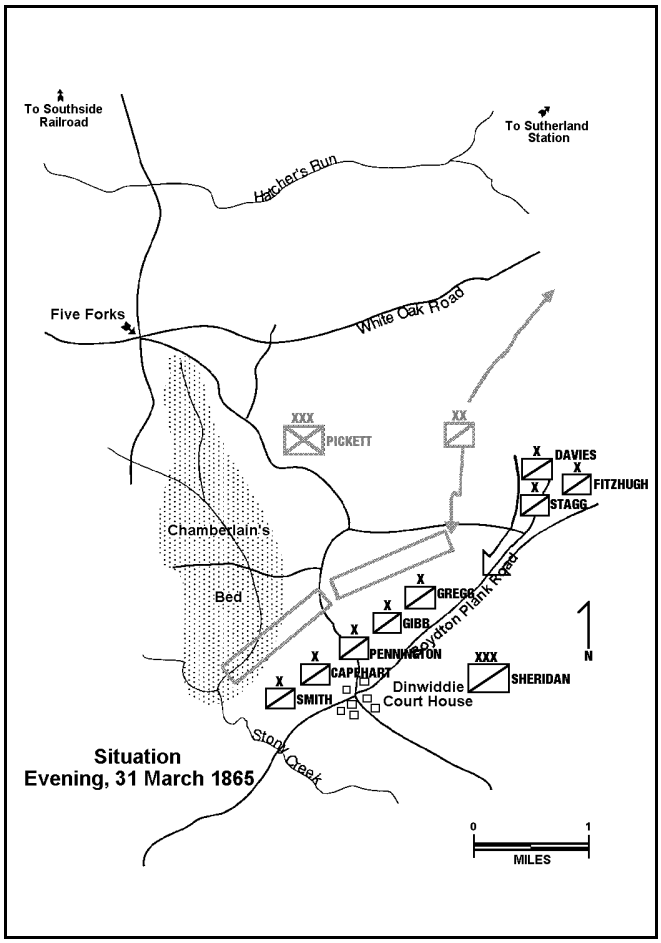
Grant's staff was caught up in the cavalryman's infectious optimism and an audience with Grant was arranged immediately. Sheridan spoke with Grant for close to an hour. The exact arguments he used have not survived, but when Sheridan emerged from his commander's tent, he had received new orders. "We will go on," Grant had said.[29]

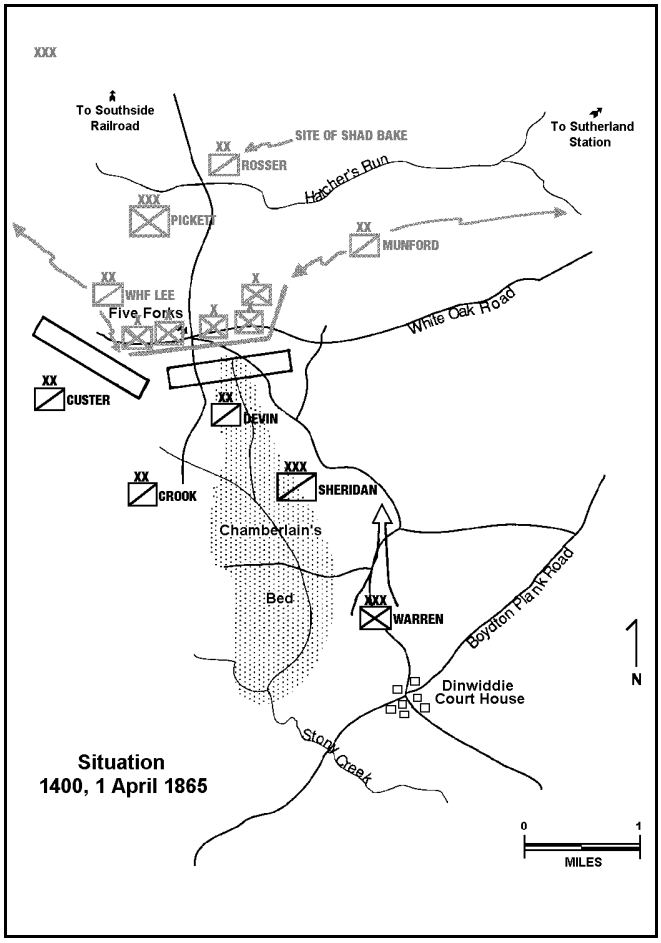
And so, when Sheridan drew rein that evening at Dinwiddie, the ingredients of a major battle were already in place. Ironically, Grant's vacillations had cost the Federals an entire day, a day which Lee had used to insert five brigades of infantry into the equation. Had Sheridan been allowed to continue the attack that morning, there is an excellent chance that his three powerful divisions would have swept aside Fitzhugh Lee's tired and depleted force. Sheridan would have advanced on the railroad, cutting the Army of Northern Virginia off from escape, and the Battle of Five Forks might never have happened.

March 31, 1865, began with light fog and damp, sticky air. The constant rain of the last two days had slowed considerably but was still an ever present annoyance. Sheridan began his movements by pushing Davies', Stagg's, and Fitzhugh's brigades north toward Five Forks.[30] He detailed Smith's brigade to guard the crossing over Chamberlain's Bed, and Gregg's and Gibbs' brigades he held in reserve at Dinwiddie.[31] His cavalry screen had identified Pickett's force moving into Five Forks the previous day, but Sheridan still was unsure of Pickett's intentions so he instructed his three forward brigades to move carefully.[32]

Pickett also began moving early in the morning. Some of Fitzhugh Lee's scouts had identified a concealed road through the woods to the west of Chamberlain's Bed. Pickett, with an eye toward decisive victory, sent his forces down that road, hoping to take the Federals in the flank.[33]

Sheridan first made contact around midmorning when some of Smith's pickets were driven away from Chamberlain's Bed. The Confederates were coming into his flank and rear, apparently in large numbers. Sheridan called Davies and instructed him to move southwest and reinforce Smith. Despite the danger, it looked as if the penetration could be contained.[34]





In fact, Pickett had crossed Chamberlain's Bed in two places. The crossing that Sheridan was reacting to was the southernmost and less powerful one. Davies, answering Sheridan's call for help, left a picket line in position and marched to aid Smith. By the time Davies arrived, however, Smith had already pushed the penetration back. At this point, Pickett's northernmost attack hit home exactly in the position Davies had just left.[35]

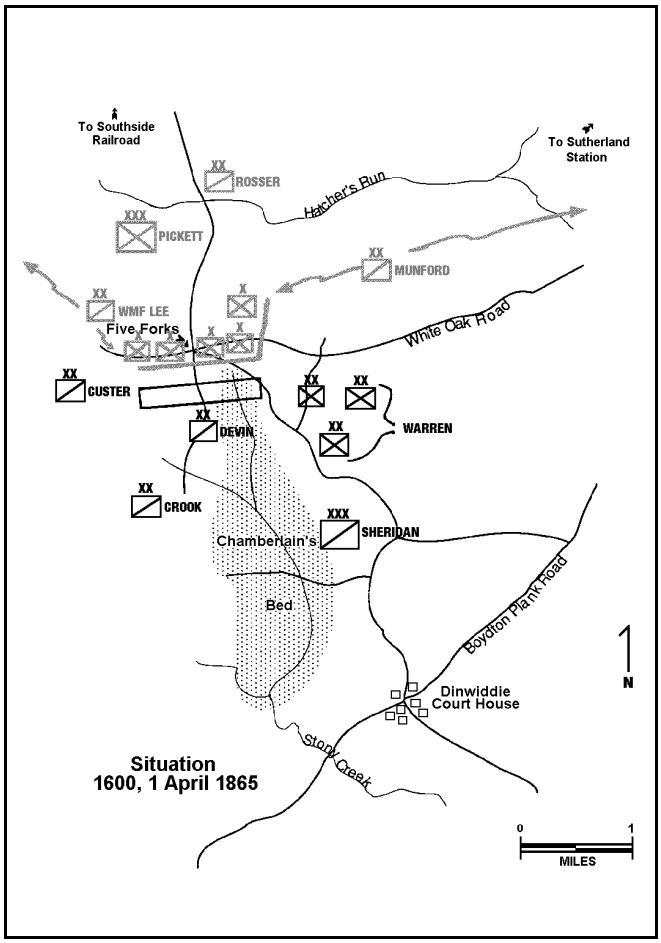
Davies countermarched quickly and even managed to get his brigade in front of Pickett's penetration,[36] but the damage was done. The Confederates pushed inexorably southwest, driving a wedge between Sheridan's forces that got wider with each passing hour. The Federals were now split with Davies, Stagg, and Fitzhugh to the north, Smith, Gregg, and Gibbs to the south, and at least 12,000 Confederates in between. Each of the separated Union forces was now less than half Pickett's force and could easily be destroyed in detail.[37]

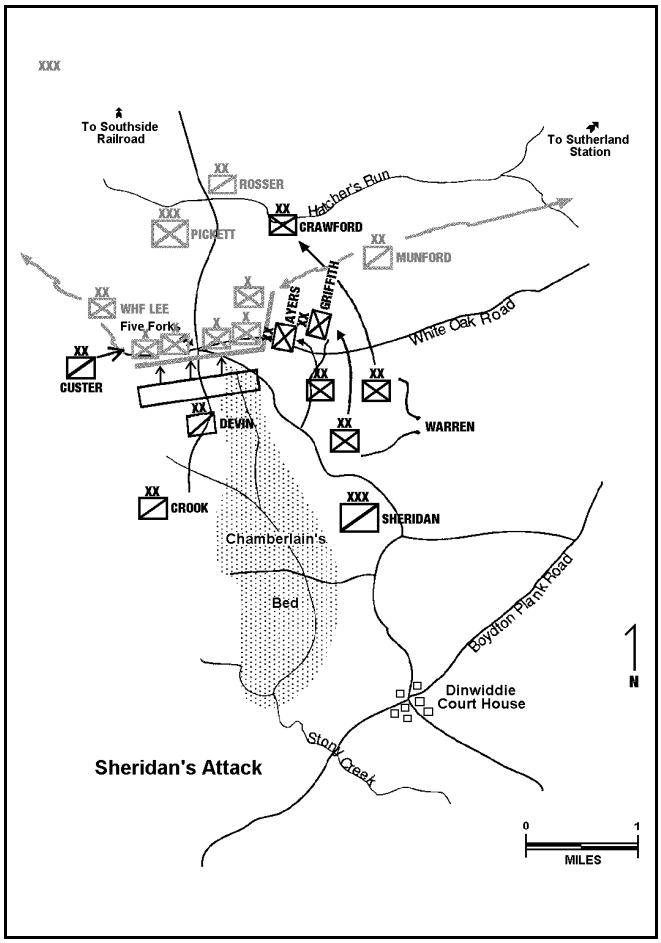
George Pickett was now the master of the hour. He could either destroy Sheridan's forces or continue to march into the Union rear. It is unclear whether Pickett realized what he had achieved, but what is clear is that he continued his march southeast, sweeping away Union cavalry to his front and heading directly for the flank of the Union entrenchments around Petersburg.

Sheridan now had to concentrate on limiting the damage. Fortunately, Pickett's advance meant that his flank would be exposed to Gibbs' and Gregg's brigades, which had been called out of reserve. At the proper moment, Sheridan had these two brigades concentrate repeating rifle fire on Pickett's advancing ranks.[38] The attack forced Pickett to stop and face south, stalling his attack. At the same time, Sheridan called up two of Custer's three brigades from the wagon trains in the rear. Custer arrived just before Pickett broke the Union line, and Sheridan threw his two brigades in between Smith and Gibbs. To the tune of "Nellie Bly," played by one of Custer's bands, the Union reinforcements shored up Sheridan's line and saved him from destruction.[39] That evening, Pickett made one final assault across Sheridan's entire line, but the withering fires of Sheridan's repeating carbines held him off. The day ended with Pickett solidly in command of the field and Sheridan, as one author put it, "on the ragged edge of a major defeat."[40]

Soon after nightfall, Sheridan sent a message to Grant telling him that while Pickett was too strong to be attacked, he (Sheridan) would hold at Dinwiddie as long as possible.[41] The three separated brigades of Davies, Stagg, and Fitzhugh rejoined Sheridan around 2200 by swinging wide to the east of Pickett's penetration and marching to Dinwiddie on the Boydton Plank Road.[42] Their arrival buoyed Sheridan's spirits somewhat, and he began to think that perhaps his situation was not so precarious as he had imagined.

Sheridan's dispatches and reports throughout the day painted a dire picture at Grant's headquarters, though. After some suggestions from his subordinate commanders, Grant decided to pull Governeur K. Warren's V Corps out of its position in the trenches and send it to aid Sheridan.[43] Warren received his marching orders and immediately sent one of his divisions, Ayers', striding toward Dinwiddie.[44] The other two divisions, Crawford's and Griffin's,





came much more slowly. Grant also sent General Porter as a liaison officer to Sheridan to guide him concerning the commanding general's intentions. Porter arrived at Dinwiddie somewhere around 2300 and told Sheridan that the V Corps should reach his position around midnight.[45] At that point, Sheridan realized his opportunity, saying to Porter,

> *"This force is in more danger than I am. If I am cut off from the Army of the Potomac, it is cut off from Lee's army, and not a man in it should ever be allowed to get back to Lee. We at last have drawn the enemy's infantry out of its fortifications and this is our chance to attack it."*[46]

Sheridan was not the only one who realized the Confederates were in danger. After a successful day Pickett had put his men in bivouac, thinking to begin the battle anew the next morning. Somewhere around 2300, however, two prisoners were captured on Pickett's left flank and brought to him. They were infantrymen, members of the lead brigade of Ayers' division of the well-known V Corps.[47] Suddenly the picture had changed. Pickett realized that when the sun rose the next morning he would not be facing eight unreinforced brigades of cavalry, but an entire corps of Union infantry. He made what was probably the only viable decision he could and ordered his force to fall back on Five Forks to "discharge his main duty, which was that of protecting the approaches to the Southside Railroad."[48]

The Confederates began executing their withdrawal quickly. The small contingent of artillery left the area of Dinwiddie at 0200 on 1 April. The infantry was supposed to withdraw at 0400 but was delayed until 0500.[49] Nevertheless, by the time Sheridan peered across his front northward, the Confederates were nowhere to be seen. Sheridan immediately sent his cavalry forward and found that the Rebels were not that far away after all. The Federals stayed close on the heels of their retreating enemy, close enough to know what was happening, but not so close as to draw a backlash from Pickett's still dangerous infantry.[50]

Sheridan would have attacked the retreating Confederates, but to his exasperation, Warren had not yet arrived on the field. Ayers' division was on hand at Dinwiddie by 0900, but General Warren's march with his remaining two divisions was so slow as to disgust Sheridan.[51] In all fairness, the condition of the roads had a lot to do with Warren's snail-like pace, but by 1300 when Warren finally presented himself to Sheridan, the cavalryman was beside himself with annoyance. "We have accomplished nothing," he spat, "but to oblige our foe to retreat!"[52]

By 1400, Pickett's forces were firmly ensconced in their entrenchments at Five Forks, which consisted of shallow trenches and hastily thrown up barricades of fence rails and branches.[53] There is no doubt that Pickett should have been more diligent in placing his forces and fortifying their positions. Pickett's excuse, such as it is, was twofold. First, Pickett's rear guard had identified no infantry following him, since Warren had not yet arrived on the field, so he simply did not expect an attack.[54] He was confident he could hold off the cavalry that faced him and he had already requested reinforcements from the main army, so he felt

secure that he had done what was reasonable.

The second reason for Pickett's negligence was more immediate. General Rosser, whose division was resting in Pickett's rear, had managed to net some shad in a nearby river the previous day. Around 1300 on 1 April, he had the fish cleaned and broiled and invited his two commanders, Fitzhugh Lee and Pickett, to a shad bake. As one of Pickett's chroniclers said, the two officers accepted gladly "in the assurance that this would provide a meal delectable at any time and incredible in the hungry days of bone-gnawing war."[55] So around 1400, just as Governeur K. Warren was receiving instructions from Sheridan on how to defeat Pickett's little band, their Confederate counterparts left the business of war in the hands of their subordinates and trotted off to a shad bake.

Sheridan, however, was more concerned with destroying his enemy than filling his belly. Once Warren arrived, Sheridan quickly got down to business and laid out his battle plan. Devin's division would be dismounted in the center of the Union line and would use their repeating carbines to suppress Pickett's center. Custer would be on the left and would demonstrate against Pickett's right flank to draw the Confederates' attention. Warren, with his entire corps, would attack Pickett's line on the Union right, just where Pickett had refused his left and created an angle in his line. Crook's division would remain in reserve. Once Warren's attack was launched, both Devin and Custer would attack as well and, hopefully, the enemy would crumble from his left to right.[56]

It was a good plan and, with the exception of Warren's continuing leisurely pace, it was executed flawlessly. Custer and Devin were both in place and pouring fire into the enemy before Warren finally got his three divisions arrayed properly. General Porter, who was still accompanying Sheridan, said that Custer's repeating carbine-armed cavalry "created a racket...that sounded as if a couple of army corps had opened fire."[57]

Around 1600, Warren finally got his people placed where he wanted them with Ayers' division on the left, Crawford's on the right, and Griffin's in the rear.[58] Almost immediately after stepping off, however, Warren began to experience problems with controlling his units. Ayers began to wheel left toward his objective but Crawford continued north and soon lost contact with the rest of the corps.[59] Fortunately, Griffin followed Ayers, not Crawford, and when Ayers began to take fire from the Confederate line, Griffin was there to shore him up. There were a few tense moments when it looked as if Ayers' attack would break, but Sheridan, through force of will and enthusiasm, was able to rally Warren's men and press the attack home.[60] Warren, meanwhile, had gone off to find Griffin, who was unwittingly marching into Pickett's rear. By 1630, the Confederate line was broken. With few exceptions, entire brigades broke and ran, only to be rounded up as prisoners. The only unit to escape intact was W.H.F. Lee's division, which rejoined Rosser's division on the north side of Hatcher's Run.[61]

The way to Lee's flank was now open. Within a day or two, Union forces would be astride the Southside Railroad. Lee had two choices. He could stay in Petersburg and be starved into submission, or he could evacuate — immediately — and try to escape. Either way, as he well knew by that point, the days of the Confederate States of America were numbered.

Pickett, Fitzhugh Lee, and Rosser, of course, were oblivious to most of this. They were enjoying their baked fish and, probably, a shot or two of spirits.[62] Around 1500 a messenger arrived from Munford's division saying that Union infantry were advancing on all roads to Five Forks. In fact, Munford was at that very moment observing the dispositions of Warren's corps. He sent numerous messages to Pickett, but the Confederate commander had told no one where he was going and only one of the many couriers Munford dispatched was able to find him.[63] Pickett and Lee read the dispatch, but they could hear no firing or commotion so they assumed that any small skirmishes that might begin could be handled by the officers at the front.[64]

Around 1600, Pickett sent a courier to Five Forks with a message for Munford. All was still quiet, but the ease of the gathering was shattered when a line of Union infantry — Crawford's errant division — emerged from the woods and captured the courier in sight of the party.[65] Pickett and Fitzhugh Lee immediately rode for the front, but by the time they arrived, the position was lost. Both generals were among the few Confederates who escaped Sheridan's expanding net.

Sheridan pursued the broken Confederates until nightfall halted him. All told, he killed or captured over 6,000 enemy cavalry and infantry, as well as six field pieces, 8,000 muskets, and 18 battle flags.[66] The Union loss was slightly more than 1,000 killed and wounded.[67] More important than the numerical returns, though, is the strategic importance of the battle. The way to Lee's flank was now open. Within a day or two, Union forces would be astride the Southside Railroad. Lee had two choices. He could stay in Petersburg and be starved into submission, or he could evacuate — immediately — and try to escape. Either way, as he well knew by that point, the days of the Confederate States of America were numbered.

Of course, learning the intricate nuances of a military conflict does us little good unless we can take some lessons away from the study. It is all very good to tell ourselves that the Battle of Five Forks had repercussions well out of scale with its size, and that, as Porter said, "Five Forks meant the beginning of the end, the reaching of the last ditch."[68] The value of the study comes from how we can fit the battle into categories or principles so that we may draw conclusions from it. In this case, the nine Principles of War are a good starting point, specifically the principles of Objective, Mass, and Offensive.

In military parlance, "objective" means the designated purpose or goal of an operation, and the lack of a clear objective appears to have been one of Pickett's most serious problems. This is not so much in evidence at Five Forks, where Pickett's mission of holding the crossroads was clear, but at Dinwiddie Court House on 31 March. Early in the day, Pickett had split the Union force opposing him and he could either defeat them in detail or march on into Grant's rear. Unfortunately, he did neither with conviction. It appears that he initially intended to march into the Union rear but he instead allowed a vastly inferior force to fix him until nightfall, when all the variables changed. Either one of the two courses would have brought some kind of victory, however fleeting. Pickett's mistake was to do neither.

The principle of Mass denotes bringing together overwhelming force at one place to influence a battle. To his credit, Sheridan seems to have mastered this concept, as he illustrated twice during the two days' fighting. On 31 March, after Pickett had split his forces, Sheridan was in somewhat of a bind. He correctly recognized, however, that massed fire from two cavalry brigades sporting repeating carbines might induce Pickett to stop his advance. The high rate of fire of these two brigades into Pickett's flank did indeed stop him, for that much force at one point was more than the Confederate commander felt he could ignore.

The use of Mass is shown even more clearly on 1 April, though, when Warren's two divisions smashed into Pickett's refused left. A salient in a line of entrenchments is a naturally weak spot in any case, since fires on either side of the salient cannot interlock and support. For Sheridan to hit this very spot with his most powerful combat element while simultaneously suppressing the rest of the line with less powerful elements shows a solid use of the principle of Mass.

The last principle is probably the most significant. The principle of Offensive tells us that the only way to achieve ultimate victory is to attack. Ostensibly, U.S. Grant understood this, as his previous campaigns clearly show. Perhaps it was fatigue or the knowledge that he could hardly lose the war at that point that made him call off the attack on 30 March, but it was apparently Sheridan's enthusiasm that put him back into the offensive mode. Sheridan's determination to let nothing stand in his way, to "strike out tomorrow and go to smashing things," was the spirit that won the Battle of Five Forks. Without it and almost in spite of it, considering the day wasted on 30 March, the Confederates may well have shored up their position to such an extent as to make an attack superfluous or worse, escaped Petersburg. The final end of the war would most likely have been the same, but it might have ended in 1866 instead of 1865, with a corresponding loss of American life.

Notes

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[6]Starr, pp. 424-425.

[7]Freeman, p. 656.

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[10]Freeman, p. 656.

[11]Starr, pp. 431-432.

[12]Ibid.

[13]Starr, p. 432.

[14]Freeman, p. 657.

[15]Starr, p. 433.

[16]Ibid.

[17]*Sheridan the Inevitable,* Richard O'Connor, Bobbs Merril Co., Inc., Indianapolis, 1953, p. 245.

[18]Starr, p. 434.

[19]Ibid.

[20]Ibid.

[21]*The Personal Memoirs of P.H. Sheridan,* Vol. II. Philip H. Sheridan, New York, 1888, p. 143.

[22]Freeman, p. 658.

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[25]Ibid.

[26]bid.

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[28]O'Connor, pp. 245-246.

[29]Starr, p. 436.

[30]Starr, p. 437.

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[33]Starr, p. 437.

[34]Starr, p. 438.

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[41]Starr, p. 442.

[42]Ibid.

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[44]Ibid.

[45]Starr, p. 444.

[46]Foote, p. 868.

[47]Freeman, p. 660.

[48]Ibid.

[49]Freeman, p. 661.

[50]Ibid.

[51]Starr, p. 447.

[52]Ibid.

[53]Ibid.

[54]Freeman, pp. 661, 664.

[55]Freeman, p. 667.

[56]Starr, pp. 447-448.

[57]O'Connor, p. 254.

[58]Starr, p. 448.

[59]O'Connor, p. 253.

[60]Starr, pp. 448-449.

[61]*To Appomattox, Nine April Days, 1865,* Burke Davis, Rinehart & Co., New York, 1959, pp. 48-49.

[62]Freeman, p. 668.

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[65]Davis, p. 45.

[66]Starr, p. 450.

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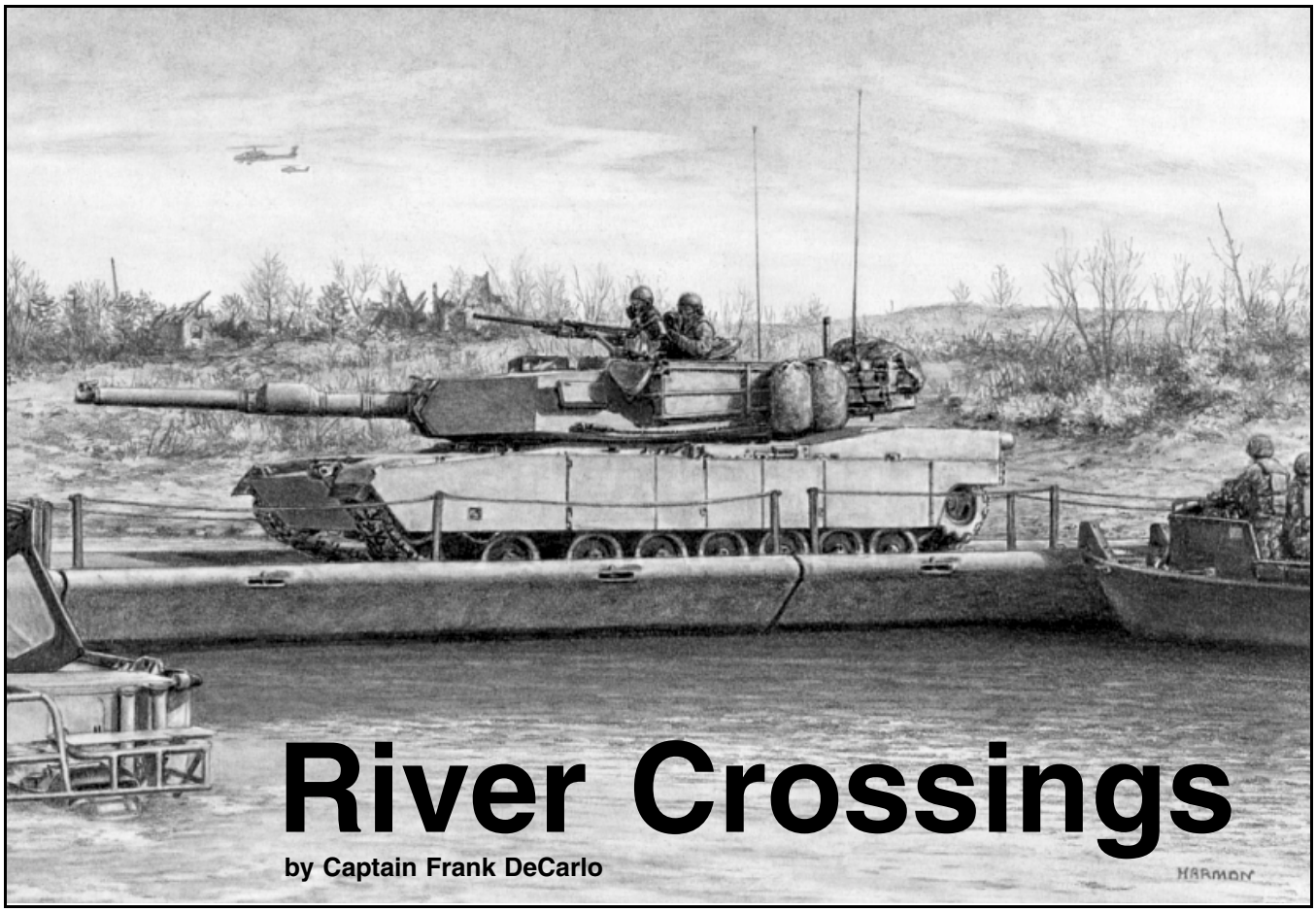

River Crossings

by Captain Frank DeCarlo

In October 1943, General Heinrich von Vietinghoff and his Tenth Army set up a heavy defense along the Volturno River line in southern Italy. The defense was set to slow the advance of the Allied movement north to allow time to prepare the main German defensive line south of Rome. Vietinghoff was under strict orders to hold the Volturno River line until 15 October. The American forces approaching from the south were from LTG Mark W. Clark's Fifth Army. Clark chose the VI Corps, commanded by MG John P. Lucas, to make the crossing. This set the stage for the first American attack of a defended river line in the war against Germany. For the Fifth Army, mass and

PHASES / CPS	ADVANCE TO THE RIVER	ASSAULT ACROSS THE RIVER	ADVANCE FROM THE EXIT BANK	SECURE THE BRIDGEHEAD LINE	CONTINUE THE ATTACK
DTAC (CROSSING FORCE HQ)	Coordinates lead brigade's seizing of near-shore objectives	Coordinates lead brigade's conducting dismounted assault of the river to seize far-shore lodgement	Coordinates lead brigade's seizure of exit-bank and intermediate objectives	Coordinates lead brigade's seizure and securing of bridgehead objectives and prepares to cross the reserve brigade (breakout forces)	Controls breakout force's attack out of the bridgehead and passes crossing force responsibilities to DREAR
DMAIN	Coordinates deep operations to isolate division advance to the river	Coordinates deep operations to isolate crossing area and far-shore lodgement	Coordinates deep operations to isolate exit-bank and intermediate objectives	Coordinates deep operations to isolate bridgehead	Coordinates deep operations to isolate enemy attack against corps objectives
DREAR	Sustain the fight	Sustain the fight	Sustain the fight	Sustain the fight	Assume crossing force HQ role
BRIGADE TAC CP	Coordinates lead task force's seizing and securing near-shore objectives	Coordinates the dismounted assault crossing of the river to secure far-shore lodgement	Coordinates TF's attack to seize and secure exit-bank and intermediate objectives	Coordinates TF's seizure and securing of bridgehead objectives	Prepares to reorganize and follow the breakout force attack out of the bridgehead toward division deep objectives
BRIGADE MAIN CP (CROSSING AREA HQ)	Moves and prepares crossing area to provide traffic control, crossing means, and obscuration	Coordinates assault crossing means for TF dismounts and controls obscuration of crossing sites	Controls follow-on TF's pass-through crossing area into attack positions within far-shore lodgement	Controls passage of brigade units through crossing and prepares to cross breakout force	Brigade CPs pass crossing area control to supporting corps engineer battalion

Figure 1. CP Tasks

speed were essential in order to deny the Germans time to build up their defenses south of Rome. On 9 October, Clark ordered Lucas to conduct an attack across the Volturno. However, due to the severity of the fall rains, excellent German tactics, and poor planning and organization, Lucas was not able to have his two divisions on line and ready to attack until 12 October. The initial assault started at midnight on 12 October, but because of poor choices in crossing sights and inadequate planning and resourcing, the assault failed. The Germans still owned the river at the end of 13 October. The next attempt on the 14th was plagued with problems of poor coordination between the various elements of the force (infantry, armor, and engineers). These problems led to improper resourcing and poor synchronization. It was only individual ingenuity and excellent small unit leadership that allowed construction of a corps bridge on the 14th. This bridge allowed armor support to the far side. On 15 October, the two American divisions broke out of their bridgehead and began pursuing the Germans north, five days later than Clark expected. Due to the weather and poor American planning, coordination, and resourcing, General Vietinghoff successfully delayed until the 15th of October, as ordered. His successful delay allowed him to withdraw north to a prepared defensive line south of Rome.

This historical example shows the terrible degradation of a force's mobility that a river obstacle can cause without the proper planning, coordination, and resourcing of a well-understood crossing operation. The Army of 1943 learned at Volturno the importance of proper river crossing operations for maintaining the armored force's mass and speed. The question I propose today is, has the Army of 1994 forgotten that lesson?

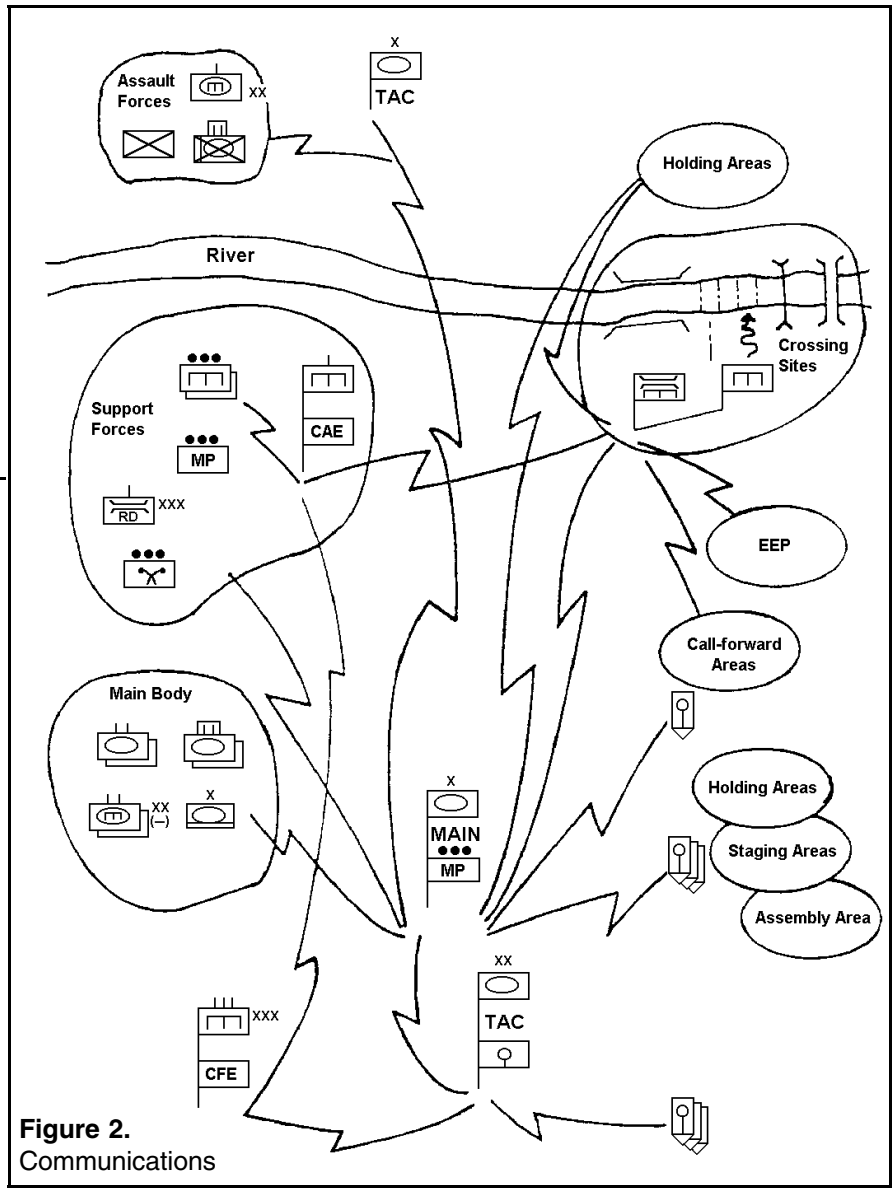

Figure 2.
Communications

Being an Engineer in the only full bridging battalion in the Army, I became well aware of the lack of combined arms training opportunities an Armor unit has in this complex operation. While attending the Armor Officer Advance Course, whose mission is to prepare the armor community's future company commanders and brigade and battalion staff officers, I saw the lack of attention given to such a complex operation. Finally with the loss of the bridging company in the divisional engineer battalion, due to the Engineer Restructure Initiative (ERI), you not only have a loss of training opportunities, but also the loss of familiarization with a bridge company's equipment and capabilities. Therefore, with the lack of training in our schools, the lack of training opportunities in the field, and the overall lack of familiarization with bridging capabilities, the question to ask is, are today's officers ready for the challenge of such a complex operation? With this in mind, this article will try to make the reader aware of river crossing doctrine, its complexity, and the need for training in this operation.

FM 9-13 describes a deliberate river crossing in this manner:

"It is an audacious attack that is planned and meticulously coordinated with all concerned elements. The deliberate river crossing requires thorough reconnaissance and extensive evaluation of all intelligence. It requires detailed planning and preparation, centralized control, and extensive rehearsals. A deliberate river crossing is costly in terms of manpower, equipment, and time... This type of river crossing requires the sudden, violent concentra-

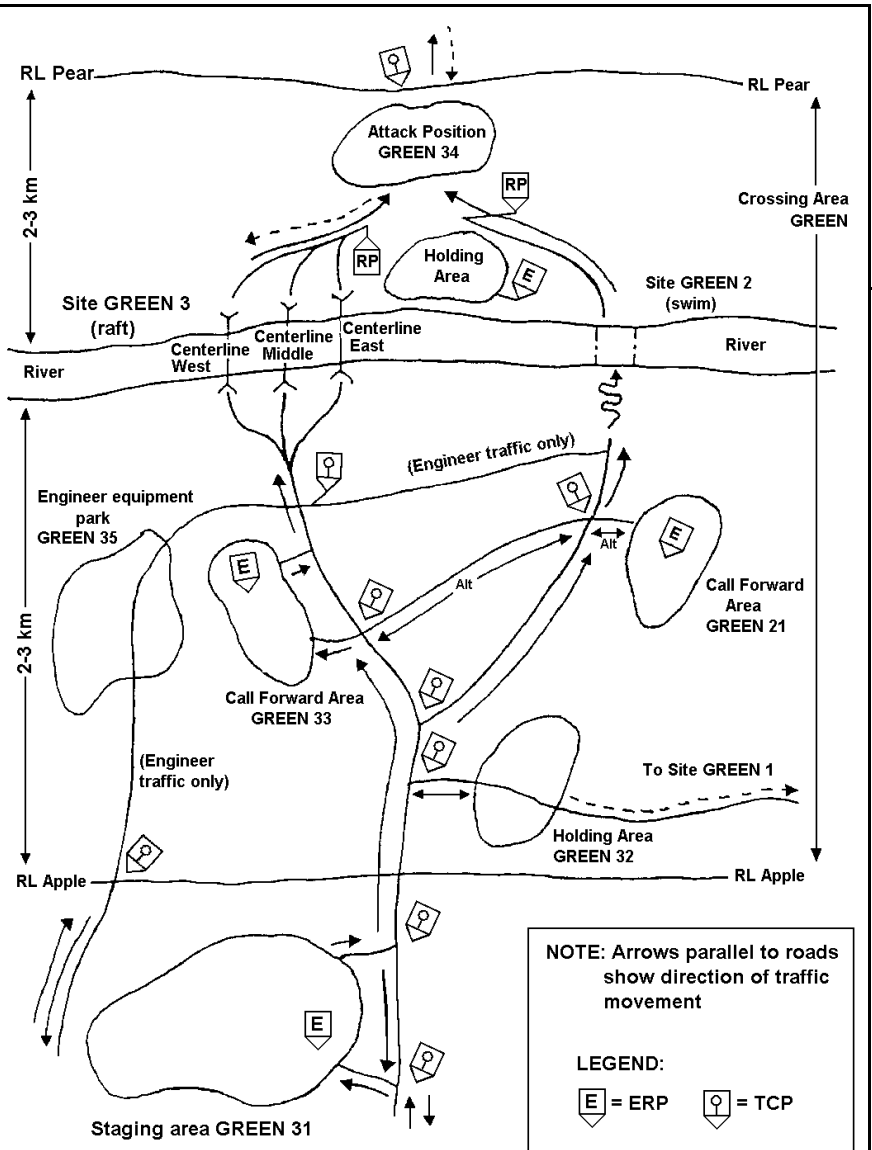

Figure 3. Control Measures

tion of combat power on a narrow front capitalizing on the element of surprise."

Such an operation requires specific planning and command and control measures which we will discuss briefly.

A crossing operation is broken down into four planning phases. Phase 1 is the advance to the river. This is a deliberate attack to seize the near shore of the water obstacle. Phase 2 is the assault across the river. This is the assault to secure the far shore and eliminate direct fire on the crossing site. Phase 3 is the advance from the exit bank. In this phase you seize the far bank and intermediate objectives and eliminate indirect fire on the crossing site. Phase 4 is securing the bridgehead line. This final phase involves the protection of the bridgehead against counterattack and the buildup of forces for the attack out of the bridgehead.

A division is the smallest unit to conduct a deliberate river crossing. There are five major command and control points which run the operation. They are the division TAC, Main, and Rear, and the Brigade TAC and Main. However, there are various other command and control points at lower levels which are also important to the success of the operation. It is critical that the personnel manning these points thoroughly understand river crossing operations as written in FM 90-13. Figure 1 is a matrix of each CP's task by phase.

There are unique terms used for the command and control of river crossing operations. Crossing Force HQ is the DIV TAC and the Crossing Area HQ is the Brigade Main CP. The crossing force commander (CFC) is usually an assistant division commander in charge of controlling the crossing. The crossing force engineer (CFE) is normally the corps engineer brigade commander or a group commander from the corps engineer brigade. He provides or coordinates engineer support from corps to division and assists in the overall planning. The crossing area commander (CAC) is normally the maneuver brigade XO. He controls all movement and positioning of all elements located in the crossing area (area between release lines). Crossing area engineer (CAE) is the corps engineer battalion commander who commands those engineers tasked to move the force across the river obstacle. He is also responsible for all the crossing sites in that forward brigade's AO. He informs the CAC of any changes in the crossing sites or the crossing means that may affect the mission. The crossing site commander (CSC) is the engineer company commander or platoon leader of the bridging unit operating the site. He is responsible for that site, its engineer regulation point (ERP), and the call-forward areas for that site. He works closely with the MP platoon leader controlling the traffic to that site. The unit movement control officer is a designated officer from each crossing unit who coordinates the unit's movement according to the unit's control plan. Figure 2 shows the complex communication network needed to control a river crossing operation.

There are specific control measures for crossing operations. Release lines are used to delineate crossing areas. They are normally located within 3 to 4 kilometers of the river and are easily identifiable terrain features. Call-forward areas are company-size waiting areas used to organize units into raft loads. The CAC controls movement from the staging area to the call-forward area. The CSC directs movement from the call-forward area to the crossing site to the far shore attack position. Engineer regulating points (ERPs) are technical checkpoints which form loads

and ensure they do not exceed the capacity of the crossing means. Each crossing site requires a minimum of one ERP located in its own call-forward area. Engineer equipment points (EEPs) are concealed sites used for the assembly, preparation, and storage of bridge equipment and material. EEPs require good routes to and from the crossing site. Figure 3 is an example of the control measures used for a crossing operation.

All these measures must be considered at brigade when preparing a crossing plan. There is one major difference when planning a river crossing operation versus other tactical operations. This difference is the added dimension of time when considering combat power allocation against threat units. Allocation of friendly forces to the battlefield is totally dependent on the rate at which they can be brought across the river. That rate is variable throughout the operation. The river crossing operation plan must include several tools by which to control that variable. These include: a crossing overlay, synchronization matrix, movement plan, and traffic circulation overlay. The officers and NCOs preparing such a plan must be well versed in FM 90-13 to ensure proper synchronization.

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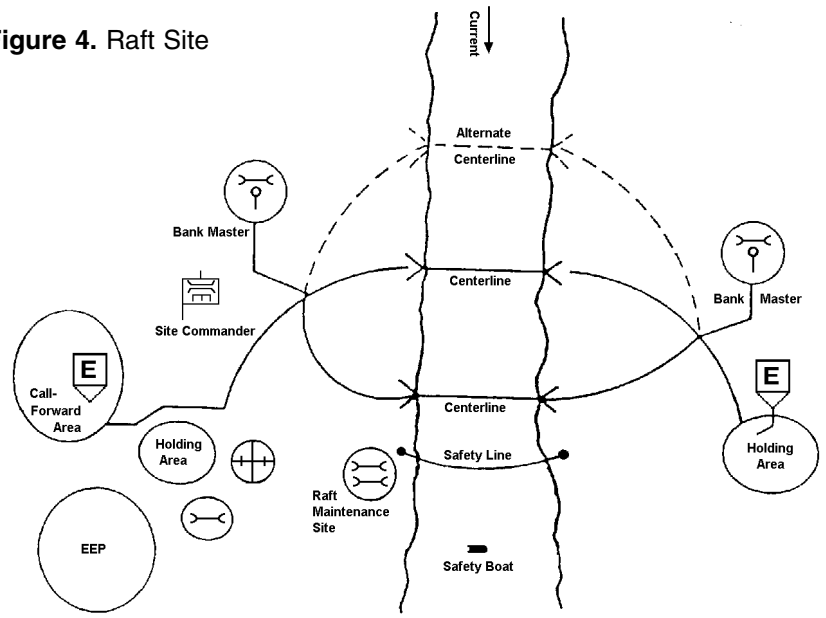
Figure 4. Raft Site



Examining a deliberate river crossing operation at a company/team level, one will see the following sequence of events. There will be initial movement along a designated route to a battalion-size, concealed staging area. In the staging area, the unit will receive a briefing on vehicle speed and spacing within the area, and it will have time to execute its own crossing preparations. On the call from the CAC, the company will move to a call-forward area with the assistance of MPs along traffic control points. There the unit will go through the ERP and the engineers will break the unit down into raft loads (during rafting operations). The CSC will then call raft loads to the crossing site. Each load will be met at the crossing site by the Bank Master and directed to a particular centerline. At the centerline the load will be guided onto a raft and transported to the far shore. The centerline guide then directs the raft load to the far shore attack position, where the unit reforms. After a sufficient amount of combat power is rafted across to allow for safe bridging operations, the engineers will convert the rafts to floating bridges for follow-on units. The follow-on units will conduct the same type of operation, except they will be called to the bridge site directly from the staging areas. Figure 4 shows the typical layout of a raft site.

As one can easily see, a river crossing is a very complex operation. It requires detailed planning, meticulous coordination, and extensive rehearsals from all personnel involved. In conclusion, with the Army of 1994 having possible areas of operation which include such obstacles as the Danube, Euphrates, Naktong, and Yalu Rivers, it would be wise to reexamine the lessons learned on the Volturno in 1943. We should take those lessons about the complexities of river crossing operations and teach them in our schools and practice them in training so we can project that mass and speed over any obstacle whenever needed.

Captain Frank J. DeCarlo is a 1990 graduate of the U.S. Military Academy. He graduated from Engineer Officer Basic Course, Scout Platoon Leaders Course, and the Armor Officer Advance Course. He is Airborne and Air Assault qualified. His previous assignments include: combat engineer platoon leader in 237th Engineer Battalion, float bridge platoon leader in the 93d Engineer Company, support platoon leader in the 517th Medium Girder Bridge Company, battalion adjutant in the 565th Engineer Battalion (Bridge), and project manager for the Armor Center Breach Laboratory. He is currently the Assistant S3 for the 588th Engineer Battalion, 2d Armored Division.

Commander's Guidance for Battle Command

by Lieutenant Colonel John Antal

"One who is confused in purpose cannot respond to his enemy."

Sun Tzu

Planning time saved is combat time gained. Battle command is the "art of decision-making, leading, and motivating soldiers and their organizations into action to accomplish missions."[1] Battle command is executed in the dynamic environment of combat, a two-sided competition immersed in the friction and fog of war. On the modern battlefield, commanders must execute battle command in rapid pace to ensure that his tempo of battle outmatches that of his adversary. To accomplish this, the command-staff team must conduct rapid decision-making.

The first step in gaining time and conducting rapid decision-making occurs with the commander's guidance to his staff. Commanders direct their staff's planning effort through verbal or written guidance. From this guidance the staff frames, sharpens, and eventually implements the commander's decision. Unambiguous commander's guidance saves staff planning time by concentrating the staffs effort on what the commander deems critical. The commander's guidance then provides a starting point for course of action (COA) development and the issue of combat orders. Bad guidance — guidance that does not specifically assist the staff to focus the planning effort — can slow orders development and wastes staff planning time. Loss of planning time often produces tragic results on the battlefield.

Most commanders believe that they know how to issue guidance. Few commanders, however, have ever received any formal instruction on how to issue clear, concise, and effective guidance in a logical, sequenced manner. Platitudes concerning "kicking the enemy's rear" or "moving swiftly with speed and agility to destroy the enemy in zone" do not provide the detailed information required by staffs to prepare effective tactical plans. Commanders who cannot communicate clear planning guidance hobble their staffs and degrade staff planning performance. Such degradation can increase the level of friction and cause the planning effort to fail.

"A leader must meet battle situations with timely and unequivocal decisions."[2] The concept of timely and unequivocal decisions is vital to effective and rapid staff operations. Nowhere is this more important than at the beginning of the planning process. Clear commander's guidance provides the foundation for effective tactical planning. Without clear guidance from the commander, time is wasted. Commanders who can issue clear and concise directions will increase the speed and efficiency of the staff's planning process. Staffs that are trained to receive commander's guidance in a sequential, systematic way are better equipped to quickly translate this guidance into effective tactical plans.

The minimum elements of commander's guidance are: a restatement of the unit's mission; an explanation of the initial concept of operation; a description of the initial scheme of maneuver; and information concerning the commander's desires concerning timings, order techniques and rehearsals. A diagram of the elements of commander's guidance is provided below:

Commander's Guidance

1. **Restated Mission**
   a. Commander's Intent
   b. Battlefield Framework
2. **Initial Concept of the Operation**
   a. Movement
   b. Objectives
   c. Responsibilities
   d. Formations/Dispositions (optional)
   e. Maneuver Options
3. **Initial Scheme of Maneuver**
4. **Time Plan, Orders Technique, and Rehearsal Technique**

Restated Mission

The first element of the commander's guidance is the restated mission. The restated mission is the commander's mission statement for **his** unit. It is his means of clearly expressing his will. The restated mission is derived from the commander's understanding of the higher commander's mission and the higher commander's intent. The restated mission must address the WHO, WHAT, WHEN, WHERE, and WHY of the assigned task. The element of WHAT is a listing of the key and ultimate essential tasks.

The communication of the restated mission is the commander's responsibility. The commander should be able to develop the restated mission on his own, without the aid of his staff. The commander deduces the content of the restated mission from his understanding of the higher commander's mission and intent. Normally, the commander has the closest and most direct access to the higher echelon commander. Often, he will receive the mission directly from the higher commander, either in person or over the radio or telephone. The commander, therefore, should have the best understanding of his higher commander's mission and intent. The staff, however, can assist the commander in developing the restated mission when time allows. If the staff develops the restated mission statement, then the commander must approve the staff's product.

To complete a restated mission statement the commander must understand and use precise terms. A mission is defined as "the task, together with the purpose, that clearly indicates the action to be taken and the reason for taking it."[3] A task is a "clearly defined and measurable activity accomplished by individuals or units. It is a specific activity that contributes to the accomplishment of the mission."[4] Missions must be explained as specific **tasks** that translate into specific actions that can be executed by the unit to a recognizable standard. Explaining the **reason** for the action helps to explain the standard.

An example is the mission to "clear in zone." This mission requires that the commander "destroy or force the withdrawal of all enemy forces in his zone of operations and reduce obstacles that may interfere with subsequent operations."[5] The task is to **destroy or force the withdrawal** of enemy forces, and **reduce obstacles** that impede future operations. The mission has two tasks; 1) destroy or force the withdrawal of enemy forces in zone and, 2) reduce obstacles in zone that impede future operations.

The first part of the first task requires that the friendly force destroy enemy forces. The definition of destroy is clear: "to physically disable or capture an enemy force.
[6] The second part of the first task is to "force the withdrawal of the enemy," if he cannot be destroyed. Importantly, if the accomplishment of this mission is to secure the higher commander's intent, the enemy must be forced to withdraw in the "right" direction. The direction that the enemy is forced to withdraw is a central piece of information in developing a successful course of action.

The second task is to reduce obstacles that impede future operations. A clear understanding of the higher commander's mission and intent is required to determine which obstacles, and how many obstacles (if any), must be reduced in the zone of attack. A clearly defined task, coupled with an explanation of why the action is being conducted, can make the difference between a successful mission and a lot of wasted effort. Tasks (clear, delay, destroy, deny, isolate, retain, and seize, for example) that confer precise conditions and standards enhance synchronization. A list of tactical missions and their definitions appears at right.

Concept of the Operation

The second step in the commander's guidance is to explain the concept of the operation. The concept of the operation consists of the statement of commander's intent and addressing the battlefield by the elements of the battlefield framework.

Commander's Intent - The commander's intent is defined as "the commander's stated vision of the battle which defines the purpose, the end state with respect to the relationship among the force, the enemy and the terrain and how the end state will be achieved by the force as a whole."[7]

The concept of commander's intent is critical to successful tactical operations. "Communications will be interrupted by enemy action at critical times and units will frequently have to fight while out of contact with higher headquarters and adjacent units. Subordinate leaders will be expected to act on their own initiative within the framework of the commander's intent."[8] **Commander's intent, therefore, cannot simply be a restatement of the scheme of maneuver.** It must explain much more than one way to accomplish the assigned mission.

The acid test of commander's intent is the ability of a subordinate to act "correctly" when the situation has changed, the initial order is no longer valid, and the subordinate cannot receive instructions in time to get a decision on a new course of action. The subordinate must either act or wait for instructions and run the risk of being defeated. If the subordinate's initiative is guided by a well-thought-out and clearly communicated commander's intent, then the chances of acting "correctly" will increase.

The commander's intent, therefore, must express what is expected of subordinate commanders and troops in order to secure the overall mission. It must explain a "way to act" for all situations. The intent must define the final end state and relate this end-state with the goals of the friendly force as a whole.

DEFINITIONS: TACTICAL MISSIONS

Attrition (Attrit) - The reduction of the effectiveness of a force caused by the loss of personnel or material. (JCS PUB-1)

Block - Deny the enemy access to a given area or prevent enemy advance in a given direction. It may be for a specified time. Units may have to retain terrain and accept decisive engagement. (FM 101-5-1)

Breach (ing) - The employment of any means to secure a passage through an enemy minefield or fortification. (JCS PUB-1)

Canalize - To restrict operations to a narrow zone by use of existing or reinforcing obstacles which may interfere with subsequent operations. (Tactics Div, Infantry School, Ft. Benning 18 April 90)

Clear - To destroy or force the withdrawal of all enemy forces and reduce any obstacles which may interfere with subsequent operations. (Tactics Div, Infantry School, Ft. Benning 18 April 90)

Contain - To stop, hold or surround the forces of the enemy or to cause the enemy to center activity on a given front and to prevent his withdrawing any part of his forces for use elsewhere. (JCS PUB-1).

Delay - To trade space for time, inflict maximum damage on the enemy force and preserve the force within the limits established by the issuing commander. (Tactics Div, Infantry School, Ft. Benning 18 April 90)

Destroy - To physically disable or capture an enemy force. (Tactics Div, Infantry School, Ft. Benning 18 April 90).

Fix - Actions taken to prevent the enemy from moving any part of his forces from a specific location and/or a specific period of time by holding or surrounding them to prevent their withdrawal for use elsewhere. (FM 101-5-1)

Interdict - To prevent or hinder by any means the enemy's use of any area or route. (JCS PUB-1)

Neutralize - To render ineffective or unusable. (JCS PUB-1)

Retain - To occupy and hold a terrain feature to ensure it is free of enemy occupation or use. (Tactics Div, Infantry School, Ft. Benning 18 April 90)

Secure - To gain possession of a position or terrain feature with or without force, and to deploy in such a manner which prevents its destruction or loss to enemy action. (FM 101-5-1)

Seize - To gain physical possession of a terrain feature from an enemy force. (Tactics Div, Infantry School, Ft. Benning 18 April 90)

Support Force - Those forces charged with providing intense direct overwatching fires to the assault force. (FM 101-5-1)

Withdrawal - A retrograde operation in which a force in contact with the enemy frees itself for a new mission. (FM 101-5-1)

Restated Mission (WHO, WHAT, WHEN, WHERE, AND WHY)

Concept of the Operation:
Commander's Intent:
Purpose (The purpose of the action.)

Method (The end state with respect of the relationship among the friendly force, the enemy and the terrain.)

Endstate (How the end state will be achieved by the force as a whole and how far to go in terms of combat power to achieve that end)

Battlefield Framework: (Offensive: Main Atk, Res, Recon & Sec, Deep, and Rear) (Defense: Sec, MBA, Res, Deep, and Rear)

Scheme of Maneuver
Outline of Movement:

Identify Objectives:

Assign Responsibilities for Zones, Sectors, or Areas:

Prescribe Formations (optional):

Identify Maneuver Options:

Time	Light Data	Actions

ORDERS TECHNIQUE: ORAL OVERLAY MATRIX FILL-IN-THE-BLANK WRITTEN

REHEARSAL TECHNIQUE: RADIO MAP SKETCH TERRAIN MODEL KEY LEADER FULL

This definition of commander's intent is enhanced by an explanation of the definition of command climate found in ST 100-9, *The Tactical Decision-making Process* (July 1993). This text translates the commander's intent as the PURPOSE, METHOD AND END STATE. This is a handy memory aid to assist commanders and staff officers in writing the commander's intent.

- **PURPOSE** (The reason for the operation with respect to the mission of the next higher unit. The purpose explains within the context of the mission of the higher unit [WHY the operation is occurring.]);

- **METHOD** (The end state with respect to the relationship among the force, the enemy and the terrain and the HOW in doctrinally concise terminology, explains the offensive form of maneuver, the alternative defensive pattern, or the retrograde operations to be used by the unit. Details as to specific sub-units are not discussed.);

- **END STATE** (How the end state will be achieved by the force as a whole and how far to go to achieve that end state in terms of combat power).

PURPOSE, METHOD, and END-STATE act as memory aids for the commander to write clear and effective intent. The commander should train himself to ask focused questions to ensure that his intent is clear. What is the purpose of my mission? What is the method that my superiors will use to secure the end state? How does this action accomplish the end state with respect to the relationship among the force, the enemy and the terrain? What is the importance of this end state and how will the end state be achieved by the force as a whole? What is success, and how much combat power can I risk losing to secure success?

Battlefield Framework - The concept of the operation is then expressed in the terms of the battlefield framework.[9] The offensive battlefield framework consists of addressing the **main attack, reserve, reconnaissance and security operations, deep operations,** and **rear operations.** The defensive framework consists of **security force operations, the main battle area, reserve, deep operations,** and **rear area operations.**

The battlefield framework is a logical way to describe the geometry of the joint-combined battlefield. The framework provides the commander a method to briefly describe his guidance for each critical area of the battlefield. At the battalion level and below, a commander emphasizes the close operation (main attack for the offense and main battle area in the defense) and need only tell his staff how battle in the other areas of the framework will affect the engagement of his force. At brigade level and higher, the commander must explain how he will fight the battle in each area of the framework. In these instructions, the commander should clearly define how he expects to fight and win in each area of the framework.

Scheme Of Maneuver

The next step in commander's guidance is the explanation of an initial scheme of maneuver. This can involve a detailed analysis of the initial plan or merely a few words and graphic control measures placed on a map overlay. The scheme of maneuver is the "central expression of the commander's concept for close operations."[10] The scheme of maneuver should:

- Outline movement
- Identify objectives
- Assign responsibilities for zones, sectors or areas
- Prescribe formations or dispositions (when necessary)
- Identify maneuver options

In describing his scheme of maneuver, the commander relates his "best plan" to accomplish the entire mission assigned to the command. The scheme of maneuver can be developed by the commander (in periods where time is short) or can be developed by the staff

and approved by the commander (in periods when plenty of planning time is available). Regardless of the time available, the commander must instruct his staff on each of the five elements of the scheme of maneuver, or acquiesce to the staff's best judgment. It is more effective for the commander to issue his instructions on the five elements of the scheme of maneuver early, and decisively, rather than to waste time muddling through confusion and changing courses of action later in the planning process.

Time Plan, Order Technique & Rehearsal Technique

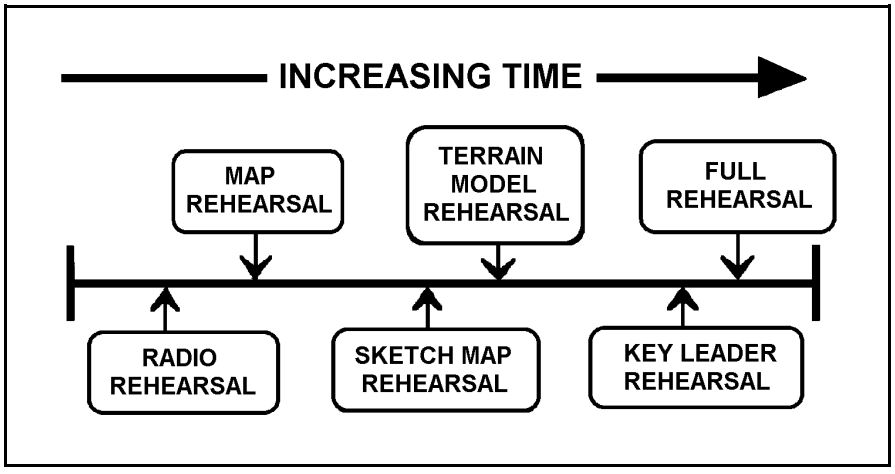
The last step of the commander's guidance involves specific instructions on time planning, order techniques, and rehearsals. Time planning is essential to avoid wasting time. The commander should plan his available time using a reverse planning process. Critical times, such as the crossing of the line of departure, the time of the battle update briefing,[11] and the issue of the operations and warning order must be considered. A time plan should be included with the warning order. A warning order that contains a time plan can aid subordinate units in using their own planning and preparation time more effectively.

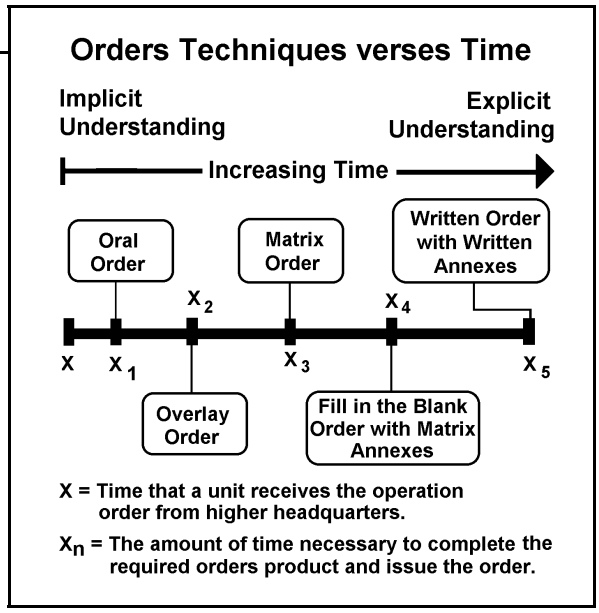
The commander must also designate what type of order he wants the staff to prepare for subordinate units. Seldom will a singular order technique fit all possible planning situations. Some situations will require fast oral orders, while other situations will allow for a more deliberate approach. Experienced commanders usually develop a "toolbox" of order techniques and train their staffs on a variety of order options. The commander armed with a variety of techniques can then selects the appropriate "tool" to fit the tactical situation. This capability increases flexibility.

There is no single "best" way to prepare operations orders. Several proven techniques are available (oral, overlay, matrix, written order with matrix annexes, or written order with written annexes).[12] Each of these techniques, based on the standard five-paragraph field order, offers a trained command-staff team a time-saving option to the written operations order.

The commander's guidance should designate the order technique that fits the time constraint of the tactical situation. Time is wasted if the staff does not know the desired format to prepare. To select a technique based on time, the commander must know the capability and quality of his staff and the time requirement for his staff to prepare various types of orders.

Lastly, the commander should prescribe what type of rehearsal technique to use. Again, several techniques are available (radio rehearsal, map rehearsal, sketch map rehearsal, terrain model rehearsal, key leader rehearsal, or full rehearsal).[13] Each of the rehearsal techniques presented above take a prescribed amount of time and effort to produce and provide a varying degree of explicit instruction. Each technique is appropriate for a specific amount of time and a specific situation.





Conclusion

In battle, success comes to the side that knows how to take decisions and to deliver strikes more rapidly. To win time is to win battle. Commander's guidance is the most significant tool that the commander has to increase the speed and the effectiveness of the planning process. Planning time saved is combat preparation time gained.

In the past, especially in staff school instruction, commander's guidance has been given too little attention. This situation has conditioned many staff officers to expect vague and incomplete guidance from commanders. Commanders are responsible for correcting this deficiency. Commander's guidance requires early decisions by the commander. The commander is uniquely suited to provide this guidance. He is, or should be, the most experienced officer in the unit. He is responsible for everything his unit does or fails to do and, in the final analysis, abrogates his decisions to his staff if he fails to issue specific guidance. When time is short, commanders must issue specific guidance.

Commanders who can issue clear and substantive guidance will improve their speed and effectiveness at battle command. Time and effort can be saved by using a standard and sequential method to issue and record commander's guidance. The format presented in this article is one way to avoid beginning the battle confused in purpose.

Notes

[1]TRADOC Pamphlet 525-5, *Force XXI Operations, A Concept for the Evolution of Full-Dimensional Operations for the Strategic Army of the Early Twenty-First Century,* (Training and Doctrine Command, 1 August 1994), p. Glossary-1.

[2]Captain C.T. Lanham, *Infantry in Battle,* (Richmond: Garrett & Masse, 1939), p. 152.

[3]From Joint Publication 1-02, *The DOD Dictionary of Military and Associated Terms,* as found in *The Joint Staff Officer's Guide 1993,* (Norfolk: Armed Forces Staff College, U.S. Government Printing Office, 1993), p. I-27.

[4]Headquarters, Department of the Army, FM 7-20, *The Infantry Battalion,* (Washington, D.C., U.S. Government Printing Office, 6 April 1992), p. 2-6. Hereafter listed as FM 7-20. FM 101-5-1, AR 310-25 and Joint Publication 1-02 provide definitions for common military terms.

[5]FM 7-20, p. 2-6.

[6]FM 7-20, p. 2-6.

[7]General Foss, letter dated 14 September 1990. Subject: "Commander's Intent."

[8]Headquarters, Department of the Army, FM 100-5, *Operations,* (Washington, D.C., U.S. Government Printing Office, 5 May 1986), p. 4.

[9]FM 100-5, p. 106.

[10]FM 100-5, p. 34.

[11]A battle update briefing (often called a BUB) is presented to the commander by his operations and intelligence staff prior to combat operations. This short briefing is designed to provide the commander with the latest intelligence information that impacts on the current plan (base plan). As reconnaissance information is gathered, a better picture of the enemy situation emerges. In the offense, a BUB is normally held several hours before crossing the line of departure. In the defense, the BUB is held several hours before the expected time of enemy attack or before the "defend no later than" time. The intent of the BUB is to confirm the base plan or select a pre-designed branch plan that best fits the situation as it is known at the time of the briefing. This "decision point" offers the commander a formal means to change plans if required. The decision to execute the base plan, a branch plan, or to change the plan is based on the confirmed information of the enemy situation derived from friendly reconnaissance.

[12]FM 7-20, p. 2-12.

[13]FM 7-20, p. 2-7.

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level is reached. This could lead to precision logistics, where only the supplies are delivered to the unit, instead of the standard Logistics Package (LOGPAC).

It was also suggested that digital technology could help the support platoon maintain a real-time asset inventory. This inventory could be structured to display what supplies are stored on each vehicle in the trains.

Other suggestions included software that would aid the executive officer in his doctrinal duties as a fighter and a combat service support operator. This software should assist him in these duties and make the chores easier to handle.

Conclusions

The responses indicate that current digital systems could all be improved. A number of new ways to use these systems were discovered during this experiment, and still other uses remain undiscovered. A few of the systems were relatively mature, and the proposed changes to these systems were few. Other systems were immature and many proposed changes were suggested.

The most important changes would be the development of a seamless digital communication network across all the BOS.

The development of a user-friendly interface for this network is imperative. This interface must be easy to use in a combat environment under all conditions. This is absolutely critical as the soldiers must use these systems to derive any benefit from them. The ability to rapidly and accurately log onto the network is imperative. The network requires a reliable, energy-efficient power source. The network must contain routing or addressing flexibility to handle the many task organizations the Army uses in a combined arms force. The architecture of the network should provide a built-in redundancy and degrade gracefully.

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The Armored Fighting Vehicle Identification Trainer

by Captain Mark Lee and Captain Jeffrey Schamburg

The first requirement in warfare is the ability to distinguish friend from foe.[1]

-Recognition Pictorial Manual, FM 30-30 (June 1943)

The ability to distinguish friend from foe on the battlefield is absolutely critical. As we have witnessed in many of the conflicts which we have fought during this century, this positive identification of friendly forces did not always occur and often resulted in fratricide. Most recently, U.S. forces deployed during Operation DESERT STORM experienced only 615 battle casualties, 148 of which resulted in the death of a soldier. What is perhaps more startling is that 35 deaths (24% of all deaths) were caused by friendly fire. Of the 467 non-fatal battle casualties, 72 (15%) were caused by friendly forces.[2]

Fratricide is not new to our military. We experienced our first documented case of fratricide during the French and Indian Wars in 1758 and have lost soldiers to friendly fire in every major conflict since then.[3] The military has conducted extensive research on this subject in an effort to capture the causes of fratricide. As a result of the studies, the military has identified the following five types of fratricide:

- Fratricide due to accidents
- Fratricide due to command and control failures
- Fratricide due to fire discipline failures
- Fratricide due to navigation failures
- Fratricide due to identification failures[4]

Although the military recognizes the fact that fratricide normally results from a combination of several of the factors above, the Armored Fighting Vehicle Identification Trainer (AFVID) focuses on the identification aspect of fratricide. This article will address the purpose for the trainer, its operational concept, and potential future extensions.

The primary purpose of this trainer is to enhance a soldier's current level of expertise in identifying armored vehicles. Based upon our recent experiences as tank and infantry company commanders, we feel the current level of proficiency of the average soldier in this area is poor.

The potential consequences of incorrect vehicle identification are often costly, specifically in terms of manpower and actual dollar figures. Consider, for example, one of the 35 cases of fratricide that occurred during Operation DESERT STORM. On February 27, 1991, six of our soldiers were killed and 25 were wounded when five M1A1 tanks and five Bradley Fighting Vehicles engaging enemy forces were incorrectly identified at night with limited visibility and engaged by other M1A1 tanks.[5] In this case, we suffered unnecessary losses in terms of human life and dollars because of the inability to distinguish friend from foe.

Many of us recognize that combat, particularly at night, is often confusing and life-threatening. In an attempt to help reduce fratricide that results from misidentification, we have developed an elementary training aid that can be enhanced to train our soldiers under realistic conditions.

The trainer's underlying model is an expert system. One definition of an expert system is: *"a model and associated procedure that exhibits, within a specific domain (subject area), a degree of expertise in problem solving that is comparable to that of a human expert."*[6] We chose to use an expert system for several reasons. First, there is a distinct difference in the performance and level of training between the experts (Master Gunners or military intelligence personnel) and the average soldier. Second, vehicle identification requires identification and classification of symbolic features which make it approachable by an expert system. Third, the subject area or domain is relatively stable in that new armored vehicles are not being introduced around the world frequently enough to render the trainer obsolete. Lastly, the expert system mimics the manner in which an expert uses filtering and pruning techniques to quickly and accurately identify vehicles.

Before we review the actual operational concept behind the trainer, let us first review several assumptions that we made in developing this initial prototype. First, we felt an ideal training environment was most appropriate for the first system. For example, the fog of war, such as limited visibility, and actual sounds associated with combat are not included. As mentioned earlier, the primary purpose of this trainer is to reinforce the soldier's basic identification skills, such as recognizing turret shapes, the location of the bore evacuator, and whether the vehicle's track is supported or non-supported. More advanced features could be addressed in future expansions of this system. Second, the vehicles in the system are primarily those taught at the Armor School and also found in *Armor Fighting Vehicle Identification,* FKSM 17-224, March, 1991.

Because of limited development time, we narrowed the vehicles contained in the system to 38. However, an unlimited number of vehicles can actually be incorporated in the system. Third, the vehicles are presented to the user exactly as they are presented in current lesson plans and training manuals. For example, minor modifications to the M48 are not considered. Lastly, we assumed the user will have received two to three hours of basic vehicle identification prior to using the trainer.

The operational concept of the AFVID trainer is generally straightforward. Once the software has been properly loaded on an IBM-compatible computer with a Windows environment, the soldier can begin training. One of the 38 vehicles contained in the system is automatically randomly selected and presented on the screen of the computer. The soldier is then asked to properly identify and classify the key characteristics of the presented vehicle. Having captured the heuristics or "rules of thumb" that experts use to

identify armored vehicles, we have the user respond to a finite number of questions that describe the presented vehicle.

In essence, the system prompts the soldier for answers to a minimal number of questions that the expert would actually answer when presented with a similar vehicle. This trains the soldier to look for the key characteristics of a vehicle, such as the shape of the hull or turret location. If the soldier does not understand a particular question, he can select the "Help" button on the screen with the mouse or go to the "Question" menu and select "Explain Question." Using either of these two methods, the soldier can get assistance with such things as understanding what a muzzle brake is, or the shapes of turrets, just to name a few.

Once the soldier has identified the key characteristics of the presented vehicle, he is asked to identify it by nomenclature. The trainer will determine if the soldier correctly described the vehicle's characteristics and correctly determined its nomenclature. The main concept behind the trainer is to ingrain in the soldier the critical characteristics used to accurately identify armored vehicles. We can accomplish this by requiring him to repetitively respond to the questions generated by the expert system. Over time, the soldier will be able to properly identify a presented vehicle based upon just a few characteristics.

The AFVID trainer has been evaluated, in a limited sense, by instructors and cadets at the University of Virginia Army ROTC unit and by a group of instructors at the Armor School at Fort Knox.[7] The ROTC personnel provided us with recommendations on how to make the trainer more "user friendly" and with general comments on its potential as a future Army training aid. Similarly, a group of Armor Officer Basic Course instructors provided comments indicating that this initial prototype can be used in the field today and, with some modifications, can be a realistic training aid in the Army's effort to reduce fratricide due to misidentification. As previous company commanders, we would have gladly welcomed such a basic trainer in our unit training program. The trainer in its current state can be used for such tasks as CTT and TCGST training. Instead of the company Master Gunner presenting a company-level AFVID class as train-up to the test, an individual soldier can now have access to this expertise in vehicle identification through the use of a computer.

There are several viable future extensions for this trainer. One advanced feature would change the system from being completely deterministic. One recommendation was to randomly place a "black box" over portions of the presented vehicle so that the soldier is no longer presented with an entire vehicle. As an advanced feature, this would help train soldiers for situations where an entire vehicle may not be visible.

Another extension would be to include actual footage of stationary and moving vehicles in various conditions. With the increased capability of personal computers, the technology exists for this to be accomplished. Not only would this add realism to the trainer but it would also help us train for situations where the "fog of war" has blanketed the battlefield. We could then train the scenarios which resulted in fratricide during Operation DESERT STORM in an attempt to reduce the unnecessary loss of life in the next war.

As technology continues to evolve, we foresee the ability to use methodologies such as expert systems and neural networks to accurately identify armored vehicles and confirm intelligence templates. However, before we can incorporate these advanced features we must first get back to the basics. That is the purpose of our trainer.

The difficulties associated with accurate vehicle identification are not new. On the other hand, the increased accuracy of our weapon systems have come to exceed the range at which the human eye, or even instruments, can now accurately identify friend from foe.[8] As a result, our soldiers must become much more disciplined and skilled in the critical task of armored fighting vehicle identification. The answer to the problem of fratricide is not to be found in computers or "black boxes" alone. Unfortunately, incidents of friendly fire will continue to occur whether you are training at NTC, CMTC, or in actual combat. However, the introduction of new training aids such as our trainer may help in reducing the number of such incidents. At least we hope so.

Notes

[1]*Recognition Pictorial Manual*, War Department Field Manual 30-30 (June 1943), p. 1.

[2]*Who Goes There: Friend or Foe?*, U.S. Congress, Office of Technology Assessment, OTA-ISC-537 (Washington, D.C.: U.S. Government Printing Office, June 1993), p. 26.

[3]*Who Goes There: Friend or Foe?*, p. 7.

[4]*Who Goes There: Friend or Foe?*, pp. 9-18.

[5]*Who Goes There: Friend or Foe?*, p. 27.

[6]James P. Ignizio, *Introduction to Expert Systems*, (New York: McGraw-Hill, 1991), p. 12.

[7]We would like to thank SFC Michael A. Lee and his fellow AOB small group instructors for taking time to review our initial prototype.

[8]*Who Goes There: Friend or Foe?*, p. 30.

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VEHICLE CHARACTERISTICS

There are several characteristics which one attempts to identify when classifying a vehicle. The prominent features of wheeled vehicles, armored personnel carriers, field artillery pieces, main battle tanks, and air defense vehicles are summarized below.

Wheeled Vehicles:

1. Tires: the number of tires on a wheeled vehicle are often the primary distinguishing feature.

2. Spacing between tires: some vehicles have distinct, identifiable gaps between some of its wheels.

3. Location of troop access doors: many of the wheeled vehicles in use today have access doors in different positions on the vehicle. One can often use this feature to distinguish between two very similar vehicles.

4. Location of the turret: turrets are positioned forward, center, and to the rear of the vehicle.

5. Shape of the turret: most Soviet wheeled vehicles have a cone-shaped turret.

6. Shape of the hull: the most identifiable feature on a Soviet-made wheeled vehicle is its boat-like hull.

Armored Personnel Carriers (tracked):

1. Shape of the hull: Soviet APCs are easily identifiable by their boat-like hull.

2. Skirt design: the German Marder has serrated skirts while Soviet APCs do not have any skirts.

3. Roadwheels: the number of roadwheels on a vehicle often determines the classification of the vehicle once other significant features have been considered.

4. Location of the turret: turrets are positioned forward, center, and to the rear of the vehicle. Soviet APCs have turrets positioned either forward or center of the vehicle.

Field Artillery Pieces (tracked):

1. Muzzle Brake: the presence of a muzzle brake is perhaps the single most distinguishable feature on artillery pieces.

2. Location of the turret: most artillery pieces have turrets located at the rear of the vehicle.

3. Length of the cannon: one can distinguish some artillery pieces by the fact that the cannon extends over the front slope of the vehicle.

4. Supported versus non-supported track: this characteristic allows one to easily further classify a vehicle based upon this distinguishing characteristic.

Main Battle Tanks:

1. Shape of the turret: all Soviet tanks have an egg-shaped turret while the tanks of other countries have a wide variety of shapes.

2. Location of the bore evacuator: one can use the location of the bore evacuator to help distinguish among different tanks. For example, the T-54/55 is the only tank with the bore evacuator at the end of the gun tube.

3. Length of the cannon: a few tanks are equipped with an unusually short cannon. An example of this is the M551.

4. Location of the searchlight: one can use the location of the searchlight, when present, to distinguish tanks. For example, the T-64 has a searchlight on the left while the T-72 has it on the right.

5. Number of roadwheels: the number of roadwheels on the vehicle can be used to distinguish vehicles when other characteristics are similar.

6. Number of support rollers: in some cases, one may use the number of support rollers to further identify a vehicle.

Air Defense Vehicles:

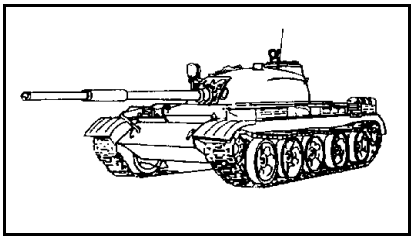
1. Number of pairs of anti-aircraft guns: one can distinguish among air defense vehicles by the number of pairs of guns the vehicle has. For example, the ZSU-23-4 is easily identifiable by the four guns on the turret.

2. Location of the radar dish: the position of the radar dish is also a key feature to use in classifying air defense vehicles. The Gepard, for example, has a radar dish on top of the turret and in the center of the two guns.

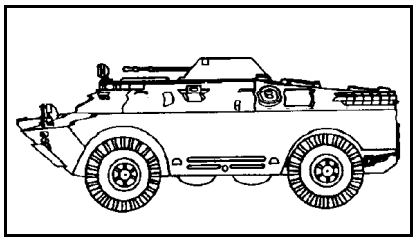
3. Type of hull: the type of hull used for the vehicle is also a distinguishing feature. The ZSU-57-2 uses the hull of the T-54/55, and the Gepard uses the hull of the Leopard 1.

Note: The key characteristics summarized here are not all-encompassing. Similarly, our trainer may not ask the user for a response to each of these characteristics. The trainer will attempt to classify the selected vehicle using the minimal number of characteristics needed.

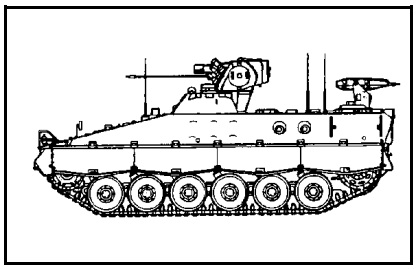
EGG-SHAPED TURRET



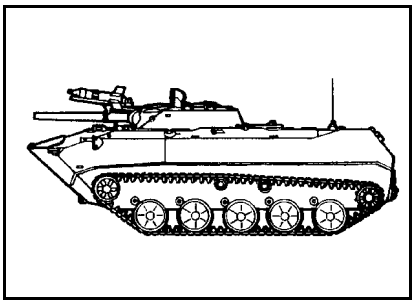
CONE-SHAPED TURRET



SERRATED SKIRT



SUPPORTED TRACK



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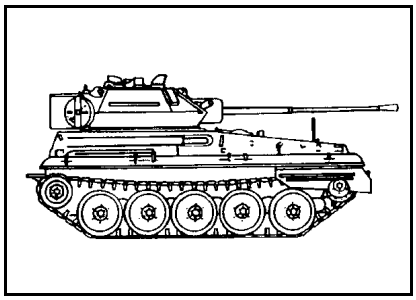


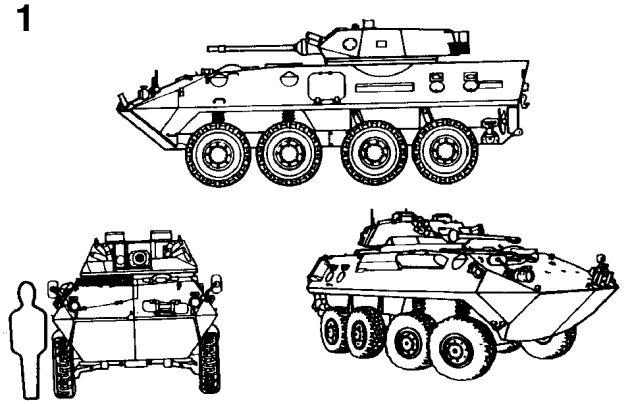
At left, the chart illustrates some of the filtering and pruning criteria that help experts identify armored vehicles.

Twelve examples from the program follow on the next two pages. Answers appear on Page 49.

The AFV Identification Trainer - Some Examples

Answers on Page 49 (back of LETTERS)

1



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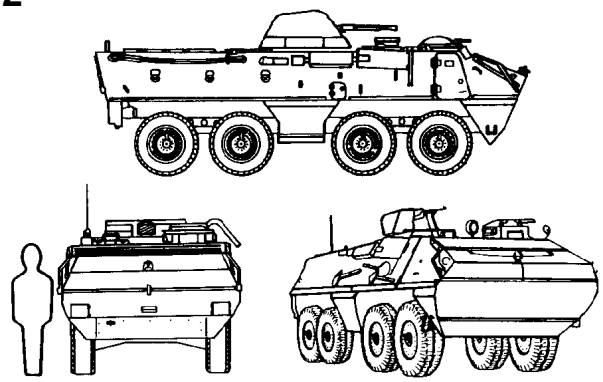

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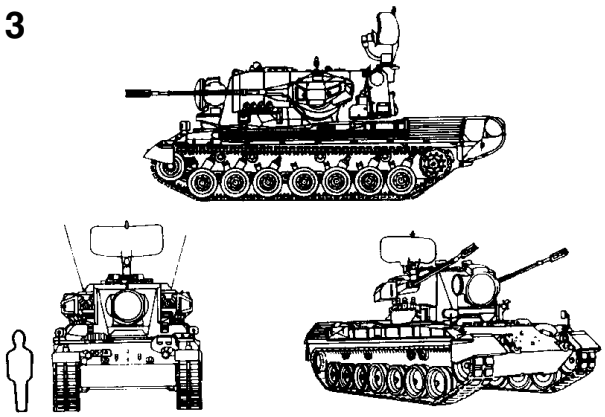

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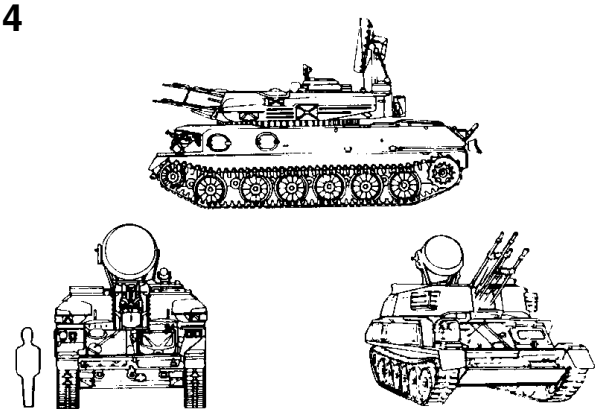

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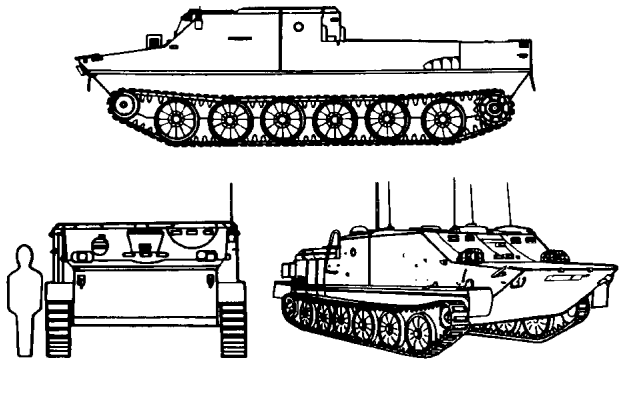

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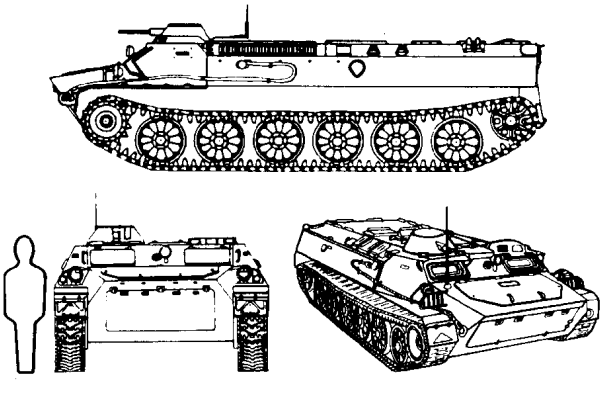

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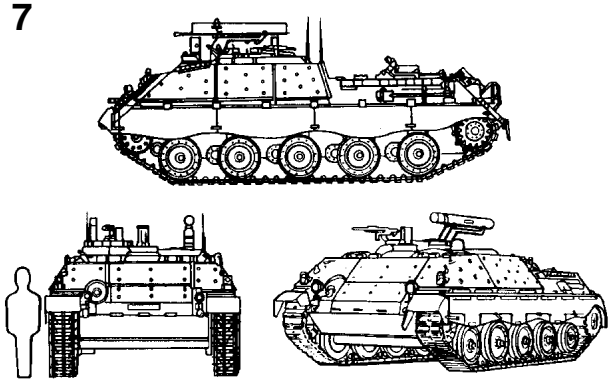

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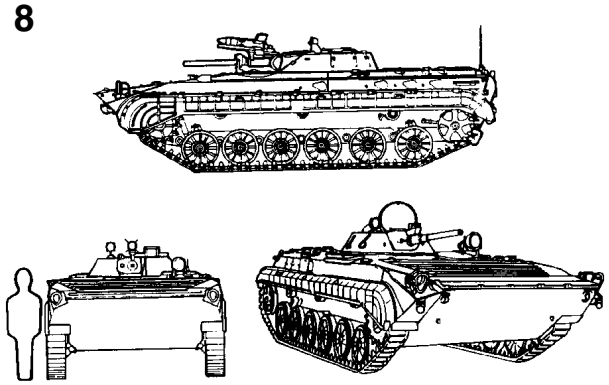

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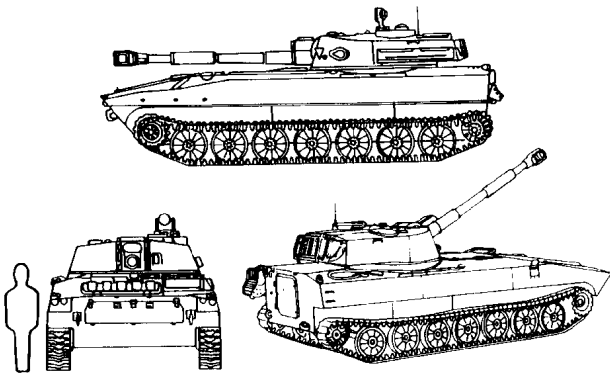

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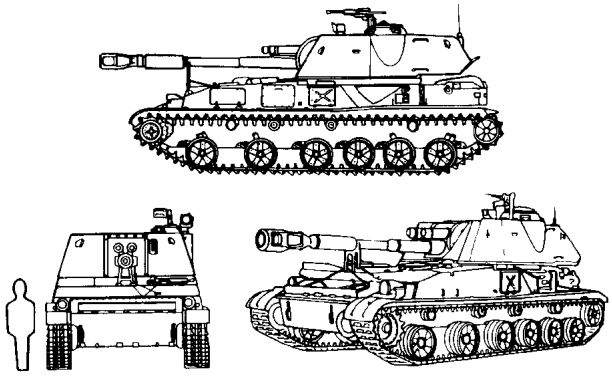

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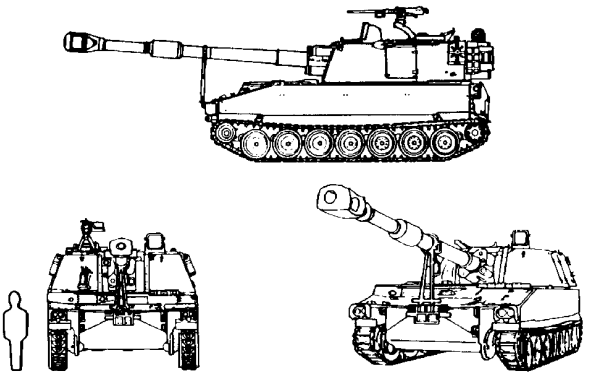

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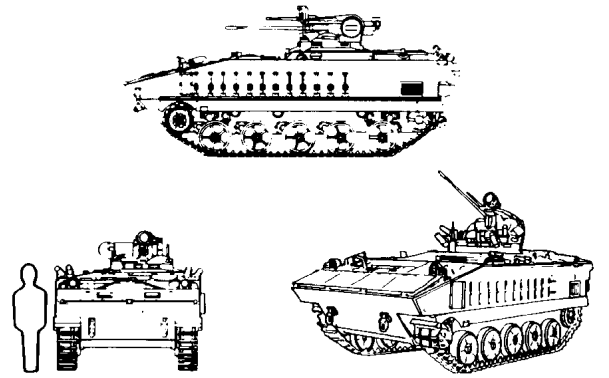


Training in the 21st Century — The Force XXI Training Program

by Lieutenant Colonel William C. Martin

As the Army moves toward Force XXI, it will face numerous challenges in determining the requirements for new doctrine, equipment, leader development, and other equally complex areas. However, the one area that presents perhaps the greatest challenge is that of training the force. The fundamental question all of us should be asking now is, how will the Army train in the 21st Century? What new training aids and devices, simulators and simulations (TADSS), and innovative training methodologies are required to train Force XXI? How will the Army transition from training today to training Force XXI? The answers to these questions are found in the Warfighter XXI.

The Chief of Staff of the Army established the Warfighter XXI to train current and future Army tactical units in virtual, constructive, and live simulations, using innovative training concepts to deliver significant improvements in combat readiness. The heart of this program is the Force XXI Training Program (FXXITP), designed as the prototype to focus on the armored/mechanized brigade initially, then expand to include light infantry, air assault, and airborne units through corps level to Force XXI in the next century.

The Force XXI Training Program includes a strategy for increasing the time the commander and staff spend training by decreasing the time they spend determining what and how to train (See Figure 1). It employs emerging technologies to turn the commander's assessment of the fighting readiness of his unit into a training program. The training program describes which tasks are to be trained to a given standard, using prescribed live, virtual, and constructive training methods. The program includes provisions to collect relevant after-action data. Training deficiencies previously not addressed, such as staff training, are addressed by combining emerging technologies with structured training. The Force XXI Training Program incorporates innovative training support packages (which include orders, overlays, scenarios, observer/controller instructions, etc) reinforced with an automated after-action review process.

The Force XXI Training Program is the mechanism for determining how the Army can effectively transition from training forces today to training forces of the future. A key objective of the program is to integrate software development, hardware development, force development, training development, combat development, and materiel development so that how we fight and train is linked to the equipment used for that purpose. The FXXITP provides the Army with a system for ensuring the changes made across the Doctrine, Training, Leader Development, Organization, Materiel, and Soldiers (DTLOMS) are synchronized and based on the requirements to train, fight, and win, both now and in the 21st Century.

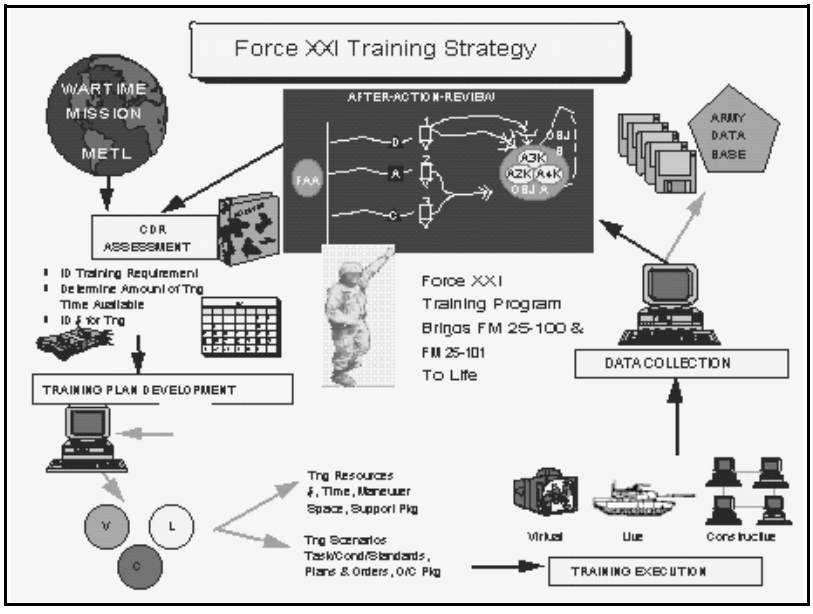


Figure 1.

The Foundation

How will the Army train Force XXI? The answer begins with an assessment of today's training. The weaknesses identified today must serve as the start point for tomorrow's training. FXXITP began with a training assessment to identify the tasks to be trained and how well the existing TADSS meet the requirement to train these tasks. This training assessment is underway and is providing the program with essential information concerning tasks to be trained, shortfalls in existing TADSS, and requirements for new TADSS that currently don't exist. As a result of the training assessment to date, the FXXITP is already focusing on a number of critical requirements, two of which are the need for defining Critical Combat Functions (CCFs) and developing commander and staff training.

Any analysis of unit training today would show that units, given the competing operational and training requirements of today's environment, have insufficient time to train the global list of tasks for which they are responsible. CCFs provide the Army a way of focusing on the number of tasks to be trained. They are derived from the *Blueprint of the Battlefield* (TRADOC PAM 11-9) and focus on the functions essential for success on the battlefield. The FXXITP is working with the Army Research Institute on the development of the CCFs which serve as the foundation for the tasks to be trained in the program.

Commander and staff training was identified in the training assessment as a critical requirement. There are at the

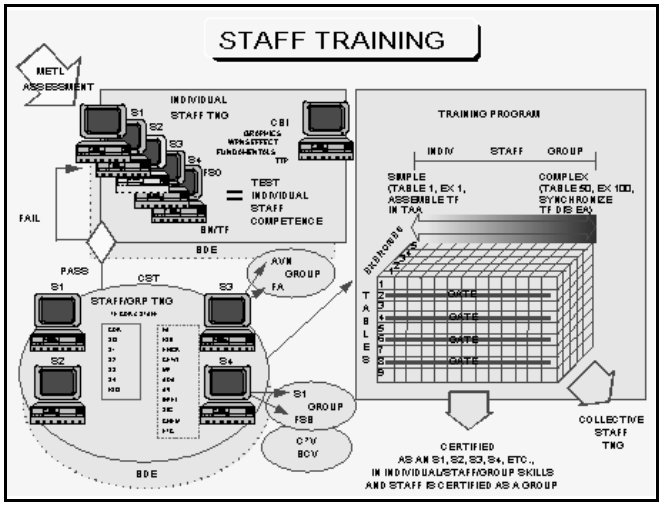


Figure 2

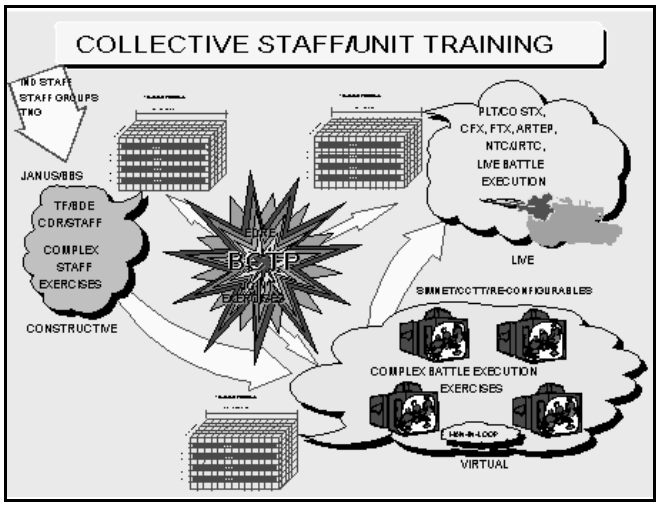


Figure 3

present time few programs to train the commander or his staff on their associated warfighting tasks. As a result, the FXXITP has dedicated a considerable emphasis towards developing a training system that evaluates and trains the commander and staff. It focuses on three areas: individual commander and staff tasks, tasks associated with operating as a part of the collective staff, and tasks associated with operating as a part of a staff group, such as the targeting or deep battle planning cell. The FXXITP commander and staff training system combines computer-based instruction with constructive and virtual training techniques. It employs the use of structured tables and exercises to train from simple to complex tasks. Figures 2 and 3 illustrate the commander and staff training system.

The Transition

The training assessment identifies the tasks to be trained, shortfalls in existing TADSS, and requirements for new training strategies, methodologies, systems, and innovative training techniques. Having identified these training requirements, the next step is to implement requisite changes and evaluate the results of these changes.

The FXXITP provides the Army with a means of integrating the DTLOMS. It accomplishes this by connecting training development, materiel development, combat development, and force development within the program. The program systematically focuses the combined efforts of individuals from each of these domains toward determining changes necessary to meet identified training and warfighting requirements. It then inserts these developmental changes in DTLOMS into a highly successful, turn-key, structured training program and evaluates the program's effectiveness. The results of this evaluation will determine follow-on requirements for improvements to the program. Should changes be required, a subsequent evaluation will follow. This experiential approach to spiral development continues until the results of the evaluation determine that the training requirements have been met.

This unique aspect of the FXXITP offers the Army two essential capabilities. First, it provides a mechanism for controlling how the Army changes. It provides a system that produces synchronized developmental changes across the DTLOMS based on identified training and warfighting requirements. Then, it evaluates these changes with soldiers through a test, fix, test method to ensure that results achieved equal results desired. Second, it provides a vehicle to transition the Army from the way it trains and fights today to how it will train and fight in the future.

The foundation for the Force XXI Training Program is the Force XXI Training Strategy. It will evolve from what we know today as the Combined Arms Training Strategy. The assessment of today's training requirements coupled with the spiral development approach of the FXXITP, will ensure that the Force XXI Training Strategy is congruent with the DTLOMS required in the 21st Century.

Conclusion

The Force XXI Training Program is a prototype for emerging and future training strategies, methodologies, systems and programs. It provides the unique opportunity to shape the future in a manner that accommodates the dynamic mission requirements and training challenges of the future. The program leverages technologies to provide the commander with a total training support package, from the assessment of unit capabilities to the execution of required missions. It enables commanders to rapidly identify training deficiencies and provides the means to correct them.

The FXXITP program allows commanders to train on tasks that are too complex, too dangerous, or too expensive to accomplish in a live environment. It provides the opportunity to train on mission-critical functions and tasks previously not addressed in units or CTCs. These tasks are referred to as *living tasks* because the specific tasks, conditions and standards have not been determined. This program has the inherent capability of providing structured training for commonality, while maintaining flexibility to accommodate uncertain training demands.

The Force XXI Training Program, as envisioned, will give the Army the capability to train every critical combat function and task to standard, in the most appropriate training setting, using the most appropriate training devices and tools. This capability, coupled with the ability to capture critical mission performance information on a database that allows both unit-specific and universal access, will move the Army into the 21st Century prepared to fight and win the nation's wars.

Lieutenant Colonel Martin is currently serving as Chief of the Force XXI Training Program. His previous assignments include regimental S3, squadron XO and S3 in the 3d ACR, and battalion S3 and company commander in the 24th ID (M).

reduce gun overhang at the front of the vehicle, but by employing external ammunition movement, would be much safer for the crew.

Tank soldiers have long admired Merkava's rear entrance and exit, recognizing that it would allow them to mount and dismount unobserved by the enemy and would provide an excellent alternative escape route. However, some form of passageway will have to be provided through the ammunition stowage space, from the crew space to the rear entrance, which immediately raises the specter of space being wasted. Although it would be possible to make use of this space to contain rounds of ammunition, which could be ejected to the rear of the vehicle in an emergency to allow the crew to escape, it seems more sensible to use it as a rest space for the third member of the crew so that his head would be close to the two crewmen operating the vehicle and his feet would be against the rear entrance.

Although increased survivability can be advanced as the principal reason for adopting a front-engined hull layout, this is certainly matched by the advantages to be gained from making the rear of the hull available for ammunition stowage. Should the introduction of a rear entrance and exit rank only third in the list of reasons for adopting a front-engined layout? With increased emphasis now on crew survivability, the introduction of a rear entrance has become of much greater importance. But whichever reason is advanced for adopting a front-engined FMBT configuration, it will be the movement of the crewmen down into the hull of the vehicle, and their consequent ability to drive their vehicle, that will confirm this change of hull layout.

Gun Traverse and Commander's "Top Vision"

With two crewmen operating the FMBT from fixed crew stations down in a front-engined hull, attention should now be focused on how its large tank gun should be mounted and how it should be traversed to engage flank targets. The simplest means of achieving this is, of course, to adopt the configuration used by the fixed gun Swedish "S" Tank, to turn the complete vehicle by the differential action of its tracks and to tip it back and forth in elevation and depression on its controllable suspension system. The breech of the gun would then be at the rear of the vehicle, close to the ammunition magazine, making it a simple matter to move rounds from magazine to breech because their relative positions would remain fixed.

But if independent traverse is considered essential for the rapid engagement of emergency targets to a flank, the "S" Tank configuration will be rejected and the gun may have to be carried either in an unmanned turret of reduced dimensions or on some form of overhead mounting. Rounds might then be supplied to the breech of the gun internally if in an unmanned turret, as has been suggested by Western Design, or externally if the gun is to be carried on an overhead mounting, although this latter system will present considerable problems as the rounds are raised one by one to the gun. Should the gun return to the 12 o'clock position after firing in order to simplify the reloading process, or should rounds be supplied to the gun in whatever direction it happens to be pointing, as was indeed the case in the Swedish UDES-19 design of the 1970s?[10]

If the gun is to be well protected in an unmanned turret, the presented frontal area of the vehicle and, therefore, its all-up weight, will still remain substantial. If, on the other hand, it is carried on a mounting above the hull, the size of target displayed to the enemy, particularly when engaging over a crest, will be much smaller, but the gun itself is likely to become more vulnerable. Moreover, with the gun carried well above and distinct from the hull of the vehicle, this latter form of mounting will be very prominent — as is apparent from the illustration on the front cover of the July-August 1994 *ARMOR* — and the FMBT will become very difficult to conceal on the battlefield.

But over and above the problems of remote reloading, an even more difficult problem will then arise — crew vision will still be exercised from the roof of the hull while the mounting will extend to well above that level. This will mean that when moving over rolling country, the unmanned turret or overhead mounting will come into the view of the enemy before our commander is in a position to see him. Our commander will then have lost what is usually described as his "top vision," which can be defined as the ability to see all round from the highest point of his vehicle. This is what he has become accustomed to when putting his head above the roof of a conventional manned turret or when he closes his hatch and uses the array of vision blocks or periscopes surrounding his turret cupola.

Although sighting vision can be obtained remotely from an unmanned turret or an overhead mounting and displayed on screens in front of the crewmen, it will be much more difficult both to obtain "top vision" remotely from the top of these mountings and also to display it at the crew stations down in the hull of the vehicle.[11] The commander could certainly traverse the restricted vision of some form of Commander's Independent Thermal Viewer (CITV) to look in any direction, but, while doing so, he would be unaware of enemy movement in other sectors surrounding his vehicle. And if an instrument could be devised with a broader field of vision, which might even be able to approach that of the human head, how would this scene be shown to the commander down in the hull of the vehicle unless he were surrounded by an array of screens?

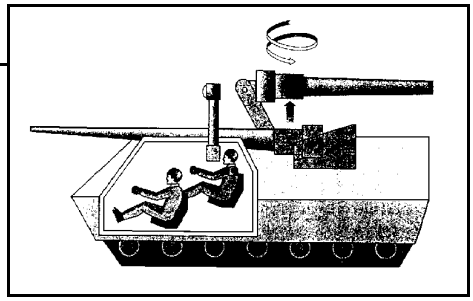
It may be that Helmet Mounted Display (HMD) will have to be adopted, as has been suggested by Western Design, so that crewmen can quickly and naturally turn their "top vision" to observe in any direction. Since crewmen cannot see through the sides of their vehicle, their Helmet Position Sensing Systems (HPSS) can be quite coarse, designed not so much to provide accuracy as to preserve orientation. Should a crewman identify a target and wish to go on to engage it himself, sighting vision from the gun mounting could be displayed in his helmet to allow accurate gun laying. Alternatively, if lack of resolution will not allow this, the crewmen would have to use his fixed display screen for fine laying and firing.

Although indirect "top vision" may thus be possible, it may not be wholly satisfactory and crewmen would, no doubt, be glad to return to direct vision from the hull roof when their vehicle was not in contact with the enemy. Moreover, the prominence of unmanned turrets and overhead mountings will put the FMBT at a tactical disadvantage, and crewmen will wish to have a low-profile vehicle, which would be

easily concealable. This might suggest that an overhead gun be lowered when not required for action, both to restore crew direct "top vision" and to remove its undoubted prominence, and that it only be raised above the level of hull top crew vision when traversed. Such a "lift-and-turn" mounting was actually proposed in Sweden in the 1970s in the form of their UDES-17 design, and it appears to embody the only means available — apart from the turret — of combining both gun traverse and direct "top vision" in one and the same vehicle. The conventional turret, of course, did this so effectively for very many years, but its large size and weight have become too much to tolerate, and it will have to be discontinued.

More recently the Board of Army Science and Technology of the National Research Council (U.S.), in their 1992 report "STAR 21: Strategic Technologies for the Army of the Twenty-First Century" have suggested a "concept for an extensible and rotatable gun mount on a direct fire armored vehicle (battle tank)," and provided illustrations of such a vehicle.[12] These show that the NRC vehicle would not carry its gun in a depression running the length of the hull center line when lowered, as it does in the UDES-17, but would carry it at one side of the vehicle above one of its tracks. Thus, the two crewmen would be able to sit shoulder-to-shoulder in their fixed hull crew stations in order to work together instead of being separated by the central cleft in the hull roof containing the gun barrel, as in the original Swedish proposal.

There appears to be no reason why an FMBT equipped with such a "lift-and-turn" mounting should not be handled like an "S" Tank while its gun remains lowered, forming a compact, well-protected, and easily-concealed configuration with crew "top vision" exercised directly from the hull top. The gun might then only be raised into its more prominent and more vulnerable position to engage emergency targets to a flank before being returned to the 12 o'clock position and lowered again to be reloaded, in effect, bringing the breech **to** the ammunition rather than moving rounds up to a raised breech. Also as an advantage, the gun could then be raised to engage targets over a crest, when the size of target exposed to enemy return fire would be small, the time of exposure would be minimal, and forward and rearward vehicle movement would not be necessary.



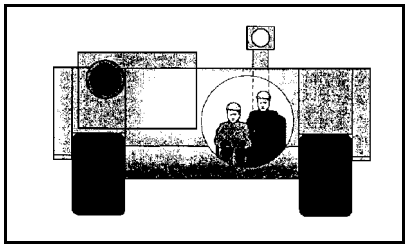


Figure 4. STAR 21 concept vehicle featured a "lift and turn" main gun.

Choice for the FMBT does not lie only between two-man and four-man crewing as three men have handled automatically-loaded, turreted MBTs satisfactorily for many years with two men up in the turret and a driver down in the hull. If the turret is going to be eliminated, because of its weight and size, and its crewmen moved to fixed hull crew stations, where both will be able to drive, the FMBT can be operated by only two crewmen while the third man can rest in the rear to extend its endurance in 24-hour-a-day continuous operations.

Relocation of two crewmen to fixed hull crew stations will also provide the opportunity of altering the MBT's configuration, placing the ammunition magazine at the rear of the vehicle and a full-width engine compartment at the front. If an entrance and escape door is provided at the rear of the hull, a passageway leading through the ammunition stowage area may serve as a rest space for the third member of the crew.

Arming the FMBT will then become a question of selecting the best method of combining gun traverse with commander's "top vision" — which the conventional turret has been able to do so effectively for so long. The Swedish "S" Tank and the overhead gun configuration each provide one of these features, but do so only by sacrificing the other. Moreover, while one is compact and easily concealed on the battlefield, the other is unduly prominent with its gun mounting above, and distinct from, the hull of the vehicle. Does the best answer lie in introducing a "lift-and-turn" mounting, as originally put forward in Sweden and more recently by the National Research Council? The FMBT could then be used like an "S" Tank until threatened from a flank, when it would raise its gun and then transverse it to engage its target.

Notes

[1]The AMX ELC described in *Les Vehicles Blindés Francais 1945-1977* by Pierre Touzin. Editions EPA 1978, pp. 45-50.

[2]"Combat Vehicle Test Bed to Play Key R and D Role" by George Taylor in *Army RD&A Bulletin*, March-April 1993, p. 30.

[3]"AGS Rollout" on the back cover of *ARMOR*, July-August 1994.

[4]"AMC-FAST: Lessons Learned in the Gulf" by Richard E. Franseen, in *Army RD&A Bulletin*, March-April 1992, p. 14.

[5]"We Have a Winner?" in *ARMOR*, July-August 1993, p. 6.

[6]*Technology of Tanks* by Richard Ogorkiewicz, ISBN 0-7106-0595-1, published by Jane's Information Group Ltd., 1991, p. 398.

[7]*Jane's Armour and Artillery, 1983-1984* by Christopher Foss, p. 103.

[8]*Jane's Armour and Artillery, 1990-1991* by Christopher Foss, p. 187.

[9]Teledyne Vehicle Systems representative speaking at Shephard Conferences 2d Armoured Warfare Conference in London in November 1994.

[10]*Jane's Armour and Artillery, 1983-1984* by Christopher Foss, pp. 52-53.

[11]"VERDI 2" by Rupert Pengelley in *International Defense Review*, 8/1994, p. 54.

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

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.

Zeroing In

Some thoughts on making our tank guns More accurate, more effective, and more lethal

by Major Bruce J. Held

Today's Army exists in an era in which threats against our national security interests continue and are becoming increasingly varied, while, at the same time, the Army's budget is being greatly reduced. In such times, increasing the effectiveness of current systems through doctrinal and procedural change can become the best, and sometimes the only, means of maintaining superiority on the battlefield. To make this happen, material and combat developers must work closely together. The approaches they choose to solve new battlefield challenges must creatively combine limited materiel improvements with changes in the way current systems are employed. This article explores one method of improving the lethal effectiveness of our current tanks through policy change. In particular, I will discuss options to current calibration procedures that may make our tanks more accurate, and hence, more effective.

Tank System Lethality

One measure of the lethal effectiveness of a tank system is single shot kill probability, or $P_{k/s}$. This measure, also referred to as the probability of kill given a shot is defined as the probability that a specific tank type, armed with a specific ammunition type, will kill a specific target. For example, given an M1A1, firing an M829 APFSDS-T against the frontal arc of a T-62, the probability that the T-62 will be destroyed with one shot can be estimated.

$P_{k/s}$ is primarily a function of ammunition lethality and tank/ammunition accuracy. Ammunition lethality is defined by a measure called the probability of kill given a hit, or $P_{k/h}$. $P_{k/h}$ is the probability that a given round of ammunition will defeat a target if it hits that target. Figure 1 plots the $P_{k/h}$ for two ammunition types, A and B, against the frontal portion of a specific target. Target penetration depends on the velocity at which the round impacts the target. Since aerodynamic drag slows a round down as it flies, an ammunition's lethality degrades with range and this degradation is reflected in the plot. In this hypothetical case, type A is a later development than type B. It was specifically designed to provide greater lethality than type B and as the chart shows, its $P_{k/h}$ is about 10% better than type B against the target at all ranges.

If I could predict the precise behavior of the fire control system, cannon and ammunition, I would always hit my target. Unfortunately, variations in the behavior of each make exact prediction impossible. Tank/ammunition accuracy error is thus the resultant effect of all the sources of variation involved in firing a tank cannon. In general, accuracy is discussed in two ways. Often, it is described as a tank's total system error, i.e. the combined effect of all the sources of variation. This error is usually measured in mils, so is range independent. A more understandable way of discussing accuracy is in terms of probability of hit, or P_h. Probability of hit is the percentage of rounds fired from a tank that will hit a given target at some range. For unguided ammunition, like tank rounds, P_h decreases with range. Consider a modern tank firing ammunition types A and B. To simplify discussion for this article, the total system error of my tank firing both ammunition types is 0.5 mils in azimuth and elevation. This is roughly equivalent to the capability of a modern tank. Given the system error, the P_h for these rounds can be calculated against a de-

fined target. For my example, I have chosen a target that is tank size. It is 2.2 meters tall and 3.3 meters wide. Figure 2 plots the P_h of types A and B against this target as a function of range. The obvious point of the figure is that the P_h decreases quickly at ranges beyond 1000 meters.

Finally, in Figure 3, I have plotted the $P_{k/s}$ for these two types of ammunition against the target. $P_{k/s}$ is simply obtained by multiplying P_h and $P_{k/h}$ together at each range. Though all of the values presented here are notional and the target is undefined, the plots are reasonable representations of what modern tanks and ammunition can accomplish. There are two points that should be clear from Figure 3. First, the effectiveness of both rounds decreases quickly with range. Additionally, despite type A's greater penetration capability, its overall effectiveness at long range is about the same as type B.

At short range, the probability of hit is nearly 100%, so the ammunition's lethality drives the value of $P_{k/s}$. This is reflected in the greater effectiveness of type A at shorter ranges. At longer ranges, the probability of hit is so low that the difference in lethality becomes masked. At these ranges, system accuracy becomes the dominant parameter for $P_{k/s}$ and the overall effectiveness of the rounds merges at very long range. I should re-emphasize that I have provided a case where the accuracy of the two rounds is the same. This is not normally true.

Typically, design trade-offs affect ammunition accuracy, so that different ammunition types do not have exactly the same accuracy as I have shown. Unfortunately, the trade-off is often between factors that provide greater accuracy and those that provide greater lethality. As an example, consider the length of a penetrator. All else being equal, the longer the penetrator, the greater the penetration capability of the round. Lengthening penetrators, however, can make launching them more prone to variability that adversely affects accuracy. For the example presented here, degrading the accuracy of type A by just 10% causes type A to lose its performance edge over type B at ranges of 1500 meters and beyond, despite its better penetration capability.

My purpose in going through all of the above analysis is to point out that accuracy is a key ingredient of tank effectiveness. We have made great strides in the penetration capability of our rounds, but it is possible to lose that advantage without concurrent improvements in accuracy. Efforts to improve the effectiveness of our tanks must, therefore, include efforts to improve accuracy. Also, to remain relevant in Force XXI, where long range battles will predominate, the Abrams series tank must be given a greater effective lethal range.

Accuracy

Tank system accuracy is a complex subject and there are a large number of error sources that contribute to overall system error. The major contributors to system error, though, are limited to three: round-to-round dispersion[1], occasion-to-occasion dispersion, and tank-to-tank variation.[2] The magnitude of these three error sources varies depending on the ammunition type. Round-to-round dispersion is the inability of a tank to shoot each round through the exact same spot when firing on a particular occasion. This is apparent to any tanker who has fired more than one round during screening exercises. If, within several minutes, a crew fires three rounds at the same aimpoint, without moving the tank, there will be some pattern of shots, not a single hole in the target. Occasion-to-occasion dispersion is the difference between the average hitting point of a tank from one firing occasion to another. These differences occur because small disturbances to the tank or ammunition occur between firing occasions that can affect how the tank shoots. Firing occasions are defined a number of ways. Separate firing occasions may be defined by time, ammunition temperature, movement of the tank, or maintenance on the cannon or fire control systems. Finally, tank-to-tank variation is the error that occurs because, on average, each tank shoots a little bit differently than all other tanks. Since we do not individually zero our tanks, but instead use a common zero, the computer correction factor (CCF), the shooting differences between tanks is a source of error.

Round-to-round dispersion and occasion-to-occasion dispersion are error sources that are primarily technical in nature. What I mean by this is that correcting these error sources requires, primarily, a technical approach; i.e., design changes to the ammunition, tank system or both. Tank-to-tank variation is an error source whose reduction can be accomplished technically, i.e, by tank/ammunition system design and production changes, and/or through policy changes. In the long run, the ideal solution is to produce each tank so they all shoot the same. However, this will be expensive and will require years of investment. As I mentioned above, tank-to-tank errors are related to our current tank calibration policy, the fleet CCF. This suggests that significant gains in the accuracy of our tanks can be accomplished by optimizing the method used to calibrate our tanks. Therefore, I will use the remainder of this article to discuss our current calibration policy and some options to replace it.

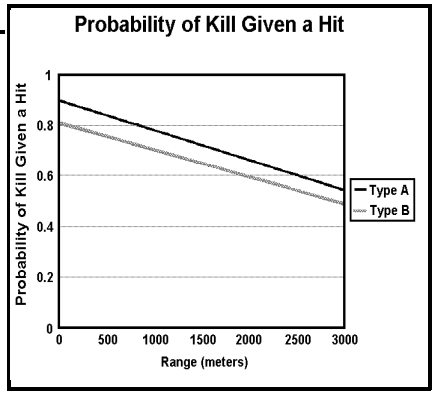


Figure 1

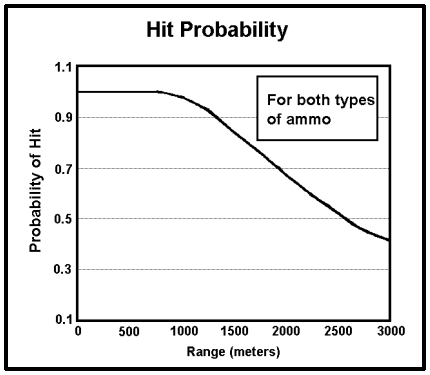


Figure 2

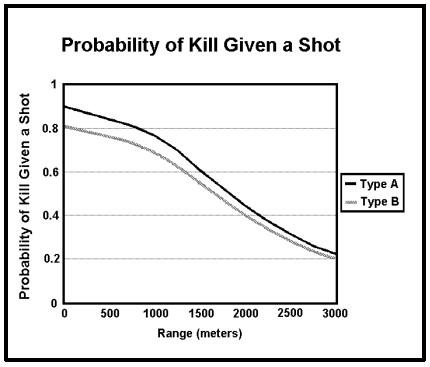


Figure 3

TANK CALIBRATION OPTIONS

Fleet Zero

The U.S. Army has adopted a calibration policy known as the fleet zero for

cost, safety and environmental considerations. This policy works well when tank-to-tank variation is small relative to other sources of error. It is implemented by estimating an average ammunition correction factor across the fleet of tanks. This average correction (one for each type of ammunition) is published in the gunnery manuals as the CCF. Every tank then uses the same CCFs.

For training ammunition, M865 and M831, the fleet zero policy has worked well. This is because tank-to-tank variability is relatively small for these ammunition types. There are still some tanks, though, that shoot much differently than most of the others. We recognize this, and as part of each gunnery, test the fleet CCF for each tank through a screening exercise. When screening demonstrates that the fleet CCF does not work for a particular tank (after correcting for maintenance and boresighting problems) that tank is zeroed — provided a new, discreet CCF — and continues through its tank tables.[3]

For service ammunition, screening each tank prior to combat may not always be possible. In this case, the published CCF must be used. This policy has proven effective because the errors associated with the fleet zero policy, though significant, have not been large enough, at typical engagement ranges, to degrade hitting probability to unacceptable levels. In the future, as we demand greater engagement range from our tank systems, and as we expect a greater number of first round hits at current engagement ranges, tank-to-tank errors associated with the fleet zero policy may become unacceptable. Additionally, to gain extra lethality from our new ammunition, we have been pushing the physical and technological limits of the ammunition and the M256 120-mm cannon. There is some evidence to indicate that this may exacerbate tank-to-tank variation, making this error source larger than we have seen in the past. As this occurs, we should consider some other means of calibrating our tanks.

Individual Zero

An alternate method for zeroing tanks is the individual zero. Under this option, each tank fires every type of ammunition that would be used in training or combat. The impact location of each type of round is noted and this information is used as the basis for each tank's individual CCF. Individually zeroing each tank is the Armor Force's version of zeroing an M16 rifle prior to qualifying with it. Some countries that use 120-mm cannons on their tanks, to include the Germans, use a one-time individual zero to calibrate their tanks.[4]

There are several problems with individual tank zero. First is the expense. Modern service ammunition is costly.[5] Since it would take four rounds, and possibly more, of each ammunition type to individually zero a tank only once, the cost of ammunition could be high over the fleet of tanks. If individually zeroing tanks must be done on a repetitive basis, the costs are even higher. Safety is another concern. Individually zeroing the M830 or M830A1, for example, would require special ranges with explosive capability and special handling of the ammunition. Finally there are environmental concerns. Modern KE ammunition uses depleted uranium or tungsten for their penetrators. These materials are heavy metals and therefore pose potential health and environmental hazards. In addition to the logistical problems, individually zeroing each tank does not provide a perfect zero.

Earlier, I talked about occasion-to-occasion dispersion. A tank will fire somewhat differently on different firing occasions. Therefore, zeroing a tank on one occasion does not necessarily mean it is well zeroed for another occasion. The real question then becomes whether the occasion-to-occasion dispersion is larger than the tank-to-tank variation. If it is, individually zeroing each tank could actually make accuracy worse if the tank is zeroed on a different occasion than the training or combat event. On the other hand, if the tank-to-tank variation is the larger error, individually zeroing the tank will improve accuracy, compared to a fleet zero.[6]

If there is an occasion-to-occasion problem, there are several possible methods to get around it. First is to zero as a part of every combat or training occasion. Unfortunately, this will not always be possible in combat situations, and it would prove expensive and logistically burdensome. Another option is to zero the tank over many occasions, when conditions permit. By maintaining a history of where a tank shoots, the average zero location for that tank can be established. The average could then be used as the zero for the tank. Again, many rounds of each type are required for this strategy and the cost could be prohibitive. Finally, as the conditions that cause occasion-to-occasion dispersion are better understood, control of those conditions on zeroing occasions could significantly reduce their impact on occasion-to-occasion dispersion, thus making individual zero a more viable option.[7]

The 'tube zero' is a variation on the individual zero. Each cannon has its own unique centerline profile. The assumption behind the tube zero concept is that a cannon's centerline profile makes the strongest contribution to its unique firing characteristics. There is some evidence that suggests this may be the case.[8] Under a tube zero concept, each gun tube would be sent to a proving ground after manufacture and all ammunition types would be fired from each gun tube. The zero values for the various ammunition types would then be sent with the gun tube and would be available when it is installed in a tank. This concept still requires a good deal of ammunition, though the safety and environmental concerns are eased by firing at a proving ground. More importantly though, there are thousands of 120-mm gun tubes already installed on tanks or in storage at depots. Getting all of these gun tubes to a proving ground is impractical. Even if that were initially possible, every time a new round of ammunition was introduced, the tube would again have to be sent away for zeroing.

Surrogate Zero

The surrogate zero concept has been around for a number of years.[9] Here, the idea is to individually zero each tank in the fleet with training ammunition or specially developed inert slugs. The zero value obtained for each tank is then used as a surrogate for the zero values that tank would use with the various service rounds. This eliminates the need to zero each tank with ammunition that may be dangerous, expensive, or environmentally hazardous. The ideal surrogate round is therefore inexpensive, safe. and environmentally benign.

The best example of how such a concept might work is with the M830 High Explosive, Anti-Tank (HEAT) round and its complementary training round, the M831. The M831 was designed to behave identically to the M830 in terms of interior and transitional ballistics and its free flight dynamics. Since the M831 lacks the explosive warhead of the M830, however, each tank could safely zero with the

M831 and use those zero values as surrogate individual zero values for the M830.[10]

Currently, other than the M830, no other U.S. service round has a corresponding training round specifically designed to mimic its ballistics. The entire series of Kinetic Energy 120-mm ammunition in the U.S. fleet (M829 through M829A2) uses one type of training round, the M865, and its ballistics differ from all the M829 family of ammunition. The M830A1 Multi-Purpose, Anti-Tank (MPAT) has no training round at all. In these cases, for the surrogate zero concept to work with a training round, a repeatable relationship needs to be established between the zero values for the service ammunition and the training round. This relationship must be statistically significant but does not need to be perfect. It only needs to be good enough to improve the hitting probability across the tank fleet over that achieved with a fleet zero policy.

Recent tests with the M829A2 and the M865PIP have shown some promise in the surrogate zero concept. If the surrogate zero concept proves viable with training rounds, it could be a relatively cheap way of individually zeroing tanks. Since tanks currently screen with training rounds prior to gunnery tables, a procedural change could be instituted to maintain the impact history of M865 and M831 for each tank. For example, if the 2408-4 is modified,[11] this history could easily be maintained with the tank. Battalion master gunners could then use the firing history of the training rounds to calculate each tank's CCFs for the various service rounds.

As with the individual zero, a surrogate zero will only work if the occasion-to-occasion dispersion is smaller than the tank-to-tank variation or if each tank's average shooting tendency is known over many occasions. Maintaining a history of how the tank shoots training rounds and using the average impact point to develop surrogate zeros is a partial answer. Also, as in the case of individual zero, understanding what affects a tank's firing characteristics and accounting for them some way, could improve the precision of a surrogate zero technique.

Silent Zero

The 'silent zero' is another proposed method[12] for individually zeroing tanks. This proposed calibration method eliminates many of the logistical type problems associated with other calibration methods, such as safety, cost and environmental hazards. Additionally, 'silent' zero eliminates many of the potential accuracy errors associated with the other techniques.

The silent zero concept assumes that all the major sources of tank-to-tank variation are well understood. If they are, the error sources may be modelled on a computer and each tank's CCF values could be computationally derived.[13] Under the silent zero concept, all the characteristics of a tank system that make it unique in the way it fires (such as its gun-tube centerline profile) are measured. Knowledge of these parameters allows construction of computer simulations that replicate each tank's unique firing characteristics. The computer then 'fires' each type of ammunition from its model tank and the CCF values are derived. These values can then be maintained with that tank until a system change requires a new simulation. New simulations could be conducted at some central location, such as a depot. Alternatively, if the data about the tank system was maintained in some data base and if the model did not require supercomputer capability, a battalion master gunner could run the simulations on a PC and generate new CCFs at battalion HQs.

The capability to conduct a 'silent zero' is still some time away. There is still a good deal that we do not understand concerning how large cannons behave when they are fired. Additional research is therefore required if this option is to become a possibility. Depending on the parameters that are determined to be needed for the computer simulations, a potentially very large data base would also have to be assembled. The potential benefits, however — ammunition cost savings, improved accuracy across the fleet, and technical spinoffs from the research — make the 'silent zero' an option worthy of consideration.

Conclusion

The U.S. Army will have to rely on the M1A1 and M1A2 tanks for the foreseeable future. In order to maintain their battlefield edge and keep them relevant in Force XXI, continual improvements in lethality at long range are essential. This means that we must make the tank/ammunition system more accurate. One potential method to do this is to alter our current calibration policy.

I have discussed basic strategies for calibrating tanks. Each one of these has its own problems and advantages, so determining the proper zeroing technique for the U.S. Army's tank fleet requires balancing the pros and cons of each one. The Army's current policy, the fleet zero, is economical and was used successfully during DESERT STORM. The other policies, individual zero, surrogate zero and silent zero, are all unproven, but all have the potential to improve long range accuracy if errors associated with their implementation are kept in control. They therefore deserve a strong look. Finally, some hybrid approach, may prove the most useful. We already use a combination of fleet CCF and individual zero for training rounds. Perhaps such an approach could also improve the accuracy of our service ammunition.

The bottom line is that, with little funding for new tanks or upgrades to existing models, we must maximize the capability of our current systems, the M1A1 and M1A2. Improving accuracy is one way to maximize their capability by significantly improving their long range effectiveness. Without a materiel change to the tank however, changing our calibration policy is one of the only methods to significantly improve accuracy. There are a number of potential methods available and they should be pursued aggressively.[14]

Footnotes

[1]Held, B., D. Webb, E. Schmidt, "Identification and Quantification of Sources of Occasion-to-Occasion Elevation Variability in Tank Gun Accuracy," Proceedings of the Seventh U.S. Army Symposium on Gun Dynamics, May 1993, pp. 103-104.

[2]Gunner lay is an error source that I have chosen not to address in this article. Gunner lay error includes effects that can be categorized as round-to-round, occasion-to-occasion, and tank-to-tank. Luckily, though this error source can be large, it is also the one that tankers can control or minimize. The best way to reduce gunner lay errors is through repetitive and correct training. I also assume for this article that boresight retention is controlled by boresighting often and by conducting MRS updates frequently.

[3]A screening policy that identifies tanks that are not accurate with a fleet CCF and individually zeroes them may, in fact, be the most accurate calibration technique.

[4]Minutes of the 22nd JCB Meeting, 120mm Tank Main Armament System, 14-16 May 1991, Munich, Germany.

[5]Training ammunition costs several hundred dollars a round, and service ammunition, par-

ticularly the newer types, costs several thousand dollars a round.

[6]Data to determine the magnitude of occasion-to-occasion error is scanty and somewhat conflicting. Additional testing is needed.

[7]For example, if ammunition temperature is determined to be the greatest root cause of occasion-to-occasion variability, it may be possible to control the temperature of the ammunition used to individually zero a tank.

[8]Schmidt, Edward M., briefing to PM TMAS, 20 December 1994, Picatinny Arsenal, NJ.

[9]I am not sure who originated the surrogate zero concept, but I first heard of it from Dr. Schmidt in 1989.

[10]Use of the M831 as a surrogate for the M830 has not been proven and should not be used in the field until it is. The fact that the M830 and M831 have different fleet CCFs indicates that we cannot assume that a particular tank will fire the two the same.

[11]This idea suggested by SSG(P) Robert Horner of 5th Sqn., 16th Cav., Fort Knox.

[12]Proposed by Dr. Schmidt at 22nd JCB Meeting, Munich, 1991.

[13]Work at the Army Research Laboratory (ARL) attempted a simulated tank firing using three tank systems. The results were promising, but are not yet good enough for a silent zero. [Bornstein, J., D. Savick, D. Lyon, E. Schmidt, J. Kietzman, D. Deaver, "Simulation of Tank Cannon Launch Dynamics," Proceedings of the Seventh U.S. Army Symposium on Gun Dynamics, May 1993, pp. 226-237.] Since this effort, much better computer models of the cannon and projectile dynamics have been constructed by Dr. Steve Wilkerson, et. al. at ARL. [Wilkerson, S., "Analysis of a Balanced Breech System for the M1A1 Main Gun System Using Finite Element Techniques," Technical Report 608, U.S. Army Research Laboratory, Aberdeen Proving Ground Md., November 1994.] These new models should greatly enhance the capability to predict projectile impacts. Finally, LTC Robert Dillon of the U.S. Military Academy has recently had very encouraging results with fairly simple simulations. He has been able to predict projectile impacts to within a half a mil. [Dillon, R., "120-mm Projectile Dynamic Response to Launch Conditions," to be published in the Proceedings for the AIAA Atmospheric Flight Mechanics Conference, August, 1995.]

[14]I would like to thank COL Richard Bregard, Mr. Vincent Rosamilia, and LTC Jim Burton of the Office of the Project Manager for Tank Main Armament Systems for making comments and very helpful suggestions after they read early drafts of this article. I would especially like to thank Mr. Al Pomey of the Armor School at Ft. Knox who also read early drafts of the article and prevented a couple of embarassing errors.

Major Bruce Held earned his commission in 1980 from the United States Military Academy at West Point. He initially served in the 32d Armor as an S2 and scout platoon leader and went on to an assignment in the 2d Armored Cavalry as an S4 and troop commander. As an Acquisition Corps officer, he has served at the Army Research Laboratory and is currently serving in the Office of the Project Manager for Tank Main Armament Systems. In addition to his BS degree from West Point, he holds an MS from Stanford University in Aerospace Engineering and a law degree from the University of Maryland School of Law. He is also a graduate of MIOBC, AOAC, and CGSC.

Letters (Continued from Page 3)

the fight smarter. The best way to do that is to train to "communicate, move, and shoot."

CPT MICHAEL L. PRYOR
Co C, 1-156 AR
LAARNG

LAV Solution Too Vulnerable

Dear Sir:

I agree with most of CPT David Nobles' reasoning on the desirability of Light Armored Vehicles (LAVs) for contingency operations (Jan-Feb 95 issue). As a Marine officer I spoke out in favor of the 105-mm LAV Assault Gun variant (now perfected but abandoned by the Corps) and against the HMMWV, unarmored and unarmed, to **prevent** tragedies like we had in Somalia, where we lacked both infantry organic shock action and mission mobility in the face of enemy small arms fire. Nobody listened, and men died.

But before we let our enthusiasm for wheeled LAVs go unchecked, we need to realize that the 8-wheeled LAV used by the USMC has bad — really bad — armor protection. The fragmented, burned out hulks of LAVs hit in the Gulf War, which once held a dozen men, is a sobering reminder that this vehicle is only marginally "armored." The 8-wheeled LAV has a hard aluminum body that can **deflect** assault rifle rounds while the HMMWV has a soft Kevlar body to **absorb** AR rounds, though the latter will be banged up. Any projectile larger than 7.62x39mm Russian will turn both vehicles into "Swiss cheese." The key advantage of the 8-wheeled LAV is its chief weakness: if its wheels get shredded by explosion and/or set on fire — "run flats" or not — it's going to be stuck. Had USMC 8-wheeled LAVs been there on October 3d in Somalia — unless they were Assault Gun variants to blast the warlord gunmen hiding in buildings before they hit them — we would have left LAVs burning in the Bakara Market in addition to the maligned HMMWVs. Until we make the wheels of the HMMWV and 8-wheeled LAV combat-hardened, **neither will be mission-mobile in the face of enemy small arms,** obstacles, broken glass, and wire. We knew this from Panama in 1989.

On the other hand, the M113 is a tracked LAV — again, it helped save the day in Somalia — **it was able to move under fire** since its tracks can absorb small arms fire and climb over debris and still be **fully mission mobile.** Just about everything CPT Nobles wants to do with a wheeled LAV, the M113A3 can already do: strategically deploy by air to include airdrop, STOL air-land, air-mobile by CH-47D helicopter, swim, carry troops in quantity, act as a weapons carrier. Its 12-ton weight is light on its tracks so it can drive itself to different places operationally without need of wheeled transporter/trailers that the heavier 33-ton M2A2 Bradley and 63-ton M1A1 Abrams require. The A3 model is fast, and with 30 years of mass production, spare parts are cheap and available all around the world, making it just as affordable as a wheeled LAV.

While not as mechanically simple as a wheeled LAV, or as fast on roads, the M113A3 will keep moving under small arms fire up to heavy machine guns and keep its occupants alive, where in a 6-8 wheel LAV, they would die a horrible death. While not as quiet, due to its tracks, as a wheeled LAV, the M113A3 can dismount scouts on folding all/extreme terrain bicycles to recon ahead as the vehicle stops short of enemy sight/hearing. The abandoned USMC 105-mm assault gun and 120-mm mortar turrets could be fitted to the M113A3 and/or its high mobility stretch (HMS) variant to give contingency forces mobile firepower. For al-

most zero cost, surplus M40A2 106-mm recoilless rifles could be fitted to give our infantry organic shock action, too.

It's not a bad thing that we don't have the money to buy 6- or 8-wheeled LAVs. They are too big for effective scouting and underprotected for APC duties better suited for the tracked M113A3 and M2. The HMMWV is better sized for scouting and, if fitted with a hard shell body like the French VBL to **deflect** bullets, and **solid** foam rubber tires like the French AMX-10RC 105-mm Assault Gun LAV or what our own 1st Tactical Studies Group (Airborne) used on its folding ATBs, could become a "4-wheeled LAV." An effective countermine armor system has also been fielded for the HMMWV. Making the HMMWV a 4- wheeled LAV would be faster and cheaper than buying a larger 6-8 wheeled LAV with serious tactical liabilities. While 6-8 wheel LAVs can carry heavier armament than the HMMWV and swim, the HMMWV can easily carry the 106-mm recoilless rifle and, as miniaturization technology improves, weapons will require smaller transports. A swimming HMMWV variant could eventually be developed. For vehicles to survive on the modern battlefield, they will need to become smaller, not larger targets, better to start small and work from there. HMMWVs can also be transported by plentiful UH-60 Blackhawk medium helicopters if their weight is kept under 4 tons.

MIKE SPARKS
Ft. Bragg, N.C.

T90 Selected as Main Tank For Russian Armed Forces

Dear Sir:

Some important new information has appeared concerning the T-90/T-90S HPT since my article, "The Russian T-90/T-90S: An Old Dog With Some Dangerous New Tricks" (*ARMOR* March-April 1995) was sent to the printer. One of the key questions concerning the T-90/T-90S is the role (if any) it will play within the Russian Army. Apparently, this question has finally been answered. According to *VOYENNYYE ZNANIYA* #9 1994, the T-90 "has been selected as the (new) main tank for the Russian Armed Forces." This significant information was included in an article comparing the Russian T-80U PT to the new German Leopard 2 (Improved) MBT in the light of Sweden's recent selection of the Leopard for its armed forces.

While this information about the T-90 answers a key question, it also leaves us with some interesting new questions as well. The possibility that Russia's historically "top-of-the-line" tank design team and production facilities (producers of the T-80U) would simply be shut down seems very unlikely. A more likely scenario would be a redirection of effort rather than no effort at all. The virtual certainty that Russian tank development will continue beyond the T-90, and the impressive capabilities of those same people who brought you the T-64 and T-80 Premium Tanks, should fuel discussion in the armor community and the pages of *ARMOR* for some time to come.

JAMES M. WARFORD
MAJ, Armor
Leavenworth, Kan.

There's Still Life in the M113

Dear Sir:

Mr. Mike Sparks' article on the venerable M113 was interesting, well researched, and proves there is still a lot of life left in the world's most produced armored vehicle. Ironically, the day I received the issue of *ARMOR* containing the article (J-F 95), I also received the latest issues of *Jane's Defense Systems Modernization* and *Defense Weekly*, both of which had articles on upgrades for the 113! With so many branches vying for Bradley platforms (FIST, ADA, ODS/A3 Upgrades, etc.), there aren't enough BFVs to go around. The Engineer School is considering the Mobile Tactical Vehicle Light (MTVL) for engineer squads to avoid using a Bradley. The MTVL uses the 350 HP engine and will easily keep up with the Abrams and Bradley during combined operations.

The latest *Jane's Defense Weekly* outlined how the Australian Army is evaluating a modified M113 with the M40 106-mm Recoilless Rifle (RCL) to augment the Milan missiles and Carl Gustaf weapons systems. M113 weapon options were also the subject in the January issue of *Jane's Defense Systems Modernization.* The options for the M113 ranged from Mk 19 to LAV25 turrets. Mid-life extensions could provide smaller armies with a formidable IFV for less money than a Bradley, Marder, or Warrior.

Naming the M113 after General Gavin is a nice thought, but after 30 years I'm afraid the name wouldn't catch on with the troops. Even though the M113 is worthy of a name it will always be called the "113" or "PC" by the troops. Mr. Sparks has done his research well and has given us much food for thought.

WADE BARTTELS
Killeen, Texas

Make NCOs Master Gunners, Not Master Billet Inspectors

Dear Sir:

I'd like to address two articles in the July-August 1994 issue — Command Sergeant Major Davis' "Driver's Seat" and Lieutenant Colonel Williams' "Leader Development — Don't Forget CSS."

In regard to CSM Davis' article on master gunners, my best tank, mechanized, and cavalry outfits have master gunners as their first sergeants. What great trainers! We must continue to develop our noncommissioned officers into master gunners. They will lead our soldiers into the future. CSM Davis is right on track with his article.

Some may read in "Leader Development — Don't Forget CSS" that the command sergeant major can only address billets maintenance. He is the master trainer for all individual and crew tasks in the organization. He can provide quality control in all CSS training, not just billets maintenance, as LTC Williams points out in his article. He is a leader developer.

Let's remember that all armor noncommissioned officers are warriors. Keep them battle-focused. Make them into master gunners, not master billets inspectors.

CSM JOHN BECK
2d Infantry Division

Some Caveats on RTD Postings

Dear Sir:

It was with great interest that I read Captain Leon Smith's article concerning Resident Training Detachments in the November-December 1994 issue. His insight provides a helpful overview into RTD operations, not only for those who are assigned to RTD posts but also for those RC soldiers who may work with such personnel.

There are, however, some caveats I would like to add as a battalion commander for an RC unit. First, CPT Smith's quote from the Orientation Course (Footnote 3) should remain paramount in the minds of RTD personnel. Never lose sight of the fact that you are there to assist, and **not** to command. By far, the majority of operational conflicts that we experienced between some of our RC and RTD personnel were linked to the issue of authority. If there is a problem with the RC leaders doing their job, go to your RTD chief and the RC battalion commander.

Second, if the brigade commander, as CPT Smith states, expects RTD personnel to be his eyes and ears, do not forget that there is a battalion commander who deserves to be informed first. The first time you provide information, whether it is to your brigade RTD chief or the RC brigade

AFV Quiz Answers

1. **LAV25**
2. **OT-64**
3. **Gepard**
4. **ZSU-23-4**
5. **BTR50PK**
6. **MTLB**
7. **Jaguar**
8. **BMP**
9. **2S1**
10. **2S3**
11. **M109**
12. **AMX10**

commander, without providing the battalion commander some advance notice first, you will cause irreparable injury to your mission and the mission of the unit you support. Treat the RC commander like he is **your** battalion commander (even though he's not). If the news you intend to report is bad, say so — he's paid to take it.

Third, the sense of community and support for your family that you have on an Army post is hard to achieve in this assignment. Many assignments are to headquarters in small towns where a majority of the RC soldiers may or may not reside. Too, there is only a limited number of peer AGR officers and NCOs. We have constantly sought to resolve this problem but to date have met with only limited success. On the bright side, because you are assisting an RC unit, this assignment should allow you to spend more quality time with your family.

Finally, you will have some lively discussions about how to train and do things with the RC soldiers. FM 25-100/101 and the standard for the task being trained should quickly put to rest any questions. Good communication between the RC commanders and staff and RTD personnel is truly the key to success.

Our RTD team has been and will continue to be an integral part of our unit. I wouldn't trade any of them, especially my RTD master gunners. They are making a difference in the quality of training every day.

CHARLES S. WOODS
LTC, IN
1-155 Infantry, MSARNG

Grow's Philosophy: An Exchange

Dear Sir:

In your September-October 1994 issue was an article on "Armor History and Operations in 1944" by George F. Hofmann, Ph.D. When describing General Grow's philosophy of life, the author said: "Grow did not believe in the superstitions and pagan formalities cherished by the churches." Since these words and their sentiment were not attributed to General Grow, they appear to be a value judgment of the author and a gratuitous insult to church-going people. By logical extension, the comment sandbags our dedicated Chaplain Corps including officers like Vietnam Medal of Honor winners Chaplains Loe Liteky and Charles Watters.

While Dr. Hofmann is free to believe anything he wants, he should no more be permitted to use *ARMOR's* pages as a platform to insult church-going people than to make racist or sexist statements.

By the way, I am neither a chaplain nor religious cult member — just an old grunt who very much appreciates the importance of religious practice by soldiers who sorely rely on it in times of battle and other personal trials.

LAWRENCE J. DACUNTO
COL, INF (U.S. Army, Ret.)
Wayland, Mass.

The Author Replies

Dear Sir:

Colonel Dacunto's letter was most provocative, and this author thanks him for his interest in armor leadership. However, I found his letter lacking substance and thus question his logical extension.

In looking through the membership roster of the 6th Armored Division Association, I did not find Colonel Dacunto listed, so, I assumed he never served in the 6th Armored Division, nor did he mention that he personally knew or served under General Grow. Since 1971 until the early 1980s, my family and I were frequent guests of General Grow at his home in Falls Church, Va. In addition, we routinely met for years at Fort Knox at the 6th Armored Division Association's annual reunions. There were many evenings we stayed up late discussing Clausewitz and his philosophy on war, and the role religion had played in numerous wars throughout history. The last mentioned subject was of interest because the General served two years (1947-1949) as head of the U.S. military mission in Iran. He was no stranger to Islamic fundamentalism. Many times, the General expressed his feelings about the superstitions and pagan formalities cherished by the various churches. He transgressed from the dogma of blind faith to a higher order in the Hegelian sense of exploring truth towards the absolute spirit. This in no way denigrates a religious practice. Thus there was never an intention in our discussions to insult "church-going people," only to quantify a personal philosophy that provided substance to leadership development. What was written in the *ARMOR* article was, in fact, an accurate reflection of a philosophy on life as expressed to me many times by General Grow. In addition, this philosophy was recorded in Chapter XV, "Epilogue," *The Super Sixth. History of the 6th Armored Division in World War II and Its Post-War Association* (1975). Before the manuscript was submitted to the printer and the publisher, General Grow had reviewed the "Epilogue" and made no changes nor offered any objections to what I wrote about his philosophy on life. He entirely approved in my assessment. General Grow had the greatest respect for his division's chaplains; they effectively served the spiritual needs of his men. I have talked to and interviewed many general officers and found General Grow possessing one of the most perceptive and challenging minds in my many years of experience in assessing military history.

Finally, to accuse one of expressing a racist and sexist statement is a very serious accusation, even more so when the accuser lacks a logical sufficient reason for assenting to the truth. Three thousand and five hundred (3,500) copies of *The Super Sixth* were printed and distributed through the United States and Europe. Not one reader or book reviewer had made a comment that the history contained a racist or sexist statement. There is no place in any logical discussion for emotional, unsubstantiated biased remarks.

GEORGE F. HOFMANN, Ph.D.

Driver's Seat (Continued from Page 5)

demolitions; i.e., calculating and designating placement of timber and steel cutting charges and calculating and designating the placement of cratering and breaching charges.

The climax of the tank and scout experience in BNCOC is a three-day Field Training Exercise (FTX), designed to test the student's ability to perform the skills learned under stressful field conditions. It incorporates the gamut of collective tasks, from conducting a tactical road march to reconsolidation and reorganization on the objective. The FTX instills pride and confidence in the sergeant's newly acquired skills.

The BNCOC graduate is a highly motivated, skilled — but as yet untested — warrior. It's up to his chain of command to afford him the opportunity to demonstrate his capabilities and show his mettle. The most important test the graduate will face is one that cannot be measured within an institution. It is the one that will test his ability to inspire his subordinates, and provide leadership that allows them to build confidence in their own abilities. This type of leadership brings recognition from both subordinates and superiors.

"NCOs also have responsibility to train sections, squads, teams, and crews."

— FM 25-101

BOOKS

Tanks For the Memories by Aaron C. Elson, Chi Chi Press, Hackensack, N.J., Phone: 1-800-807-TANK. 1994. $10.00.

Walk into any bookstore in the U.S. and you will find an almost overpowering number of Vietnam "I was there" books detailing life as an infantryman, Marine, or Long Range Patroller. Some books about the Gulf War are beginning to appear. All of these books detail what war feels like to the participant who fights dismounted. You will look hard and unsuccessfully for a book about fighting from armor, from the viewpoint of the tank crew. Recently, a new book, *Tanks For the Memories,* was published that talks about tank warfare in World War II. It is hard to get by the title, as it is a classic pun, detested by most tankers, but it is a must read for any tanker, and should be purchased by all libraries near an armored unit.

The book is a work of love by Aaron C. Elson. Mr. Elson's father was a replacement officer assigned to the 712th Tank Battalion in World War II. He served from June to December 1944 in the 712th before being wounded and evacuated. While Mr. Elson's father would tell stories about World War II, Aaron Elson could not remember them. After his father died, Elson began to attend reunions of the 712th Tank Battalion Association. He began to record what members of the battalion told him about the battalion. The story is not complete because he normally recorded information only from veterans of A and C companies.

The 712th Tank Battalion was an independent tank battalion, not permanently assigned to any division. During the Normandy invasion it supported the 90th Infantry Division and the 82d Airborne Division. Later it worked with the 8th Infantry Division before returning to attachment with the 90th, with which it stayed for the remainder of the war. It was the seventh tank battalion to land at Normandy, but the first to land with virtually all of its equipment. Units in the battalion won three Distinguished Unit Citations.

The book is organized chronologically, with individual members of the battalion saying what they did before, during, and after a battle. The book includes acts of heroism as well as the mundane and sometimes funny facts of life as a tanker. In one case he tells how a tank came to participate in a friendly fire incident; in another, what it feels like to have a mine go off under your tank. There are some grisly parts, like having to clean out a tank after it was hit, incinerating the crew in a fire of 100-octane gas. The gore is not there to shock, but rather as a discussion of what it was like to fight in a tank battalion from Normandy to a concentration camp in Germany.

Tanks For the Memories contains few details about the strategy of World War II. It does contain some tactical insights, but it is mainly a story about how a unit really functions in wartime. There is a monument to the 712th outside the Patton Museum at Fort Knox. On the monument are 97 names listing all but one of the men killed in action in the battalion. You may compare this list of casualties with that of the Gulf War and realize that this was indeed a battalion that was in a hard-fought war. Their story is one well worth reading.

GERALD A. HALBERT
Earlysville, Va.

Red Army Tank Commanders: The Armored Guards by Richard N. Armstrong, Schiffer Publishing Ltd., Atglen, Pa., 1994. 475 pages. $24.95.

This book is comprised of six individual essays on the combat careers of Soviet tank army commanders (Katukov, Bogdanov, Rybalko, Lelyushenko, Rotmistrov, Kravchenko) during World War II. Each essay makes for fascinating reading concerning the personality, command style, and operational perceptions of the Red Army's leading World War II tank army commanders. The author is well qualified to write on this subject, given his expertise in Red Army operations and military history, and has gathered an impressive collection of Soviet sources.

This work represents a signficant contribution to armor scholarship for two reasons. First, it approaches armored warfare on the Eastern Front from the Soviet commander's perspective. This is a subject usually given to a German bias. Second, it addresses the evolution of armor doctrine during the course of a war — a doctrine based on prewar theoretical concepts which, unlike those which developed in Germany, were unable to fully mature in a peacetime environment.

In each essay, the commander in focus is seen developing his operational skills by means of a trial and error process with ever-increasing forces (e.g. brigade, corps, army) under his command. The outcome of this process held the life of the individual Soviet tanker in the balance. The Soviet penchant for night operations and ability to quickly recover and repair damaged tanks to sustain operations represents two lesser themes which also run through many of these essays.

Detractions from this exceptional work are relatively minor and specifically concern technical mistakes regarding German weaponry. But overall, *Red Army Tank Commanders: The Armored Guards* is a first rate work which not only explores a little-known subject area, but the process of doctrinal change, a relevant topic in light of current issues (e.g. non-Western military environments vs. traditional battlefields, advanced technologies and unmanned AFVs, and budgetary constraints) facing U.S. Army doctrine today.

DR. ROBERT J. BUNKER
Associate Professor
American Military University

Armored Forces: History and Sourcebook by Robert M. Citino, Greenwood Press, Westport, Conn. 1994. 328 pages. $75.00.

For a book with such great potential and promise, *Armored Forces* by Robert Citino is an extravagantly priced, myopic failure. Touted by the publisher as a "teaching tool and reference guide for teachers and students of military history, history buffs, and professional soldiers," this book just does not measure up to its goals, its claims, or its price. It will be especially disappointing to readers who know anything at all about the development and history of armor.

The author, Robert Citino, is a university-level associate professor of history with two previously published books to his credit. However, his credentials for writing this book are obscure and may explain this book's lack of depth and detail. His writing is clear and succinct, but his research and presentation are sadly incomplete for a book which claims to be a "sourcebook."

Armored Forces is organized into four major sections — armor history, bibliographic essays, biographical profiles, and appendices. Citino's recreation of armored forces history is textbook material, dry and unleavened, without the power and drive that armor deserves. He does hit some bright spots in his discussions of armor history personalities such as Hart, Swinton, Lutz, and Fuller ("All of Fuller's books are written with the intention of annoying someone."). Citino's early history of armor in the Great War is the best-balanced, best-supported and most interesting. As Citino moves through the interwar years, World War II, and into modern tank warfare, he seems to lose steam or interest. For example, although published in 1994, well after the Gulf War, Citino devotes only four paragraphs to the greatest modern tank battles since Kursk. His synopsis of tank battles in the Iran-Iraq War is credible, but to virtually ignore armor in "Desert Storm" is to ignore the present and future of armored forces. Technical information is also thin and sketchy, and again only four paragraphs are provided for discussion of modern tank ammunition and armor design. Hardly a comprehensive approach to a subject of such vast scope and detail.

As with his armor history, Citino's appendices are weak and poorly presented. The brief chronology of important dates is basi-

cally filler material of little value. The other four appendices are supposed to list tanks by country of origin corresponding to Citino's four phases of armor history. However, these lists are gravely incomplete, clearly listing only tanks of accepted prominence or appeal, omitting many and removing any possibility of this book's acceptance as a "sourcebook" for armor. The author omits the French CharB and the H-35, the Italian L/3 and M/11, the Czech LT35 (also known as the German PzKpfw 35), the U.S. M24 Chaffee, M22 Locust, M48A3 (the armor workhorse of Vietnam), M103, and M551 Sheridan, as well as many others. Additionally, with a wealth of marvelous photos easily available for such a book, Citino uses only six photos of World War II tanks, all too conveniently obtained from the U.S. Army Ordnance Museum. No maps and few charts complete the book's lack of format and research support.

Despite its major weaknesses, this book does have its good points. For the serious student, avid reader and lover of military history, Citino's bibliographic essays are the highlights of his book. He has compiled a superb collection of recommended readings of books and articles on armor operations in combat, tank development, employment doctrine, and armor personalities. Without a doubt, these bibliographic essays are the best, most useful, and interesting parts of this book. The biographical profiles also deserve favorable mention. Citino has provided capsule profiles of 42 men who contributed to the development and employment of armored forces from the early days to the Yom Kippur War in 1973. Surprisingly, nobody makes the list after that, but you will read of the famous (Patton, Guderian, Rommel) and refreshingly, the not-so-famous (H.G. Wells, Percy Hobart, Oswald Lutz). But, even these two well-done sections cannot breathe life into this book.

Armored Forces does not match its claims; it is neither a convincing history nor a comprehensive sourcebook on armored forces. Most any of the armor books by Kenneth Macksey, John Batchelor, and R.M. Ogorkiewicz are far better and more complete.

WILLIAM D. BUSHNELL
COL (Ret.), USMC
Harpswell, Maine

Vietnam POWs Tell Their Story by Zalin Grant, De Capo Press, New York. 1994. $14.95.

Powerful — is the single most appropriate word to describe Zalin Grant's *Survivors.* This is one of those rare compelling works that you truly can't put down because it will haunt you until you pick it up again.

Originally published in 1975 by Norton, this is the story of nine American soldiers and pilots captured during the Vietnam War and held under the most hideous of conditions until repatriated by the Paris Peace Agreement of 1973. This is a story told in their own words through interviews conducted by the author soon after these men returned to the United States. It is their own words, their own emotions, their own pain that makes this book so evocative.

In this latest edition, Grant has written a new introduction primarily to fill in some of the details in the strange case of Marine PFC Robert Garwood. Garwood was a turncoat who played a major role in the torment of these prisoners in the early years of their captivity in South Vietnam. The details of his story didn't become available until his repatriation and subsequent court-martial in 1979. Even today, the Garwood case remains enigmatic.

Aside from the easy flow of these stories from these former POWs, what is most intriguing about the book are the lessons that keep leaping off the pages. The lack of preparation these young men had for their ordeal is stunning. Neither their service nor their society gave them the necessary informational tools to deal with the situation in which they found themselves. They were almost completely ignorant of their society's goals and agenda in fighting an Asian land war. At the tactical level, they didn't know their objective; they didn't know their commander's intent. They didn't know where they were on a map. They were denied the fundamental tools needed to resist an enemy if captured, and in short order, they were psychological victims of a system that controlled every aspect of their lives.

Given the information vacuum prior to capture, it is easy to understand how they broke down. The brutality of the Vietnamese POW system was complete. The young, the confused, and the desperate were not difficult to ensnare. They broke down mentally and physically, and ultimately they became pawns of the North Vietnamese penal system — only the very senior Air Force and Naval pilots retained their sense of purpose. The junior enlisted were left to flounder for more than five years. Eventually, most succumbed to enemy coercion or outright joined the "Peace Committee."

To military leaders, the failure to provide these men with a reason for fighting and a reason for resisting seems unconscionable. More than that, it seems impossible that American units could be so mentally unprepared to take to the field. We pride ourselves in keeping everyone informed, passing the details of combat operations down to the lowest level. What this book drives home is the cost of failing to do so.

LTC J.C. ALLARD
Brunswick, Maine

Unarmed Against Hitler: Civilian Resistance in Europe, 1939-1943 by Jacques Semelin. Translated by Suzan Jusserl-Kapit. Greenwood Publishing Group Inc., Westport, Conn. 1993. 216 pages. $55.00 hardbound/$18.95 paperback.

The author examines an interesting proposition: that a society has the capability to defend itself AFTER occupation. Moreover, by developing such a capability a country can actively dissuade aggression because the potential occupier realizes that the gains will not be worth the price.

By examining the German occupation of Europe, Semelin develops several models of civilian resistance. This resistance is NOT to be confused with armed resistance, such as occurred in France and other occupied countries. Instead, it consists of maintaining the national and cultural institutions of the society against the occupier, resisting collaboration that supports the occupier's goals, and maintaining national identity until the occupation ends.

He examines several instances where such resistance succeeded, and others where it never materialized or failed. He also identifies several key attributes necessary for a successful civilian defense. Key among these is a society committed to its national identity. Those countries that most successfully defended themselves against the Nazi occupation did not have a lot of division at home. On the other hand, those that were least able to resist were the societies having divisions that the Germans could exploit.

Semelin also identifies three screens that "protect" the society against the occupier. The first is an established government that does NOT collaborate. Another is public opinion that can be mobilized to resist. Finally, the third screen is composed of social networks which can serve as support and communications structures.

The book itself is a detailed intellectual analysis of this topic. As such, it is not much use to military art. However, from a grand strategy viewpoint, it offers some very valuable insights. Moreover, in today's complex world of nuclear powers, where the weapons of choice may no longer be military but political (terrorism, economic blackmail, development of internal dissent), the same elements necessary for civilian defense are the ones needed against these political attacks. Social cohesion, identification and support of one's culture and government, networks of support, all provide the societal structure to resist such pressures. Consequently, this book should be read by policy makers and theorists interested in international defense in the nuclear age.

LTC FRAME J. BOWERS III
IMA, SARDA, Pentagon

Brewer's Axioms (Continued from Inside Front Cover)

place — a very small place — in the big scheme of things. I have observed, however, that many officers and noncommissioned officers don't understand when or how to use that approach. Treating people with respect, recognizing their talents, correcting them for their mistakes, and setting the example in your own behavior may not take you farther in the rank structure, but it will surely guarantee you a better night's sleep, and, quite often, greater mission success. Pushing people around is a substitute for leadership. You can always escalate to power if finesse fails, but if you start-off with power and you fail, you've got nowhere to go. Cultivate a variety of leadership styles, because if the only tool in your toolbox is a hammer, the whole world looks like a nail.

"The truth only hurts if it should." Be courteous, but direct, with seniors, subordinates, and peers. Don't tell your boss what he wants to hear; tell him what he *needs* to hear. "Yes, sir, I'll make it happen," sounds gung-ho, hard-charging, and mission-oriented. Some leaders will mistake it for dedication. Like "Hoooahh," it is often a substitute for thinking, or worse, for telling the boss the real consequences of his directive.

"Say 'yes' when you can, and 'no' when you have to, rather than the opposite approach." Key concept here. I've had S3s, S4s, company commanders, platoon sergeants, and civilians spend longer telling me why they can't accomplish something than it would have taken to execute the task. Often, I suspect, they say 'no' simply because it gives them a sense of power. Kingdom-building. Entrenchment. Protecting one's powerbase. That's like crying wolf. No one pays attention to you when the answer really should be 'no.' Use your "no's" sparingly, and you'll get more respect when you need them.

"Don't bleed green." If you allow the Army to become your life, you're walking the edge of a precipitous cliff, and no PLF ever designed will help you if you slip off the edge. The service is a sacrificial institution. We all give up something to be a part of it, e.g., constitutional liberties, geographical stability, time with our families, etc. A certain amount of that we must accept with the turf. But pay attention to what you're giving up, and never let the Army or anyone else take it all. If you want to be Sergeant Major of the Army, or a general officer, go for it. Build your dreamhouse. Just be sure you count the construction cost, and don't allow your family, your friends or your dignity to become casualties along the way. We've all seen the guy in the Officers Club, NCO Club, or the gymnasium who says, just loud enough for everyone around him to hear, how's he's going to be forced to take leave or lose it. He's too busy, too valuable (he thinks) to his unit, to be away from it. That's a power trip and a fantasy, and it demonstrates poor leadership. Lee Iaacoca said in his book that if he had an executive who couldn't plan his time well enough to allow for a week or two of family vacation each year, he didn't want that individual handling multi-million-dollar accounts.

"Diversify yourself." Never allow your self-image, your sense of worth as an individual to become wholly dependent upon being a soldier, for once that prop is knocked from beneath you, you will collapse unless you have cultivated other supports. Prepare yourself for what you will do when you leave the Army while you are *in* the Army. Get a skill. Make the time to attend school. Sure, be dedicated to your unit and your mission. Just don't become so intoxicated on the martial opiate that you forget how to do anything else.

"No sniveling." This was the motto of one of my former commanders — a man with whom I had a bet-your-bars, verbal, knock-down-drag-out altercation about how I spent my time as his S3 — and once we understood each other, I came to respect him as one of my finest leaders. Stand up for yourself. You'll win some, lose some, and some will be called on account of rain. But you'll be able to look yourself in the mirror the next day and be comfortable with what you see. Win or lose, don't snivel. We have enough victims looking for space-A in our society. Don't add to the manifest.

So roll the credits and start the music because I'm riding off now to teach English and continue writing my mystery novels. And while a tear will surely come as I salute the final time, there will be an unmistakeable cavalryman's jaunt in my step as I accept a new mission in the civilian world. May God be with you.

— J. D. Brewer

Active Armor/Cavalry Force Locations

CONUS Units

Ft. Carson, CO
4th Inf Div (Mech)
1-10 Cav
1ST BDE
3-68 Armor
3D BDE
2-77 Armor
2-35 Armor

Ft. Carson, CO
4th Inf Div (Mech)
3D BDE
1-68 Armor
3d ACR
1/3 ACR
2/3ACR
3/3 ACR

Ft. Riley, KS
1st Inf Div (Mech)
1ST BDE
1-34 Armor
2-34 Armor
2D BDE
3-37 Armor
4-37 Armor

Ft. Riley, KS
1st Inf Div (Mech)
1ST BDE
1-34 Armor
2-34 Armor
1st Ar Div
3D BDE
2-13 Armor
2-70 Armor

Ft. Knox, KY
1st Armor Tng Bde
1-81 Armor
2-13 Armor
5-15 Cav
16th Cav Regt
1-16 Cav
2-16 Cav
3-16 Cav
4-16 Cav
5-16 Cav
194th Ar Bde
1-70 Armor

Ft. Knox, KY
1st Armor Tng Bde
1-81 Armor
2-81 Armor
5-15 Cav
16th Cav Regt
1-16 Cav
2-16 Cav
3-16 Cav
4-16 Cav
5-16 Cav

Ft. Drum, NY
10th Mtn Div (LT IN)
3-17 Cav (Recon)

Ft. Lewis, WA
2d Inf Div
3D BDE
3-77 Armor
5-77 Armor

Ft. Lewis, WA
2d Inf Div
3D BDE
1-32 Armor
1-33 Armor

Ft. Hunter Liggett, CA
EXP SP CMD

Ft. Hunter Liggett, CA
1-40 Armor

Ft. Bragg, NC
XVIII Airborne Corps
82D ABN DIV
3-73 Armor (LT AR BN)

Ft. Irwin, Ca
11th ACR
1/11ACR (TK)

Ft. Stewart, GA
24th Inf Div (Mech)
2-4 Cav
1ST BDE: 3-69 Armor
2D BDE: 1-64 Armor, 4-64 Armor

Ft. Stewart, GA
3d Inf Div (Mech)
3-7 Cav
1ST BDE: 3-69 Armor
2D BDE: 1-64 Armor, 4-64 Armor

Ft. Bliss, TX
3d ACR
1/3 ACR
2/3 ACR
3/3 ACR

3d ACR MOVES TO FT. CARSON

Ft. Hood, TX
III Corps
1st Cav Div
1-7 Cav
1ST BDE
2-8 Cav (TK)
1-12 Cav (TK)
2D BDE
1-8 Cav (TK)
2-12 Cav (TK)
3D BDE
3-8 Cav (TK)
2d Ar Div
2-1 Cav
1ST BDE
1-66 Armor
3-66 Armor
2D BDE
1-67 Armor
3-67 Armor

Ft. Hood, TX
III Corps
1st Cav Div
1-7 Cav
1ST BDE
2-8 Cav (TK)
1-12 Cav (TK)
2D BDE
1-8 Cav (TK)
2-12 Cav (TK)
3D BDE
3-8 Cav (TK)
4th Inf Div (Mech)
1-10 Cav
1ST BDE
1-66 Armor
3-66 Armor
2D BDE
1-67 Armor
3-67 Armor

JRTC/Ft. Polk, LA
2d ACR (LT)
1/2 ACR
2/2 ACR
3/2 ACR

Ft. Benning, GA
24th Inf Div (Mech)
3D BDE
2-69 Armor

Ft. Benning, GA
3d Inf Div (Mech)
3D BDE
2-69 Armor

= CURRENT (FY95-96)

= FUTURE (FY 97)
[To be completed by 30 Sep 96]

NOTE: White box only indicates no change.

OCONUS Units

ALASKA

Ft. Wainwright
A Trp 4-9 Cav

Ft. Wainwright
10 MTN ID (L)
E Trp 3-17 Cav

HAWAII

Schofield Barracks
25th Inf Div (LT)
5-9 Recon

Schofield Barracks
25th Inf Div (LT)
3-4 Cav

GERMANY

Kirchgoens
1st Ar Div
1st Bde

Friedburg
1st Ar Div
1ST BDE
2-67 Armor
4-67 Armor

Friedburg
1st Ar Div
1ST BDE
1-13 Armor
1-37 Armor

Buedingen
1st Ar Div
1-1 Cav

Baumholder
1st Ar Div
2D BDE
2-68 Armor

Baumholder
1st Ar Div
2D BDE
1-35 Armor

Schweinfurt
3d Inf Div (Mech)
3-4 Cav
1ST BDE
2-64 Armor

Schweinfurt
3d Inf Div (Mech)
1-4 Cav
2D BDE
1-77 Armor

Vilseck
3d Inf Div (Mech)
3D BDE
1-37 Armor
2-37 Armor

Vilseck
3d Inf Div (Mech)
3D BDE
1-63 Armor
2-63 Armor

KOREA

Camp Pelham
2d Inf Div
5-17 Cav

Camp Pelham
2d Inf Div
4-7 Cav

Camp Casey
2d Inf Div
1ST BDE
1-72 Armor
2-72 Armor

PIN: 073648-000