ARMOR
The Magazine of Mobile Warfare

BALLISTIC LENS

Eye Protection for Armor Crewmen

page 25

July-August 1985

United States Army Armor School

"To disseminate knowledge of the military arts and sciences, with special attention to mobility in ground warfare, to promote professional improvement of the Armor Community, and to preserve and foster the spirit, the traditions, and the solidarity of Armor in the Army of the United States."

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ARMOR The Magazine of Mobile Warfare

ARMOR magazine (ISSN 0004-2420) is published bi-monthly by the U.S. Army Armor Center, 4401 Vine Grove Road, Fort Knox, Kentucky 40121. Unless otherwise stated, material does not represent policy, thinking, or endorsement by any agency of the U.S. Army. Use of appropriated funds for printing of this publication was approved by the Department of the Army 6 January 1984.

SUBSCRIPTION RATES: Individual subscriptions to ***ARMOR*** are available through the U.S. Armor Association, Post Office Box 607, Fort Knox, Kentucky 40121. Telephone (502) 942-8624.
Domestic: $16.00 one year; $27.75 two years; $39.50 three years. **Foreign:** $23.50 one year, $36.75 two years. Single copies, $2.50.

CORRESPONDENCE: Address all correspondence to U.S. Army Armor Center, ATTN: ATSB-DOTD-MAG, Fort Knox, Kentucky, 40121. (Telephone: AUTOVON 464-2249/2610 or commercial (502) 624-2249/2610.)

SECOND class postage paid at Fort Knox, Kentucky and additional mailing office.

ARMOR may be forwarded to military personnel whose change of address is caused by official orders (except at APO addresses) without payment of additional postage. The subscriber must notify the postmaster.
USPS 467-970

July-August 1985 Vol XCIV No. 4

FEATURES

DEPARTMENTS

COVER

With improved tank ammunition, eye injuries are accounting for a greater and greater number of casualties in modern war — more than 10 percent in some theaters of the Mideast wars. This led to research on improved "eye armor" for tankers, including the new ballistic goggle inserts described in the story that begins on page 25.

LETTERS

Leave The Cav Where It Is

Dear Sir,

I have just completed reading the March-April 1985 issue of *ARMOR* Magazine and found many references threaded throughout the issue to the cavalry of yesterday and today. Admittedly, we have progressed far beyond the horse cavalry and the early mechanized forces to the modern realm of mechanized and perhaps motorized cavalry, whether it be with the tanks and personnel carriers of the cavalry regiments or the APCs and new CFV of our modern cavalry forces.

It seems to me the theme expressed in this issue was the importance of the cavalry and our modern day, well-trained 19 Delta cavalry scout — truly, the ground eyes and ears of the regimental or divisional commander. Yet in our current and soon-to-be implemented doctrine pertaining to the division cavalry squadron, we see a squadron that in recent years consisted of three ground troops and one air troop now being structured as a two-plus-two cavalry element. I'm not faulting or discounting the obvious importance of the air troops in the squadron of today and tomorrow for they provide another set of eyes and ears for the ground commander.

I do have misgivings of taking the traditional role of the cavalry away from the control of the division commander and plugging into an organic role and chain of command of the soon-to-be constituted Air Cavalry Attack Brigade. I'm fearful that within the next few years, using current doctrine as a guide, the cavalry squadron as we know it today will soon disappear, for the two squadron troops will be so inundated with their air cavalry comrades it will be difficult for them to realistically perform their mission. And, should this happen, the ground commander at division level will lose a perspective that could lose the battle, for he loses access to the almost instantaneous frontline information and intelligence he gets from the current organization. We need the Air Cavalry Attack Brigade to perform important reconnaissance and attack missions in today's fast-moving battlefield environment. But let's not lose sight of that important 19 Delta cavalry scout, as set forth in a past issue of *ARMOR* in an article titled "The Indispensable Cavalry Scout", by then-Brigadier General David K. Doyle while serving as assistant commandant of the Armor School. General Doyle made a succinct and positive argument as to the importance of the ground scout.

I would agree with those who believe that cavalry is a concept on how best to operate, so with that in mind, it is my view we need a true balance between the air and ground side of the cavalry and, for that matter, the cavalry squadron; a side that in my judgment cannot be properly balanced while part of the Air Cavalry Attack Brigade. I am one of those individuals who looks to the future — the future of the Air-Land Battle; however, I've yet to be convinced the meshing of the division cavalry regiment into the Air Cavalry Attack Brigade is in the best interests of the command, our troopers and our soldiers, and for that matter the results of the battle.

Perhaps we need to rethink the role of the cavalry squadron without placing the two remaining ground troop commanders in a position where they *cannot effectively* be the ground eyes and ears of the division commander and thus insert their influence on the outcome of the battle by being unable to provide that instantaneous intelligence information so crucial to the commander and his staff.

PHILLIP J. ZELLER, JR.
Brigadier General, USAR (Ret.)
Junction City, KS

BG Zeller served as the commander of the 5th Cavalry Brigade (Training), USAR, the sister brigade of Fort Knox's 1st Armor Training Brigade. -Ed.

No Missiles on Tanks

Dear Sir,

I found "Our Tanks Need Missiles, Too" in the Jan-Feb 1985 issue of *ARMOR* Magazine disturbing to read. I think it misapplies the basic concept of tank-versus-antitank.

A tank is an offensive weapon system. It can kill enemy tanks, but it's primary purpose is to inflict destruction on all elements of the opponent through a combination of shock, mobility and firepower. A missile-firing tank, waiting in some treeline, or dug into a hole so that it can fire at the enemy at extended ranges, is a waste. It has sacrificed shock and mobility to increase its firepower against targets that can be engaged just as efficiently by other weapons systems developed specifically for that defensive purpose.

In the past, a missile tank has not been as effective as a tank firing conventional ammunition, because it created a much larger firing signature (especially if the launchers are the 'strap on' type), and exposed itself longer due to the missile guidance or target lock-on requirements. Several APFSDS rounds can be fired at a target in the same time it takes a single missile to fly the same route. And, when it hits, there is no guarantee that the missile will be more lethal than conventional ammunition.

A tank with missiles would also encourage the commander to use it as a supplement for his infantry, and aircraft-and artillery-fired antitank systems. Tanks are truly effective only when they are in the attack; taking the fight to the enemy, counter-attacking, pursuing and surrounding. Whether they have a 105-mm or a 150-mm main gun is not as important as how and when they are used. Installation of guided missiles will not enhance the purpose for which tanks were intended.

Don't put missiles on our tanks!

G.J. SAMSOM
Mount Clemens, MI

Reinventing the BTMS?

Dear Sir,

I read the Professional Thoughts article on "Improving The Training Approach" (March-April 1985 *ARMOR*) three times before the impact dawned on me.

The Army's congratulations are due to Lieutenant Colonel Hartjen and Mr. Duncan, PhD — they've discovered the Battalion Training Management System, a TRADOC initiative that's been in being for a number of years,

Doctrinal publications (ARs, SMs, CGs, etc.) of TRADOC proponency have recognized for years that IET (TRADOC's Little Red Schoolhouse) trains the soldier to standards in only a limited number of skills mainly oriented on individual survivability; this because of restraints on time and money for IET.

Training doctrine for IET soldiers mandates that the balance of individual/squad/crew/section/platoon and company skills are to be learned in the unit to standards established by the Soldier's Manual, Commander's Guide and the ARTEP.

Further, doctrinal guidance also mandates that the individual only be trained in those required skills appropriate to the unit mission and equipment on hand.

The authors' review of NETT Payoff (Master Gunner Corner, March-April 1985) should provide them insight on how units/soldiers are trained on new equipment.

It is inconceivable that senior officers (?) at HQ TRADOC should write an article espousing (and using *all* the training buzzwords except AirLand Battle) a system extant that can accomplish what they appear to conclude is the way soldiers and units should be trained.

JOHN R. FREEMAN
Colonel, AR (Ret), Texas ARNGUS

A View On Armor Manning

Dear Sir,

In the Jan-Feb 1985 issue of *ARMOR* Magazine there was a letter from First Lieutenant Steve J. Eden commenting on an article about automatic loaders for tanks. Mark him well, for we sorely need his common sense at the highest levels of leadership.

I support his position of retaining the human loader even with the advent of a mechanical loading device; however, I am certain that such a contraption will not be that accommodating. If I am correct, this will compound an already unsatisfactory situation.

The problem of inadequate tank personnel started with another developmental blunder. That was when the bow gunner's station was designed out of the *M48* tank, thereby reducing the crew from five to four.

Today, as in the pre-*M48* days, four crewmen is the *absolute* minimum required to properly operate and maintain a tank. In the days when five crewmen were authorized, you could usually count on having four available, but only after some juggling of personnel within a platoon or even a company.

You don't have to be too quick on the uptake to realize that with only four crewmen authorized you cannot possibly average four present for duty. That means many, if not most, of our million dollar-plus weapons systems are not adequately manned. Consequently, training and maintenance are adversely affected and mission accomplishment and survivability are jeopardized.

Sure, you can operate after a fashion with just three crewmen, but that is not good enough. And spare me the song and dance about battlefield overstrength authorizations. We need to close the barn door long before that.

Armor is only one of two arms with the mission "to close with and destroy the enemy." That is the very guts of the Army, yet armor units are short of personnel even when they are at full strength. QM, Finance, et al, are better off. If David Stockman wants to know of a real scandal and outrage he need look no further.

The absurdity of tank manning can be best illustrated by comparing it to that of the 155-mm SP artillery piece (which any layman would swear is a tank!). Counting the driver of the companion ammunition vehicle, the 155 has a crew of nine. I think most artillerymen will concede that this weapon can be effectively operated, under most conditions, with seven men — and I say that is overstated. Anyway, the point is, armor units have a manning level with absolutely no leeway and tanks have a direct fire role which presents a lot more alligators than artillery's usual indirect approach.

Lord knows I don't begrudge the artillery having plenty of soldiers, but I do resent armor not enjoying as good a situation.

Sadly enough, we in armor are largely to blame for paring the tank crew to an ineffective level (something the artillery will never be accused of doing to their units or letting others do to them). With few exceptions, armor leaders either openly or tacitly agreed to give up the BOG (bow gunner). When this happened, we lost the firepower of a machinegun, an assistant driver, a possible replacement hand, help in rearming and refueling, someone to aid in observation and guard duty, and someone to share in performing the many other tasks associated with operating a military force. In exchange, we got somewhat more space in the tank for adding a few rounds of ammunition. The Indians got a better deal for Manhattan.

In the event the loader is replaced by a machine, the justification will be that it enabled "them" to increase the loading rate by 17.6 percent or to reduce the tank silhouette by 7 inches, or some equally inane tradeoff. When the artillery eventually gets a mechanical ammunition loader, you can be sure that no manpower reduction will even be considered.

A factor that has been bandied about for years and is allied to manning is the use of double crews to facilitate 24-hour a day operation of tanks. I have reservations about the suitability and workability of this concept but, regardless, the first thing that needs doing is attaining authorization for a proper-size crew. Two undermanned crews, used in shifts, present the same problems as one.

Reinstatement of the five-man crew should be the overriding issue in armor. Return to the five-man force was broached about seven years ago. It narrowly failed acceptance because the armor people involved were not resolute, concerned, and knowledgeable enough to see it through. We need to do it once more with feeling.

Everyone else associated with armor will continue to be hampered, harmed or negated until this crucial situation is righted.

T.G. QUINN
Colonel, Armor (Ret)
Radcliff, KY.

Reading List Additions

Dear Sir,

Your Jan-Feb 1985 issue of *ARMOR* Magazine carried a basic reading list for armor officers and NCOs. While well-balanced in its technological, theoretical and Western historical aspects, it lacks an insight into the Soviets who, supposedly, we're supposed to know, be able to fight, and win against.

Martin Caidin's *The Tigers Are Burning* is largely an anecdotal account that deals only with the Battle of Kursk.

While I realize that you're going to get millions of letters like this, I nevertheless offer the following additions to your reading list:

Erickson, John. *The Road to Stalingrad*, Westview Press, Boulder, CO., reprinted 1984.

Erickson, John. *The Road to Berlin*, Westview Press, Boulder CO, 1983.

Gabriel, Richard A. *The New Red Legions*, Greenwood Press, Westport, CT, 1980.

Goldhammer, Herbert. *The Soviet Soldier*, Crane, Russak & Co., New York, 1975.

Hemsley, John. *Soviet Troop Control*, Brassey's Publlishers, Ltd., London, 1982.

Isby, David C. *Weapons and Tactics of the Soviet Army*, Jane's, London, 1981.

Scott, Harriet Fast, & Scott, William F. *The Armed Forces of the USSR*, (third edition), Westview Press, Boulder, CO., 1984.

There are, of course, many other good works in the field, notably P.H. Vigor's *Soviet Blitzkrieg Theory*, but many should be left to the specialist. If I had to recommend only one book from the list, it would be the Isby book, which is probably the best unclassified source on the Soviet military I've found yet.

PETER L. BUNCE
SFC, Armor
FRG

Responsibility for Ground Guides

Dear Sir,

The excellent article, "Preventing Combat Vehicle Injuries" (March-April 1985 *ARMOR*), was marred by the suggestion in the final vignette that the Chaparral crew was responsible for their injuries because they had not expected tracked vehicles in the area.

Responsibility for the accident rests squarely on the shoulders of the tank company commander who failed to ensure that all vehicles had ground guides once they left the tank trail.

JOHN C. CORNELSON
Colonel, Infantry
West Point, NY

Deep Attack - A New Buzzword?

Dear Sir:

During the past several months, I have become increasingly concerned with the continued misuse of the term "deep attack" and its association with our new doctrine. The two articles in your March-April issue, "Mounting the Deep Counterattack" and "The Deep Helicopter Raid" increased my concern. Although both articles were well written and very informative and I certainly agreed with the offense-minded philosophy of the authors, the terms used in these articles indicate a serious misunderstanding of the theory of maneuver warfare which forms the basis for FM 100-5 *Operations*. It appears this theory is being overshadowed at the tactical level by use of what could become a new buzzword — deep attack.

In recent months I attended seminars at both Fort Leavenworth, KS, and Fort Knox, KY, at which we discussed maneuver planning at the tactical level in great detail. In almost every circumstance, "the school solution" included a deep attack into the enemy flanks or rear using attack helicopters. I fully support an offense-minded philosophy and agree that we must penetrate to the enemy's rear area wherever and whenever possible. However, to merely capitalize on the term "deep attack" as a primary aspect in tactical problem solving indicates a superficial knowlege of the theory presented in FM 100-5 and, more

importantly, oversimplifies a dangerous and highly-risky maneuver option.

For the most part, "deep attack" as a means of planned maneuver should not even be considered at other than the strategic and operational levels of war. Certainly, at the tactical level it presents itself only as a tactical maneuver option. To plan as common practice in every tactical operation to send very vulnerable attack helicopter assets deep into the enemy's flanks and rear, or to send a battalion-size force of tanks "up the seam" is not what was intended as the basis for our tactical doctrine.

The Army has made great strides toward abandoning firepower-attrition warfare in hopes of relearning a method of tactical warfare that will bring us success on the battlefield. A more thorough understanding of the principles of Clausewitz and others from which our doctrinal theory was derived will hopefully prevent overuse of deep attack as a new buzzword and, more importantly, misapplication of our doctrine as outlined in FM 100-5.

JOSEPH W. SUTTON
Lieutenant Colonel, Armor
Washington, DC

Supports Chopper 'Ace' Probability

Dear Sir,

The March-April 1985 article by Captain Peters, "The Deep Attack Helicopter Raid," raised numerous excellent points with respect to how the helicopter as a new tool of war is evolving through the same painful process that the tank did 50 years ago. However, I was disappointed to read the comment about "There is no room for helicopter 'aces' in AirLand Battle."

We take pride in the U.S. Army of the three-dimensional aspects of our AirLand Battle doctrine and the flexibility that our Army Aviation forces gives us, yet we somehow still have difficulty grasping the fact that others, the Soviets in particular, may have also noticed this.

In the past decade, the Soviets have fielded a major combat helicopter force designed to operate as an Army Aviation ground forces asset. Unlike some Western observers, they do not anticipate two combined arms forces approaching each other like two inclined planes with all weapon systems concentrating on the tank as the major target.

Their *Mi-24 HIND* attack helicopters are intended to engage and destroy any high-value target (especially antitank systems like antitank helicopters) in its operational envelope. As a result, those who would employ U.S. helicopters in the face of such a threat should not expect to see them used in their intended roles and missions; i.e., antitank, medevac, air assault, command and control, or even fixed-wing close air support. If we intend to have a three-dimensional AirLand Battlefield, by using our own Army Aviation assets, adequate self defense capabilities for all of our helicopters is mandatory; otherwise, there could be a two-dimensional battlefield on our side of the FLOT and when the force ratios are as much in favor of the Soviets as they are, the subject of helicopter aces can be suddenly quite desirable.

Unfortunately, as in the development of the tank, we are lagging in this area compared to some other more progressive nations, to include, believe it or not, even some Third World nations with fairly small helicopter forces.

Armed Soviet helicopters like the *HIND* are currently prepared to engage other aircraft either offensively or defensively throughout the modern battlefield; in the future this threat will only be intensified with the arrival of new systems like the *HAVOC* or *HOKUM* (new model Soviet helicopters).

Those responsible for planning or commanding operations which employ large numbers of helicopters can be guaranteed that "aces" will be generated in the future. With all the extra leverage that helicopters in their various roles and missions can exert, a mission of dedicated air-to-air support could be the most important of all. After all, can the *ZSU-23-4* or *DIVAD* gun escort deep attack helicopter raids?

CHARLES B. COOK
Major, Army
Alexandria, VA

Armor Conference Videotapes Available

Videotapes of the 1985 Armor Conference are available from the TV Division, DOTD, USAARMS, Ft. Knox, KY 40121-5200. Requests must be channeled through your supporting TASC on a reimbursement tape basis. For further information, contact Ms. Barbara Greer, videotape librarian, at AV 464-3725/6146; Commercial (502) 624-3725/6146.

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Excerpts of the Armor Conference sessions will also be published in the Septemer-October issue of *ARMOR* Magazine.

Safety Is the Key

Dear Sir:

The article "Preventing Combat Vehicle Injuries" in the March-April 1985 issue of *ARMOR* magazine is superb.

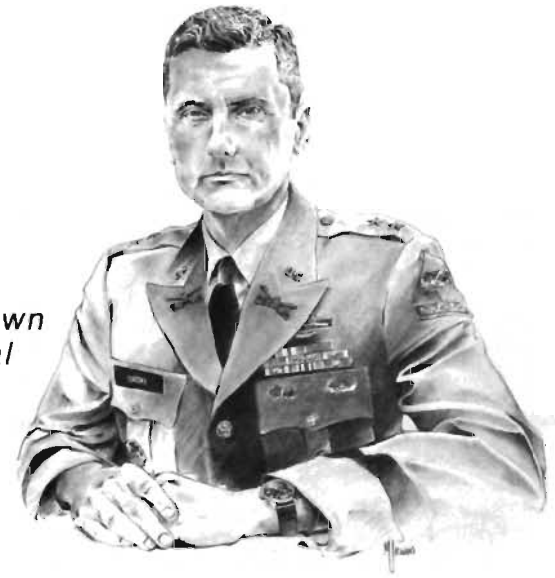
Many of us can relate to each one of the accidents described in the article, plus many, many, more similar type accidents which resulted in injuries, both minor and fatal. Emphasizing safety is the key — but persistence by all commanders is what will turn that key.

Inclusion of safety articles in *ARMOR* magazine is a good idea. This will improve safety awareness throughout the Armor Branch, decrease injuries, and prevent accidents. The net result is a combat multiplier.

Keep up the good work.

JOHN C. BAHNSEN
Brigadier General, GS
Fort Hood, TX

COMMANDER'S HATCH



MG Frederic J. Brown
Commanding General
U.S. Army Armor Center

Supporting and Maintaining Armor

Our fighting vehicles have come a long way in the past two decades. With the introduction of our new *M1A1 Abrams* and the improved *Bradley M2/M3*, we have a fighting capability unheard of not many years ago, with combat power on an order of magnitude greater than our fathers took into battle in World War II.

But we have not developed the support systems needed to get the most from these new systems. Battlefield maintenance, vehicle recovery, and supply have not kept pace.

We're moving to redress these problems, and our efforts are being supported by the other service schools and gaining the attention of decision-makers on the Department of Army staff. Let's look at some of the changes being worked on in various areas.

Maintenance

The same advances in technology that improved our combat power brought with them added complexity, which makes maintenance more difficult and time-consuming. Simplified test equipment, like the STE developed for the *M1* tank, were an attempt to ease the troubleshooter's task. It was a solid concept, but the set we fielded is bulky, difficult to use, and overly limited in its application. Many of our mechanics avoid using it completely. As a result, diagnosis is often faulty and the mechanic resorts to parts substitution until he hits on the solution to the problem. This is a primitive way to do it, expensive and unacceptable.

Now under development by USAARMS and the Tank Automotive Command (TACOM) is a new program to develop improved built-in test equipment (BITE) applying the latest in vehicle electronics, or vetronics. The goal is to simplify troubleshooting to the point where the fault is isolated to not more than two line-replacement items while scaling down the size and complexity of the testing equipment. Vetronics promises to be "user-friendly" and capable of supporting the two-hour fix-forward concept. Vetronics would provide almost instantaneous isolation of the fault. A process that now involves selecting the faulty system by reference to a technical manual, hooking up the test set, running the self test, and performing the selected test routine, would be accomplished in seconds.

Another good idea, developed by a mechanic here at Fort Knox, is now undergoing evaluation by the Army Materiel Command. It is a low-cost, locally-fabricated device that can be attached to the diffuser housing of the *M1* tank engine, using bleed air from the engine to provide a 50-60 psi. air source. Linked to a cleaning wand, this compressed air source can then be used to purge dirt and grit from the tank's air filters and oil coolers. We've tried this device and it works. Now USAARMS is pushing for early fielding to the people who developed it, the tankers.

Battle Damage Repair

Over the years, we've given little thought and too little action to the question of repairing battlefield damage. Who does it? How much is he supposed to do? How does he do it?

USAARMS is currently teamed up with the Army Materiel Systems Analysis Agency and the Ballistic Research Laboratory in evaluating whether tank crews and mechanics are able to apply the Army's new Battle Damage Assessment and Repair (BDAR) doctrine. As part of this effort, soldiers will assess realistic battlefield damage and make repairs to their level of capability, following TM 9-2350-255BD. We're going to try to assess the adequacy of the procedures and how best we can

return a damaged vehicle to combat quickly. The need is clear and we should have done it a long time ago. Now we're on track.

As an adjunct to the BDAR assessment, we're also evaluating the adequacy of combat Prescribed Load Lists (PLL). The items on our current combat PLL will be compared to those damaged in the BDAR evaluation as well as to a list of line replacement units (LRUs) having a high usage rate. From this evaluation, I'm confident we will be able to restructure the combat PLL into one having a high probability of supplying the parts most needed in the battle area.

Recovery

M1 Abrams units have already been experiencing difficulty attempting to tow and recover their tanks with the *M88A1*, which is on the verge of being underpowered and underweight, weighing less than the tank being recovered. The problem won't get any better with the fielding of the heavier *M1A1* and the *Sergeant York* air defense system.

USAARMS is now working with the U.S. Army Ordnance School to improve heavy vehicle recovery. At the moment, two possible solutions are under consideration. One is to field an *M88A1* with a bigger engine. Also being considered is the development of an entirely new, heavier recovery vehicle based on the *M1* chassis and power plant.

The decision on what course we'll take will be made this year, but whatever course of action is chosen, you will get a recovery vehicle capable of doing its job well into the 21st Century.

The Ordnance School is also initiating a requirement for a new Armored Maintenance Vehicle (AMV) designed to replace the *M113* now used by battalion maintenance personnel. The vehicle would include a crane capable of lifting a tank's power pack, plus increased stowage space for tools, test sets, parts, and maintenance personnel. AMV prototypes are now being evaluated at Fort Hood. Your pleas have been heard; now it's time for action.

Supply

We're also concerned about resupply of armor units, particularly the tactical delivery of fuel and ammunition. Part of the price we paid for the agility and mobility of the *Abrams* and *Bradley* systems has been a significant appetite for fuel. With the introduction of the 120-mm gun on the *M1A1*, rounds will be larger and fewer, meaning our resupply vehicles will have to carry more fuel and more ammunition than in the past and deliver it farther and faster. Because the new ammunition is larger and requires more protection in transport, a single truck can carry only two-thirds the amount of 120-mm ammunition as it can 105-mm rounds. Our problem, then, is threefold: speed, tonnage, and mobility.

Improvements are on the way. We saw the first major improvement last year, with the introduction of the *M833* 105-mm AFSDS round with its new packaging system. Each round is stored and shipped in a metal canister, 30 canisters to a pallet. Each canister can be opened and the round removed without breaking the pallet banding.

In a test last fall at Fort Hood, a truck loaded with palletized ammunition pulled alongside an *M1* tank and two crewmembers, standing on the tank's fenders, extracted clean rounds from the canisters without breaking the pallet strapping. They passed the rounds to the loader, who placed them in the turret racks. The crew rearmed the tank at the rate of five rounds a minute. Compare that to rearming from the old wooden boxes. Under those circumstances, a crew of four was needed to achieve a rearm rate of only one round a minute.

A similar canister system is being developed for the *M1A1's* 120-mm round, and we're pushing for an even better lighter weight container in the near future. A metal pallet will replace the wooden one.

Our new ammunition packaging will not only speed the rearming process, but will also permit the decontamination of a palletized load should it become exposed to chemical attack. The new system will also eliminate "packaging litter," a headache well known to all of us who have had to "hump ammo."

Another step forward in resupply will be taken this year with the first issue of the *M977* (cargo) and *M978* (POL) 10-ton Heavy Expanded Mobility Tactical Trucks (HEMTT) to armor units. These trucks will not only carry more of our critical supplies, but will have material handling equipment on board to speed the resupply process. A HEMTT wrecker, the *M948E1*, will enter the inventory next year.

While the HEMTT trucks provide an important step forward, USAARMS recognizes that trucks, even with the most advanced wheel technology available, lack the mobility and survivability to totally resupply our fighting units unless the units withdraw from fighting positions. We all know that is not good enough. The vehicle will have to be able to transfer the supplies to the fighting vehicle rapidly without tiring the crew. It will have to be mobile enough to keep up with the units it is supporting in the deep attack. It will have to protect crew and cargo against small caliber weapons and ballistic fragments. This is a tall, expensive, but needed order.

To carry it out, we've begun a new research and development program for a Forward Area Armored Logistics System (FAALS). The concept calls for a vehicle that can be easily tailored to different roles, from POL or cargo haulage to medical evacuation. This will be accomplished by tailoring the vehicle's configuration to the mission at hand. The vehicle will be armored and equipped with material handling equipment to speed the transfer of fuel and ammunition. This same basic vehicle with a different module could perhaps replace the *M577* command post vehicles and the *M113*-based armored medical evacuation vehicles.

Support for this program has been building at a number of other Army centers and schools. Our aim is to use prototypes of the FAALS in support of the next product-improved *M1* tank when it is tested next year.

USAARMS is dedicated not only to providing the members of the armor team with the best possible weapon systems, but also to providing them with the tools, equipment, and doctrine necessary for adequately maintaining and supporting those systems. I have outlined a number of new ideas, concepts and equipment. Clearly, they are not all-inclusive, but they are all needed. As Chief of Armor, I need to do all I can to improve combat service support for our branch, but I need and want your help. Good ideas have no rank. How are we doing?

Forge the Thunderbolt!

ARMOR'S SEAT

CSM John M. Stephens
Command Sergeant Major
U.S. Army Armor Center

The Excellence Program and Armor's Future

The Armor One Station Unit Training (OSUT) Excellence Program, which was developed in late FY84, is being continued as an experimental program pending further evaluation. What exactly is the program?

The Excellence Track (ET) Program is designed to provide the best possible training. Briefly, it:

- Identifies those high-quality Initial Entry Training (IET) soldiers who possess a high degree of motivation and places them in an accelerated training program which goes beyond the requirements of the current Program of Instruction (POI).
- Gives the selected IET soldiers more time with hard-skill tank tasks and technical subjects and provides them tangible rewards.
- Documents the accelerated training and ensures that the gaining command is made aware of the pending assignment of an ET graduate.

The above goals are accomplished through:

- A stringent selection process designed to nominate the most qualified candidates at the end of the seventh week of OSUT. The nomination is based upon the soldier's demonstrated ability to learn, his motivation, leadership potential, physical fitness, and technical proficiency.

All IET soldiers are evaluated by their End of Block (EOB) test results, physical fitness performance, individual weapons qualification, End of Phase Test results during the initial seven weeks of training, and a written comprehensive test.

Nominated soldiers must pass a unit-administered psychomotor test to determine their ability to track a target. (Note: All soldiers have previously had their visual acuity and ability to distinguish colors evaluated at a Military Entrance Processing Station (MEPS) and at the Armor Center's Reception Station.)

As the last step, the unit conducts a selection board consisting of the CO, 1SG, and PSG, and develops an Order of Merit List (OML) of nominees. The company commander then uses the list to select soldiers for participation in ET. The number of soldiers selected for ET is determined by the number of qualified soldiers and the unit's training capacity; usually 20 percent of its trainees.

Additional training for each ET soldier includes over 40 additional hours of gunnery instruction, 11 to 14 main gun rounds per ET student (versus five rounds per regular student), approximately five hours driving time per ET student versus 2.5 hours per regular student and, execution of a moving live-fire tank gunnery table.

The company commander can recommend up to 10 percent of the E-1 population at the time of selection to be promoted to E-2. The Order of Merit List established for selection is also used to select those who will be promoted. The company commander may also recommend that soldiers who successfully complete ET training be promoted to E-3 upon OSUT graduation.

The soldier's personnel file is annotated with distinguishing data upon successful completion of ET. Additionally, the training identifies the soldier as an ET participant who possesses skills beyond those of the average OSUT graduate. This information can then assist the gaining commander in his assignment of the ET soldier.

Why is early identification of quality personnel imporant to the force?

First, it gives the commander in the field a better feel for the quality of soldiers he is receiving. Knowing that the soldier has received increased skill training and has been promoted ahead of his peers should influence the decision of rapid crew assignment to the gunner's position.

However, training and assignment of the soldiers is only the start. The unit has the responsibility to improve on the soldier's quality by continuing a stepped-up training program. This can be accomplished by exploiting the soldier's leadership and technical capabilities through assignments that require increased responsibility. As those responsibilities are increased, the soldier must still maintain good discipline by demonstrated outstanding performance in areas of military appear-

ance, appearance of individual area of responsibility, obedience to orders, etc. Any soldier who is in the excellence program and is not a disciplined soldier should be removed from the program quickly.

A well-motivated soldier who has demonstrated good discipline with increased technical proficiency skills should be advanced to a higher grade early on. As he becomes eligible and is selected for promotion to E-5, the soldier must attend the Primary Leadership Development course to build the leadership skills needed to be a noncommissioned officer.

We, Armor, lose high quality NCOs to other career management fields simply because we don't take care of our own. That's why it is important that Armor develops an Armor Commander Professional Development Program for tankers and scouts.

Through the use of the noncommissioned officers education system, skill qualification testing, Certification I Testing (TCGST) and Certification II Testing (two-hour written skill 3/4 for the E-5 after BNCOC), we have now identified a highly-motivated noncommissioned officer who is chomping at the bit to excel. Now comes the secondary advancement to SSG.

If a soldier has demonstrated the discipline, esprit, and proficiency needed to be a front-running achiever for five years, he obviously should be retained in Armor at a higher expense than the average soldier. A bonus, SRB or whatever you want to call it, needs to be made available. The bonus for ET NCOs should be larger than the bonus for the average soldier. However, when he reenlists for 6 years, receives a big bonus, and is promoted SSG, he must stay in Armor. He cannot migrate to another CMF nor be involuntarily assigned to another CMF. In my opinion, this NCO should be sent to Master Gunner School after promotion to SSG, and stabilized in a unit for three years.

At this point, we will have captured the top quality Armor soldier up to the grade of SFC (Secondary promotions to E-7 are being identified at 2.8 years in grade as a SSG). He has not been diverted to recruiting duty, drill sergeant duty or other assignments that remove our best NCOs before some of them have had enough time on the vehicles to become competent tank commanders. Even if they are later assigned outside their MOS as SFCs and after ANCOC, there would be a minimal amount of training required compared with the training of an NCO who is taken from his CMF as a SGT or newly promoted SSG. At this earlier stage, he hasn't had a chance to execute his skills individually or as part of a crew.

How important is the Excellence Track? Look beyond the grade of SFC. Look at the impact this program will have at the MSG, 1SG, SGM or CSM (E-8, E-9) level. Even beyond that is our ability to move into our leader's position in combat if necessary. I am sure all of us agree that the excellence program would be more than welcomed in the field.

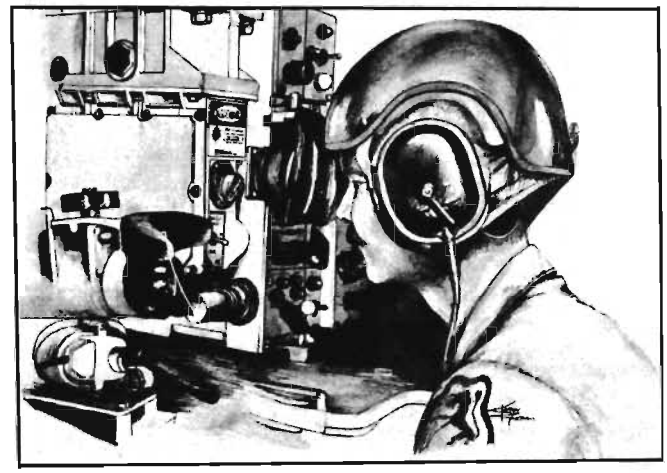
During recent visits to the field divisions, those officers and noncommissioned officers who had ET soldiers in their units had nothing but praise for the program. There were a few negative comments, but as I mentioned before, when you find a bad one, take him out of the program.

In any case, we need to hear from you. No test is going to survive without hard copy facts from the user who says the product is worth keeping. Write to the Commanding General, the 1st Armored Training Brigade Commander, the Office of the Chief of Armor, or myself, here at Fort Knox. Tell us what the quality is —good, bad, recommendations to improve, etc — The important point is that we need documentation from the field.

The Excellence Program is essential to the future of the Armor Force!

MASTER GUNNER'S CORNER

Donald M. Kristiansen
US Army Research Institute,
Fort Knox Field Unit



Factors in Gunnery Success

In the spring of 1983, representatives of the Army Research Institute's (ARI) Fort Knox Field Unit went to Europe to examine the state of training in a sample group of armor battalions. Individual and crew performance had been assessed in the fall of 1982 and the question was: "Could the battalions maintain this level of performance out of their own resources across a six-month time period?"

Since we could not be on the ground throughout this six-month period, we needed to get descriptions of the training that took place from someone who was there. The best way to do this was to conduct in-depth interviews with all levels of the chain of command at several time intervals. To make sure that we captured everyone's perspective, we covered all the officers and well over half the enlisted men in two armor battalions. The final major exercise that we had a chance to talk to them about was Level I Gunnery.

We were concerned with how they felt they had done. Were they satisfied with their performance? We asked them to describe their "success" on Tank Table VIII; i.e., did they qualify? Were they "distinguished?" Since the training schedules showed essentially the same preparation activities, and the battalions did not differ much in percent of tanks qualified, we expected to get essentially the same reports from both battalions.

We didn't!

The battalions differed considerably in their self-reports (see table 1), particularly in the number that reported qualifying "distinguished." Since this was so unexpected (observers reported no real differences in the way the tables had been conducted — one battalion was not "more lenient" than the other), we decided to search through all the interview data we had collected to see if it would account for the difference. We felt that, surely, we would find a *key* to help us explain why one battalion felt very good and did very well.

Table 1
Percent Reporting "Distinguished"

	Bn 1	Bn 2
NCOs	8	52
Crewmen	6	45

As we sorted through the interviews, it became apparent that we were not going to find one *key* factor; we were going to find a host of factors that seemed to support the difference in gunnery success. Since gunnery success (or lack of it) is often explained by an appeal to one or two significant pre-gunnery exercises (or constraints), we felt that we should highlight the fact that, at least in this instance, success was caused by several factors. Battalion 2 had a lot more going for it than was apparent on the surface. Detailed below are the reports from the officers and men of the two battalions that, with little doubt, support the gunnery difference.

Turbulence. Battalion 2 experienced less duty position turbulence than battalion 1. Company commanders averaged over 4 months longer in position, the platoon leadership (platoon leaders, platoon sergeants, and tank commanders) averaged over 3 months longer in position, and crewmen averaged over 2 months longer in position. Battalion 2 also experienced less tank-to-tank turbulence among the men in platoon leadership positions (almost 4 months longer on "current" tank).

Reclassification. A lower percentage of the platoon-armor level MOS.

Pre-Gunnery Training. Crewmen in battalion 2 reported getting "lasing" training prior to Table VIII;

no one in battalion 1 mentioned lasing training. Few crewmen in battalion 2 reported getting "no training" prior to gunnery; over a third of the crewmen in battalion 1 gave such a report. (Note that this says the crewmen *felt that* they received no training, whether they did or not. Whatever happened, they didn't think it was "training.") Battalion 2 fired Table VII; battalion 1 did not.

In Battalion 2:

- Commanders reported more hours of training conducted and more hours of personal training supervision.
- Platoon-level leaders reported more hours spent instructing.
- More of the platoon-level leaders and crewmen reported that tasks "are normally trained to a standard" in their unit.
- Commanders reported more freedom to plan and conduct training (more about this below).
- More of the platoon-level leaders said they had few significant training problems.
- Fewer platoon-level leaders said that "details" were a training problem (while both battalions appeared to have the same detail load).
- More crewmen reported using the Soldier's Manual to prepare for training.

Both of these battalions were assigned to the same brigade. There are no data to support the notion that battalion 2 was filled with higher quality manpower. The battalions had similar local training areas (LTAs) and maintenance facilities. The difference between them appears to lie in three areas: duty position turbulence (a form of cohesion?), the freedom given to company commanders to conduct home station training (an indirect result of cohesion?) and the attention paid to home station training.

The impact of turbulence has been amply documented. Duty position turbulence is especially destructive of crew performance. (Most commanders, however, tend to see duty position turbulence in a positive light. Promotions in grade, or within a crew to a more responsible position, are examples of duty position turbulence. These changes put men into positions for which they are relatively untrained. Few units have viable in-unit programs to train individual tasks to qualify crewmen for these new duty positions. Hence, at any given time, a number of men are serving in positions for which they have received no "recent" formal training. This acts to degrade unit performance levels.)

Battalion 2 enjoyed a longer period of pre-gunnery stabilization which reduced duty position turbulence. Battalion 2 also had less tank-to-tank turbulence (men staying in the same duty position but moving to a different tank). Such turbulence is not as serious as duty position turbulence but still takes its toll on crew performance.

As a result of less turbulence, the crews, platoons, and companies of battalion 2 were more "cohesive." They had been together longer, trained together longer, and had a basis, from their shared experiences, for realistically adjusting to each other's strengths and weaknesses.

In battalion 2, each level of the chain of command had more trust in the levels below and above. Company commanders were given more freedom to plan and conduct training. Company commanders reported that the battalion commander trusted them to prepare their units for each major exercise. One company commander said that, "Colonel X trusts us. We've been together a long time now. He knows us now and lets us pretty much alone. We know what we have to do to get ready for an exercise." There seemed to be a more relaxed training climate in battalion 2.

The relative decentralization of training had another benefit. From the crewmen's perspective, more training was conducted in battalion 2. Both battalions had about the same amount of training planned and both battalions conducted essentially the same exercises. What decentralization seemed to do for battalion 2 was to put more men on the ground when a training activity was taking place. We saw less waiting around for "someone with authority" to get things going. There was also more platoon-level activity in the LTA.

The commander in battalion 1 had less experience with his subordinate commanders and, hence, exercised more control. In battalion 2, the company commanders responded very positively to the trust given them and created imaginative training programs out of meager training opportunities. For example, one commander made a deal with the airfield commander to use the airstrip and the surrounding ground to set up a dry-fire Table VIII. Each platoon took multiple turns on this makeshift Table VIII between aircraft landings and takeoffs. One company moved to the LTA and trained crewmen available for duty within four-hour blocks. Each four hours was taken as a training window and, whoever was available was inserted into a training activity. In battalion 1, platoons and companies tended to wait for battalion sanction before conducting a training exercise of this magnitude.

Finally, in battalion 2, more attention was paid to day-to-day sustainment training activities. There was more supervision of training which kept training activities on track, tended to keep them from being prematurely curtailed, and tended to increase attendance. There was more training volume; that is, more crewman-training hours were conducted (and time spent performing a task is a good predictor of proficiency). Crewmen in battalion 2 spent more hours actually performing tasks under supervision (which is a good definition of training).

During post-gunnery discussions in battalion 2, soldiers attributed their success to home station training that was conducted immediately prior to Level I Gunnery. This training did not differ appreciably from that conducted by battalion 1, however. This was not a *key* factor. Soldiers did not focus on the other factors uncovered by the interviews. How does a commander (or his men, for that matter) come to know (without too much ambiguity) that his unit is ready? Positive reports of readiness are usually accompanied by frantic activity to prepare. The two evoke an image of incompatible behaviors; "We're ready, but we have to work like mad to get ready."

A longer view has to be taken. Instead of the usual cycle of "rehearse for the next exercise — conduct the exercise — stand down — rehearse for the next exercise — etc.", units can perform better, like battalion 2, if they establish a long term commitment to attention to detail in day-to-day training and if they work to establish a more *cohesive* combat force.

RECOGNITION QUIZ

This Recognition Quiz is designed to enable the reader to test his ability to identify armored vehicles, aircraft, and other equipment of armed forces throughout the world. *ARMOR* will only be able to sustain this feature through the help of our readers who can provide us with good photographs of vehicles and aircraft. Pictures furnished by our readers will be returned and appropriate credit lines will be used to identify the source of pictures used. Descriptive data concerning the vehicle or aircraft appearing in a picture should also be provided.

(Answers on page 48)

1

2

3

4

5

6

Getting Ready to Draw POMCUS Stocks

by Major (P) Lyman L. Harrold

Soldiers assigned to Continental U.S. (CONUS)-based units with POMCUS equipment stored in Europe are familiar with the acronym POMCUS. For others, POMCUS stands for pre-positioning of materiel configured to unit sets. POMCUS is stored by the U.S. Army Combat Equipment Group, Europe (USACEGE), a major subordinate command of the 21st Support Command. In 1985, USACEGE will store 476 unit sets of equipment at twelve different locations (Combat Equipment Companies) within West Germany, Belgium, Great Britain and the Netherlands. These unit sets include more than 35,000 wheeled and tracked vehicles, plus all of the ancillary equipment authorized by the Tables of Equipment and Organization (TO&E).

The POMCUS concept is a viable alternative to the stationing of fully-manned and equipped units in Western Europe. This concept is tested each year during the REFORGER exercises. REFORGER (Return of Forces to Germany) has proven that POMCUS works.

Drawing POMCUS is not as awesome an undertaking as it may seem. The personnel assigned to USACEGE are a highly skilled and experienced group of civilian and military personnel. All that must be added to make your POMCUS experience a rewarding and meaningful experience, is an understanding of the procedures and some preliminary CONUS training.

Each year, the 21st Support Command and USACEGE receive CONUS units, with POMCUS stocks, as participants in the POMCUS Inspection and Reconnaissance Program (PIREP). These units receive briefings and orientation tours of the appropriate Combat Equipment Company (CEC), Marshalling Areas (MA), Ammunition Supply Points/Pre-stock Points (ASP/PSP). During their time at the CEC, the unit representatives receive detailed briefings, which explain how their particular set of equipment will be issued. They also inspect the storage site and the POMCUS equipment, and they review all of the applicable supply documents. This information, along with the USACEGE Issue SOP for POMCUS Equipment and the CEC's SOP, is taken back to CONUS and will provide the starting point for unit and individual training.

The Issue SOP provides a wealth of information for the unit. It explains procedures to be accomplished prior to the unit's arrival at the storage site; recommended composition of the liaison party and the advance party, and their responsibilities and issue procedures. Site configurations, logistics considerations, safety requirements, and even a commander's checklist are also provided.

For the purpose of clarity, this article focuses on a tank battalion. As always, good training begins with prior planning. The battalion should plan on drawing everything shown on their POMCUS hand receipt, identified in the on-hand column. The equipment is stored in a ready-to-issue posture. Ths means all radios are mounted on vehicles, in accordance with a COMMEL Upload Plan (CUP), and that vehicles are stored with camouflage support systems and screens, basic issue items (BII), rail load tie-down equipment, tank and pump units (TPU), organizational tool sets, and prescribed load lists (PLL) already uploaded in accordance with a CEGE-wide standardized plan. About all that must be added to make each vehicle fully operational are the batteries and a

Pre-charged batteries are ready for installation by members of units drawing POMCUS equipment, but units must bring tool sets with them.

tank of fuel. This is where the training should begin.

The advance party is critical to the successful accomplishment of a POMCUS issue. If the soldiers know how to perform their various tasks and are cross-trained to perform one or two others, the draw of POMCUS will proceed smoothly.

The composition of the advance party, identifies the training requirements. The advance party, by USACEGE SOP, should be organized into eight units: The command element; property book officer hand receipt holder; battery installation team; fuel team; driver team; maintenance team; ancillary equipment team, and trailer team.

An examination of the duties and responsibilities of each team will help to identify some of the specific CONUS training requirements. The command element should be in the liaison party, which arrives 48 hours before the advance party. The battalion XO and senior NCO are recommended for this duty. As part of the liaison party, they will have already had an opportunity to recon the site, pre-inventory, and to gather information from the CEGE Issue OIC. They will work closely with the Issue OIC to coordinate issue requirements and to command and control the unit's personnel.

The unit property book officer hand receipt holder should also be a member of the liaison party. He should have reviewed the unit hand receipt and conducted a preliminary end-item inventory, so that he knows what he is to receive and will assume responsibility for it once the equipment is issued.

The battery installation team members do exactly that; they install the batteries, which have been pre-activated by CEGE, into the vehicles. This team must be thoroughly familiar with the battery wiring diagrams of each type of vehicle in the unit set. Speed and safety are of the essence in this operation. The team should practice with 3/8-inch drive speed wrenches and sockets to install batteries into the battery compartments of each type of vehicle to be drawn.

The fuel team is made up of personnel who must be certified as fuel handlers. This team must be totally familiar with the operational requirements and safety procedures necessary to operate all types of military equipment. The fuel team will be responsible for all in-warehouse fueling operations, as well as exterior fuel points where all vehicles are topped off.

The driver team is the most critical of all the teams and should also be the most versatile. During the initial stages of the POMCUS issue, the drivers will assist the battery installation team and the fuel team as they activate the vehicles. As the vehicles are activated, the drivers will drive them through the issue flow to the staging area, then ultimately onto the marshalling area. In most instances, the drivers will return to the storage site and drive following vehicles through the issue flow. It is not necessary for the drivers to be certified as fuel handlers. They should, however, be qualified to operate several different types of vehicles, both wheel and track.

The maintenance team performs necessary organizational maintenance and assists with starting stubborn vehicles. The mechanics on the maintenance team must bring tool boxes with them on the aircraft because there are no mechanic's tool boxes in POMCUS. The battalion maintenance platoon is ideally suited for this mission.

The ancillary equipment team is comprised of a multi-functional group of specialists, including the unit armorers, who draw crew-served weapons; and supply sergeants who inventory, draw, and hand-receipt the ancillary equipment, crew-served weapons and CTA equipment. This team also operates the inventory control point.

The trailer team is the least technical team. The team's primary function is to attach the trailers to the prime-movers, by size, and to hook up inter-vehicular cables, safety chains and brake lines.

The duties and responsibilities just described are really nothing out of the ordinary for the soldiers of a typical tank battalion. However, it is in everyone's best interest if extra training is conducted to increase proficiency. The drawing unit must also

Above, a unit fuels its trucks as they move from temperature-humidity-controlled warehouses.

At left, a warrant officer explains the fueling routine and operation of the hose reels.

Below left, a driver clears the property book stop enroute to Reforger.

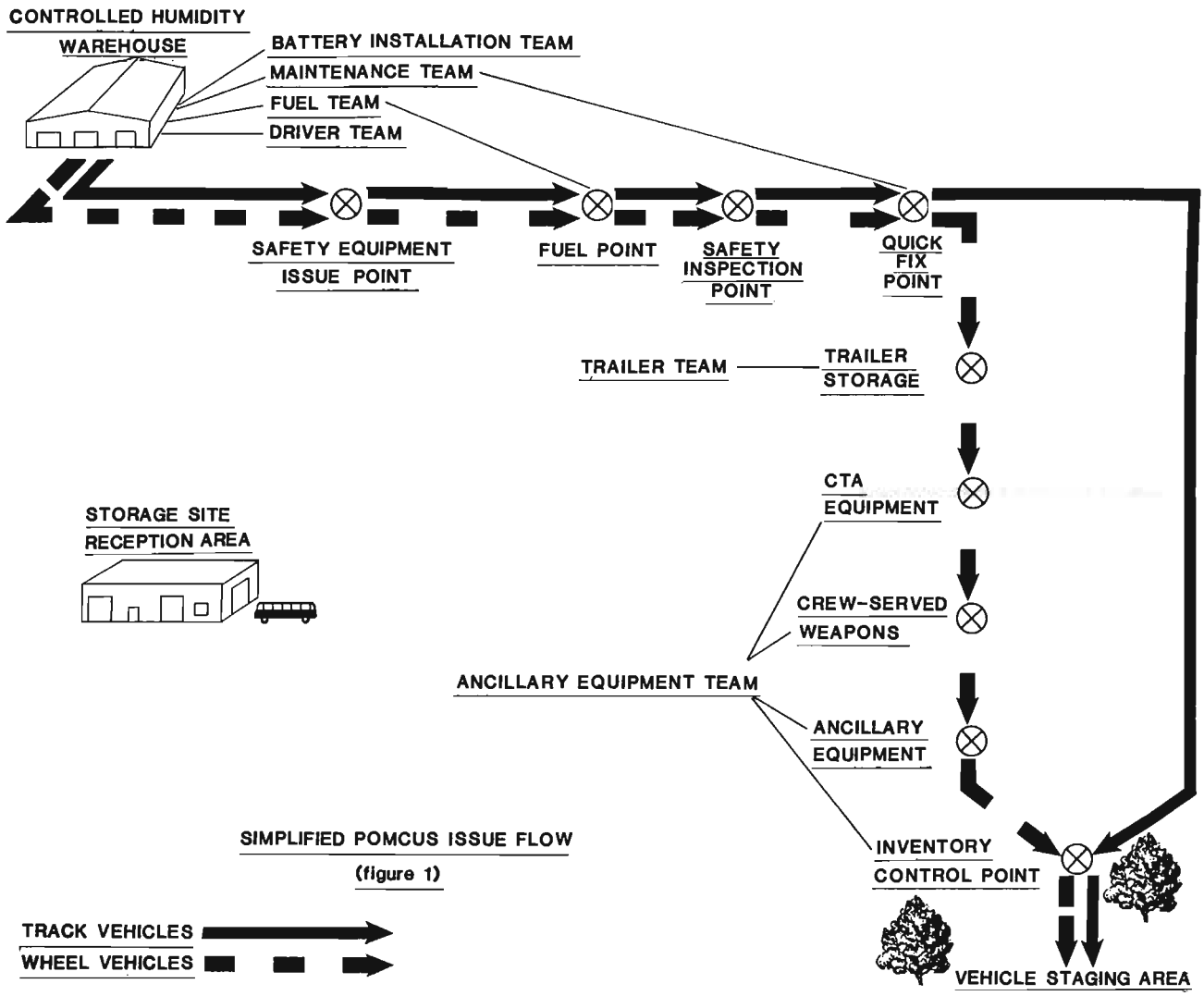
Figure 1, at right, illustrates the flow of POMCUS issue process for both wheeled and tracked vehicles.

be prepared to provide for site security during the issue of equipment. This is best accomplished by assigning that mission to one of the organized teams. Coordination with the storage site commander or issue OIC should include this critical mission. Once on the ground, the unit security element will conduct a reconnaissance of prepared defensive positions which have been established by the combat equipment company's security element.

There has been much said of the *issue flow*. Although it will vary from one storage unit to another, the issue flow is nothing more than an organization of those activities which must occur from the time the advance party arrives until the equipment departs the storage site *enroute* to the marshalling area. Variations of the issue flow are driven by the configuration of the storage sites themselves. An example of an issue flow is shown in figure 1.

The advance party arrives at the POMCUS storage site and is met by representatives of the drawing unit's liaison party OIC, a representative of the marshalling area control group, and the issue OIC. The briefings will provide information pertinent to the tactical situation, site configuration, activities in the marshalling area, and other information. Simultaneously, the rest of the advance party is formed by the unit NCOs. Once formed, they are then joined by key personnel of the CEC and organized into their specified teams. Within approximately one hour of the arrival of the advance party, everyone will be ready to begin issue operations.

The issue flow begins at the controlled humidity warehouse (CHW) where the battery installation, fuel, maintenance, and driver teams, augmented by CEGE military and civ-



SIMPLIFIED POMCUS ISSUE FLOW

(figure 1)

ilian personnel, begin to work. Twenty gallons of fuel will be pumped into all diesel-fueled vehicles by the fueling team. Following on their heels, the battery installation team activates the electrical systems and the drivers perform simultaneous preoperational checks. Gasoline-fueled vehicles must be pushed or towed from the CHW for fueling because of the fuel explosion hazards of gasoline. Once activated, the vehicles are started and driven from the CHW to a safety equipment issue point and on to a fuel point where they will be topped off. The fuel team is responsible for operating all fuel-dispensing equipment, and ensuring that safety precautions are observed.

Once topped off, the wheeled vehicle drivers follow a clearly marked route to the trailer issue point (track vehicles do not draw trailers), then to a safety inspection checkpoint. If minor repairs or adjustments are required, the quick fix point will be the next stop.

The inventory control is the next stop for all vehicles. Here, an end-item accountability check will be made by a team of both the drawing unit and CEGE supply personnel. Then it's on to the staging area for the tracked vehicles and light, wheeled vehicles. All cargo trucks will be directed to up-load points where pre-inventoried ancillary equipment will be loaded. Finally, it is at the staging area where all vehicles join up and await clearance to move on to the marshalling area.

A POMCUS equipment draw must be a very efficient undertaking and you can be assured that the storage site personnel will do everything possible to make it well organized. However, the drawing unit's preparation and attitude are what really determine the outcome. As in every operation, prior coordination, preparation and training are critical.

If the soldiers know what to expect, have been trained for it, and their leaders set the example, the outcome will be an efficient, safe, and successful POMCUS equipment issue.

MAJOR (P) LYMAN L. HARROLD is a graduate of Arizona State University and has 16 years service. His primary specialty is armor with a secondary of maintenance management. He has commanded a tank company, a maintenance company and served as battalion S3 at Ft. Hood, Texas. He is presently commander, 6th Combat Equipment Company, Miesau, West Germany.

Light Armour in Light Force Operations

by Lieutenant Colonel Michael E. Cullinan

Introduction

In the 40 years since the end of WW II, the United Kingdom (UK) has deployed light forces on operations of various kinds on 74 occasions. These operations involved a variety of force levels, anything from three divisions to less than a battalion, and a wide range of environments from Western Europe to Asia, Central America and the Middle East. Experience has been gained of operating in deserts, mountains, jungles — including the concrete city jungles — and the particularly bleak terrain of Korea and the Falkland Islands. The availability of light armoured vehicles (LAV) in 72 of these operations proved invaluable.

These light armour forces employing their classic armoured tactical characteristics of firepower, mobility and protection, were the "Jack of All Trades" of the operations. Mobility and flexibility have been their most important characteristics, while firepower and protection, though useful, have generally been less in demand. In the same way that main battle tanks exploit their characteristics to produce shock action, so LAVs have provided versatility, an asset demonstrated in the way light armour units performed their role and many varied tasks.

Light Armour Characteristics

The principal characteristics of an armoured vehicle are its mobility, protection and firepower. The priority given to each determines the nature and the use of the vehicle. In the main battle tank, the emphasis is on firepower and protection, whereas the LAV's design emphasizes mobility with limited firepower and relatively little protection. To the LAV's advantages may be added flexibility which stems from the versatile nature of the vehicle and the excellent communications provided.

Mobility. LAVs can travel quickly on roads and tracks and have good endurance. Their excellent agility and cross-country performance reduces their dependence on roads for tactical movement. They are also airportable, and in most cases, airdroppable. A light armour force can take on wide-ranging operations and achieve quick shifts in weight and direction of operations. It is important, however, to appreciate that mobility is not an end in itself but a means of achieving that end at minimum risk and maximum effectiveness. An LAV is relatively useless when on the move, as it cannot observe or fire effectively, and thus if there are enemy about it is likely to come off second best in the ensuing battle.

Mobility enables a vehicle to move from one position of observation and fire to another by the shortest or safest route and at best speed, cutting unproductive time to a minimum. It also provides a degree of protection, as a vehicle moving fast across country is likely to be much harder to hit then one moving slowly on a road.

Running Gear. The choice of wheels or tracks is determined by the LAV's operational role. If cross-country mobility, especially over soft or marshy ground, is of prime importance, then the lower ground pressure achieved by tracks offers a major advantage. However, in general, track-laying vehicles tend to be noisier, more complicated, and harder to maintain. They cannot travel as fast on roads and the tracks wear out sooner. Track life is a significant factor in the cost of ownership. Thus, when cross-country mobility is less important, a wheeled vehicle is preferred.

It is interesting to note that various attempts have been made to combine the advantages of wheels and tracks, such as the highly successful U.S. half-track which was used extensively in the desert. A UK-

At left, cannon-armed Scorpion crew performs reconnaissance.

At right, British infantry in the Falklands action get a lift from a Scimitar crew across desolate landscape.

Below, Scimitars take gunnery practice after Falklands fighting died down. The light tracked vehicles served well in the boggy terrain.

designed experimental wheeled vehicle, which employed shear steering, showed considerable promise and a prototype was built but it never entered service.

In reality, there is no unresolved wheels-versus-tracks debate as the choice is determined by the LAV's operational role.

Firepower. The principal direct ground-fire capability of light armoured vehicles in service today lies with 76-mm/90-mm guns, 25-mm/30-mm cannons, and coaxial/commander's machineguns. The main guns can knock out a tank if it is hit in the side or rear at close range, and they can be used very effectively against enemy APCs and reconnaissance vehicles. If firepower is the primary consideration, which it seldom will be, then vehicles should be sited to engage an enemy with defilade fire.

In its primary role of observation,

the LAV will only use its main armament just prior to moving to a new position. To shoot and stay is to invite destruction. LAVs also have a semi-direct and indirect fire capability. This capability may be used in operations world-wide to carry out the deliberate bombardment of an enemy strongpoint.

Protection. LAVs have limited protection and thus are sometimes vulnerable to antitank fire, mines, and direct hits by artillery. They give crews some measure of protection from small arms fire, mortar bombs and shell fragments. All vehicles must use the ground to best advantage to offset their lightweight armour. Some vehicles can be pressurized and these have an NBC filtration system.

Flexibility. The mobility of LAVs combined with communications and the versatility of the crewmen gives light armour units operational flexibility. This allows for a change of task at short notice, quick redeployment and the simultaneous, rapid execution of several diverse activities.

Tasks for Light Armour

Advance to contact. The task of light armour in the advance or pursuit is to obtain and pass back accurate and timely information about the enemy and to find and exploit gaps in his defences so that they can be used by the follow-up main force. The *Scorpions* and *Scimitars* of 5 Brigade in the Falklands campaign provided such a screen and in the words of the brigade commander, "... it was good to know that we had something with tougher skins than the infantry which could go ahead."

Offensive Operations. Light armour units lack the equipment and manpower to mount deliberate attacks against enemy positions organized and deployed in strength. They may, however, carry out quick or diversionary attacks against enemy parachute/heliborne landings, airfields, bridgeheads and other such targets. Again, by way of example, in the Falklands campaign, the light armour provided firepower in a diversionary attack which was mounted to mask the first phase on Tumbledown Mountain.

The direct-fire capability of *Saladin* armoured cars was also used most successfully in the 1964 Radfan (S. Arabia) operations against difficult land targets which could not be engaged effectively by artillery or mortars.

On other occasions, light armour firepower was used when air strikes were prohibited because of the lie of the land or due to political repercussions. In addition, light forces in the Middle East theatre were called upon to carry out such tasks as: independent raids, deep penetration missions, and disruption of the enemy in the pursuit. The light armour force deployed to the Falklands was also

At right, Scorpion's sting is a 76-mm main gun firing HESH and HE rounds.

A land mine caused headaches, but little else, for the crew of this Scimitar employed in the Falklands fighting.

trained and prepared for their task of NBC reconnaissance; a task in the final event they were not called upon to carry out.

If there is a lack of organic heavy armour it is almost inevitable that the light armour contingent of a light force will be called upon to take a share of defeating enemy armour. However, other than in the Korean War and the Falklands, where the threat did not materialize, British light armour has seldom been required for this task.

OP line. A line of observation is manpower-intensive, particularly in close country and in jungle terrain. The heavy demand on infantry can be eased by light armour taking part in the line where suitable arcs can be found. Normally, in campaigns such as the Malayan Emergency and in Brunei, where overt OPs had been established and it was decided that these needed to go covert, then light armour was brought in to cover the same arc from a different location. This had the added advantage in that OPs could act as delaying positions if or when necessary.

British light armour forces are also trained in the use and direction of artillery, this being the primary offensive area of armoured reconnaissance. As the crew are relatively well-protected in comparison to dismounted infantry, they can bring fire down almost on their own position. This cuts down the time spent in adjusting fire on those occasions when any adjustment is possible.

Mobile patrols. Mobile patrols have been one of the major tasks for British light armour forces and their

success has been out of all proportion to the numbers of men and vehicles involved. The most recent example was the British contingent of 100 men in the 4-nation peace-keeping force in Lebanon equipped with *Ferret* scout cars; probably the highest in profile of the contingents in the force, although by far the smallest, and all due to an intense programme of flag patrols.

The patrolling principles employed in the rural areas of Northern Ireland have differed little from those in similar areas in counterinsurgency and conventional operations elsewhere. The only important differences have been in the emphasis placed on gathering information and the constraints on aggressive and retaliatory action.

Many types of patrols have been employed by British light armour forces in operations worldwide: route reconnaissance/clearance patrols; antismuggling patrols; patrols to deny enemy freedom of action and to isolate him from the local population; intelligence-gathering patrols both to get to know terrain and information on the enemy identity, location, habits and methods; combined vehicle and foot patrols where the light armour has been a useful adjunct to foot patrols where rapid reinforcement or additional fire support has been necessary.

Protective tasks. Light armour escorts for columns and VIPs, particularly when reinforced by infantry and helicopter support, has been a prime task in British counterinsurgency/counterrevolutionary and internal security (IS) operations. Vehicles used have been wheeled *(Saladin/Ferret/Fox),* or tracked, *(Scorpion/Scimitar),* and all have proved successful, although on balance, the tracked CVR with their high road speed and cross-country performance have proved more versatile.

In the British experience, antimine patrols are best done by light armour forces supported, when available, by infantry and helicopters. Although antitank mines with the equivalent of 15 pounds of explosive will remove wheels, sprockets and tracks and displace the vehicles, bodily injury to the crew is rare. One such mine detonated under the right hand track of a *Scorpion* in the Falklands, removed both tracks, most of the road wheels, lifted it some 3-4 feet and bent the belly plates, but did not penetrate. The crew evacuated with nothing worse than headaches for the next few days.

Communication tasks. Since LAVs are protected, armed, agile and equipped with radios, they have excellent communication potential with the ability to extend the range and reliability of a net with their rebroadcast facilities. The vehicle-charging system means that power to the radios can be supplied for extended periods without any logistic requirement for resupply of batteries.

Light armour platoons in the Middle East operations also formed small command groups which could, for example, carry and escort a forward observing officer, a forward air control officer, a political officer and an Arab liaison officer into a prescribed area during active operations. The force headquarters then had the armour direct-fire guns, artillery, and aircraft support available as required and the presence of a political advisor and Arab interpreter. The availability of a large number of radios in light armour units also makes them particularly appropriate for deployment as a traffic control organization, for the crossing of a water obstacle, a minefield, or the negotiation of any major defile.

Crowd dispersal. In IS situations, the dispersal of large crowds, particularly in enclosed areas, is a task for dismounted infantry and the use of armoured vehicles in close proximity to large crowds is inadvisable. They can only be effective as a threat, much like that of a policeman on a horse.

However, light armour has been used on many occasions in urban areas such as Hong Kong, Palestine, Aden and Singapore as a follow-up to crowd dispersal by infantry, to provide road blocks and communications.

Road blocks and cordons. The mobility and good communications of light armour suits it well to the task of setting up and operating deliberate and snap road blocks and has been fully exploited in most British Army operations and has proved particularly successful in the Northern Ireland situation. Conversely, light armour has been used to demolish road blocks and barricades erected by rioters, either by crashing through or towing them away using grappling hooks or tow ropes. Light armour has also been used to form outer cordons to warn off or prevent groups outside cordoned areas, villages, housing estates, etc., from breaking in and attempting to disrupt troops searching the area and carrying out interrogation.

Conclusion

In the light of British experience since WW II, in many different levels of conflict, it can be judged that the LAV's characteristics of mobility, flexibility and protection have exerted a major impact. Highly versatile LAVs such as *Saladin, Ferret, Fox, Scorpion* and *Scimitar,* although lightly gunned, carried out all tasks required of them and proved invaluable.

LIEUTENANT COLONEL MICHAEL E. CULLINAN was commissioned into the 14th/20th King's Hussars from Mons Officer Cadet School in 1966 and served in Germany, North Africa, Hong Kong and Singapore in armour and reconnaissance until 1971. He has served in Northern Ireland several times in urban and border areas and for 14 years with the British Army of the Rhine including three years as an armoured squadron commander and staff appointments with G3 Headquarters, 1st British Corps and G1, Headquarters 1st Armoured Division. In 1983 he became the British Liaison Officer to the USAARMC, Fort Knox. In April, this year, he returned to the United Kingdom at the completion of his Fort Knox tour.

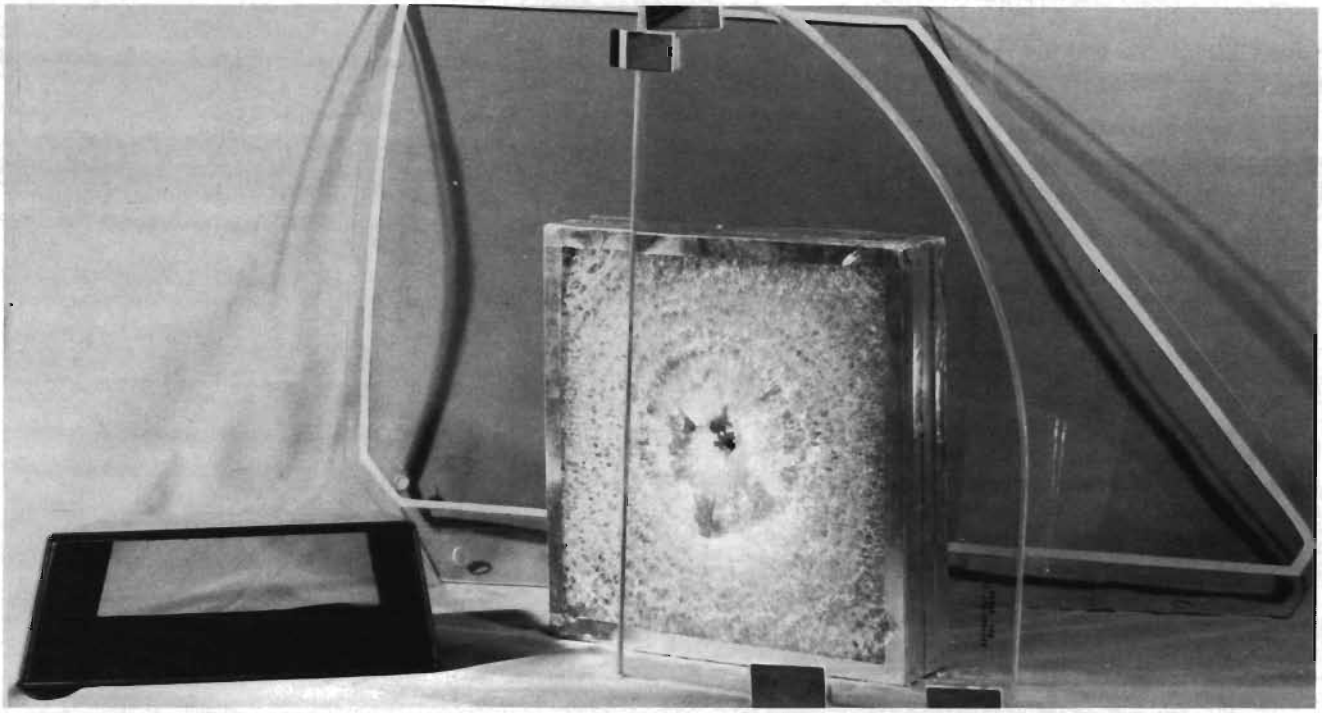


Figure 2: Vision blocks, auto glass and aircraft windows are among the products being improved with new glass-plastic laminates.

Progress in Transparent Armor

by Gordon R. Parsons

There is a growing need for transparent armor that can provide good visibility with ballistic protection.

- The soldier maneuvering a ground combat vehicle through hostile fire must be able to see outside to navigate.
- The windshields of military helicopters must be both transparent and ballistically protective.
- As terrorist violence increases, the need grows for armored limousines that completely shield their executive and diplomatic passengers.
- Banks and command centers need security enclosures that provide protection while allowing personnel to monitor the surrounding area.

Since 1965, significant advances in armor design have been part of the mission of the Army Materials and Mechanics Research Center (AMMRC) in Watertown, Massachusetts, five miles west of Boston. In its charter as the Army's lead laboratory for materials research and development, the AMMRC is unsurpassed in the nation, and probably in the world, in the field of transparent armor materials.

Earlier Developments

In the 1940s and 1950s, transparent armors were laminated glass assemblies popularly known as "bulletproof glass". Their uses were limited: attaining sufficient ballistic protection required materials of great weight and thickness, with consequent low light transmission. By the 1960s, the laminated glass armors used in WWII and the Korean conflict were not practical for the new lightweight vehicle concepts designed for increased payload and mobility. Following the principles of opaque armor design introduced in the 1960s, transparent armor evolved from laminated glass to glass/plastic laminates which offered significant reductions in weight and thickness.

Tests on transparent ceramic materials, such as single-crystal aluminum oxide laminated to plastic, have shown high ballistic performance levels. However, the lack of availability in sufficient sizes and quantities of transparent ceramics has precluded their use in these applications. Current process development is endeavoring to establish the manufacturing technology to produce adequate sizes of transparent ceramics at acceptable cost and production rates. Meanwhile, the Army's persistent requirements for improved optics, greater ballistic protection, and lighter weight are being addressed by development of more efficient glass/plastic armor systems.

Stopping Projectiles

Both private industry and U.S. Army laboratories have conducted armor development programs to investigate materials and their geometric synergism for enhancing defeat of kinetic-energy projectiles. Results have generally indicated that the optimum configuration is as shown in figure 1.

The exterior of transparent armor consists of either one ply or a number of laminated plies of glass selected for its ballistic performance. Except for the introduction of new kinds of glass materials, this face of the armor is similar to laminated "bulletproof glass." However, the old glass armor assemblies had a glass interior face, and impacts often caused dangerous secondary projectiles, or spall, to break off from the inner layer and endanger personnel.

To counteract this problem, the new transparent armor incorporates a tough plastic back plate bonded to the glass laminate, which serves a dual role. First, it acts as a "catch-

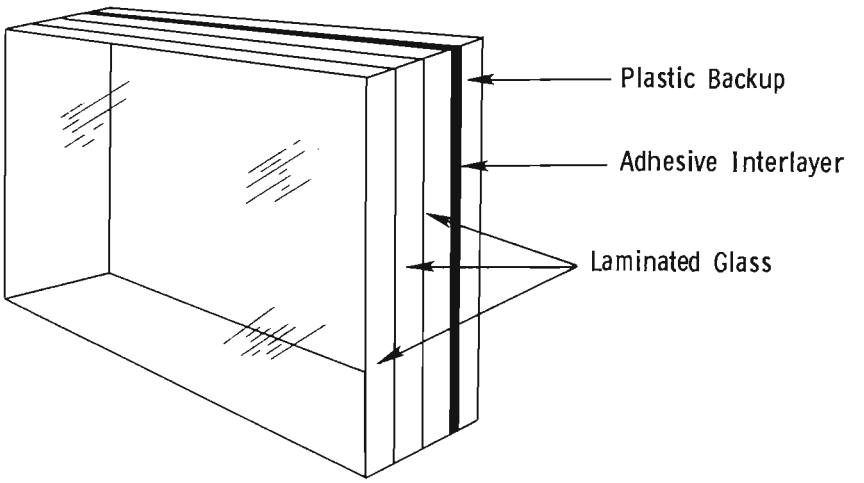


Figure 1: Tests have shown this sandwich of glass and plastic materials stops penetration of even 20-mm AP ordnance.

er's mitt" to absorb energy not dissipated in the glass, and second, there is no spall ejected from the rear face of the armor system as long as the projectile doesn't penetrate. The versatility of the glass/plastic armor system is shown in figure 2 by the variety of transparent armor constructions and configurations now available.

The helicopter performs an expanded combat role in modern warfare. When executing rescue, search, attack, and close-proximity missions, it is exposed to hostile fire. In addition to defeating projectiles, windshield transparency must be provided while the material withstands multiple hits from small-arms fire and after being hit, the windshield must retain enough residual visibility to allow the pilot to complete his mission. To compile sufficient data for designers to incorporate transparent armor in new aircraft concepts, prototype UH-1 helicopter glass/plastic windshields were fabricated and flight tested for a year at the Army Proving Ground , Yuma, Arizona and at Fort Rucker, Alabama.

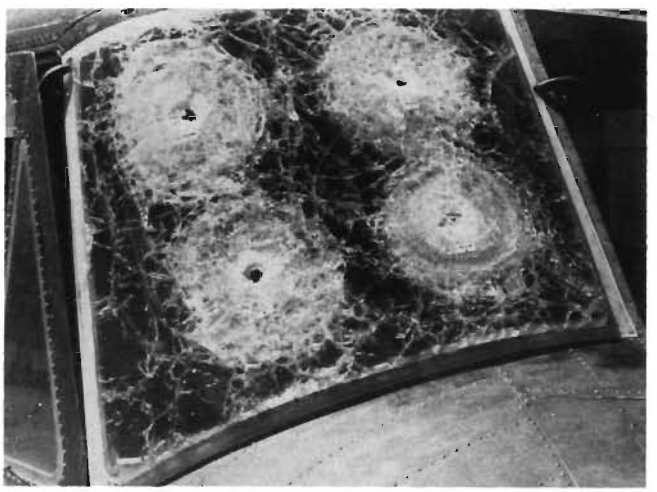
These two locations provided the climatic extremes desired for the flight test program. Figures 3a and 3b are photographs of the UH-1 armored windshield after successive defeats of caliber .30 ball projectiles, showing the effect of multiple impacts, residual visibility, and the condition of the rear, or inner, face of the windshield.

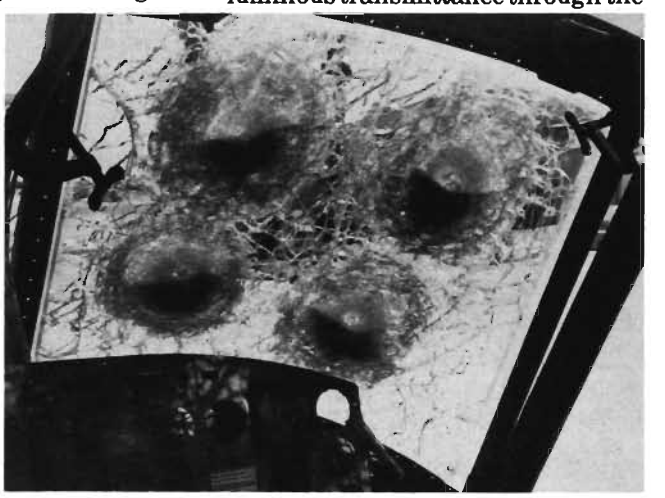
In figure 3a, the windshield has been hit by four caliber .30 ball projectiles at standard muzzle velocity and zero degree obliquity. Approximately 40 per cent of the visibility remained and the windshield remained intact. Figure 3b shows the rear face of the transparent armor and dramatically illustrates the ability of the plastic backup layer to deform and absorb energy while preventing any spall fragments from endangering personnel.

Readiness to engage in battle anywhere in the world requires that transparent armor be capable of performing in a wide range of of environments, from humid tropics and searing desert to Arctic cold. The optical quality and general condition of this armor were unaffected by temperature cycling from 140 degrees Fahrenheit to minus-40 degrees, and prolonged exposure to relative humidity above 95 per cent at 125 degrees. Glass/plastic transparencies used to defeat the caliber .30 ball projectile were continually exposed over two years to the high temperatures and ultraviolet radiation of the Arizona desert, and were periodically tested for ballistic performance. After two years, they lost none of their design integrity.

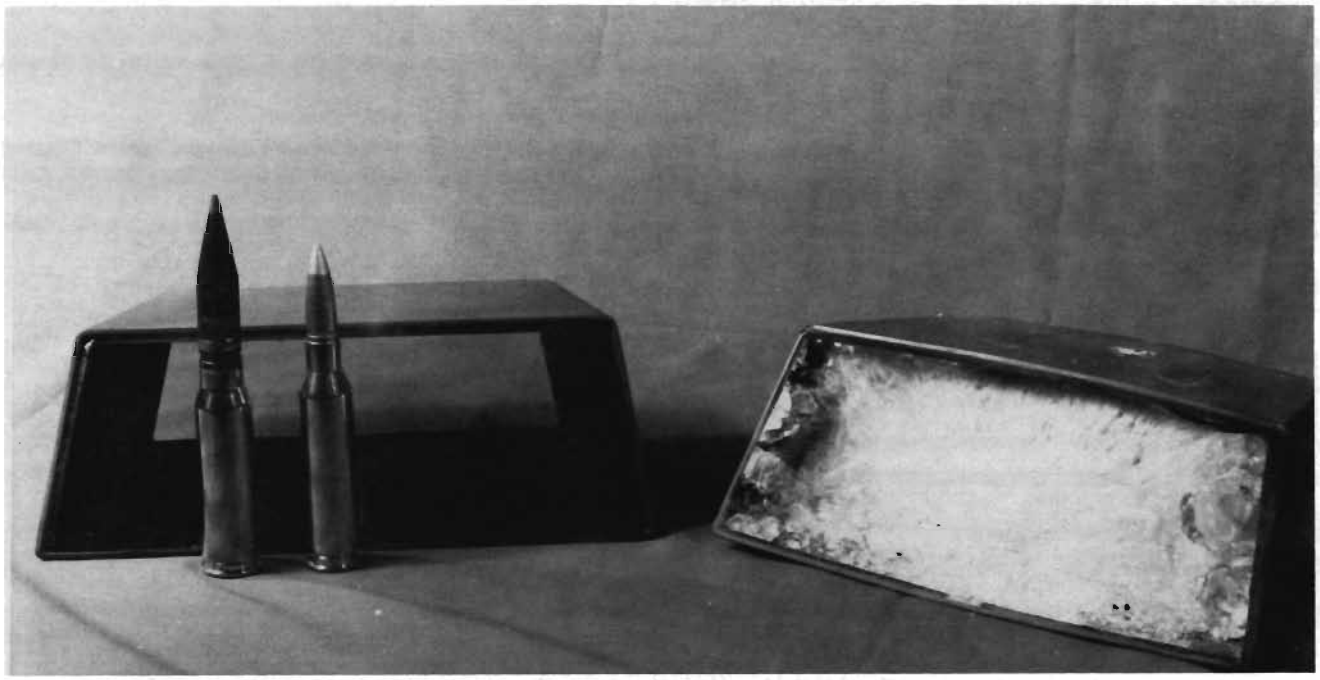
The AFV Challenge

The viewing ports of tanks and personnel carriers are wedge-shaped windows called "vision blocks", contained in a metal case and installed in the turret or body of the vehicles. Current all-glass vision blocks, having even modest protection against armor-piercing kinetic-energy projectiles, have very marginal visibility characteristics because of the low luminous transmittance through the





A helicopter windshield retains 40 percent of its visibility after being hit four times by .30-cal. ball ammo at 0-degree obliquity. Spall did not enter the cockpit despite multiple strikes. The same windshield is seen from the outside in photo at left and from the inside in accompanying view. (Figures 3a, 3b)



No spall emerged from the back of this new plastic-glass laminate vision block despite being hit by a 20-mm HVAP autocannon projectile at a range of 250 meters. The projectile is tungsten carbide and is seen at far left with a .30-cal ball round for comparison.

appreciable thickness of laminated soda-lime glass. This limitation is worsened as ambient light decreases, in such cases as overcast sky or near-dusk conditions. The requirement for high performance, lightweight armored vehicles has compounded the visibility handicap, because increased road speed and advanced reconnaissance and combat requirements make greater demands on the vision of operating personnel.

Prototype glass/plastic vision blocks developed by AMMRC to replace the conventional laminated glass blocks have shown impressive optical and ballistic improvements.

Comparing the two, the prototype glass/plastic block weighs 15.7 pounds, versus the 18.4 pounds of the earlier system. The new blocks have an in-line light transmission of 75 per cent, compared to 63 per cent on the old blocks. And the newer blocks will protect against 14.4-mm (BS41 API) and 20-mm (HVAP-T) Soviet rounds at a 45 per cent obliquity. (see Fig. 4, above)

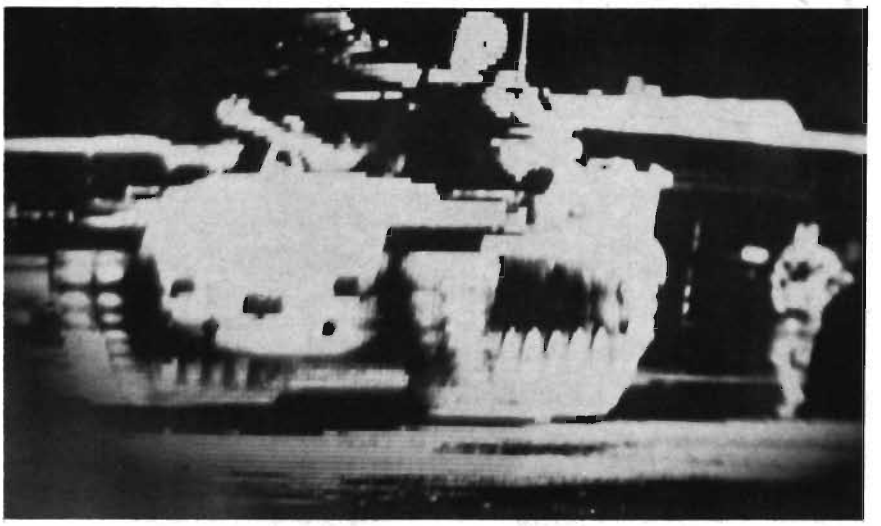
Figure 4 shows the prototype glass/plastic vision blocks and the projectiles they are designed to defeat. The block shown on the right has successfully defeated a 20-mm HVAP-T tungsten carbide projectile at a range of 250 meters.

Evolutionary improvements in transparent glass/plastic laminates will continue, keeping in pace with the Army's increasing requirements. The future of transparent armor includes:

- New types of glass, both amorphous and crystallized, and transparent ceramics should be pursued for improvements in ballistic efficiency.
- Coatings must be developed to make the plastic rear face armor more durable by increasing its resistance to scratching and chemical attack.
- The development of new interlayers promises to reduce manufacturing costs.
- Analytical methods are now being investigated to correlate construction parameters with ballistic performance for opaque materials. Extension of these correlations to transparent materials may minimize trial and error in determining the most efficient composite construction.
- Innovative approaches will be developed to counter new threats, such as directed energy devices and weapons.

Transparent armor development should continue evolving: to enhance the survivability of the soldier and the materiel upon which both he and the mission depend; and to be prepared to defeat the threats anticipated throough the end of this century.

GORDON R. PARSONS, a veteran mechanical engineer with 16 years' service at the U.S. Army Materials and Mechanics Research Center, has been a major participant in the development of armored transparencies for helicopters and ground vehicles, and has published many papers on the subject. He holds a BS degree and a masters in mechanical engineering (materials) from Northeastern University. Currently, he is a supervisory materials engineer in the Composite Development Division of AMMRC's Organic Materials Laboratory.



"When does realistic training merit taking unwarranted risk?..."

Safety vs Realism in Night Training

by Rosalene E. Graham

One of the most difficult challenges facing the armor leader and crew is the conduct of night training using night vision devices (NVD), which present certain risks if training is to be realistic.

Doctrine prescribes that "unit training simulate as closely as possible the modern battlefield's tempo and scope."[1] Training must be under realistic weather conditions. And there must be increased emphasis on night training because the force that can operate at night as it does in the day by fully using cover, concealment, suppressive fires, and night vision equipment can easily defeat the force that does not.[2] The use of night vision devices allows the armor crew greater freedom of movement, but the effect of adverse weather and low ambient light levels and the associated risk to our tank crews must be assessed and understood.

The U.S. Army Safety Center (USASC) at Fort Rucker, AL investigated two fatal accidents in which the driver used the AN/VVS-2 night vision viewer. One accident occurred in severe weather conditions with no ambient light during rain and lightning. The second accident was under almost zero illumination. In both cases, the driver told the tank commander (TC) that he could not see to drive, but the TC in both cases elected to continue because of the training exercise schedule. Although the TCs had confidence in the night vision device's capability under all low light conditions, the NVD's capabilities were exceeded. In both cases, the TCs were killed. And in both cases, the chain of command indicated that it believed the devices would perform in the low light conditions encountered.

The question that arises from these accidents is this: Under what conditions should an armor crew modify realistic training because conditions are not conducive to safe training?

The Army accepts the inherent risk of war and must train to minimize that risk. The point where training realism must give way to the safety and welfare of the soldier and his equipment is not well defined. When does realistic training merit taking unwarranted risk?

No one is suggesting that realistic training must cease. In war, the battle doesn't cease for safety considerations. The purpose of battle is to win with minimum losses, and losses are expected. The purpose of training is to win the battle, and any loss hinders that preparedness. Therefore, the armor leader must be able to make risk management decisions and choose to either continue training or to modify training to reduce the associated risk.

Assessing Risk

Risk is a safety term coming into vogue. Risk is the potential for realization of unwanted, negative consequences of an event.[3] The leader must determine the desired safety level and evaluate the acceptability of the risk. The level of risk accepted is usually based on mission necessity, compliance with all regulatory requirements, training benefit, public opinion, past experience and other criteria. In determining acceptable risk levels, one must remember that society's or the public's acceptance of risk drops quickly if even one or two lives are at risk. The drop in public acceptance occurs, even though the probability of loss may be small.[4]

The armor leader has no formal guidance about what constitutes an acceptable level of risk in realistic training scenarios involving extreme low ambient light or severe weather conditions. The armor leader, based on past experience and good judgment, evaluates the risks associated with the operation against the training and other benefits to be gained. This evaluation forms the basis of the risk acceptance or management decision. Generally, the higher the risk to be accepted, the higher in the chain of command the risk acceptance decision is made.

In making a risk management decision involving the use of passive night vision devices in an extreme low light environment, the leader would assess the facts known to him, to include:

- The passive night vision device used on the *M60A3* and *M1* tanks is the AN/VVS-2, which requires ambient light for operation.[5]
- Light from lightning is not sufficient. When weather is severe or no ambient light is present, the viewer will not function well enough for the driver to operate his tank safely.
- The AN/VVS-2 does not mag-

"Armor leaders must recognize that night vision devices have limitations..."

nify an image. Objects difficult to see during the day are difficult to detect with the NVD. With sufficient ambient light, objects can be identified at a great distance and an armor unit can fight at night or during periods of reduced visibility effectively.

- Depth perception and distance estimation are effected by night vision devices.
- Color discrimination is absent when night vision devices are used.
- The use of infrared will assist the AN/VVS-2 in no-light conditions, but can be easily detected.

The armor leader must recognize that night vision devices have limitations. Accidents have occurred because the driver has been unable to see while using the AN/VVS-2.

The army leaders manual states: "We must teach our soldiers how to think and solve problems while under stress."[6] Driving a tank almost blind because of ineffective night vision devices is definitely a stressful situation. When should the crew be given the flexibility to cease or modify operations? At the point in time when the training ceases and crew and equipment survivability becomes the overriding issue, a risk acceptance decision must be made and must have been planned for. Who makes this decision? Is the crew allowed to use initiative in reducing their risk or is that a decision for their chain of command?

The crew could accept the risk and voluntarily continue the mission. Or better, they could take other actions — such as putting out a ground guide, stopping movement, changing to infrared, or breaking radio silence for instruction. When voluntarily reducing their risk by any of these actions, they often must answer for their decisions later. This dilemma leads to armor crews accepting unequal risks and gaining unequal benefits due to the variety of risk-reduction steps taken.

A preplanned policy is necessary within armor units on prodecures and acceptable crew performance when light and weather conditions may cause the night vision device's capabilities to be exceeded. The individual crew can best assess the effectiveness of their NVD under training conditions and should advise their leaders. However, if they are not aware of what is an acceptable method of reducing their risk, the decision may be inappropriate. A preplanned policy gives the armor crew guidance and allows for training flexibility.

Summary

Armor leaders must recognize that night vision devices have limitations and cannot be relied on in adverse weather and during periods of no ambient light. Risk decisions become necessary under adverse conditions when survivability becomes an issue. Individual crews must be able to tell their leaders the conditions they face, but someone in the chain of command other than the individual crew must accept the risk associated with realistic training under adverse environmental conditions.

Training plans and SOPs must contain policies to allow for contingencies and flexibility. Armor crews must be permitted to employ defined flexibility when survivability becomes an overriding factor.

Footnotes

[1]FM 100-5, *Operations,* 20 Aug 82, p 1-4.
[2]FM 71-1, *The Tank and Mechanized Infantry Company Team,* 30 Jun 77, p 1-10.
[3]W.D. Rowe, *An Anatomy of Risk,* New York: John Wiley & Sons, 1977, p 463.
[4]J.V. Grimaldi, *Safety Management,* Homewood, IL: Richard D. Irwin, Inc., 1984, p 228.
[5]TM 11-5855-249-10, *Operator's Manual, Viewers, Driver's, Night Vision,* Aug 82, p 1-2.
[6]FM 22-100, *Military Leadership,* 31 Oct 83, p 199.

ROSALENE E. GRAHAM is a safety and occupational health specialist at the Systems Division, Directorate of Systems Management at the U.S. Army Safety Center, Fort Rucker, AL.

Eye Protection for Armor Crewmen

by John Brand, Mark Reches, and Mikey M. Carroll

The increasing use of explosive munitions over the last century has led to an increasing proportion of eye wounds. A host of variables are involved, but a major cause has been the increasing use of high-explosive munitions which produce many small fragments. Heavy artillery bombardments, antitank missiles with explosive warheads, and the spall debris generated by kinetic energy projectile impacts, have increased the density of small, high-velocity fragments on the battlefield.

Table 1 tracks this historic change, showing how the percentage of eye injuries has increased since the Crimean war of the 1850s.

Battlefield research following the Yom Kippur War of 1973 verified that the causes of many tank crew eye injuries were small fragments and combat debris. Israeli tankers had gone into battle wearing the US *M1944* tanker's goggles, which have 1-mm-thick cellulose acetate lenses designed to protect the eyes from dust, wind, and rain. The *M1944* goggles did that job well, but provided no protection from energetic fragments. In fact, when these goggle lenses were struck by fast-moving fragments, small, sharp-edged pieces of plastic spall were thrown toward the eye. The result of fragment impact on standard goggle lenses is shown in Figure 1.

An Israeli Centurion driver wears U.S. M1944-type goggles in 1967 war. In some sectors, 10 percent of Israeli combat injuries involved the eyes, spurring research on better goggles.

WAR	YEARS	PERCENTAGE
Crimean	1854-56 (English only)	.56
American Civil War	1861-65	.57
Franco-Prussian	1870-71 (German)	.86
Franco-Prussian	1870-71 (French)	.81
Russo-Turkish	1877-78	2.5
Sino-Japanese	1894	1.2
WWI	1914-1918	2.14
WWII	1939-1945	2.0-4.1
Korean	1950-53	5.0-8.0
Six Day War	1967 (Jerusalem area only)	10.0
Six Day War	1967 (Total Israeli)	5.6
Vietnam	1964-74 (American)	9.0
Yom Kippur	1973 (Israeli)	6.7

***From Belkin, M.,** *Opthalmological Lessons of the 1973 War, June 1977.*

Table 1. Eye injuries as a percent of total combat injuries, 1854 to 1973.

Assessing the Problem

The Army Materiel Systems Analysis Activity (AMSAA) began to investigate potential solutions. The first step was to identify and evaluate the problem.

Characteristically, the initial velocity of fragments from an explosive munition is on the order of 1,066 meters per second (3,500 feet per second). The random shape of explosively-shattered fragments of forged steel causes them to slow down rapidly because of high aerodynamic drag. The dashed curve in Figure 2 shows the average remaining velocity for different size fragments at 30 meters (100 feet) from the burst point. For any given size fragment, there is a velocity at or below which the fragment will not penetrate a given thickness of armor. This is called the critical velocity. The critical velocity of various-sized fragments fired against 2-mm-thick injection molded polycarbonate helicopter pilot visors (MIL SPEC MIL-V-43511A, Visors, flyers, helmet, polycarbonate) are shown by the solid line in Figure 2. The region underneath the critical velocity line represents the fragment size and velocity combination which will not penetrate the polycarbonate. This clearly shows that many small high-velocity fragments can be stopped by a readily available lens material. How this relates to an exploding munition can then be seen by examining the two curves. The remaining-velocity-versus-mass curve exceeds the critical-velocity-versus-mass curve between about 9 to 10 grains at 100 feet from the explosion. This shows that at 30 meters from a burst, the 2-mm polycarbonate can stop fragments up to about 10 grains in weight.

The next question is, how many fragments from real munitions fall into the non-penetrating region of Figure 2? Data from many sources indicate that over 95 per cent of all mortar fragments and over 70 per cent of all artillery fragments are 10 grains or less. This would indicate that a 2-mm polycarbonate lens could protect a soldier's eyes from most (about 80 per cent) of the fragments

Results of Ballistic Tests:

Figure 1. The standard M1944 tanker's goggle.

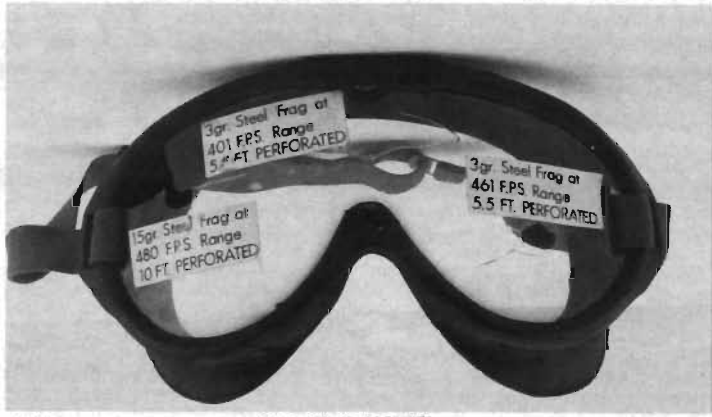


Figure 2. The 1944 goggle as first modified.

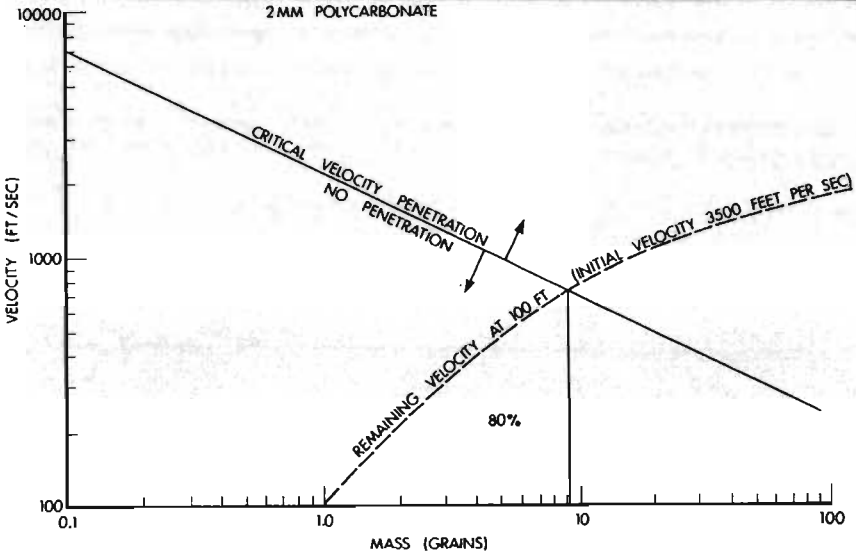


Figure 2. Critical Velocity and Remaining Velocity for Fragments.

Graph illustrates how new 2-mm polycarbonate lenses resist penetration at different projectile masses and velocities.

from a munition burst 30 meters away. Such a lens could significantly reduce the frequency of eye injuries. Based on these findings, the Survivability Office, AMSAA, recommended that the existing lenses for tanker goggles be replaced by 2-mm polycarbonate lenses. The initial work was supported by the Human Engineering Laboratory, where it was demonstrated that lenses cut out of the polycarbonate visor material could be fitted in the standard Army goggle frames. The results of fragment simulator impact on these modified lenses is shown in Figure 3.

In February 1976, AMSAA transmitted information on the potential of polycarbonate lenses to the Israeli Defense Forces (IDF). By November, 1976, the IDF had fielded new tankers' goggles with polycarbonate lenses made from 3-mm LEXAN MR 4000 sheets with a scratch-resistant coating on both sides, scored in the center, and bent. The lenses were inserted into soft, injection-molded plastic frames with foam cushioning, screened air vents, and a provision to accomodate eyeglasses. The total elapsed development and fielding time was only 6 months.

At the same time, the Natick Research and Development Command (NARADCOM) produced prototype goggle lenses cut from helicopter pilot visors to fit the U.S. M1974 frames. These lenses were coated with different anti-scratch coatings.

There were now two different goggle prototypes available for testing. The U.S. Armor and Engineer Board at Fort Knox, KY, tested the IDF goggles and the NARADCOM goggles. The test results and conclusions indicated that the NARADCOM goggles were an improvement over the current standard goggles, but the strong outward lens curvature (inherent in the semi-spherical shape of the helmet visors from which the goggle lenses were cut) led to scratches on the lens surface. Dust also accumulated inside the U.S. goggle frame. The Board recommended that the U.S. goggles be redesigned to incorporate design features of the Israeli goggles.

Ballistic tests of the IDF goggles were conducted by the Ballistic Research Laboratory for AMSAA in November 1976. Results were poor. Inadequate ballistic performance was traced to the scratch-resistant coating, and further testing was conducted to find a coating that would not degrade ballistic properties. Two such coatings were found and the results reported to the IDF and NARADCOM. The IDF then promptly fielded new goggles with 4-mm LEXAN lenses. A set of these goggles was tested in June, 1980, and the results were vastly improved. The critical velocity increased from about 150 m/s (November 1976 test) to over 240 m/s (about 800 fps) for a 15-grain fragment simulator in the June, 1980 tests.

Meanwhile NARADCOM purchased an injection mold and produced 2-mm lenses with single curvature to fit modified U.S. standard M1974 sun, wind, and dust goggle frames. A total of 4,000 of these lenses were made and tested by the Armor Board, which concluded:

"Pending successful completion of goggle ballistic evaluation, the USARMC recommends that the improved goggles be type-classified Standard A, replace the standard goggle (NSN 8465-00-004-2893) and be issued to priority armor and armored cavalry units. The standard goggle should continue to be issued to non-armored units until supply is exhausted."

Additional testing was also performed by the BRL for AMSAA to verify that the addition of lens-tinting pigments to the plastic does not degrade the ballistic properties.

Although the basis of issue for the improved goggle lens does not follow the recommendation of the Armor Board, action was initiated to pro-

Figure 3. The new ballistic lenses, untinted.

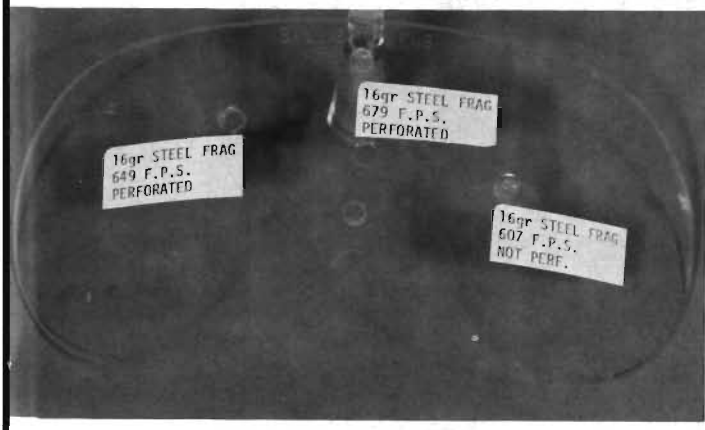
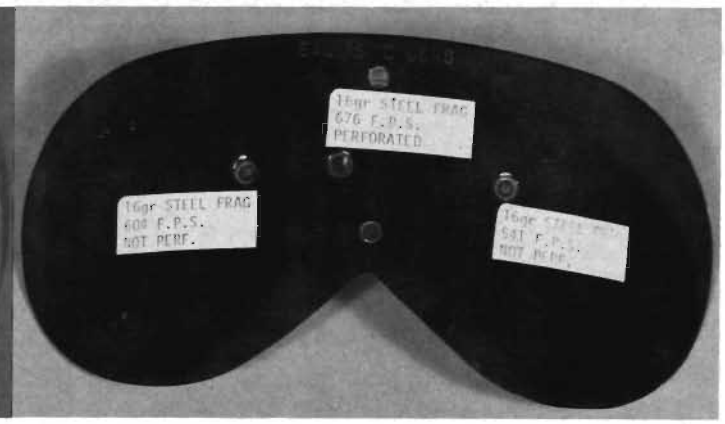


Figure 4. Tinted version of the new polycarbonate lenses.



cure ballistic lenses, both clear (Class 3) and tinted (Class 4). Thus, the ballistic lens would supplement, not replace, the more vulnerable lens.

The new protective lens has now been procured by the U.S. Army. Initial production samples have passed first article acceptance tests and the lenses are now available separately, without the frames, through normal supply channels. The NSNs that have been assigned are 8465-01-109-3996 (neutral gray) and 8465-01-109-3997 (clear). Present procurement is for a total of 100,000 lenses but demand may support further orders.

AMSAA obtained a quantity of these lenses. Firing tests were conducted to verify the ballistic resistence of these new production lenses. Figures 4 and 5 show tinted and clear lenses that have been tested against 16-grain circular cylinder fragment simulators. The impact velocities shown illustrate that these are indeed high quality lenses.

In addition to these efforts, a separate development program has been initiated to produce an "eye armor" usable by all soldiers all the time. These are to be stylish and function as very effective safety glasses in peacetime, while affording protection from fragments and debris in combat. The statement of need has been approved by the Department of the Army and the laboratories have been actively investigating different materials and designs.

In summary, ballistic lenses for eye protection are now in the U.S. Army inventory. They can protect the eye from 70 per cent or more of expected shell fragments at 100 feet from munition burst.

(The author wishes to thank the BRL for releasing its firing data and Col. La Piana, Walter Reed Army Institute of Research, for reviewing and suggesting improvements to this article.)

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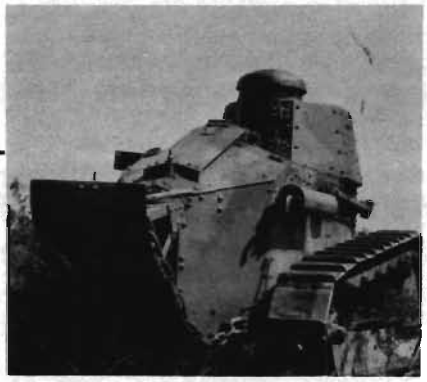

In the Beginning. . .

by Major Michael R. Matheny

In the beginning, war covered the face of Europe. Trenches, barbed wire, and ruins scarred the earth from Switzerland to the North Sea. Even the most casual reader of military history is familiar with the character of WW I. Most are also aware that this war saw the creation of the tank, borne out of the hope of overcoming the static and costly trench warfare.

But there are few veterans today who can talk of the experience of that war, of going over the top in those early war machines called tanks. The story of the men who became the first tankers needs none of the usual embellishment of veterans gathered around the barracks with the opening line, "You ain't gonna beleive this. . ." The reports, reminiscences, and letters speak for themselves. Their story is filled with the courage and humor, the determination and sacrifice that has always marked the American citizen-soldier.

It was, of course, a different world then; fewer shades of gray, a certain confidence, pride, and conviction not so easily found today. For the Americans who eagerly enlisted for the war to end all wars, it was a great, great adventure. For the draftees it was, as always, an interruption of their civilian careers simply to be endured. For the professional soldiers it was an avenue for ambition and glory as well as a job to be done. Altogether, America was seized by a kind of enthusiasm that three years of war had long since drained from Europe. Undoubtedly, these men had a great deal in common with all 20th Century soldiers, but they were nonetheless the first to enter the chaos and the confusion of the battlefield in machines. It was upon these machines that many pinned a good deal of hope for ending the slaughter of that terrible war.

The hope that the tank might restore mobility and become a decisive advantage was almost stillborn. Without sufficient numbers or an effective doctrine, the tank's initial performance was disappointing. In fact, the American Military Mission in Paris reported in early 1917 that the tanks were a failure.[1] Enough success was achieved, however, to keep the program and the hope alive. After entering the war, American studies of allied tactics and organization recommended the establishment of a separate tank corps. In November 1917, the British success at Cambrai, using massed tanks over good ground, revived the reputation of the tank and pointed the way to a more effective doctrine for its employment. Reassured by this victory, the Americans went about organizing their own tank corps with more conviction.

Plans originally called for the organization of five heavy tank battalions and 20 light tank battalions. Two tanks centers (one heavy, one light) were established in Europe to train the tankers, but by the end of the war only one heavy battalion and one brigade of three light tank battalions actually saw action in France. To command the tank corps, General John J. Pershing, commander of the American Expeditionary Force (AEF), chose Colonel Samuel D. Rockenbach. To assist Rockenbach in organizing the light tanks service, Pershing permitted his former aide, Captain George S. Patton, Jr., to transfer to the tank corps. Once Patton's energy was unleashed on the project, the new branch slowly began to take shape.

The first obstacle to overcome was to obtain men and materiel to transform plans into reality. In his request for officers, Rockenbach highlighted the fact that they must be men of "no timidity" and the desirable qualities of the enlisted men were "10% mechanical and 90% soldierly."[2] The Tank Corps was to be fleshed out with volunteers eager for adventure and a chance to get at the Hun.

These men began to arrive well in advance of the material necessary to train them. Lieutenant Theodore Sledge, one of the first recruits to the new branch, remembered receiving orders to report to Langres, France, for duty with the Tank Corps and, "having great hopes of going into something exciting. On arriving I immediately began looking for tanks and Tank Corps Headquarters, expecting at least to see signs in large glowing letters — HEADQUARTERS TANK CORPS, but no, I was conducted to a small room in a typical French mansion, with a small sign, "Tank Corps" hanging outside. On the inside was a chair, a table, and an empty wastebasket. But behind this table sat the Tank Corps — Captain George S. Patton, Jr., who in a very few words thoroughly convinced me that the Tank Corps was really in existence and in time would rain death, hell, and destruction on the Boche."[3]

The organization of the Tank Corps in the U.S. encountered many of the same problems as in the AEF. In February 1918, the War Department authorized a Tank Service under the Chief of Engineers. Not until the spring was the tank service made a separate branch. Tank training in the U.S. was initially centered at Camp Colt, Pa. For seven months in 1918, Major Dwight D. Eisenhower commanded Camp Colt while the Tank Corps steadily expanded. Lacking equipment, a good deal of the training centered on completing transition from civilians to soldiers. Classes were given to the newly-commissioned officers, much of which aimed at improving leadership techniques and maintaining discipline. Lieutenant Robert J. Veit recorded in his notebook, "If offense (is) not covered by any other Article of War, put it under Article 96." He also noted that, "Be sure to make out court martial forms correctly or they will come

back to you."[4] Apparently even an army at war depends on a combination of improvisation and paperwork.

In matters of training, the stateside tankers had to rely on a British colonel and a few noncommissioned officers armed only with British training manuals and their experience on the Western Front. By July 1918, although 12 heavy and 24 light tank companies had been formed, none of the approximately 5,000 tankers in the U.S. had ever seen a tank.

Only two units, the 65th Engineers converted to the 301st Heavy Tank Battalion, and the 331st Light Tank Battalion, saw combat in Europe.

For most of the stateside tankers, their worst experience of WW I was the trip over. Crowded in transport ships, the troops were ravaged by the beginnings of the great influenza epidemic. First Lieutenant F.S. Dunn recalled that his ship, the *H.M.T. Ocontes,* was supposed to carry 700-1,200 passengers but, in fact, 1,875 troops were crammed on board. Hardly a morning went by that was not marked by burials at sea for the men who died during the night.[5] Battered by gales, they were, indeed, eager to reach Europe. Most of these men arrived too late; the brunt of the fighting for the Tank Corps was borne by the men organized and trained in units already there.

It was a long time before even the tankers of the AEF got their hands on enough tanks to conduct realistic training. Patton established the First Tank Center for the training of light tank troops at Bourg, France, close to the AEF training center at Langres. He obtained a condemned Atlas truck upon which many tankers labored long hours assembling and disassembling the gasoline engine. Athletic contests, construction projects, and school of the soldier occupied most of their time until at last a train arrived with ten of the new weapons of war.

Patton personally drove seven of the ten light *Renault* tanks off the train and immediately initiated a rigorous training program. By June 1918, 15 more tanks arrived, enabling the two light tank battalions to begin collective training at the company level. Patton scheduled the training to allow for the driver's training in the morning and company maneuvers in the afternoon and late evening. Rotating the companies through training with the available tanks, Patton sought to quickly get his brigade combat-ready. Not until three weeks before the brigade's first combat action were sufficient tanks available to actually assign vehicles to units.

The light tank battalions were equipped with the French *Renault* tank. The *Renault* was a simple machine weighing six tons with a top speed of about five miles an hour. Armed with either a 37-mm gun or a Hotchkiss machinegun, the tank's two-man crew communicated using hand signals. This tank was the first to carry Americans into battle.

The American tankers' first opportunity for combat came on 12 September 1918, in the St. Mihiel salient. From the beginning, Pershing resisted attempts to use American troops simply as replacements for wornout allied armies, demanding instead the formation and employment of an American army. In July 1918, Marshal Foch, Supreme Allied Commander, relented, and Pershing got his chance. The target was the St. Mihiel salient which the Germans had held for four years. A few weeks before the attack, Patton was notified that the light tanks would take part. The tankers were aware of the importance of this first action.

"Never will the feeling of pride, when the orders came to proceed to the front, be forgotten. Scarcely any of the officers and men had ever been under fire... Everyone realized that the two battalions were destined to initiate the history of the American Tank Corps, and all grimly set themselves to an inititation of which the American Army and the American people could be justly proud."[6]

The plan called for the Americans to attack the flanks while the French held the nose of the salient. The major effort would be made against the southern flank, and it was here the tanks were to lend their support. Patton had available the two American light tank battalions, the 326th and 327th (later redesignated and hereinafter referred to as the 344th and 345th respectively) as well as two groups of French *Schneider* tanks. From left to right, Patton deployed the 344th, the French tankers, and the 345th. The 344th, commanded by Captain Sereno Brett, had the mission of leading the infantrymen of the 1st Division to their objectives. In the center, the slower, heavier (at 14.6 tons) French tanks were to follow the infantry of the 42d Division. The 344th, commanded by Captain Ranulf Compton, also supported the 42d Division and — faced by rough terrain — would initially follow the infantry. Upon gaining easier ground, Compton's tankers were to lead the infantry to their two objectives, the villages of Essey and Pannes.

Despite all the planning, just getting to the battle was troublesome. Beginning on 8 September, the tankers moved by train into the sector. One train was rerouted and frantic officers searched for the missing train until it was located on a siding 3 kilometers from its original destination. A long approach march of 25 kilometers to the assembly area took its toll. Suffering from engine trouble and broken fan belts, many tanks fell out. With a good deal of effort all the tanks were eventually gathered together "in the worst mud hole in the world."[7] It was pitch black the night before the attack and rain continued to make the ground worse. At about 2100 hours the tankers silently and secretly moved from the jumpoff point. It took three hours to go 3 kilometers with confusion and tension rising every step of the way. By the time they arrived, orders were being "howled back and forth, cigarettes and flashlights were being used to guide the tanks into positions and pistols were being fired to attact attention. Barnum and Bailey's circus never came to town as well advertised."[8]

Nervous tension before their first battle did not affect all the tankers, as some managed to get some sleep; in one company's case, almost too much sleep. As one junior officer recalled: "0530 was H Hour. About 0515 Captain Weed approached me shouting, 'Rush like hell down the line and tell my blankety-blank drivers to get their blankety-blank tanks cranked up and be ready to start.' "[9] Promptly at 0530 the U.S. Tank Corps went over the top for the first

time. The tankers battled the mud as much as the Germans. Lieutenant Wilson, whose job it was to recover mired tanks, believed that, "mud was the worst enemy to the tanks in the St. Mihiel show. Not mud in the radiators nor in the carburetors, but sticky, soggy, awful mud in which the tanks wallowed belly-deep."[10]

As for the Germans, Ludendorff had ordered the evacuation of the salient four days before the Americans attacked; resistance was light. Against the remaining enemy troops, the 345th was credited with the destruction of several machineguns; a battery of artillery, and the capture of 30 prisoners. Brett led his tanks into their objective, the village of Nonsard, personally blasting a sniper out of the church steeple with his 37-mm gun.[11]

On the second day, the tanks ran out of gas and oil behind the infantry. The third day of the attack was spent attempting to re-establish contact. As they moved forward, looking for friendly troops, three of Brett's tanks stumbled upon a battalion of German infantry in close column near Woel. Reinforced with five more tanks, the Americans quickly scattered the Germans and hastened their departure from the salient.

This battle did not prove to be the test many thought it would be. The lessons the American tankers gained cost them five killed and 20 wounded. Of the 174 tanks committed, only three were knocked out by enemy fire, another 43 were lost to the mud and/or maintenance failures.[12]

It was a merciful baptism of fire, but many tankers were disappointed. The Americans looked forward to the next opportunity to show what they could do. They did not have long to wait.

In order to obtain Foch's permission for the attack on St. Mihiel, Pershing had agreed to immediately shift American efforts to the Meuse-Argonne sector. Ten days after their first action, the tankers found themselves leading the asault on the Hindenburg Line in what would be for the Americans their toughest battle of the war.

Pershing put 10 divisions into the line between the Aisne and Meuse Rivers. The Argonne Forest dominated the western part of the sector near the Aisne River. Between the Argonne and a smaller woods, the Bois de Cheppy, near the center of the sector was a narrow break in the terrain through which ran the Aisne River and the road to Apremont. It was here that the light tank brigade was committed in support of the 28th and 35th Divisions.

Patton, still the commander of the tank brigade, wanted to provide as much depth as possible in the attack. He arranged his battalions in three waves. Brett's 344th would lead with two companies on the eastern side of the Aisne River supporting the 35th Division, and one company with the 28th Division on the western side of the river. Next would come Compton's 345th deployed in the same fashion, and the French *Schneider* unit, which accompanied the Americans at St. Mihiel, would bring up the rear. The plan called for Compton's tanks to take the lead when Brett's men and machines became exhausted or destroyed. Likewise, the French would leapfrog through Compton's tankers when necessary, hopefully by then better terrain would be reached making the *Schneider* tanks more effective.

At 0530 hours on 20 September, the tankers went over the top for the second time. Early morning fog covered their initial advance, but by 1000 hours the fog lifted and German fire became intense. The infantry clung to the ground, but the tanks rolled on attempting to clear the way. Lieutenant Neff of B Company, 345th Battalion, recalled: "Suddenly, the front of the tank seemed ablaze with heat and smoke. I could not exactly understand what was on. I inquired of the gunner if he was firing. "No," he said. Then I guessed. We advanced, but on account of the lay of the ground could not exactly see what was before us. Suddenly, right in front of us, bobbed up. . . a whole bunch of Germans and they went running all hunched over."[13]

The tanks entered Varennes at 0930 but the infantry did not arrive until 1330 hours. Cooperation with the infantry, or rather the lack of it, hampered operations throughout the offensive. In the face of intense fire, the infantry would not advance; without support and with only limited visibility, the tanks simply rumbled on attracting German fire and doing as much damage as they could. Control, obviously, was a problem. The tank company commanders frequently dismounted and led their tanks on foot. Battalion commanders likewise often followed their leading units on foot surrounded by a host of runners.

A constant danger to the tankers was the possibility of getting stuck. The experience of Lieutenant Higgins' platoon on the third day of the

attack was typical. When two of his tanks mired in shell holes, he attempted recovery by towing with his tank while the remaining tank provided covering fire. As soon as he and his driver dismounted to hook up the tow cables, they came under machinegun fire from three different directions. Soon artillery added to their harassment and hastened the tankers' efforts to unditch their vehicles. With all four tanks mobile again, Higgins' platoon bore down on the enemy position. "I had four machineguns turned on my tank at about 15 yards range, with the result my driver was totally blind, and I was wounded in the right arm and right eye."[14]

His driver cooly continued to operate the tank under Higgins' direction until they changed places. Higgins left the platoon sergeant in charge and drove his own tank back to the rear. It soon became stuck again and the wounded lieutenant led his driver, "who presented a ghastly appearance, his entire face and chest being a mass of blood," to the dressing station on foot.[15]

The brigade began the battle with 141 tanks. By 13 October, all that could be mustered were 24 tanks which were formed into a provisional tank company. This unit continued to support operations until 3 November, after which no American tanks were again called into action.

When the smoke cleared from the battlefield, it was a melancholy scene. Lieutenant Don Wilson, in charge of the Repair and Salvage Company, remembered: "We found them (tanks) in every conceivable predicament, just plain lack of gasoline, in rivers, mine craters and trenches, and even shot almost to pieces. One, particularly, had been the recipient of no less than six direct hits by 77s or 88s and the remaining mass was burned to char."[16]

There were the usual commendations and praise from senior commanders; indeed, the tank brigade had lent valuable support in the first few days of the attack. The fact is, however, that the brigade quickly fought itself to exhaustion. The problem was not in the courage of the tankers nor their tactics, but in the technological limitations of their tanks.

Mechanically frail and with only limited range, the tanks of this period could not be decisive but were merely another weapon in the arsenal of attritional warfare. If the success of the tank in the Argonne campaign was not spectacular, it was sufficient to earn it a permanent place in the American Army.

The experience of the 301st Heavy Tank Battalion was similar to that of the light tank brigade. The heavy tankers, however, were carrried into battle with British tanks. The battalion was equipped with 47 British *Mk V* and *Mk V Star* tanks. Like the lighter tanks, these heavies were designated as either male or female, depending on their armament. The male tanks weighed 36 tons and were armed with two 6-pounder cannons and two machineguns. The female version was equipped with four machineguns; the *Mk V Star* had an additional machinegun for a total of five. The eight-man crew was carried into battle no faster than four miles an hour, and had to contend with high levels of noise, plus engine heat that kept the temperature inside the tanks between 105° and 120°F, all of which combined to exhaust crews within three to four hours.

Shortly after the beginning of the Argonne offensive, the heavy tankers went over the top with the Americans of the 27th Division in the Battle of Catelet-Bony. The American division was in support of the British offensive, one of the several which Foch hoped would bring Germany to her knees in the fall of 1918.

The battalion reached the front by train without incident but the approach march to the forward assembly area was made difficult by enemy artillery fire, particularly gas shells. Wearing gas masks increased the crews' discomfort and decreased their visibility. From the forward assembly area to the jump off point, the routes were marked by white engineer tape. The preliminary barrage covered the battlefield with smoke, most of which drifted toward American lines.

In the thick smoke, the tanks lost their way as soon as they left the tape, but at least the smoke prevented the German gunners from finding targets. Around 1030, the smoke began to lift and the tankers were subjected to a murderous fire. Direct-fire artillery, antitank rifles, and armor-piercing bullets all combined to defeat them. By 1 October, the battle came to a halt. The attack was unsuccessful.

Even more than the light tanks in the Argonne campaign, the 301st Heavy Tank Battalion suffered from a lack of control and, above all else, a lack of cooperation with the infantry. In the Argonne, Patton sought to control his units and pass information through runners and by laying telephone wire from battalion to brigade and higher.

The 301st followed the British practice of runners from company to battalion and using a wireless (radio) tank to establish communication from battalion to higher echelons. The wireless tank, however, was as blinded by the smoke as anyone. Unable to directly observe the action, the battalion commander had to rely on runners from the companies for in-

formation. Company commanders still found it necessary to occasionally lead their tanks dismounted. Captain Varney, revolver in hand, died while directing his company on foot.[17]

Even more significant was the lack of cooperation on the part of the infantry. The 27th Division had never worked with tanks and "the infantry commanders did not seem to grasp the idea of tanks cooperating with infantry."[18] C Company never gained contact with the infantry they were to support, but continued attacking until they became combat ineffective. Of the 40 tanks committed, 36 were put out of action, roughly half by enemy fire and the rest by mechanical difficulties or ditching. In terms of men, the battle cost 22 killed and 71 wounded.[19]

On 8 October, the 301st attacked again, this time at Brancourt with the 30th Division. Tank-infantry cooperation was greatly improved and rewarded with success. On 17 October, the battalion was used to support both the 27th and 30th Divisions, but like the experience of the light tank brigade, it dwindled in strength until only a small provisional tank company could be formed. On 23 October, this remnant tank company made the final attack of the 301st Tank Battalion against weakened German resistance. Completely successful, all tanks which started the attack rallied when the smoke cleared.

On 11 November the Armistice finally ended the fighting on the Western Front. The veterans of the American Tank Corps reflected upon their experience with the new machines of war. Their reports, letters, and, later, their reminiscences attempted to capture the experience of being the first in a new branch —a new way of war. Unfortunately for them, they were handicapped by the technological limitations of the machines they rode into battle, and by simply being the first.

But they wrote the initial chapter in the history of mechanized warfare and left a tradition of sacrifice, courage, and enthusiasm that still endures.

Footnotes

[1] *U.S. Army in the World War, 1917-19: Organization of the AEF*, Vol. 1. Washington: Historical Division, U.S. Army, 1948. p. 138.

[2] Letter from Rockenbach to CIC, AEF, (3-16-18), Box 320, Records Group 120, National Archives.

[3] "Narrative of Personal Experience," from 1LT Theodore Sledge to A C/S TC, 12 Dec 1918, U.S. Army Armor School Library, Ft. Knox, Ky.

[4] "Training Notebook," LT Robert J. Welt, WWI TC File # 2, U.S. Army Military History Institute, Carlisle Barracks, Pa.

[5] "Narrative of Personal Experience," from 1LT D.S. Dunn to A C/S TC, 8 Dec 1918, U.S. Army Armor School Library, Ft. Knox, Ky.

[6] "Narrative of Personal Experience," from Major Sereno E. Brett to A C/S TC, 14 Dec 1918, U.S. Army Armor School Library, Ft. Knox, Ky.

[7] "Narrative of Personal Experience," from LT Harry G. Bourland, U.S. Army Armor School Library, Ft. Knox, Ky.

[8] "My Horrible Experience," by 2LT D.M. Taylor, U.S. Army Armor School Library, Ft. Knox, Ky.

[9] Ibid.

[10] "Narrative of Personal Experience," from 1LT Don C. Wilson to A C/S TC, 13 Dec 1918, U.S. Army Armor School Library, Ft. Knox, Ky.

[11] D.M. Taylor, "My Horrible Experience."

[12] "Lecture on Tanks and Their Operations," Samuel D. Rockenbach, 13 Jan 1919, TC Folder # 5, Box 3292, Group 120, National Archives.

[13] "Narrative of Personal Experience," by 2LT Harold Neff to A C/C TC, 9 Dec 1918, U.S. Army Armor School Library, Ft. Knox, Ky.

[14] "Personal Experience Report," from Capt. Ernest A. Higgins to Chief, TC, 12 Dec 1918, U.S. Army Armor School Library, Ft. Knox, Ky.

[15] Ibid.

[16] Wilson, "Narrative of Personal Experience."

[17] "Personal Experience," from Capt Reynell to A C/S TC, 13 Dec 1918, U.S. Army Armor School Library, Ft. Knox, Ky.

[18] "2d Tank Brigade: Report on Operations, September 27 to October 1st, 1918," by Major R.I. Sasse, TC Folder # 5, G-3 Reports, Records Group, National Archives.

[19] Ibid.

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The PROWLER unmanned vehicle is seen here compared to a tank and an APC.

Research Progress in Unmanned Vehicles

by Steven M. Shaker and Alan R. Wise

Unmanned ground vehicles suitable for various military applications are being aggressively researched and developed by several U.S. companies. These mobile robotic systems are not meant to replace manned vehicles in the foreseeable future. Rather, they will allow tanks, armored personnel carriers, and other manned vehicles to become more selective in choosing missions.

Combat operations of lower priority or those with a slight chance of survivability can be geared toward unmanned vehicles. Possible missions for these robotic weapon systems include: sentry, mine-laying and disposal, nuclear-biological-chemical (NBC) detection and decontamination, medical evacuation, firefighting, antitank, intelligence gathering and radar jamming.

Unmanned vehicles could also play an important role in the Army's AirLand Battle scenario through the surveillance, harassment and interdiction of enemy reinforcements in their rear positions.

Army, Defense Advanced Research Projects Agency (DARPA), and various corporate funding and support has advanced the technology of unmanned vehicles to the point where actual systems can be introduced onto the battlefield in the near future.

Simple remote controlled systems have given way to programmable robots. These vehicles are capable of taking actions in response to situations anticipated by the programmers. The next step, involving the development of unmanned vehicles that can reason on their own as to the best course of action to achieve a goal, is part of the rationale behind the Department of Defense's $600 million Strategic Computer initiative to develop artificial intelligence (AI).

In Columbus, Ohio, the Battelle Corporation has developed a mobile platform named ROCOMP — radio or computer operated mobile platform. The basic system is a tracked, 250-pound (113 kg) vehicle that can climb and descend stairs as well as maneuver on both hard and soft outdoor surfaces. The vehicle can be equipped with radio-controlled and televised feedback umbilical or wireless systems. It can also have obstacle avoidance navigation. The ROCOMP can, therefore, be maneuvered according to a programmed itinerary or be driven by remote control. A manipulator arm capable of lifting 50 pounds (23 kg) when extended, 200 pounds (91 kg) when retracted, and other specialized equipment can be added to the vehicle. RECOMP was designed to function in environments such as nuclear power facilities, chemical plants, security patrol areas and burning buildings.

The ROCOMP's physical dimensions are 18 inches (46 cm) high by 28 inches (71 cm) wide by 54 inches (137 cm) long.

In 1983, the Denver-based Robot Defense Systems, Inc. (RDS) was formed. They had developed the PROWLER — Programmable Robot Observer With Logical Enemy Re-

The 6-wheel, all-terrain PROWLER can sense motion, follow orders, and send back television views of a remote scene. The operator can also communicate over an audio channel.

sponse — series of unmanned vehicles. The basic PROWLER vehicle is mounted on a 6-wheel, all-terrain vehicle chassis. The undercarriage weighs 3,700 pounds (1,678 kg) and the PROWLER can carry a 2,000 pound (907 kg) payload at a maximum speed of 17 mph (27 km/hr). As with the ROCOMP, the PROWLER can operate both autonomously and through remote controlled commands, and has a real-time audio and visual link.

The PROWLER is equipped with Motorola 68000-class onboard computers that can be programmed so that the vehicle can patrol a perimeter without human supervision. Onboard sensors use reference points such as a fence or road to keep the PROWLER on a prescribed course. If the remote controlled option is wanted, the operator controls the robot through a triple camera video system with night vision optics and other senors.

The operator can be up to 19 miles (30 km) distant, and the PROWLER's cruising speed range is 155 miles (250 km). A scenario of how the PROWLER might operate follows: While on a preprogrammed patrol pattern of a nuclear missile silo, the robot's electromagnetic motion detector senses someone scaling the fence. The PROWLER informs the operator of an intrusion, at which time the operator takes remote control of the vehicle, directing with a joystick. The operator moves the PROWLER closer to the intruder to view the area with its camera system. Once the perpetrator is visible, through its audio feedback with directional pickups, the PROWLER allows the operator to talk to the intruder.If the intruder is uncooperative and appears to have terrorist objectives, the PROWLER can then use either non-lethal or lethal weaponry to disable him. The PROWLER has the added feature of providing a continuous video recording capability to document the incident.

The PROWLER has been equipped with two *M60* machineguns and a grenade launcher. However, other weapons — such as Chain Guns, antitank missiles, tactical missiles and flamethrowers — can be installed depending on the mission. DARPA funded the initial field demonstration of RDS's PROWLER In May 1984. The demonstration was conducted on behalf of the Army's Ninth Infantry Division and the Army's Missile Command. The 9ID awarded a second contract to RDS in September, 1984 to demonstrate the various combat capabilities of PROWLER.

The Defense Electronics Division of Gould, Inc., teamed up with RDS in October 1984 in a cooperative bid on an upcoming Army proposal for robotized tanks. Also in the same month, Boeing Aircraft Company awarded a research contract to RDS to advise Boeing regarding robotic security systems to protect intercontinental ballistic missiles (ICBMs). A similar contract concerning ICBM security was awarded to RDS by Bell Aerospace Division of Textron, Inc.,

Iron Scouts for Armored Forces?

Legged robots, currently being developed, are the first vehicles built that will duplicate and even improve on the obstacle-traversing capability of man.

Under the control of a tank commander, a legged-type robot could be capable of performing many of the intelligence-gathering functions presently done by the foot soldier. In its storage position, (legs folded), it could be carried on a tank or other armored vehicle and deployed as needed. The robot would be equipped with video and infrared cameras, microphones, nuclear, biological and chemical sensors, and mine detectors. A variety of electronic intelligence gathering equipment would be on board as well.

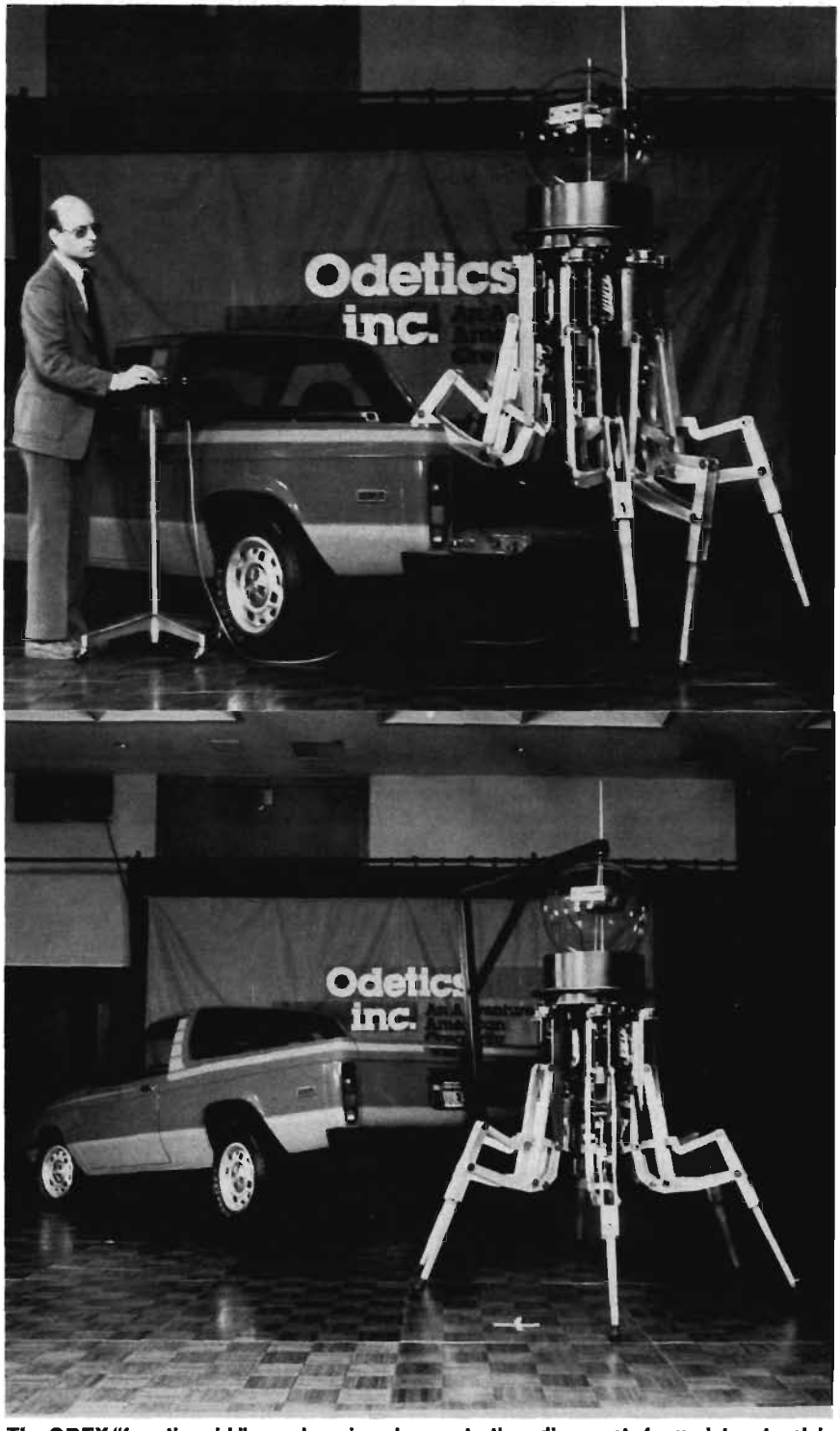
While operating in a hostile environment, the robot's survivability will be greater than man due, in part, to its low sound and smaller heat signatures. It will be impervious to NBC and severe weather.

On the battlefield, a mission might be to reconnoiter over a hill and into the next valley to a specific coordinate. The robot could travel through a wood, crossing natural obstacles such as fallen trees and large rocks, in the same way as a soldier. Tactical obstacles such as tank ditches and minefields would be located, studied and crossed. When the enemy is located, long periods of direct observation might be achieved. All gathered intelligence could either be transmitted or stored on discs to be retrieved upon return.

If a robot were to be captured, a self-destruct device could be activated. Robots generally do not show much loyalty. They do, however, hold up well under painful interrogation.

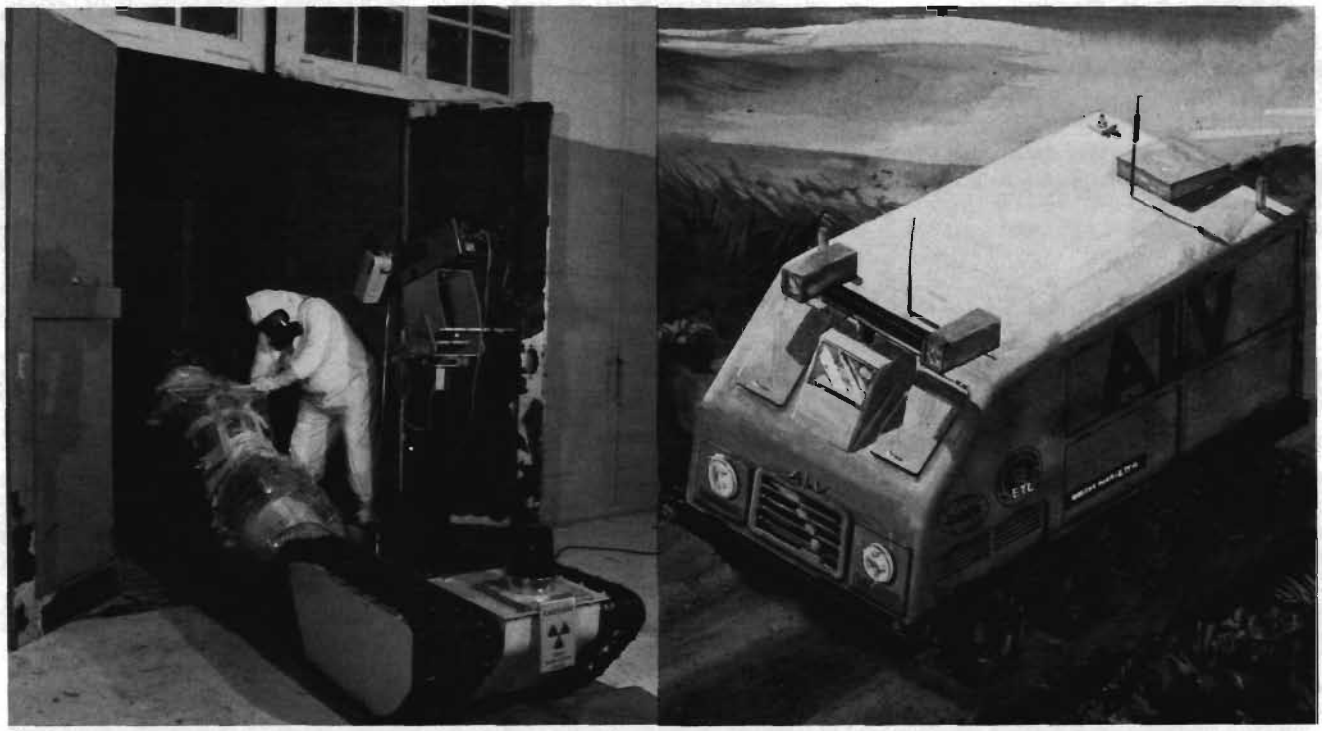
in January 1985. In addition to these contracts, the international construction firm Bechtel National has proposed using the PROWLER at a security installation in a Middle Eastern country.

A circular-designed mobile robot which walks on six articulators has been developed by Odetics, Inc., of Anaheim, CA. This type of unmanned legged vehicle has been termed a "functionoid" by its developers. Such a system equipped with walking articulators can traverse areas inaccessible to tracked or wheeled vehicles. The first prototype, named the Odex I, is serving as a base technology for future functionoids built to perform specialized tasks including military missions. The Odex I can move at a speed comparable to a man's brisk walk. It can lift a maximum load of 2,100 pounds (952 kg), nearly 5.6 times its own weight, while in a stationary position with all six legs on the ground. While walking it can carry a weight of 900 pounds (408 kg), which is 2.3 times its own weight. This strength-to-weight ratio is unique to the functionoid-type unmanned vehicle. The structure design of the Odex I allows its height and width to vary dimensionally. In a squat position for minimum exposure, the Odex I's height is 36 inches (91 cm). With the articulators fully extended its height is 78 inches (198 cm). Its width can vary from 21 inches (54 cm) to 27 inches (69 cm). Odetics designed the Odex I's computing system which includes one microprocessor per articulator and one central computer. A joystick control provides commands to the computer that in turn computes the required articulator motion using in-house-developed algorithms. The joystick communicates with the Odex I's central computer through a radio link. A peripheral data distributor communicates to the articulator microprocessors through a cable, daisy-chained and terminated at the last articulator. The Odex I relies on the instructions of an operator to perform a particular task, but it is the goal of Odetics, Inc. to build a completely autonomous functionoid that can operate on very global orders.



The ODEX "functionoid," seen here in a demonstration, dismounts from pickup truck in upper photo and then lifts the truck. ODEX can move at the pace of a man's brisk walk and can lift almost six times its weight.

In April 1984, RCA Government Systems Division signed an agreement with Odetics, Inc. aimed at sharing technology in order to develop a mobile robotic system that can be applied to military missions. The joint effort involving Odetics' expertise in robotics and RCA's experience in sensory packages — including system vision and artificial intelligence — is aimed at developing a functionoid capable of performing sentry duty and hazardous tasks such as mine disposal and exploration of hostile areas. In August 1984, the Army's Human Engineering Laboratory (HEL) at Aberdeen Proving Ground, MD, awarded a contract to Odetics, Inc., to develop a preliminary design for a high-payload-to-weight manipulator structure. Applications for such a manipulator



Radio-controlled, with television feedback, the 250-pound ROCOMP, at left, is seen here moving radioactive material in a test at Battelle Corporation. The autonomous land vehicle (ALV), seen at right as an artist's conception, is a Martin-Marietta Aerospace project.

include a multitude of forward area materials-handling tasks such as moving bridging sections, fuel drums and transferring ammunition. That same month, the Naval Surface Weapons Center in White Oak, MD, funded a study by Odetics to provide preliminary design specifications for a tele-operated firefighting hose delivery system.

In September 1984, Martin Marietta Aerospace Company was awarded a $17 million, five-year contract from the U.S. Army Engineer Topographic Laboratories at Fort Belvoir, VA. The project, funded by DARPA, is to build an autonomous land vehicle (ALV) using advanced computer architectures, artificial intelligence and robotic technologies. The contract calls for a planned evolution of the ATV capability from traveling over a paved road during the first year to having the ability to autonomously change course around impassable objects at completion of the contract in 1989. DARPA hopes to end up with a truly autonomous prototype vehicle capable of traveling cross-country at 50 kilometers per hour over rough terrain, and that can collect electronic and visual battlefield intelligence. Denelcor Inc., of Denver and the supercomputer manufacturer, Cray Research Inc., of Minneapolis, are assisting in the development of the artificial intelligence necessary for the ALV to determine its own course of action.

Recent breakthroughs in artificial intelligence, computer vision, sensors and robotics have converted the far-out dreams of science fiction writers into the near-term feasibility for developing unmanned ground military vehicles. The opportunities for weapons designs and tactics afforded by these technologies, as well as the increasingly dangerous environment, may serve as a catalyst for the emergence of unmanned vehicle systems on the battlefield.

Additional Reading

1. *Military/Space Electronics Design*, Dec. 1984. "DARPA Seeks Mobile Battlefield Robot Capable of Thinking for Itself." pp. 10-11.
2. *Defense Systems Review*, Nov. 1983. "Mobile Robotics Will Serve Many Roles in Future Land Warfare." pp 13-17.
3. *TWA Ambassador*, Oct. 1984. "Metal Warriors." pp. 22-30.
4. *Unmanned Systems*, Spring 1984, Vol. 2, No. 4. "A Mobile Military/Security System: Tactical Application of the Prowler Robot." pp. 28-31.
5. *Defense Electronics*, Sept. 1984. "Mobile Robot for Perimeter Patrol." p. 188.
6. *International Defense Review*, Vol. 17, No. 11/1984. "Prowler 60 Robotic Patrol Vehicle." p. 1757.
7. *Newsweek*, 25 June 1984. "Birth of the Killer Robots." p. 51.
8. *Unmanned Systems*, Fall 1983. "Odex I the First Functionoid."
9. *Unless Peace Comes — Forecast of Future Weapons*, Viking Compass Book, N.Y., 1968. "Robots on the March," chapter.

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The Heavy Force/Light Force Mix-Up

by Brigadier Richard E. Simpkin (Ret.)

In the time I have had the privilege of working with your editor, we have agreed about most things. But we have had one or two fruitful clashes too, and this article is the product of one of them. "Light forces. . . ," he wrote me, "are more suitable for defensive purposes than the more offensively suitable heavy forces." A recent multiple feature in *Infantry* magazine shows that this is indeed the U.S. Army's thinking. As it is the precise opposite of the conclusions I have drawn from my studies of the past few years, there is evidently food for thought.

This disagreement represents two theories coming down to earth and colliding head-on. In attrition theory — the tradition of American and British military thinking culminating in the 1976 edition of FM-100 — heavy forces are for attack and light forces may be used in defense on the principle of economy of force. Maneuver theory, as promulgated in the 1982 edition of FM 100-5 and applied in the Starry/Richardson "AirLand Battle" and the Rogers "Strike Deep" concepts, sees offensive power as being developed not so much from mass as from momentum. No need for the addicts of attrition and the masters of maneuver to come to blows, though! In a book now in press (*Race to the Swift — Thoughts on Twenty-first Century Warfare.* Brassey's, London. July, 1985.) I have demonstrated, to my own satisfaction at least, that, once hostilities have broken out, maneuver theory ceases to contradict attrition theory and embraces it, adding a third and dynamic dimension to it. In an offensive operation based on maneuver theory, the holding force action, including the break-in battle if one has to be fought, remains attrition-oriented and thus calls for heavy forces.

How Light is Light?

Comparing and contrasting *"light"* with *"heavy"* tends to mask the equally important distinction between *light* and *light mechanized.* As a result, the *hi-tech* light division concept piloted by 9th Infantry Division — or at least the 1984 form of it — has fallen neatly and hard between these two stools. HTLD 84 could put only 648 men, 4.5 percent of its strength, in foxholes (as opposed to the U.S. airborne division's 33 percent); yet it lacks *protected* mobility. Light mechanized forces have been out of fashion in the U.S. Army for 25 years or so. Although I have heard a number of tactical justifications for this, I suspect it is at least partly due to the extraordinary and disastrous history of American armored reconnaissance vehicles. At the same time, the farsighted preference of the cavalry for the rotary wing has diverted manpower and money from the light mechanized area. Like *M2 Bradley*, the *M3* cavalry fighting vehicle (CFV), is essentially a heavy-force vehicle, the more so as it is too wide for the *C-141B Starlifter* aircraft.

Perhaps we can fairly define a *light mechanized force as a force mounted in airportable, amphibious, cross-country vehicles which provide all-around armor protection and a full range of mounted firepower.* To this we must add two riders — the force is likely to contain a rotary-wing element equivalent to that of the heavy division's air cavalry attack brigade (ACAB); and its firepower may exclude the latest main battle tank gun.

In these terms, the U.S. Army has neither the equipment in its inventory nor the formation in its structure. The technology to field a light mechanized division, with the 105-mm tank gun in its armory, is now available. The need for it in a number of possible intervention theaters is self-evident. The question is whether light forces can contribute to the defense of the NATO center and, if so, how. I have written extensively elsewhere about special forces, *semi-special forces* like paratroops and helitroops, and light infantry. Here I want to address the role of the light mechanized force both as a component of the main maneuver force in Europe, and in intervention.

Mass and its Key Multipliers

All armies I know of, including the Soviet Army, the *Wehrmacht*, and the pre-1973 *Bundeswehr*, reckon mass in terms of numbers of men. Attempts to work with a number of other primary parameters convince me that this is the only practicable one. Yet in equating numbers of men

to physical combat worth, one is making a host of hidden assumptions. Among these is that every combat and combat support soldier, from the paratrooper to the chopper pilot to the heavy rocketeer, has the same chance of survival.

While I question the British Parachute Regiment's contention that a paratrooper has a life expectancy of only six hours in contact, this sweeping assumption is patently untrue. We, therefore, need to find a way of starting from numbers of men and arriving at an estimate of physical combat worth. After following many a false trail and primrose path, I found that one can do this with one or both of two key multipliers.

The first of these, *organic weight per man*, gives one a compound parameter of *physical fighting power*. This applies mainly to attrition theory and the attritional component of maneuver theory. But it also represents the potential threat conveyed by the mobile force in an operation based on maneuver theory. In battling my way towards this notion, I used Soviet formations (1980-ish vintage) as models and arrived at these figures, deliberately rounded to preempt nit-picking:

Airborne Assault Brigade, including helicopters — 0.85 tonnes/man.

Airborne Division, c. 33 per cent BMD-mounted, excluding transport aircraft — 1.25 tonnes/man.

Mechanized Division — 2.5 tonnes/man.

Tank Division — 4 tonnes/man.

These figures strike me at least as making very good sense. On ballpark figuring (since I do not have all the relevant data), the U.S. Army's Heavy Division *86* seem to come out at around 3 tonnes/man, the figure being pulled down by the ACAB and the large softskinned tail. A similarly structured light mechanized division, based on a 15-to 18-tonne indivisible load and articulated heavy weapon platforms, would give a figure of rather under 2 tonnes/man.

The principal maneuver multiplier is *tempo*, which one might roughly envision as *operational rate of advance*. For a maneuver-based offensive operation, the Soviet Army regards an all-arms army, a tank division, and an airborne assault brigade as having roughly the same combat worth. In an earlier analysis using simply mass; i.e., number of men, and tempo to give a figure for *momentum*, I found the figures matched the Soviet estimates of combat worth to the nearest order of magnitude. But adjusting mass by organic weight per man and then multiplying by tempo brings one much nearer the mark — as common sense suggests it should. Similarly, amphibious performance, better trafficability, and a higher cruising speed might give a light mechanized force a 50 percent advantage in tempo over a heavy one.

Thus, *as long as it can exploit its speed*, a light mechanized division would have about the same physical combat worth as a heavy one. We shall see in a moment that a comparison by types of combat and role largely bears this out.

This brings me, though, to two pitfalls I must highlight before switching from this approach. *Physical combat worth is not an absolute quantity, only a relative one.* It depends on what the U.S. Army so aptly summarized as METT-T conditions. (For the benefit of non-American readers, METT-T is a complex parameter which takes account of *M*ission, *E*nemy, *T*errain, *T*roops and *T*ime.) In many METT-T conditions associated with intervention, organic weight per man may be a powerful *de*multiplier, and high tempo may be wholly unrealizable. Second, all this figuring is, as Mahan puts it, "a guide which warns you when it is going to go wrong." It takes no account of the overriding factors of generalship and morale.

Structure and Equipment

Another possible reason for the U.S. Army's light mechanized void is the way the 1986 force structure plan stepped back from two brinks. With the emphasis still very much on the NATO center, the *division* remained the key structural formation. For a single-role army like that of the Federal Republic of Germany, this may still make sense — although the Soviet Army, designed to operate on central land lines, is showing signs of moving towards a brigade-based organization for some types of forces.

But with the direct and real cost of the individual rising even more rapidly than his combat worth, the arguments for a structure based on self-contained brigades (brigade groups) gain force. What is more, the integration of a brigade's-worth of air cavalry into the division, tactically desirable as this may be, makes it expensive, unwieldy, and complex to handle.

Once force structures really begin to reflect the need to shift the combat arm/artillery ratio from 3-to-1 toward 1-to-1, this unwieldiness will run wild. Above all, where intervention over long or medium air lines is called for, even a modest division mainly composed of any one type of force is out of scale with the airlift available for deployment and logistic support, while a division-sized task force made up of different types of brigades — say air cavalry, light mechanized, airborne, light infantry — is in the right ballpark. A light mechanized brigade will require about the same airlift as, say an airborne division; if the METT-T conditions are right, it should have around the same combat worth.

The second and more evident brink is the failure (against USAARMS' recommendations) to reorganize the combat arms. Here again, a single-role army like the *Bundeswehr* can just forge ahead and integrate armor and infantry. For a multirole army faced with mounting emphasis on intervention, the problem is less simple; armor and infantry alike are already pulled in more directions than they can reasonably cope with. But the key to a value-for-money light mechanized force is clearly an organically and intimately integrated combat unit. Apart from all the other factors going for it, this is dictated by technology.

In the heavy maneuver force, the need for a point defense antihelicopter weapon system to protect the MBT is steering several armies towards the idea of a *MBT/IFV pair*. In an airportable light mechanized force, the *vehicle pair* concept is dictated not so much by the state of the art as by the shape of the man.

I have rehearsed the arguments at length several times over in your columns and elsewhere; here I will just summarize my current view of them. Strange as it may be, the U.S. Army has twice embarked on *third time lucky* projects and come up with winners. The *M1* is a fine tank. And there can now be little doubt that the *M2* is a worldbeater as a squad IFV. But to cut a *M2*-like

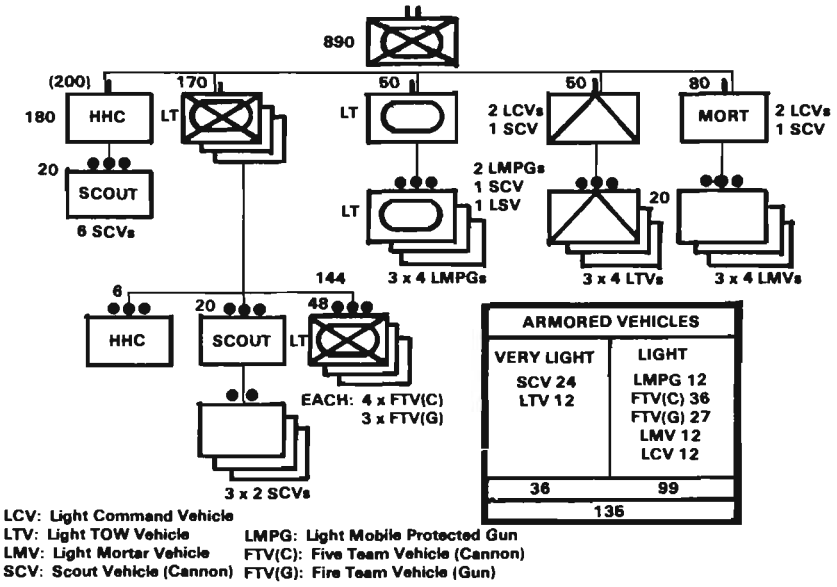


Figure 1. A Possible Light Mechanized Battalion Structure

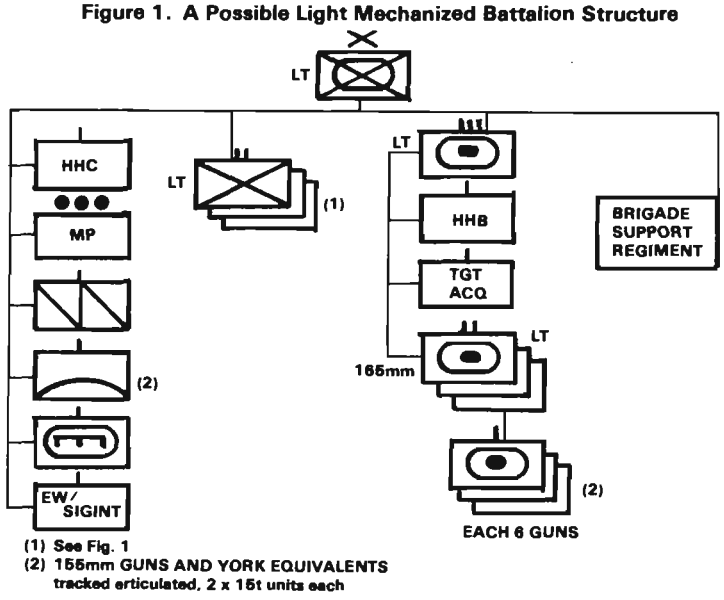


Figure 2.

design to *Starlifter* size, you have to make it a fire team (half squad) IFV. This means seven vehicles per mechanized platoon. Throw in a light mobile protected gun (LMPG) per squad, making up the equivalent of the MBT/IFV pair, and you have a 10-vehicle platoon. This is out in terms of tactical handling. So your squad has a pair of fireteam IFVs or *fire-team vehicles* (FTVs) — the FTV (cannon), probably also a gun such as the Israeli IMI 60-mm HVMS in some kind of cleft turret or semi-external mounting. The kinetic energy (KE) performance of this gun is claimed to be about that of spin-stabilized 105-mm APDS — a claim borne out by the way U.S. work in this area is looking at calibers down to 40-mm. The FTV(C) is the platoon command vehicle, with a lookalike light command vehicle (LCV) for company and battalion headquarters. With guided, antiarmor mortar projectile (GAMP) coming into service, the light mortar vehicle (LMV) ranks at least equal to the light *TOW* vehicle (LTV) and the LMPG in importance, and either the LTV or the LMPG might be discarded.

The Reinmetall 105-11 SLR, 105-mm tank gun ammunition, will fit on the *M2* with a cleft turret or (semi-) external mounting. But no way can this gun be made compatible with a narrow 15-tonne vehicle and a trunnion height of over 2 meters. By contrast, a dedicated *topless* LMPG mounting this gun is feasible within the *Starlifter* loading gauge at 17 or 18 tonnes; and novel hull configurations might get this figure down below 15 tonnes. A powerful LMPG firing existing ammunition is thus available if required.

Figure 1 shows a light mechanized battalion of this kind, that I developed last year. Being intended as a basis for discussion, it is on the lavish side, including LMPGs, LTVs and mortars as support weapons. Figure 2 indicates how a self-contained brigade built around it might look. Given suitable METT-T conditions, the battalion has roughly the same physical combat worth as a standard infantry brigade; and it requires just about the same number of *C141Bs* to lift it. Likewise, the brigade roughly equates in both respects to a standard infantry or airborne division. The company is the structural equivalent of a balanced tank-infantry company combat team, and can put about the same number of men in foxholes. I will use this brigade and combat battalion as models in examining the role and worth of light mechanized forces.

Light Mechanized Force on NATO Center

The arguments being put forward for the use of a heavy-light mix in 7 (U.S.) Army look to be based on versatility and speed of reinforcement. Briefly, the U.S. needs first-rate forces of various types that are suitable for intervention; some at least of these must also be suitable for employment on the NATO center. This is a fair enough argument. But one can justify the heavy-light mix in terms of operational advantage; and this may be a more fruitful way to address the problem.

All armored vehicles, including the latest MBTs, are wide-open to top attack. This threat is growing apace; by the end of the century it is likely to be the dominant antiarmor threat. Given this, the light mechanized is less powerful than the heavy in two respects. With a caliber of 60-mm or so, the FSV(G)'s gun will defeat the MBT front only at short and medium ranges — out to 2,000 meters at the most and maybe 1,500 meters. Similarly, the light force lacks a vehicle with the MBT's survivability in face of KE attack on the classical frontal arc.

This means that a light mechanized force cannot deliberately confront a force containing MBTs on open ground. It cannot carry out a frontal attack (such as a break-in) against a deployed force containing MBTs. Likewise, in positional de-

". . .A light force needs room to maneuver at speed if it is to develop its full combat worth. . ."

fense, it cannot maneuver in the open or move forward under the guns of an attacking force containing MBTs. Sure, a light force needs room to maneuver at speed if it is to develop its full combat worth; but with these two exceptions, it can do anything the heavy force can do.

Unfortunately, the immense politico-economic value Federal German territory has now acquired in NATO eyes deprives the Alliance of the ability to trade off real estate for attrition and time to anything like the extent that maneuver theory requires. The post-1973 *Bundeswehr* is committed to a forward positional defense, with maneuver limited to the middle tactical levels. This constrains the American and British forces to adopt a lattice-type defense, with firmly held strongpoints at the nodes of the lattice *(active defense)*, and with robust if less enduring anvils of various sizes *(active defense* and AirLand Battle).

The nodes of a lattice defence are evidently no place for light forces; if forced back, they can neither maneuver on open ground, nor counterattack, in face of a full-scale assault led or supported by MBTs.

Similarly, in view of the mass of the attack facing them, anvils composed of light forces may not be robust enough to set up the attacker for the hammer blows. In positional defense, or in the positional component of a mixed defense, the best use of light forces, mechanized and dismounted alike, is in the economy of force role.

Until the early '60s, the U.S. Army, like most others, employed lightish but fairly powerful cavalry units as a forward screen or covering force, as well as for reconnaissance in the strict sense of gathering information. Then, as mentioned earlier, the U.S. Army decided to assign battalion combat teams from the main maneuver force to the screen/covering force role. Whatever the reasons for this decision, and however high some Allied eyebrows were raised when they learned of it, I suggest it was and still is a tactically sound one in the particular circumstances of the NATO center. Like other components of the defense, even more so maybe, the covering force has to gain a lot of time at the cost of very little space. To do this, it must certainly be able to stand and to maneuver in the open, and it may have to make short, sharp counterthrusts against advancing tank formations. It, therefore, itself needs MBTs.

I have not seen the phrase "anvil and triple hammer" in black and white. But if one reads the AirLand Battle as an evolution of active defense and sees AirLand Battle and *strike deep* as complementary, the concept as a whole calls for three kinds of hammer. The first is a low-level tactical hammer, probably formed by the anvil's tactical reserve. This delivers a short blow under cover of direct fire support from the anvil and of artillery fire controlled by observers within the anvil.

If, for example, the anvil was based on a defile, this blow might consist of a tank-heavy battalion combat team launched into the mouth of the defile to isolate the emerging vanguard and nip deployment of the second advance guard battalion in the bud. In terms of maneuver theory, this is essentially a tactical maneuver within the holding force (main force), and calls for the striking power conferred by MBTs.

The higher tactical hammer — the classical one — is normally launched from a secure area behind the anvil onto the flank and/or rear of the enemy formation, say a division, that has been set up by the anvil. In heavy force terms, this hammer might consist of a tank-heavy brigade-level task force, supporting or supported by a suitable task force from the ACAB. Although still at tactical level, this more far-reaching blow is a mobile force action in terms of maneuver theory. The key to success is momentum achieved by high tempo. If it moves fast enough, the only deployed force this higher tactical hammer should expect to face is the enemy flank screen. Provided it penetrates this quickly, the enemy main bodies will have neither time nor space to deploy. Here the higher tempo of a light mechanized force should more than offset its limited firepower and direct protection. What is more, this higher tempo bridges the very uncomfortable mobility gap between the heavy track and the rotary wing, thus allowing the helicopter force to operate to greater effect and at less risk.

Of greater importance still, though, is the operational hammer of the *follow-up force attack* (FUFA), designed to strike into the *windows* between enemy echelons created by the air and long-range artillery interdiction *strike deep*. This could conceivably be executed by a rotary-wing force of one or more ACABs acting at operational level. But at the present stage in the rotary-wing story, one has to ask the question: "What do they do when they get there?" The Soviets may well be right in their caution about operational employment of their rotary wing airborne assault brigade, and in their insistence on a land follow-up within six hours.

The arguments deployed in the preceding paragraph gain still more force here. A heavy division reinforced by a light mechanized brigade to spearhead the advance and link up with the ACAB would seem ideal.

In a major counterstroke, say a corps-level offensive, the role of light mechanized forces would be threefold (and what follows is based rather closely on Soviet thinking about BMP-based forces). Initially their role would be to open up a penetration by a *slashing attack* if a weak spot (a boundary for instance) or a gap can be found. The light force is inserted and follows the line of least resistance to the defender's divisional or (depending on his density) army rear boundary; it turns in along this lateral until it reaches a potential primary axis and advances down this. The heavier component of the mobile force follows as close on its heels as it can, peeling off combat teams (Soviet *raid forces* or *air-ground assault groups*) to deal with gun lines and C^3 nodes.

In sum, positional warfare, or the heavy break-in phase of an offensive, relegates light mechanized troops to an economy of force role. They cannot and should not mix it with the big boys within the confines of a ring. By contrast, once mechanized manuever warfare offers free play, these troops become a significant military asset and can

play a leading role in both senses. Their value is further enhanced in an airmechanized scenario with higher tactical and operational actions by rotary-wing formations.

Light Mechanized Forces in Intervention

There will be many cases where intervention is desirable or necessary but the METT-T conditions rule out the use of light mechanized forces. The different types and balances of force required are a further argument for a brigade-based structure. At the other extreme, there are theaters and situations where mission and terrain call for mechanized forces but the mechanized and antiarmor threat is minimal or absent. Here a light mechanized battalion combat team (figure 1), maybe minus one or both of its antiarmor support companies (LMPG, LTV) could dominate the situation and do pretty well as it pleased. Even a company combat team of this kind might be decisive.

As a rule, though, the intervention will face an opposition with American, European, or Soviet heavy equipment, including MBTs, no more than a half-generation out of date. No intervention force operating at the end of its air lines could hope to defeat such an enemy in positional warfare. Allowing him to adopt a posture of positional defense puts minimal pressure on his weak points — command, staff and logistic skills, and ability to maintain his heavy equipment. Given a firm base (presumably round the airhead) and logistic sufficiency, a rotary-wing/light-mechanized force can sally forth, dislocate the enemy by swift and sweeping operational maneuver, and destroy him in detail if needs be. I doubt I need enlarge on this concept for *ARMOR's* readership.

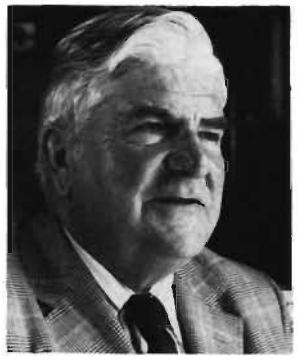
But, despite its ability to put a reasonable number of men in foxholes if needs be, the light mechanized force is not exactly manpower-intensive; and a rotary-wing attack/assault force is even less so. On the other hand, both strategic and operational/tactical airlifting of standard and airborne infantry is a massive business. (Just to drive this point home (using 1984 figures), the U.S. airborne division is over 18,000 strong, requires a lift of 1,111 *C141Bs*, and puts 4,100 men in foxholes), the light infantry division (7th ID model) packs just over 10,100 men into 461 *Starlifters* and puts 3,400 of them in foxholes.) The light mechanized force *must* therefore be balanced by a truly *light infantry force* to secure a forward base, to deal with *downtown* urban terrain and impassable terrain, and/or to take out any guerilla threat by the roots.

In yet another type of situation, a light mechanized force may be called on to operate in support of airborne or standard infantry against an enemy with MBTs. This is extremely dangerous unless the infantry commander himself understands the strengths and weaknesses of light armored vehicles or listens closely to the mechanized commander, now his advisor. In terms of figure 1, the key mechanical elements in the defense now become the *TOW* and mortar companies, reinforcing the infantry's own. The LMPG company could be grouped with an infantry battalion for attack, provided that the LMPGs are not asked to lead and can therefore make use of cover from fire. The light mechanized companies must not be employed in frontal attack. They could be used in a dismounted positional defense with their vehicles in support, much on the line of current *Panzergrenadier* thinking. Or, if there is — as there may well be, an open flank, they can carry out a harassing or turning role.

Conclusion

If the U.S. Army wants a light mechanized force, it will need to structure, equip and train one virtually from scratch, basing it in some way or other on integrated armor-infantry units. The decision against an integrated combat arm for the 1986 force structure suggests that this might give rise to serious cultural shock. A whole family of equipment would have to be developed, this in an area that is historically not the U.S's. strongest. This would divert much talent and money from the heavy maneuver force programs. The development of doctrine and subsequent training would add to the problems of multiplicity of role that are already making armor and infantry scratch their heads. Opponents can and do argue that no other advanced army, except maybe the French, has such a force.

Yet no other advanced nation, except maybe France, has the strategic need to intervene militarily at the end of long air lines, backed by the political will to do so. The switch to operational and tactical doctrines based on maneuver theory, coupled with the employment of air cavalry at operational level, makes a light mechanized element a clear-cut military asset in the heavy maneuver force setting — maybe an essential rung in the mobility ladder. At the same time, both the strategic need for effective intervention and the political will for it are on the up and up in the U.S. These factors argue for a force of one light mechanized brigade per 1986 type A Heavy Division, distributed in peacetime between CONUS and 7 (U.S.) Army. One of these four brigades could be deployed as part of a rapid intervention force; or they would be speedily concentrated in Europe. In the short term, there looks to be a case worth examining. In the long haul, a force based on the rotor and the fast track is the vehicle needed to carry thought and reality from the baroque bludgeons of the present to the hi-tech rapiers of the future.



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Using Technology to Train the TC

by Bill Burnside, Ph.D.

We hear a great deal about training technology and sometimes we even see the results. But those of us who have been around since you couldn't fit a calculator in your hand may still be somewhat uncomfortable with new technology. Are we running it, or is it running us? How can we most effectively use new technology to improve our training programs?

As new training technology becomes available, developers and users of it need to work together to systematically test and apply training innovations. One way to do this that has been suggested several times in recent years is designation of a specific site within a training institution for controlled operational testing and refinement of new technology.[1] That is, some training program is picked as a model or "guinea pig" for trying out new technology. The assumption is that the potential benefits outweigh the disruption that will be caused by refining new technology in one or a few training programs.

The Army is currently applying this approach through Training Technology Field Activities (TTFAs) at Fort Knox, KY, Fort Lee, VA, Gowen Field, ID., and Fort Rucker, AL. TTFA's have the overall mission of systematically identifying, introducing, and evaluating new technology to improve Army training. The first TTFA was established at Fort Knox during November 1983, by mutual agreement among the Training and Doctrine Command (TRADOC), the United States Army Armor Center (USAARMC), and the Army Research Institute (ARI).[2] Initial efforts of the Fort Knox TTFA are concentrated upon the Basic Noncommissioned Officer Course (BNCOC) for training *M1* tank commanders (MOS 19K).

Benefits of CBI

Saving in student training time, through individualized instruction.

More effective use of instructor time, by automation of administrative functions.

Reduced need for support by non-instructor personnel, through automation of scheduling and delivery of support.

Increase in number and variety of practice opportunities for students.

Tailoring of initial and remedial instruction to meet individual student's needs.

Automated collection and management of data relating to training cost and effectiveness.

Automated maintenance of student records and reports.

Capability to rapidly revise and update course materials.

Saving field training resources by accomplishing the "crawl" phase of instruction through simulation.

Improved student feedback through immediate analysis of responses.

Increased test security through increase in test item pool and reduction in need for hard copies.

Decreased testing time through automated scoring.

Automated control of group exercises, such as sandtables.

Standardization of instructional packages throughout the Army.

Provision of instruction during times other than normal classroom hours (i.e., through terminals in study halls).

Increase student motivation by using realistic computer games rather than boring lectures.

The potential applications of new technology to training are practically limitless. The Fort Knox TTFA should allow the armor community to be at the forefront. Within the next two years, many new technologies will have been implemented and evaluated in 19K BNCOC. Successful applications will be available for transfer throughout armor training and eventually throughout the whole Army.

Need for Technology

Technology is not just fancy machines or displays; it is a body of knowledge that is directed to developing equipment, practicing skills, and gathering and distributing information. Training technology includes techniques, strategies, methods, models, hardware, and software. Examples include drill and practice techniques, training manuals, training simulators, microcomputers, videodisc systems, and the Systems Approach to Training (SAT)[3]. When we think of technology we tend to concentrate on new computer-based systems, but we should not forget that many useful technologies do not have bells, lights, and whistles.

In fact, the Army's best training technology is already in use. It's not fancy, but it speaks the Army's language, tailors itself to trainees' needs, works long hours, and has an imperfect but nearly unlimited memory. It's called the NCO. All other training technologies should support the NCO and allow his or her expertise to be used more effectively.

Technology should not be implemented for its own sake. It should address specific problems. A key problem is that the Army's best training technology (the NCO) is not available in sufficient quantity. The NCO as a classroom instructor is steadily being shifted to the conduct of field training. When sufficient classroom instructors are available, much of their time is consumed by activities other than training. For example, during classroom training, 19K BNCOC instructors spend less than half their time interacting directly with students. The rest of their time is spent in meetings, bargaining for support for future training, paperwork, or other administrative require-

ments. Instructors are hard-pressed to meet the Program of Instruction (POI), and they have little time to give individualized remedial instruction. Technology can automate course management and standardize basic instruction so that instructors can concentrate on individual students.

Another specific problem is that resources for field training are dwindling. The cost of fuel and ammunition is up while the availability of ranges and training areas is down. The cost of operating an *M1* tank is approaching over $120 per mile and the cost of firing the main gun is over $200 per round. The training areas available to BNCOC at Fort Knox are generally limited to two or three kilometers in depth. Technology can simulate the field for the "crawl" and "walk" phases of training, so that students are ready to "run" on a field exercise and make maximum use of limited resources. Field training can then be used to integrate and evaluate classroom training. Technology can also gather data during field exercises, so that students can get objective feedback and learn more from field experiences.

Yet another problem is that students do not get enough practice with individual feedback on their skills in either classroom or field training. For example, tank commanders straight from 19K BNCOC should be able to give fire commands automatically, almost without thinking, but development of this ability depends on extensive practice with feedback. Students currently receive almost no classroom practice on fire commands due to lack of time, instructors, and target pictures. Each student usually gives less than ten simple fire commands during range firing or a situational training exercise (STX), and an instructor is not always available to say whether the command was given correctly. A similar situation exists in the training of Communication-Electronics Operating Instructions (CEOI). Students receive a lecture but little or no classroom practice, due to lack of radios and assistant instructors.

Only limited practice is available in other important areas as well, such as land navigation, tactics, and gunnery. The resources for the obvious solutions — more equipment, more instructors, and more time — are simply not available. Technology can provide practice and feedback without more operational equipment or a one-to-one student-instructor ratio.

We need to exploit technology to supplement limited classroom and field training resources. Much of the technology needed is available off-the-shelf and being used, at least to a limited extent, in academic, industrial, and military settings. But the training problems that still exist indicate that we are not getting the most out of training technologies. Why is this the case?

Many of the problems in applying new technologies in any organization revolve around continued failures to communicate. Technology developers and users not only speak a different language, they also have limited opportunity to interact. This leads to difficulties in identifying key training problems and ensuring that technologies are appropriately applied. Attempts to implement technologies may be resisted by trainers who were not involved in their development. All too often, useful technologies end up as technical reports and prototype equipment sitting on the shelf.

Implementation of new technologies in the Army training system has also been inhibited by operational training environment constraints. The need for a steady flow of trained soldiers does not provide much time or freedom for applying and refining new technologies. Resources are often in short supply, and training managers have many short-term problems to resolve. The training environment does not provide time for collecting the detailed data needed to assess the effects of new technologies.

The communications gaps and environmental constraints often result in piecemeal implementation of new technologies which does not facilitate the transfer of benefits throughout the Army. The TTFA approach has been designed to breach these obstacles.

How the TTFA Works

The Fort Knox TTFA does not follow normal procedures for development and implementation of training technologies. It is basically an attempt to get developers and users working together. USAARMC provides instructional resources, facilities, and subject matter expertise, ARI (primarily through its Fort Knox Field Unit) provides expertise on available technologies and methods of evaluating them, and TRADOC provides resources for implementing and testing technologies, as well as the channel for transferring successful applications throughout the Army. These organizations are working as a team to identify key training problems and refine the technology to solve them. Sticky issues are resolved by the TTFA Management Team which is made up of a representative from each of TRADOC, ARI, and USAARMC.

The Fort Knox TTFA supports research relating to the use of technology, but it is not a research and development activity. It takes available off-the-shelf technologies and applies and refines them for 19K BNCOC. Technologies found to be effective will be transferred throughout armor and then Army training.

The implementation strategy at Fort Knox TTFA has four steps: identify training problems and potentially useful technologies, establish a base line, implement and evaluate off-the-shelf technologies, and transfer successful applications to the field.

A good deal of progress on the first step has been made. TTFA personnel have observed several cycles of 19K BNCOC and have surveyed and interviewed students, instructors, and instructional managers. Several key training problems have been identified by instructors and other personnel. Continuous monitoring of technological developments in military, industrial, and academic settings has led to identification of an initial set of technologies which appear to be appropriate for addressing these problems. (These technologies will be described later.)

The second step (establishing a base line) is crucial for determining effectiveness of new technology. The time, cost, and effectiveness of present training will be determined before any new technology is introduced into 19K BNCOC. Initial estimates based upon FY82 cost and workload are that BNCOC training costs $378 per trainee per day during field exercises and $124 per trainee per day during classroom instruction.[4] An automated data base for maintenance of detailed cost and effectiveness information is being installed at Fort Knox.

The third step of the TTFA strategy (implementation and evalua-

tion) is in progress. Many of the technologies being introduced fall under the category of computer-based instruction. The final step of the strategy (transfer) will follow determination of cost and effectiveness of current versus technology-based training.

Application of CBI

Computer-based instruction (CBI) consists of computer-assisted instruction (CAI) and computer-managed instruction (CMI). In CAI, a student receives instruction directly from a computer terminal. CMI, on the other hand, automates various administrative and management functions, such as maintenance of student records. For example, a CMI system can determine when the student should proceed to the next block of instruction.

Work is currently underway to implement both CAI and CMI in 19K BNCOC. In order to prevent a host of incompatible computer systems from descending upon the course, all CBI will be compatible with the MicroTICCIT System II.[5] This system is based upon the IBM Personal Computer, and it is designed to support automated production (authoring), delivery (CAI), and management (CMI) of instruction. A training developer sits at a computer terminal and writes instruction which is later used by students at similar terminals. MicroTICCIT options allow authors to use videodisc and audio presentations, as well as computer-generated text and graphic displays. Students can use light pens and other simple input devices, rather than responding through a keyboard.

CAI will first be implemented in 19K BNCOC for training land navigation. This important skill is generally recognized as difficult to acquire. Land navigation is a particularly fertile area for applying CAI using videodiscs. Films of movement through actual terrain or a terrain board can be shown on a monitor. By manipulating a joystick or similar device, students can interact with the videodisc and see the terrain as if they were actually moving through it. This is commonly referred to as "surrogate travel". Work is currently underway to design and develop all 19K BNCOC classroom land navigation training on MicroTICCIT using videodiscs. If successful, this instruction is immediately transferable to many other Army training programs.

Another area for which CAI is being developed is the remedial training of tasks prerequisite to 19K BNCOC. Students are currently being tested on about a dozen such tasks during the first two days of the course. They get remedial instruction on failed tasks during non-program hours. By developing CAI for prerequisite tasks, students can be tested and provided individualized remedial instruction on the computer. This helps insure that students can perform all prerequisite tasks, and frees instructors for concentration on POI subjects. Remedial CAI is also immediately transferrable, because the prerequisites for BNCOC are also primary tasks for other training programs.

CMI at the Fort Knox TTFA is being designed for instructors who have had no previous experience with computers. It will keep records, schedule delivery of training and resources, and produce reports. This will give instructors more time for their students. The CMI system is expandable. Once it works in 19K BNCOC, it can be applied to other training programs and interfaced with other training management systems (e.g., the Automated Instructional Management System (AIMS)).

Before discussing other technologies for 19K BNCOC, a few basic points should be made about implementation of CBI. First, all CBI at the Fort Knox TTFA is designed to be user-friendly; that is, it is being designed for students and instructors who have no previous familiarity with computers. Light pens and touch screens will minimize the need for using a keyboard. Students and instructors will have to become comfortable with operating some simple controls, but they will not have to become computer experts.

Will users accept the technologies developed for them? The probability is high that they will, for two reasons. First, as stated above, the technologies are designed to be easy to use. Second, the users will be involved in technology development every step of the way. Instructors are identifying the technologies they need, being consulted regularly during development, and will be directly involved in implementation and evaluation. Thus far, instructors and students have been enthusiastic and eager.

Another important point is that CBI supports self-paced instruction. But this does not mean that the Fort Knox TTFA is attempting to self-pace 19K BNCOC. Portions of the course, such as remedial training, will be individualized, but not all of the course will be put on a computer. Much of a tank commander's training requires hands-on experience with actual equipment, and much of it must be evaluated during field exercises. Technology will not replace hands-on or field training; rather, it will prepare the soldier for maximum benefit from field training.

The final point relates to the cost savings and benefits to be derived from implementation of CBI. How much money will this technology save and when can it be expected to pay for itself? This question is difficult to answer at present. Development of CBI for BNCOC is ongoing, so its precise cost is unknown and the degree to which CBI can effectively replace conventional instruction will be determined during initial implementation. We do know that over 100 hours of work are required to develop one hour of effective CBI. This indicates that use of computer-based instruction will have to be expanded beyond 19K BNCOC for it to be cost-effective. A review of previous applications of CBI has indicated that individualizing instruction saves an average of 30 percent of student time.[6] This savings can be used to shorten course length or to provide additional instruction. Many benefits can be derived from use of CBI (see Table 1), some of which are difficult to quantify. The Army must find ways to obtain these benefits in a cost-effective manner. The TTFAs should provide a major impetus toward achieving this goal.

Beyond CBI

In addition to the primary CBI examples discussed above, the Fort Knox TTFA plans many other training technologies for implementation. One technology allows users to speak to the computer and the computer to respond in a close approximation to the human voice. Right now, voice recognition systems are limited to a small vocabulary of short statements. But, when merged with CAI, such a system is capable of training tasks requiring a limited number of verbal statements, such as the giving of fire commands. Target pictures can be obtained from videodiscs, with students responding to each picture by giving a fire command, followed by verbal feedback from the computer. Such a system is presently being developed by the Fort Knox TTFA, and it should provide 19K BNCOC students with almost unlimited practice on fire commands. As this technology develops, it will also be applied to training CEOI.

Another technology under development is directed to the design of Situational Training Exercises (STXs) and Field Training Exercises (FTXs).

The 19K BNCOC POI currently calls for the conduct of three STX's and one FTX during the course. The Fort Knox TTFA will soon begin to examine and redesign these exercises to ensure that classroom and field training correspond appropriately. That is, each exercise will be designed to reinforce classroom training and to provide objective feedback on students' performance. Objective field evaluation will be supported by hand-held data collection devices which can directly interface with the BNCOC CMI system.

BNCOC instructors have said that they need an "automated sand-table" to replace the unwieldy sand-table presently used in the course. To meet this need, a platoon-level tactical trainer developed for research purposes will be adapted for training command, control, and communication skills in 19K BNCOC. This system will use a network of microcomputers, voice synthesis/ recognition, and videodiscs. It should build a bridge between classroom and field training and be less cumbersome than the sand-table. Factors such as line-of-sight and movement rates will be computer-controlled rather than debated among instructors and students.

Various other technologies are planned for 19K BNCOC. Available videodiscs systems are being examined for training leadership, tactics, and other task clusters. Various instructional techniques are being examined for use in training tank commanders to train their crew members. An effort is also underway to use an automated hand-held tutor to assist students in using booklets for training degraded mode gunnery and handling of multiple returns from the rangefinder. Other potentially useful technologies will be examined by the Fort Knox TTFA as they become available.

The Future

Videodisc-based land navigation training should be available within the next few months, along with *CMI*, remedial *CMI*, and an initial application of voice synthesis/recognition to training fire commands. These technologies will be tested in 19K BNCOC within the next year. If successful, they will then be available for integration throughout armor training.

If the TTFA approach is successful, what does the future hold? The development of a system for automating management of institutional training should allow the integration of various training programs. Students being trained as tank crew members, tank commanders, platoon leaders, etc., can then participate in joint STXs and FTXs, just as they will in the field. The continued development of BNCOC classroom training on microcomputers should result in development of a model automated classroom. This classroom can be used as a test-bed for addressing many issues related to CBI, such as cost-effectiveness, the design of facilites, and the training and use of instructors. This should help insure that the Army effectively uses available training technologies, as well as providing a framework for the adoption of new technologies, such as artificial intelligence.

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Footnotes

[1] Examples of references proposing such an approach are: Seidel, R.J. & Wagner, H. "Management". In H.F. O'Neil, Jr. (Ed.), *Computer-Based Instruction: A State-of-the-Art Assessment.* New York: Academic Press, 1981, pp. 211-230; and memorandum, DRDCO-FE, TRADOC Deputy Chief of Staff for Training, 22 Dec 1980, subject: Army Experimental Training Center.

[2] Memorandum of Agreement (MOA) between USATRADOC, USARI, and USAARMC, 4 Nov 1983, subject: Establishment of Field Training Technology Activity, Fort Knox, Kentucky.

[3] TRADOC Regulation 350-7, *A System Approach to Training,* 5 November 1982.

[4] DF, ATZK-DPT-P&M, Directorate of Plans and Training, USAARMC, 8 February 1984, subject: 19K BNCOC Efficiency.,

[5] MicroTICCIT is a registered trademark of Hazeltine Corporation.

[6] Orlansky, J. & String, J. Computer-Based Instruction for Military Training. *Defense Management Journal,* Second Quarter 1981, pp. 46-54.

The Legacy of Warriors

The following address by General Donn A. Starry, Ret., marked the rededication of the 11th Armored Cavalry Regiment monument at Fort Knox on 11 May. Starry commmanded the regiment in Vietnam during 1969-70.

We have met here to honor the memory of the soldiers whose names are inscribed on this monument; they are our comrades who died while serving our country and our regiment in the war in Vietnam.

For the first time, the names of all 716 of our honored dead from that war are recorded in one place. It is our intention to now move this monument to the grounds of the Patton Museum of Cavalry and Armor where it will take its place with other permanent records of the service of cavalry and armor in our nation's wars.

And so this event is a milestone. Someone observed that this might be the last occasion on which we assemble around this monument. I truly hope that is not the case, for several reasons.

For while this monument honors our dead, it is truly a monument for the living. As we view it, gathered round, we are reminded that these were men who answered when their country called, went where they were told to go, did what they were asked to do, and in the process paid the ultimate price. While many of their peers sought refuge in colleges and universities, in neighboring countries, in strange little communes in remote parts of the United States, these men stood up, saluted and marched to do their country's bidding.

While the media babbled on in strident tones, these men served on in silence — their deeds remarking more eloquently and meaningfully than all the words of the others.

While the enemy fueled the fires of discord and dissent in our own homeland, these men went about their difficult and dangerous tasks, ever true to themselves, true to their leaders, true to their regiment, true to their country.

For us, the living, there can be no greater example.

Now, I know war is out of fashion.

I also know that war can be frightening, exciting, even dull.

But, I know, too, that after time has passed, it becomes evident that war's message was perhaps more divine than profane.

That's why we need occasions like this one — to gather round once more to reflect on the example that the lives, the service, the sacrifice, of these men and their families represent to us, the living.

We need occasions like this to remind us that our relatively comfortable routine is really just a little piece of calm in an otherwise tempestuous world, so that, being reminded, we may be better prepared for danger when danger finds us, for find us it will.

We need occasions like this in times of individualist negation, of cynicism, of seeking after personal well-being at the expense of all else, of denying that anything is worthy of reverence; we need them to remind us of all things the buffoons would have us forget.

For the ultimate challenge of war's danger teaches us to believe things our doubting minds are soon to prove for themselves: out of heroism grows faith in the undying worth of heroism.

I do not profess to know any ultimate truths.

Nor do I pretend to know the meaning of the universe.

But in the midst of doubt about values; in the collapse of beliefs and creeds, in the denial of the virtues of duty to God, fellowman, country, there is one thing I do know beyond all doubt.

And that is: That faith is a true faith that brings soldiers to risk and sacrifice their lives in acknowledged duty, in a cause they may imperfectly understand, in a battle whose plan of campaign may be to them obscure.

Having tasted of battle, the warrior knows the cynic force with which reason assaults the human mind in time of stress. The warrior knows well the vicissitudes of humor, terror, victory and death in war.

But in a larger sense the warrior knows the joy of life is in the living of it; that, as one of them said — to those who fight for it, life has a meaning the protected can never know; that the ultimate worth of war's challenge is that it forces men to bring their full powers to bear, stretched as far as their capacity will allow, in order to solve life's most difficult problem — fear.

Above all, these warriors speak to us with but a single voice — one which rises over the dissonant sounds — one which reassures us that man has in him that unspeakable something that makes him capable of a miracle; able to lift himself above the commonplace by the might of his own will; able to face annihilation based on faith in his God, faith in himself — in his warrior's soul — and faith in the men who are his comrades in arms.

That is the legacy left us by these warriors; it is a large legacy: it is perhaps larger than we deserve.

DONN A. STARRY
General, Ret.
Detroit, Michigan

Platoon Leader Roles and Responsibilities

The Army theme of "Leadership" for 1985 calls upon each leader to focus on his obligations to inspire and develop excellence in individuals and organizations. Within that obligation we must produce leaders who understand the bond between the leader, those being led, and the organization. Looking back on my own "bonding" into the Army, I find one primary individual who is two-thirds responsible for my development, both as an officer and as a leader. That individual was my platoon sergeant.

One of the major questions that confronted me as a newly assigned second lieutenant was my role and responsibility in regard to my platoon sergeant. The teamwork that a platoon leader and his platoon sergeant develop had to become the focal point of the entire platoon's cohesion.

Well, it wasn't always smooth sailing when my new platoon sergeant and I first got together. It was more like two men in a rowboat who couldn't agree on which side to paddle or on which direction to go. Needless to say, we spent a lot of time going around and around in circles. But, as each of us figured out how the other worked, we gradually came to agree on our mission and, eventually, the direction we needed to take.

As it turns out, there is a lot of material to aid the new second lieutenant in developing the platoon leader-platoon sergeant relationship. One of the most useful and yet most overlooked is FM 22-600-20, "The Army Noncommissioned Officer's Guide." If a platoon leader can read, study and understand that little pamphlet, it stands to reason that he should have a better understanding of the responsibilities of his subordinates. If a platoon leader understands what his NCOs are focused on, then the platoon leader can better focus on his own responsibilities and requirements. In developing the direction that your "team" should take, both you and the platoon sergeant should have some mutual expectations. What are these expectations?

You command the platoon. Officers command. Not just in the field, but both in garrison and in the field. When at home or away, you alone are responsible to the company commander for the training, maintenance, discipline and welfare of the platoon — everything the platoon does or does not do. Remember, you are still learning and the platoon sergeant is your chief advisor whose expertise you need to tap.

Within the company, the platoon leader is the communication link, up to the company commander, and down to his subordinates. You act both as a buffer, or shield, and as a translator of messages which are essential to the mission. As the downward link in this communication chain, you have to assert yourself and be firm in enforcing the commander's guidance.

As an upward link for your people, you have to know your people well, be available to them and be able to find out what's going on before it happens. You must be "people oriented." Keep in close touch with the company commander and the company executive officer. Understand their wants and their priorities. Your commander should keep you informed. Likewise this "two-way street" requires that *you* keep the commander informed of the problems and needs of you and your soldiers. You should monitor standards within the platoon, including appearance and maintenance of living areas and equipment. However, the platoon sergeant is the enforcer. You should inspect your platoon at least twice a week, if not more often. Not every nut and bolt, but areas which you and the platoon sergeant agree upon. Areas which the two of you think need improvement.

When you conduct an inspection, it should — as a minimum — be conducted with accountability, cleanliness and serviceability in mind. The platoon sergeant should pre-inspect and ensure that personnel and equipment are ready at the time of the inspection.

The motor pool — with all the dust, mud, sweat, cussing, and knuckle-busting that goes on there — is your primary work area. Your platoon will probably be in the motor pool more than anywhere else, except in the field. So you should be there too! You can't lead your platoon if you're not with it. Your time should be oriented to the platoon, listening and teaching, observing and learning, as well as supervising.

As the platoon leader, you should already have a basic understanding of how maintenance is conducted and what is to be checked. The platoon sergeant should brief you on the system the company and battalion is using so that you can grasp your platoon's maintenance posture as soon as possible. The platoon sergeant should point out problem areas and let you know what to do, at the platoon level, to solve it.

Your platoon is responsible for a lot of different specialized equipment. Advice on the best way to inventory, inspect and maintain that equipment is expected from the platoon sergeant. He should tell you what to look for or to check. Before going into an inspection or inventory, the platoon sergeant should remind you what the unit SOP says, to ensure that the platoon is in compliance. You should have already read the SOP and understand the basics of the program. You must strive to be expert on everything! Again, if a problem exists, it's your responsibility to attempt to rectify it through the company commander.

As a new platoon leader, when you are in your local training area for the first time, hanging on in your

commander's hatch, a lot of questions will be going through your head as you listen to the chatter of yet unfamiliar voices on your platoon net. What training do I need to focus on? How am I going to accomplish that training? What do I have to concentrate on? Which missions do I need to improve on? Everything, and I mean *everything* you do, should focus on *combat*. Everything else is secondary. Develop the mentality that everything you do, or do not do, is driven by the fact that tomorrow, you may find yourself deploying not for another exercise, but for battle. This "warrior spirit" will help you and your platoon survive.

You and the platoon sergeant need to jointly define where the platoon is going and agree on where you want the platoon to be in a given time frame. The platoon's training priorities and sustainment programs will be developed accordingly. You are the planner. You should receive an honest opinion of the platoon's training status and assistance from the platoon sergeant in balancing available time, equipment, and personnel within your allocations of crew and individual training time. Remember, your focus should be on your platoon's combat effectiveness and readiness, with teamwork as a constant modifier of your focus. Your platoon sergeant will concentrate on each subordinate NCO and individual to ensure that each is well trained and motivated. Don't neglect your own training. Leadership by example is paramount. Tankers have to be able to shoot, move, and communicate. You should strive to be the best! Prior to gunnery, ask your platoon sergeant to run you through a complete checkout on what you will need to know as a tank commander and for advice on what you and your crew need as additional drill. Again, emphasize combat! A "warrior spirit."

The platoon leader should be involved in decisions concerning any member of the platoon. You have to know who is expecting leave, and who wasn't promoted, etc. This is called maintenance of the soldier. Your soldiers have to know that both you and the platoon sergeant are deeply concerned about each individual's advancement and personal welfare. Don't be the one who is surprised. You have to be involved with promotions, awards, punishments, assignments, and reassignments. When interacting with the soldiers in your platoon, ask you platoon sergeant or other NCOs who are acting platoon leaders, for guidance in handling the situation. The skill of "dealing with people" can only be acquired through experience. Don't ever promise anything that can't be delivered. Have a platoon meeting at least once a month and tell members of your platoon where they really need improvement. Don't try to be everybody's friend. Burn them if they deserve it, congratulate them if they deserve it.

The platoon sergeant is your administrator and your contact with the informal NCO support channel and the company 1SG. Don't forget to delegate authority and let the NCOs lead. Trusting your subordinates helps them to grow professionally and does wonders for developing teamwork and cohesion. You should expect to be kept informed on anything and everything dealing with the platoon. You in turn should react in the same manner to your platoon sergeant.

NCO and officer business should be kept separate, yet you and the platoon sergeant need to be aware of the other's actions, trusting each other as teammates. The platoon sergeant should keep you closely advised as to what he defines as NCO business and let you know why. At the platoon level both the officer and NCO must be of one mind to accomplish the mission.

By working closely together, you and the platoon sergeant can stay ahead of the problems which may block the platoon's success; moreover, your own transition into the platoon will be smoother. You have to create the conditions for things to happen. Care enough to insist on the high standards. Trust enough, in your subordinates, to get the job done. Train like you expect to fight tomorrow.

MARK W. MAIERS
CPT, AR
Fort Knox, Kentucky

Recognition Quiz Answers

1. GREIF Armored Recovery Vehicle (Austria). Crew, 4; weight, 19,800 kg (21 tons); maximum road speed, 67.5 km/h; maximum road range, 625 km; fording, 1 meter; 6-cylinder, turbocharged 320-hp diesel engine; armament, 1 x 12.7-mm machinegun.

2. SALADIN Armored Car (U.K.). Crew, 3, 6x6 wheel drive; weight, 11,590 kg (11 tons); maximum road speed, 72 km/h; maximum road range, 400 km; fording, 1.07 meters, 2.3 meters with kit; 8-cylinder, RR 170-hp gasoline engine; armament, 1 x 76-mm main gun, 1 7.62-mm coaxial machinegun, 1 x 7.62-mm AA machinegun; maximum armor (turret front) 32-mm at 15 degree slope.

3. M-901 ITV (U.S.). Crew, 3; maximum road speed, 67.59 km/h; maximum water speed, 5.8 km/hr; maximum cruise range, 483 km; armament, Improved *TOW* launcher with 2 tubes and 10 TOW rounds onboard, 1 x 7.62-mm machinegun; 6-cylinder, 215-hp GMC Detroit Diesel engine; 360-degree turret rotation, +34-degree turret elevation to -30 degree depression.

4. STRIKER ATGW (U.K.). Crew, 3; maximum road speed, 80.5 km/h; maximum road range, 483 km; 6-cylinder gasoline 190-hp engine; armament, 5 *Swingfire* ATGWs with five onboard; maximum missile range, 4,000 meters; armament, 1 x 7.62-mm machinegun.

5. M-109 155-mm Howitzer (Can). Crew, 6; weight, 25 tons; maximum cross-country speed, 20 mph; maximum road speed, 56 km/h; maximum road range, 390 km; armament, 1 x 155-mm howitzer with 28 rounds onboard, 1 x 12.7-mm AA machinegun; 8-cylinder, turbo-charged, 2-stroke, 405-hp diesel engine.

6. FAV (U.S.). Crew, varies with mission and armament; weight, 1,500-2,000 lbs; maximum road speed, 70+ mph; maximum road range, 300 miles; gasoline 94-hp or diesel 90/100-hp engine; armament, TOW, *Mk 19* 40-mm grenade launcher (shown), .50 caliber machinegun or squad automatic weapon (*SAW*); air transportable.

NATIONAL NEWS

A *Bradley* Fighting Vehicle shown with the new Combat Vehicle Armament System Technology (CVAST) turret and rapid-fire 35-mm cannon as tested recently at Aberdeen Proving Ground, MD.

New Turret, 35-mm Cannon for Bradleys

A new antiarmor capability for the *Bradley* series of vehicles and, possibly, the *M113A3* series vehicles, was recently test-fired at Aberdeen Proving Ground, MD. Named the Combat Vehicle Armament System Technology (CVAST), the new turret developed by FMC Corporation mounts a 35-mm automatic cannon firing armor piercing long-rod penetrator ammunition. During the tests against simulated Soviet BMPs, the ammunition penetrated both sides of the target vehicles.

The "BMP Killer" was developed to counter recently upgraded armor and armament systems on Soviet infantry fighting vehicles.

The CVAST gun and turret drives, developed by General Electric, provide a fully stabilized gun system that was demonstrated during fire-on-the-move exercises at Aberdeen. The cannon is the 35-mm Ares *Talon* capable of single-shot or burst-fire modes. It fires the full family of 35-mm NATO ammunition and uses linkless ammunition feeds and a full-solution fire control system.

The new system has been under development for the past 18 months at Honeywell Proving Ground, Minn.

A variety of armor targets were engaged at ranges from 1,000 - 2,000 meters and all were successfully hit and penetrated with the Army Research and Development Center-developed ammunition.

Future plans call for mounting and testing the turret on the *M113A3* armored personnel carrier.

All Army Guard Units To Be "Uptanked"

According to the Army Chief of Staff, all Army National Guard units will be equipped either with the *M1 Abrams* or the *M60A3* tanks within the next four years.

Some Guard units have already been issued the *M1* and the *M60A3*. Others are equipped with the *M48A5* or the *M60A1* tanks.

The Army Guard, said General John A. Wickham, Jr., will be a key participant in any future war and the decision to accelerate tank deliveries to Guard units is part of an overall plan to improve the combat readiness of the Reserve Components.

Seven Guard units will be equipped with the *M1 Abrams* main battle tank, the general said, and all other units will receive *M60A1* models that have been reconfigured to *M60A3* status at the Anniston Army Depot, Alabama.

M1 Fire Safety Hazard Noted

If you're running an *M1 Abrams* MBT, keep an eye on the asbestos seal lining on the inside of the rear grille doors to the engine compartment or you might have a tank fire on your hands.

The lining wears from contact with the compartment frame or it drops down when the screws attaching the lining brackets to the door become loose. In this event, some crewmen have been tearing the lining off.

DON'T! The transmission oil cooler crossover is then exposed to engine heat which cracks the hose, spraying transmission oil onto the exhaust manifold — and you have a fire in your tank.

Security Clearance Processing

Security clearances for soldiers who now, or who may in the near future, fill security-sensitive positions continue to be a bugbear to personnel offices at all levels. All such clearances are handled at MILPERCEN and proceed to the U.S. Army Central Personnel Security Clearance Facility (CCF) at Fort George G. Meade, MD. CCF grants, revokes and denies security clearances for all Army activities worldwide based on completed investigations and other information.

CCF tells the career manager at MILPERCEN the current security clearance status of the soldier and what must be done to update or upgrade an existing clearance. The career manager, through Centralized Assignment Procedures III (CAP III), informs the losing command's military personnel office (MILPO) of the planned assignment and the security clearance requirements.

The security manager, working with the soldier, initiates a request for a security investigation, with the clearance needed, and forwards it to the Defense Investigative Service (DIS). This must be done within 21 days after the security manager receives the CAP III.

DIS conducts all security investigations for the military services and requires from a few weeks to four or five months to complete its investigation.

DIS sends the completed investigation to CCF for adjudication and CCF determines whether or not to grant a clearance. Normally, CCF completes this portion of the clearance paperwork within 15 days.

When CCF has adjudicated the case, it informs the security manager by sending a Certificate of Clearance (DA Form 873). The security manager must send the certificate to the MILPO for filing.

If a soldier has departed his station before the clearance arrives, the losing command must promptly send the clearance certificate to the gaining command.

For more information about the personnel security clearance process, write or call: Commander, U.S. Army Central Personnel Security Clearance Facility, ATTN: PCCF-S, Fort George G. Meade, MD 20755-5250, Autovon 923-7613.

CSC Importance Stressed

Captains (P), majors (P), and lieutenant colonels who have *not yet* attended Command and Staff College or who *have not* enrolled in the nonresident course are advised to do so if they wish to be considered for further promotion, according to MILPERCEN.

To apply for the nonresident course, you must be a captain or above, have completed at least eight years active federal commissioned service, be an advanced course graduate and have not attended (nor declined residence attendance at), a U.S. command and staff college or equivalent foreign college. In addition, the grades listed above are eligible for selection to attend a resident CSC if they have less than 168 months of active federal commissioned service before the convening date of a CSC Selection Board that usually meets in the fall of each year.

The importance of attending prior to being in the zone of consideration for lieutenant colonel is shown in recent board results. Of those selected for LTC in FY 82, 92.6 percent had completed CSC-level schooling, FY 83 92.3 percent, FY 84 99.8 percent, and FY 85 100 percent. However, completion of CSC is no guarantee of promotion; your file is always viewed in the context of overall performance.

If you have not been selected for resident attendance after your second CSC board review, it is strongly recommended that you begin the nonresident course.

Questions should be directed to your assignment officer or the Combat Arms Division Professional Development Officer at AUTOVON 221-9846.

UCOFT In Schweinfurt

Training for a tank crewmember is a never-ending process and personnel turbulence makes it even harder because of the constant need to train new people. However, a solution is now in place in the armor units of the 3d Infantry Division stationed at Schweinfurt. It is the Unit Conduct of Fire Trainer (UCOFT) and provides all stages of tank gunnery training in a simulator-enhanced environment.

One soldier said of UCOFT's realism, "The only thing missing is the rough ride and the smell of diesel!"

UCOFT is a computerized simulator that provides the tank gunner with every possible shooting experience short of going to the range and firing the main gun. The system features all types of weather and can simulate all key malfunctions in the *M1* fire control system.

Currently available in the *M1* version, UCOFT will soon be ready in the *M2/M3 Bradley* versions from General Electric, prime contractor. Every armor and mechanized infantry battalion is slated to receive the UCOFT. Other versions are being developed for National Guard and Reserve Component use.

Cavalry Descendents Record Ancestors

Americans from across the land are flooding the U.S. Horse Cavalry Association at Fort Bliss, Texas, with letters containing information on their forebears who served with the Cavalry, said Colonel James R. Spurrier, (Ret.) chairman.

The Association announced last fall that it would record in its archives the cavalry service of any trooper who served between 1776 and 1945 in any branch, Regular, Militia or Volunteer. There is no charge for the service "and the response has been far beyond our expectations," Colonel Spurrier said.

Those who wish to list the names of forebears who served in the U.S. Cavalry may do so by sending the person's name and any additional information available (service number, unit, period of service, etc.) to the U.S. Horse Cavalry Association, P.O. Box 6253, Fort Bliss, TX, 79906.

Openings for Special Forces Lieutenants

MILPERCEN has resumed assignments of lieutenants into four Special Forces Groups of 1st Special Operations Command (SOCOM). Requests will be handled on a case-by-case basis until about September 1986. Selectees will be sent to the JFK Special Warfare Center at Ft. Bragg, NC, for five months to attend the Special Operations Detachment Officer Qualifications Course. Interested lieutenants should consult their battalion adjutants and submit their requests under the provisions of AR 614-162.

New Rubber Treads For M1

George Kentros, the only rubber chemist employed at a U.S. Army Depot System Command installation, has developed a new rubber compound for use on the tracks of *M1 Abrams* tanks, according to the Red River Army Depot at Texarkana, Texas.

Kentros, employed in the Quality Systems and Management Division of the Red River facility, began his independent work on the new track pad rubber compound in 1983 when the *M1* project manager requested the assistance of private contractors and Army facilities with the capacity to develop new compounds.

The rubber chemist pointed out that he took on the unique challenge as a "sideline" to his normal duties. "It was an effort to help the Army in addition to my regular responsibilities," he said.

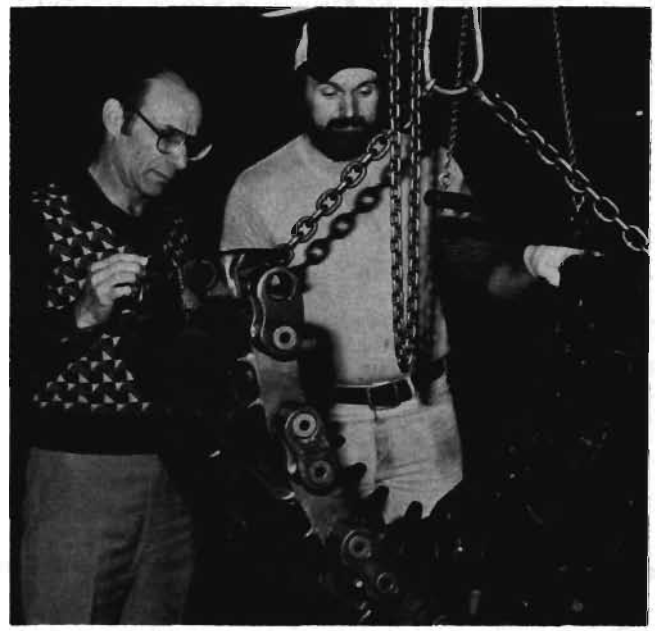
The need for a new track pad for the heavy and speedy main battle tank became apparent when track pads were wearing out more quickly than expected due to heat and friction. The *M1* can travel up to 45 mph, almost twice as fast as any previous tank.

After developing the new rubber formula, Kentros had a private contractor prepare a batch for laboratory testing. Preformed blocks were made and then vulcanized at the Red River facility and assembled onto tracks there. The tracks were shipped to Aberdeen Proving Ground, MD, where they underwent trials on *M1s*. The new compound held up well in field tests and representatives of the U.S. Army Tank-Automotive Command were so impressed with the results they decided to use Mr. Kentros' compound as a benchmark against which other compounds will be measured. Using this reference, the Army will be able to award contracts for *M1* tracks to the lowest bidder, but will pay them on performance. "They are then going to have to do better than the reference," Kentros said, "because they will have a financial incentive."

The new compound is now being tested at Yuma Proving Ground, AZ, in hot desert terrain and Kentros is confident this new formula will do well.

An additional benefit of Kentros' new compound is that it has led to the establishment of compound specifications for the rubber the Depot purchases for use in the rebuild of roadwheels as well as track.

"It was a team effort," Kentros insisted, "the workers, supervisors and inspectors in the roadwheel and track section all had a hand in it."



George Kentros, left, rubber chemist at the Red River Army Depot, Texarkana, TX, who developed a new rubber compound for use on M1 Abrams MBTs, is shown inspecting some of his new rubber track blocks with Jimmy Barlow, right, of the Shops Division. Kentros' new rubber compound was developed to lengthen the life of the M1 track pads which were wearing out faster than anticipated due to the tank's high speed and weight. The new rubber compound was tested at Aberdeen Proving Ground, MD, and is now undergoing tests in the desert at the Yuma Proving Ground, AZ.

Tank Ammo Accident Study Concluded

From March 1980 through March 1984, some 1,636 accidents involving tanks, tank ammunition, tank antennas, tank batteries and tank electrical systems were reported to the Army Safety Center. It was estimated that 717 of these accidents caused damage severe enough, or personnel injury serious enough, to take the tank out of action. Of all the accidents reported, 27 involved, or potentially involved, detonation or burning of main gun tank ammunition. A study of these accidents was undertaken by John Reed, safety engineer at Army Research and Development Command (ARDC).

Tank gun ammunition accidents were separated into two broad categories for the study: actual detonation or burning of ammunition, and potential detonation or burning of ammunition. Eight of the nine accidents that resulted in ammunition detonation or burning were caused by electrical energy; tank batteries, antennas striking power lines, a power cable severed by an empty cartridge case, and a short in a driver's panel.

Sixty-three percent of the 27 ammunition-related accidents were caused by electrical energy release. This is a potent factor in the study because most tank ammunition is electrically primed. When electrical energy is the cause of an accident involving tank ammunition, the resultant detonation or burning of ammunition occurs at such a fast rate that crewmembers have little time in which to escape.

Reed's report identifies accident causes and made recommendations for prevention. These include procedural changes and training of crewmembers. Reed, however, acknowledges that despite changes, human nature will sometimes lead people to violate, disregard, or forget procedures.

Some of the design changes can only be incorporated in future tank design, such as the relocation of batteries so that they are not dangerously close to ammunition. Some minor changes could be made in fielded equipment, such as placing rubber mats under batteries with extra material to be folded over the batteries before the access cover is closed.

Also recommended were better cushioning pads for ammunition in ready racks and locking handle design changes for storage racks.

The overall goal of the report is to highlight design flaws and procedural errors, allowing for their correction during peacetime.

BOOKS

WORLD DIRECTORY OF MODERN MILITARY VEHICLES by Bart Vanderveen. ARCO Publlishing Co., New York. 256 pages. $19.95

As always, our prolific Mr. Vanderveen has produced an exceptional volume. Dealing only with soft-skinned vehicles, he has assembled a comprehensive collection of data on a wider range of vehicles which have served in the armed forces of the world since around 1970.

He is a careful researcher, and this book is evidence of the expertise which has become his hallmark. He covers everything from motorcycles to earthmovers, with sedans, ambulances, trucks, tractors, amphibians and crash/fire/rescue vehicles in between.

No country is neglected. In all, there is a fascinating array of nearly 800 makes and models from 38 countries.

The equipment is subdivided into 15 categories and each chapter is prefaced with a generalized sketch of its purpose.

Chapters are logically arranged by vehicle weights and an index helps in locating specific makes and models. The description accompanying each vehicle type gives basic specifications and explains which manufacturer built the vehicles, the years of construction, and the countries which used them.

Mr. Vanderveen obviously could not include each variation of each type of vehicle included but he has done an admirable job of presenting the military automotive world which exists today.

Anyone attempting to stay current (or get that way) on military equipment must include this volume in their library. There is nothing on the market that can touch it at the price.

FRED W. CRISMON
Louisville, KY

A DISTANT CHALLENGE: THE U.S. INFANTRYMAN IN VIETNAM, 1967-1972 edited by *Infantry* Magazine. Battery Press, Nashville: Jove paperback 1985. 319 pages. $3.50

Like its acclaimed predecessor, *Infantry in Vietnam*, this sequel is a valuable addition to the first person combat literature of that war. The succinct, factual and enlightening essays, written by combatants, treat principles of infantry combat during various periods of that long war. They touch on most of the infantry units in that war and cover such topics as cordon and search; firebase defense; riverine operations, special forces activity, the district advisory team, fire support, mechanized infantry, intelligence and the Vietnamization advisory role. A section on the "enemy" which contains a report from a captured NVA lieutenant is an especially interesting feature.

This is a highly recommended volume to anyone interested in the military history of that war, especially ground combat operations.

JOE P. DUNN, Ph.D
Converse College, SC

VIETNAM: THE OTHER WAR by Charles R. Anderson. Presidio Press, Novato, CA. $13.95. 218 pages.

The Vietnam war has produced a growing list of memoirs, novels and historical works, most of which have concentrated on the combat areas. However, many Vietnam vets never saw combat. This book is about them. The author, a former Marine Corps lieutenant who wrote *The Grunts*, has provided a rare glimpse of that 'other war,' or as he puts in "in the rear with the beer."

In this collection of vignettes, Anderson proves to be an acute observer of the 3d Military Police Battalion at Da Nang. His descriptions of people, events and institutions have an authentic ring. Of particular note are the chapters dealing with scrounging for supplies, R&R, race relations and the dirty details associated with compound living.

Some readers may find this style irreverent, profane and even disrespectful of the military; others will thoroughly enjoy this amusing and highly readable book. The book has an appeal for professional soldiers who can do worse than be prepared for the not inconsiderable challenges and frustrations of service in future rear areas.

AUGUSTUS R. NORTON
Lieutenant Colonel, USA
West Point, N.Y.

SHERMAN'S MARCH AND VIETNAM by James Reston,Jr. Macmillan, New York. 323 pages. $14.95

It is difficult for this book to live up to its enticing title, however the author succeeds in offering a thought-provocative discussion of how war was conducted during the Civil War and Vietnam.

In retracing Sherman's march from Atlanta to Savannah, Reston addresses the rules and ethics of war, command responsibility, proportionality in the use of force, discrimination in distinguishing between combatants and innocents, and reprisals against civilian populations. He applies these principles to the generalship of Sherman and William Westmoreland.

Heavy on Civil War history and sometimes short on Vietnam comparisons, Reston gives us a quick reading and a unique approach to history.

Reston reminds us that total war was introduced in the Nineteenth Century by Napoleon, not Sherman. Sherman's major contribution to total war was the "withering away" of ethical standards for civilized warfare. By the time Savannah was taken, the standards of proportional response and discriminating protection of civilians had "nearly ceased to exist."

Westmoreland, says Reston, joins Sherman in having irreversibly widened the license of war.

Both generals are the most controversial military figures of the most divisive wars of their respective centuries in American history. Each wrote "towering and revealing" biographies and each had to contend with his reputation after their wars.

Both wars hit emotional nerves of the American public like no other wars in our past. Reston covers the healing process for each and how we treated returning veterans, including treatment of those who chose not to fight.

This work is an instructive and enjoyable approach in applying history.

THOMAS J. VANCE
Captain, AG Corps,
Fort Knox, KY

A PHOTO HISTORY OF TANKS IN TWO WORLD WARS by George Forty. Sterling Publishing Co., New York. 192 pages. $16.95

This volume is an effort to describe the world's tanks from their beginnings in WW I through WW II. The size alone restricts how much coverage could be achieved and Forty has chosen to dwell primarily on those vehicles whose material was most readily available.

The development of British tanks is rather well documented, as is the progress made by the Germans during WW II, although even this covers no new ground. The U.S. tank enthusiast will not find anything very exciting in the historical sketch of the Ordnance Corps' efforts to field viable tanks. Indeed, his continuous references to the U.S. 6-ton tank of WW I as a Ford product makes one wonder just how well he researched the remainder of the U.S. machinery. (Ford was not involved in the 6-tonner, which was built under license from Renault, but they had built two earlier and smaller tank types.)

The period of U.S. tank development from its inception up to WW II is covered in only seven pages and 23 photographs which include only the most basic types. WW II covers 42 pages, but the majority of

that involves the *M3* and *M4* mediums, with minimal coverage of anything else. Even the *M4* is included primarily in action shots, which often conceal essential details which help to identify precisely which variation of the ubiquitous *M4* the reader is viewing. The accompanying story of the progressive development of U.S. tanks is sketchy, at best.

Overall, there is nothing in this volume to make it particularly desirable for ones' library, especially when compared to numerous other current books on the subject. Indeed, it would be a disappointment to most U.S. tank enthusiasts.

FRED W. CRIMSON
Louisville, KY

INSIDE THE GREEN BERETS by Charles M. Simpson, III. Berkley Books, New York, 1983. 258 pages. $3.50.

This excellent volume is now available in paperback and is highly recommended as a vehicle for understanding the "why's" of the Army's Special Forces (SF) and their various roles (stay-behind/guerilla support/counter-insurgency/trainer/direct action) all of which have had varying degrees of priority since 1952.

One consistent hallmark of U.S. Army SF has been the high degree of professionalism engendered by careful selection, rigorous and continuous training and high *esprit*.

The book is at its best in describing the inevitable bureaucratic battles which accompany the development of any elite military program, particularly one which must often operate in a "need-to-know" mode. Although the great bulk of the book covers the era of the southeast Asian conflict, Colonel Simpson also provides an insightful final chapter on "The Future of Special Forces."

ARMOR readers will find this book to be a highly readable insight into the development of a first-class military organization.

JOHN A. HURLEY
Lieutenant Colonel, USAFR
HQ, USAF

BRUSH FIRE WARS: MINOR CAMPAIGNS OF THE BRITISH ARMY SINCE 1945 by Michael Dewar. St. Martin's Press, New York. 208 pages. $22.50

The British Army has been in action since 1945 and this book highlights 12 campaigns in jungle, desert and urban settings, primarily against insurgent forces from Malaya to Dhofar.

Michael Dewar, who saw service in three of these campaigns, argues that the British Army succeeded in these near impossible tasks in a way that no other army could. It is difficult to disagree that Britain does indeed have an historical reputation for handling international "emergencies", as they refer to these conflicts.

The book is important to the American military because of the lesson-learned approach. British military techniques, combined with civil affairs, are valuable studies for today's small-scale military confrontations.

Dewar also illustrates how Britain benefits by employing political expedience at the expense of military efficiency, however frustrating that tends to be for the military.

The British Army found success in using minimum force and adopting the tactics of their enemies. Incentives for disillusioned insurgents, local population support, detention of terrorists without trial, food control programs and ID cards are all methods used throughout the campaigns.

Several of the campaigns, such as Belize, were resolved without casualties, proving the effectiveness of deterrence.

This book is time well spent for an understanding of how one army has faced the threat of non-conventional forces.

THOMAS J. VANCE
Captain, AG Corps
Fort Knox, KY.

BROTHERS: BLACK SOLDIERS IN THE NAM, by Stanley Goff and Robert Sanders, with Clark Smith. Berkley Printers, New York. 224 pages. $3.50

Black soldiers played a major part in the Vietnam War. They served in disproportionate numbers in combat units, spent longer tours in the field, and had high rates of casualties.

Thus, this fine book and Wallace Terry's *Bloods: An Oral History of the Vietnam War by Black Veterans* are particularly important.

When Goff and Sanders were drafted they had little understanding of the war; they simply entered the Army and learned to fight and survive. In Vietnam they learned that Blacks took care of each other and attempted to orient the new "brothers" to help them survive. They also learned that while racial tensions were high in the rear, they were not carried to the field. In the boonies, all distinctions were set aside as everyone worked together to survive.

Goff received the Distinguished Service Cross and Sanders received the Air Medal.

Brothers conveys the reality of the combat soldier's experience as well as any other first person narrative I have read; and it does it without overemphasis on gore and the stress syndrome or undue philosophizing, These were ordinary young men who did their job, served honorably, and tell their story.

This is a book worth reading.

JEANETTE R. DUNN
Spartansburg, SC

CAVEAT: Realism, Reagan and Foreign Policy, by Alexander M. Haig, Jr. Macmillan Pub. Co., Inc., NY. 367 pages. $17.95

This lively book moves well but is marked by a degree of self-justification and pontification often found in works of this nature. General Haig's goal is to portray his view of events during his often turbulent 18-month tenure as Secretary of State.

Few men filled the post with better qualifications than General Haig. He attempted with zeal, industry and dedication to form a coherent foreign policy. He was never able to do so and was ultimately defeated by the style of the Reagan presidency and the President's inner circle of advisors. He was also hampered by the lack of personal relationship between him and the President, despite their ideological similarity.

There is an underlying tone that indicates that measures were taken by close presidential associates to minimize the competitive role General Haig and his not inconsiderable ego and ability might play.

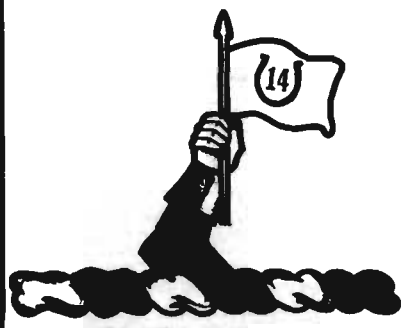
General Haig repeatedly and bitterly complains about "leaks" and notes that they "constituted policy; they were the authentic voice of government."

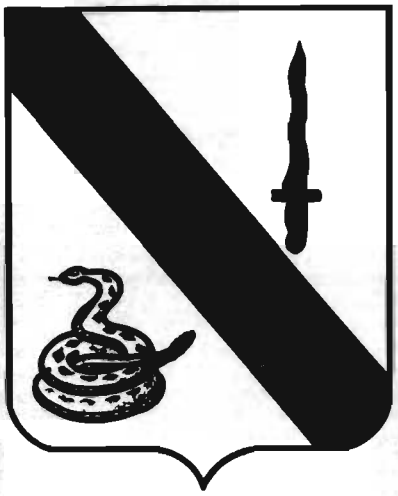
He discusses his often acrimonious relationships with the National Security Council, Secretary of Defense Weinberger, and the UN ambassador, Mrs. Jeane Kirkpatrick.

The "caveat" (Latin for "beware") that Haig offers is apparently that the lingering negative effects of Watergate undermine the confidentiality of the environment the Secretary of State functions in.

The book was published a scant 22 months after Haig left office. There is the possibility that the passage of time could have strengthened the former secretary's case and improved the book.

BEAU BERGERON
Lieutenant Colonel, Armor
National War College





Symbolism

The shield is yellow for cavalry; the bend is in the color of the uniform worn at the time of the regiment's formation (1901). The kris is for Moro campaigns and the rattlesnake for service on the Mexican border.

Distinctive Insignia

The distinctive insignia is the shield and motto of the coat of arms.

14th Armored Cavalry

Souvez Moi (Follow Me)

Lineage and Honors

Constituted 2 February 1901 in the Regular Army as 14th Cavalry. Organized 19 February 1901 at Fort Leavenworth, Kansas. Inactivated 15 July 1942 at Fort Riley, Kansas; personnel and equipment transferred to 14th Armored Regiment (see ANNEX).

Headquarters, Headquarters Troop, and Service Troop, 14th Cavalry, reorganized and redesignated 12 July 1943 as Headquarters and Headquarters Troop, 14th Cavalry Group, and activated at Fort Lewis, Washington. Reorganized and redesignated 21 December 1943 as Headquarters and Headquarters Troop, 14th Cavalry Group, Mechanized. Remainder of 14th Cavalry disbanded 26 October 1944.

Headquarters and Headquarters Troop, 14th Cavalry Group, Mechanized, converted and redesignated 1 May 1946 as Headquarters and Headquarters Troop, 14th Constabulary Regiment, and assigned to the United States Constabulary. Reorganized and redesignated 10 February 1948 as Headquarters and Headquarters and Service Troop, 14th Constabulary Regiment. Converted and redesignated 20 December 1948 as Headquarters and Headquarters Company, 14th Armored Cavalry; disbanded elements of 14th Cavalry concurrently reconstituted, redesignated as elements of 14th Armored Cavalry, and activated in Europe. 14th Armored Cavalry consolidated 8 January 1951 with 14th and 711th Tank Battalions (see ANNEX). (Battalions and companies redesignated 15 May 1960 as squadrons and troops.)

ANNEX

14th Armored Regiment constituted 11 July 1942 in the Regular Army and assigned to 9th Armored Division. Activated 15 July 1942 at Fort Riley, Kansas, with personnel and equipment from 14th Cavalry.

Regiment broken up 9 October 1943 and its elements reorganized and redesignated as follows: 14th Armored Regiment (less 3d Battalion, Band, and Maintenance, Service, and Reconnaissance Companies) as 14th Tank Battalion, and remained assigned to 9th Armored Division; 3d Battalion as 711th Tank Battalion, and relieved from assignment to 9th Armored Division; Reconnaissance Company as Troop E, 89th Cavalry Reconnaissance Squadron, Mechanized (separate lineage); Band and Maintenance and Service Companies disbanded.

14th Tank Battalion inactivated 13 October 1945 at Camp Patrick Henry, Viginia. Consolidated 8 January 1951 with 14th Armored Cavalry and relieved from assignment to 9th Armored Division.

711th Tank Battalion inactivated 21 January 1946 at Seattle Port of Embarkation, Washington. Consolidated 8 January 1951 with 3d Battalion, 14th Armored Cavalry.

Campaign Participation Credit

Philippine Insurrection
- Mindanao
- Jolo

World War II
- Rhineland
- Ardennes-Alsace
- Central Europe
- Ryukyus
- Leyte

Decorations

Presidential Unit Citation (Army), Streamer embroidered REMAGEN BRIDGE (14th Tank Battalion cited; WD GO 72, 1945)

Cited in the Order of the Day of the Belgian Army for action in the ARDENNES (14th Tank Battalion cited; DA GO 43, 1950)