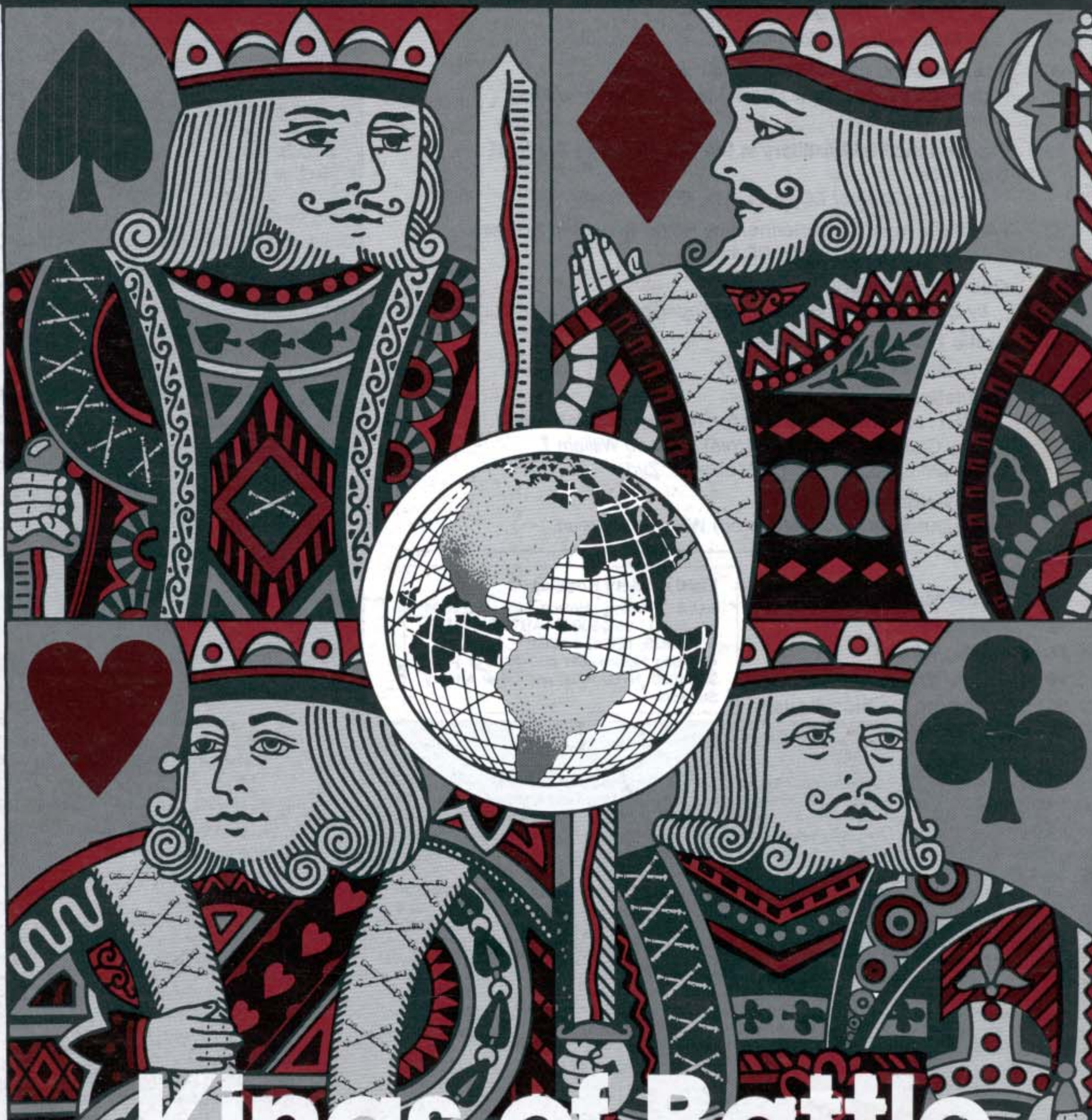
Field Artillery

A Professional Bulletin for Redlegs

February 1990



HQDA PB6-90-1

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Articles

Features

Field Artillery Hotlines

- Unit Training Hotline—AV 639-5004 or (405) 351-5004: ARTEP, AMTP, SQT, MQS, TEC and ACCP.
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PURPOSE (as stated in the first *Field Artillery Journal* in 1911): *To publish a journal for disseminating professional knowledge and furnishing information as to the Field Artillery's progress, development and best use in campaign; to cultivate, with the other arms, a common understanding of the power and limitations of each; to foster a feeling of interdependence among the different arms and of hearty cooperation by all; and to promote understanding between the regular and militia forces by a closer bond; all of which objects are worthy and contribute to the good of our country.*

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Flexible Perspective

An extended period of relative peace has allowed our Army in general and the Field Artillery in particular to refine its doctrine and become comfortable with its position on just about everything—at least until very recently. We've made a concerted effort to focus our attention on joint and combined-arms operations, as well we should. And our comprehension of the phrase "spectrum of conflict" is universal. There is nothing inherently bad in all of this, unless we let our arrogance blind us to other points of view. And there *are* other points of view—those of our Allies worldwide.

In this Allied edition of ***Field Artillery***, you'll encounter many different approaches to fire support. As an example, Israeli Brigadier General Arie Mizrachi's use of his howitzers in the 1974 War of Attrition runs counter to the conventional US employment of similar systems in AirLand Battle. His mental flexibility allowed him to defeat an overwhelmingly superior force by concentrating his indirect-fire assets at a chokepoint and digging them in so as to allow the use of overhead cover—not a technique you're to likely encounter at a combat training center. General Mizrachi's flexible perspective made the difference between victory and defeat. Each of the excellent articles in this edition can instruct us through its similarities and differences to the US approach.

Now that "peace is breaking out all over" and the attendant instability makes operational planning even more complex and difficult, better understanding and working more closely with our Allies may make the critical difference between peace and war, victory and defeat.

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On the Move

MAJOR GENERAL RAPHAEL J. HALLADA

"The world is changing" is a statement that's beginning to seem overused—but it's certainly true. The events we've witnessed for the past few months have been simply incredible and would have been unheard of even a year ago: packed "freedom trains" heading West; hundreds of thousands marching in the streets of Eastern European cities, demanding reforms—and being heard; and citizens of both East and West hammering down sections of the Berlin Wall, while once-feared border guards are lost in a river of humanity pouring through its checkpoints.

By all appearances, the Cold War that has dominated our defense planning for the past 40-plus years is ending...or at least going through a dramatic metamorphosis. NATO can claim a cautious measure of victory as the Warsaw Pact fragments and we witness the democratization of some of the world's hardest-line Communist governments.

Still Formidable Threat

Given these events, is this the time to pat ourselves on the back, exchange congratulations with our Allies for a job well done and pack up our belongings and come home? Not hardly.

The threat in Europe hasn't gone away, though the face of it is changing. While the Soviet Union is reducing its forces, its military is also going through a period of major restructuring and modernization. And while the ultimate aim of the Soviet Union is a subject far beyond the scope of this column, we must maintain ***our*** focus on its continued formidable military power.

Global Challenges

Meanwhile, the threats we face in other parts of the world continue to grow. The military power of many Third World nations is increasing beyond that of some of our fiercest enemies of wars past. The global challenges we face as an army and a nation today are more diverse and complex than at any time in our history. Concurrently, the realities of fiscal constraint are forcing us to rethink our approaches to these challenges. Our need for close cooperation and understanding with our partners is more important than ever.

Renewed Partnerships

Indeed, this period of uncertainty and turbulence is a time for renewed partnerships with our Allies, for mutual growth and sharing of knowledge, and for meaningful dialogue in areas that haven't previously been fully explored. It's a time to ensure commonality of our world views as the issues become more complex and the threats perhaps less obvious. Few of the situations we'll encounter will be entirely new, and through the years many of our Allies have faced similar circumstances and achieved success—experiences we can learn from.

Mutual Reliance. In these times of austerity templated over increasing requirements, there's no doubt we'll continue to see an increasing reliance on the combat power of fire support in our land forces, as well as those of our Allies. We of the fire support community have traditionally had a very close working relationship with our Allies that has proved advantageous to all. Our forwardly deployed units have good host-nation partnership and interoperability programs. Our TRADOC representatives at our Allies' artillery schools provide for a productive interchange of ideas and information, as do the Allied representatives at our Field Artillery School. The US Field Artillery groups in Europe work closest of all with our Allies, and their concern goes beyond their very demanding custodial duties to ensuring "total surety"—assisting our Allies in all ways, to include training on and maintaining delivery systems when needed.

Cooperative Combat Developments. A facet of our relationship with our Allies that we must continue to expand is our cooperation in combat developments. Several important projects of the past few years have shown great possiblities in cooperative research and development activities. Examples include our very successful co-development of the howitzer improvement program (HIP) with Israel, our adoption of the British light gun (M119 105-mm howitzer) and our development of the multiple launch rocket system (MLRS), munitions and command and control systems with our NATO Allies.

Forward Thinking

As we begin this new decade, it's clear we have great challenges ahead, challenges we may find very difficult to meet on our own. But by fostering even closer ties with our Allies and continuing the forward thinking that's a hallmark of the Field Artillery, freedom's **Kings of Battle** will meet the challenges and lead our combined forces into the next century.

Incoming

LETTERS TO THE EDITOR

Why Do TFT/GFT and BCS Disagree?

I am an FDO [fire direction officer] in a self-propelled 155-mm battery. Recently, my FDC [fire direction center] section and I were computing GFT [graphic firing table] settings from the battery computer system [BCS]. We realized that even though there were no special corrections applied (i.e., all conditions were standard), the BCS-derived quadrant was not equal to the elevation from the TFT/GFT [tabular firing table/GFT] plus site. As we investigated this phenomenon further, we realized that as range increased the difference between the BCS quadrant and the TFT/GFT increased.

I cannot see why this difference exists unless the data from the AM-2 TFT are outdated or the BCS somehow accounts for increased probable error by manipulating the quadrant. Would you please comment on the cause for this difference.

1LT Calvin T. Harris, FA
How Btry, 3 Sqdn, 11th ACR
West Germany

Here's Why They Disagree

Why doesn't the BCS—battery computer unit (BCU)—quadrant match the GFT/TFT elevation plus site, even when the BCU data base reflects "standard conditions"?

The GFT (AM-2) basically represents a "hand-held" (partial) Table F from the TFT (AM-2). Both are based on standard conditions. The TFT has additional tables and information that allow you to determine corrections for nonstandard conditions.

The BCU uses equations of motion to solve a ballistic trajectory. Those equations are essentially the same as those used to produce the data contained in the TFT. When computing a ballistic solution, the BCU uses its data base as a measure of nonstandard conditions. Corrections for the nonstandard conditions are then applied to determine the firing data necessary to engage the target.

The BCU operator has both direct and indirect influence on the measure of nonstandard conditions represented by the data base. For example, the operator directly "tells" the BCU a nonstandard propellant temperature of + 80° F; however, he indirectly tells the BCU a measure of nonstandard rotation of the earth when inputting the unit and target locations. The BCU contains the programmed information necessary to determine these corrections just as the GFT/TFT-equipped computer can determine them using each of the appropriate tables.

Even if an operator were to try to set all conditions in the BCU data base to standard, there would still exist nonstandard conditions in the data base that the operator has no direct access to. The operator cannot tell the BCU not to apply range or azimuth corrections due to the rotation of the earth. (It's possible, however, to creatively produce situations where the effects of the nonstandard conditions that the operator has no direct access to can be made "zero.") By simply entering the battery location into the BCU, the operator has introduced nonstandard conditions for which the GFT alone can't account.

Why doesn't the BCU quadrant match the GFT when using a BCU-derived GFT setting?

If the GFT setting were derived correctly and no changes to the data base have occurred, the two solutions would match at the range that the GFT setting was derived. As the range to a given target increases or decreases from the derived range, the solution would begin to differ.

With a one-plot GFT setting, the range K (fuze K) varies with range. This rate has been approximated from an average percentage determined from 50 nonstandard trajectories at five different ranges. (For more information on range K and fuze K, see the Ballistic Research Laboratory or BRL Memorandum Report BRLMR-2035.)

The BCU, however, determines its own range K based on the information obtained from a registration, where range K equals the range correction divided by the registration range. This BCU-derived range K is then multiplied by the chart range for a given mission, and the result is added to the chart range. This provides a range adjusted for the range correction of the registration.

Why does the difference increase as the range increases?

The difference increases because the range-K rates for the BCU differ. The farther a mission's chart range is from the registration range, the larger the difference between solutions. If the BCU-determined range-K matched the rate represented by the range-K line of the GFT, the solutions between the BCU and GFT (with BCU-derived GFT setting) would match. Changes to the BCU's data base after the GFT setting is derived or applied also will affect the two comparative solutions.

Does the BCU account for increased probable error at increasing range by manipulating the quadrant?

The BCU doesn't account for probaable errors in aim-point selection or firing-data calculations.

If you or others have questions about this information or would like a copy of the BRL Memorandum, call the Cannon Division, Gunnery Department, Field Artillery School, Fort Sill, Oklahoma, at AUTOVON 639-2622 or commercial (405) 351-2622.

Capt Steven M. Hanscom, USMC
Gunnery Department
Field Artillery School

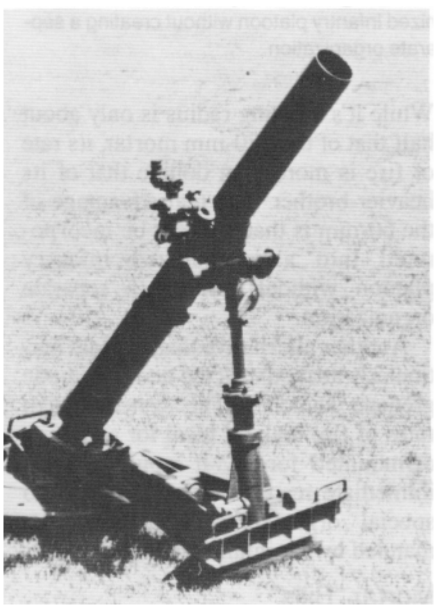
No Mortars in Heavy Forces

A great deal has been written of late about mortars. The big issue seems to be whether they should be an Infantry or Field Artillery system. I propose they should be neither—at least not in the heavy forces. As I see it, the Army simply can't afford to keep mortars in mechanized infantry and armor battalions.

Mortar Problems

From a materiel standpoint, the current 4.2-inch mortar has some significant problems. In an effort to increase the range, we bought a new high-explosive round. This round provides a slight increase in range, but it also presents some new problems. The round has rifling that must be aligned with the rifling in the tube. In addition to reducing the maximum rate of fire by some 30 to 40 percent, the new round has a tendency to stick in the tube.

The mortar's two other munitions also have problems. Safety problems with the white phosphorous round preclude its use in training, and the illumination round is plagued by an excessive dud rate.



The majority of our forces will be stuck with the outdated and problem-plagued 4.2-inch mortar for many years to come.

New 120-mm Mortar. The 4.2-inch mortar is scheduled to be replaced by the 120-mm mortar. This mortar has a smooth bore that eliminates the alignment and sticking problems. It also provides a faster rate of fire and a slight increase in range. However, as of the last information available, we're buying only enough 120-mm mortars to equip about one-third of the force. The majority of our forces will be stuck with the outdated and problem-plagued 4.2-inch mortar for many years to come.

We must consider that the Army will have two separate heavy mortars to train with, maintain and employ. Funding constraints also have impacted on our buying 120-mm mortar ammunition. We're buying high-explosive munitions at a less than desired quantity, and although the illumination round is being type-classified, there are no plans to buy the round.

Mortar Carrier. The carrier for the 4.2-inch mortar is the M106, basically a modified M113 armored personnel carrier. As the 120-mm mortar comes into the force, the old 4.2-inch mortar carriers are going to be revamped and used for the new mortar.

This carrier lacks the mobility of the Bradley fighting vehicles and Abrams tanks of the supported forces and provides only limited protection against small arms and shrapnel. It's also very vulnerable to overhead artillery fire. This, coupled with the ease with which high-angle mortar fire can be acquired by radar, makes our mortar system particularly vulnerable.

Mortar Organizations. Mortars are not in much better shape organizationally than they are from a materiel standpoint. They suffer from being an indirect-fire system in a direct-fire unit. They generally receive less emphasis than the line platoons, and although there may be exceptions, commanding a mortar platoon isn't generally a sought-after position for the young lieutenant.

Combat service support for mortars is shared with the other systems of a battalion. Aside from the mortar carriers, we have no dedicated ammunition hauling or resupply capability for the mortars.

Mortar Training

Ask most commanders what the problem is with mortars, and they'll probably tell you it's the training. Interestingly, this is the same answer given for many years.

Mortar training seems to be an ongoing problem. The primary contributor to this is that mortars are commanded by those whose primary business and orientation is direct-fire maneuver systems. By comparison, if the Field Artillery battalion had an infantry platoon, it would probably be the most poorly trained platoon in the battalion.

While being an indirect-fire system in a maneuver battalion may be part of the training problem, the issue goes even deeper. It could be that commanders just don't consider their mortars a primary combat contributor. If maneuver battalion commanders knew their success on the battlefield depended on mortars, they'd probably train their units better on them. I suspect commanders think they can get along without mortars, so they don't emphasize them. If they had to choose one platoon to "do without" in a battle, it would be interesting to see how many tank or mechanized infantry commanders would opt for keeping their mortars to give up a Bradley or Abrams platoon.

The New Battlefield

So far I've said that mortars have materiel, organizational and training problems. We could fix these problems, but the real question is whether mortar contributions to the battle make them worthwhile. The battlefield has changed and is going to change even more as we move into the 1990s.

The Threat. On the Threat side, we're seeing an ever-increasing emphasis on mounted operations. Indications are that in a heavy scenario, the enemy won't dismount until he has closed to within about 500 meters. From a mortar survivability standpoint, we also are seeing increased vulnerability because of the improved radar systems of our potential adversaries.

Our Army. On our side, there have also been some significant changes. The Bradley has changed our thinking from its being merely a vehicle to bring soldiers forward to being one that joins in the battle.

The fight itself has moved deeper. We're no longer looking at just using high-explosive (HE) munitions to suppress the enemy when he closes. We're looking at more lethal and sophisticated munitions to destroy him before he closes.

Mortar Contributions

Perhaps the best approach to articulating the contributions of mortars is to look at them from a subjective point of view. We must ask ourselves what the mortar does that we can't accomplish or compensate for by using other systems. **Illumination.** From an illumination standpoint, we must take into account the high dud rate of 4.2-inch illumination rounds and the fact that we're not buying illumination for the 120-mm mortar. But, there are some other considerations. Although illumination still is required on the battlefield, we won't rely on it as much because of the proliferation of night-vision devices.

A second consideration is that the Field Artillery also can provide the illumination and at a greater range. If we eliminated illumination from the Field Artillery, the case for mortars might be stronger. But, there always will be times when the mortars can't put the illum out to the necessary ranges. In fact, we could probably make a case for eliminating the illumination mission for mortars, leaving it to the Field Artillery. It goes without saying that we can't justify heavy mortars for illumination alone.

Smoke. Mortars have been touted as excellent "smokers." Right now, that's not the case; they only have white phosphorous (WP) smoke. Although mortars provide smoke quickly, their rounds don't have the duration to build smoke screens. Smoke screens are best accomplished with the hexachloroethane (HC) smoke round found in the Field Artillery.

Smoke really comes into play on the offense, and experience shows that mortars can't meet the requirement. The problem is their range is too short for a fast-moving offensive situation. So the Field Artillery is still going to have to meet a large portion of our smoke requirements.

Lethality. The real issue is mortars in the killing role. In this area, the mortars have the HE round and, when compared to Field Artillery, have a high rate of fire. Mortar HE is useful for suppressing combat vehicles and defeating dismounted forces. It's in these roles that the mortar must defend its usefulness.

In the past, we've relied heavily on *suppressing* combat vehicles as a means of reducing the enemy's direct-fire capability. However, the extended depth of the battlefield and the use of sophisticated acquisition systems and munitions is shifting the emphasis to *killing* combat vehicles before they close. There will always be a requirement to cope with enemy combat vehicles in the close battle, but the contribution of mortars to this task is questionable. The cannon, with its greater range and more lethal munitions, is a more effective alternative.

A primary role of mortars is to defeat dismounted forces. The HE munition and rapid rate of fire make the mortar suited to this task. However, we need to ask ourselves whether we really need the mortar's ability to defeat dismounted forces to win the battle. Ideally, we'll defeat the enemy in depth with long-range artillery and high-lethality munitions. But setting that aside, let's consider the capability of the mortar against the dismounted threat and also consider alternatives.

The dismounted infantry fight has changed. With the advent of infantry fighting vehicles with improved armor and weapon systems, there's an increased emphasis on mounted operations. We can expect to see enemy forces staying mounted until they have closed to within about 500 meters. These close ranges demand accurate fires, both to increase the killing of enemy forces and for the safety of our own. The mortar, with its inherent and operationally induced inaccuracies, isn't well suited for this role.

Conversely, the cannon provides a greater inherent accuracy and has the advantages provided by accurate position location and the application of meteorological and muzzle velocity corrections. The cannon also delivers more lethal munitions.

There are alternatives to defeating dismounted infantry. In looking at the need for mortars in this role, we must consider the contributions of the 25-mm gun on the infantry fighting vehicle and other possible systems. The 60-mm mortar may be a better choice for the close battle. Used as a direct-lay system, it provides instant responsiveness, requires no fire direction center or communications and has a good capability against dismounted infantry.

The real advantage of the 60-mm mortar is that it might be incorporated into a mechanized infantry platoon without creating a separate organization.

While it's bursting radius is only about half that of the 120-mm mortar, its rate of fire is more than double that of its heavier brother. The real advantage of the 60-mm is that it might be incorporated into a mechanized infantry platoon without creating a separate organization.

Another alternative that appears particularly attractive is the new automatic grenade launcher. The system's high rates of fire make it ideal for attacking dismounted forces. It would provide immediate responsiveness, require no special organization and could be manned by the infantry platoon.

Mortar "Bills"

A major argument for mortars is that since we already have them, why give them up? Mortars aren't free! Even without fixing the materiel problems, they do cost us.

Spaces. There are several thousand personnel spaces in the mortar platoons of the heavy forces, and this number includes only the minimum personnel required to fire the mortars. It doesn't account for any overhead beyond the platoon headquarters or any support and sustainment personnel. Putting this number in perspective, we're talking about several battalions' worth of force structure.

Associated Materiel. We also have materiel costs associated with the mortars. They use about 200 M577 command post carriers, a vehicle critically short in the Army. Those command post carriers would more than meet the needs of the program to convert 8-inch howitzer battalions to multiple launch rocket systems (MLRS).

There are also about 500 tracked mortar carriers. It might be possible to change some of these carriers to meet the equipment shortfalls holding up the fielding of combat observation lasing teams (COLTs).

Mortars use 1,000-plus radios, not counting the planned fielding of the enhanced position locating and reporting system (EPLRS). Significantly, fire support teams and fire support sections need about 50 percent of these radios just to manage mortar fires.

Operations. But the cost of mortars is more than personnel spaces and equipment; there are operational costs as well. If one lays down the fire support command, control and communications structure in a heavy task force, it becomes obvious that mortars place significant demands on the system. Fire requests from observers must be coordinated between mortars and Field Artillery, placing additional demands on the fire support team headquarters and on the battalion fire support element.

Streamlined Fire Support

The final argument for mortars is that they're responsive to the needs of the task-force commander. However, if we eliminated the heavy mortars, the fire support command and control system would be greatly streamlined, increasing its overall responsiveness.

If the concern is that we don't have enough artillery to "take up the slack," then we should consider using the mortar force-structure spaces to "beef up" the direct-support artillery, increasing the number of cannons in the battalion.

From a cost standpoint, we probably could get more firepower for the dollar by going to a single indirect-fire system where we'd be concerned with only one caliber of munition, one set of fire direction frequencies, etc. From an operational standpoint, the longer range and greater variety of artillery munitions gives the maneuver commander more flexibility.

The Bottom Line

The bottom line is that the heavy mortar is not a cost-effective system in the heavy forces. In this era of a constrained force and constrained budget, we need to look at streamlining our force by eliminating mortars in our heavy forces. The Field Artillery "bit the bullet" and is eliminating its 8-inch howitzer. Now it's time for the Infantry to bite the bullet with regard to the heavy mortar.

120-mm Mortars for Light Forces

As a closing note, perhaps I should discuss what we might do with the 120-mm mortars we're committed to buying. We could offer them up for foreign military sales, but there's another alternative.

The current buy of 120-mm mortars is only enough for about one-third of the heavy force. However, it's about the right amount for the light forces! Light forces generally face dismounted forces, they don't move at the speeds of armor and mechanized forces, and their range requirements are not as great. They need a system that's easily deployed with minimal air sorties. These factors seem to point to using the 120-mm to increase the firepower of our light forces.

Edward J. Stiles
Concepts and Studies
Directorate of Combat Developments
Field Artillery School

Author's Response to Article Critique

The Soviet 2S1 122-mm howitzer, like *any other* self-propelled cannon system with collective overpressure protection, breaks its seal when it fires.

Captain [Donald R.] Sims, thank you for your reflections [Incoming, June 1989, Page 6] on my article "Soviet Artillery: Myth versus Reality" [April, 1989]. Your attention to the problem posed by our potential adversary is noteworthy, and your comments have some merit. However, I feel your criticisms have missed the point somewhat.

You said the 2S1 breaks its seal when it fires, making it dangerous in an NBC environment. The 2S1, or *any other* self-propelled cannon system with collective overpressure protection, will break its seal *anytime* it fires. It is impossible to open the breech to reload the weapon without doing so. However, during the brief time the breech is open or that the cartridge case ejection port on the 2S1 is open, the air is being forced *outside* by the pressure. In fact, the loader's hatch on the 2S1 is positioned so a powerful stream of air blows out the hatch whenever it is opened. Any contaminant that might enter the fighting compartment would be negligible.

The Soviets obviously chose a less-than-perfect system over none at all, as was the choice for the M109. This argument is a little like criticizing the neighbor's sports car because it's the wrong color when you're driving a clunker. By the way, the caption for the photograph on Page 6 is incorrect: the howitzers are not 2S1s as says *Soviet Military Power* but are D-30s, as can be seen by the towing lunette visible forward of the muzzle brake. [The picture was provided by *Field Artillery*.]

The comment about the MI-2 artillery correction and reconnaissance helicopter's not being comparable to our OH58D is misleading. The MI-2 spotting variant is the *second* such aircraft fielded by the Soviets since the 1960s. A recent Soviet publication detailing a comparison of Warsaw Pact and NATO equipment pointed out the "...MI-8 and MI-24 reconnaissance and spotting aircraft...," and an East German publication reported that a trainer was being developed for a "...reconnaissance and spotting helicopter with laser and data transmission equipment...." A spotting variant of the MI-24, presumably with a laser range finder or designator and a link to automated C^3 [command, control and communications], would represent a major improvement in heliborne artillery spotting.

Last, the comments about the Soviet artillery headquarters' operating manually, as opposed to using automation, are incorrect. The Soviets (like their Bulgarian, Hungarian, East German and Czechoslovakian allies) have developed their own modernized artillery command and control system.

The system has digital message equipment in the command observation posts, battalion and battery fire direction centers, mobile reconnaissance posts, radar stations and, presumably, in aircraft. There are digitally linked computers at battalion and higher levels and probably at battery level as well. This system has been described in detail in a recent article in *Voyennie Vestnik* and doubtlessly has been in the field for several years.

As I mentioned at the close of the article, the Soviets have vulnerabilities. These include limited numbers of higher-level artillery headquarters, extensive use of the infrastructure for movement, individual soldier performance and others. They are, however, very good planners and excellent designers.

The qualitative edge we held in the 1970s has been squandered, in part, because we have been arrogant and not given the Warsaw Pact credit where it was due. We now have to accept its advances, buckle down and catch up.

Michael D. Holthus
Intelligence Research Specialist
Foreign Science and Technology Center
Charlottesville, VA

General Clarke—Not Palmer

Having received the October 1989 copy of ***Field Artillery,*** I immediately began devouring its contents. In my joint assignment, it is my only link to the Field Artillery Community.

As I have come to expect, it is full of information and worthwhile articles. I especially enjoyed the three History Writing Contest submissions. The article "Danger Close: A Historical Perspective on Today's Close Support" by Major Thomas Waller was certainly worthy of First Prize.

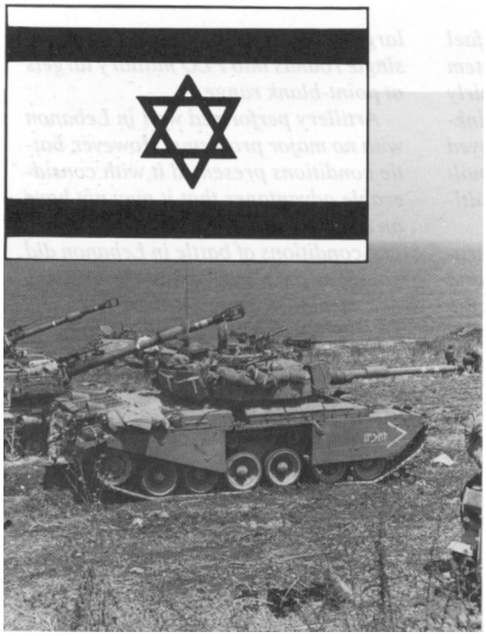
I must, however, point out that on Page 12 in the discussion of the Battle of Saint Vith, Major Waller states that Combat Command B of the 7th Armored Division was commanded by Brigadier General Bruce Palmer. More precisely he wrote, "the infantry of Brigadier General Palmer's Combat Command B...." I can only assume Major Waller meant to say *Brigadier General Bruce Clarke,* one of the US Army's finest leaders.

General Clarke led CCB of the 7th AD in a fight that had at least the same significance as the Battle at Bastogne in determining the outcome of "The Bulge."

I'm sure Major Waller made an honest error, and this is strictly to set the record straight.

CPT Richard J. Lyons, FA
Field Command
Defense Nuclear Agency
Kirtland AFB, NM

"A good camouflage job, besides offering concealment, also makes a great dinner salad."



Israeli Artillery Tactics and Weapons—Lessons Learned in Combat

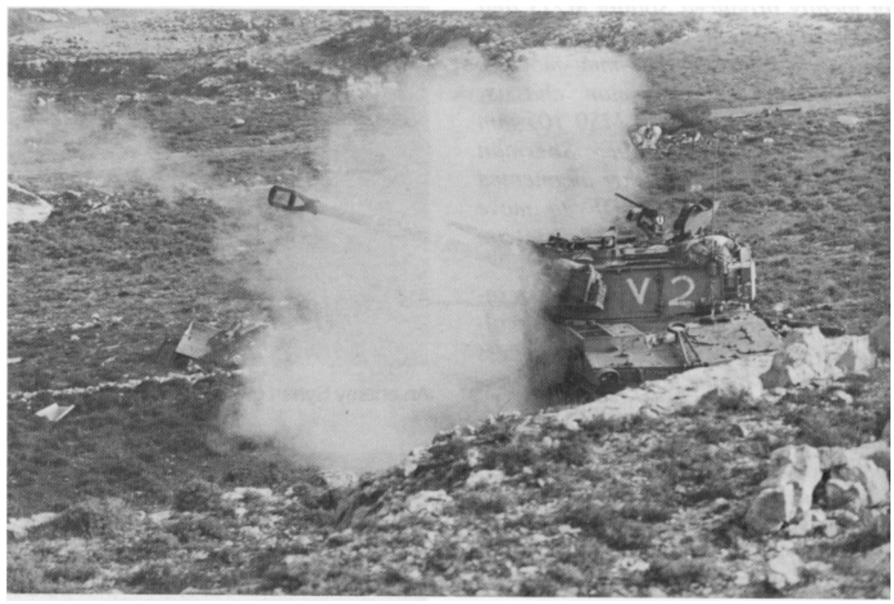
by Brigadier General (Reserves) Arie Mizrachi, IDF

Firepower played a major role in the 1982 Lebanon War. This War, one of many in the long and continuous conflicts of the Middle-East, was in fact, "The Artillery War." The "secret" of the Israel Defence Forces (IDF) artillery's success rested in the correct combination of new tactics that had emerged from the lessons of the 1973 Yom Kippur War and modern, locally developed weapon systems.

Characteristics of the Lebanon War

The 1982 confrontation was the first war in which the IDF had employed large quantities of the M109A1 and A2 self-propelled howitzers (SPHs). The main portion of the divisional artillery's combat equipment was based on those M109 SPHs and the M107 175-mm guns, which were converted, in certain cases, into 8-inch tubes. The IDF also used rocket artillery in the form of the medium artillery rocket (MAR) 290.

As far as I am aware, this was the first war in which each battery had an integral battery computer system. Our forward observers (FOs) at all levels used laser range finders (LRF) while remotely piloted vehicles (RPVs) were used for target acquisition, fire control and damage assessment. Our Smart fire control radar, still in its prototype version at the time, also was successfully used for registration missions.



The M109, firing in Lebanon, is deployed in accordance with terrain features.

The 1982 War was, in fact, the first in history where 155-mm improved conventional munitions (ICMs) coupled with rocket artillery were used widely. This had a tremendous "impact" on the enemy, affecting his armor, infantry, artillery batteries and built-up areas. Direct-fire techniques, implemented by the M109s and the 8-inch tubes against pinpoint targets, also proved very effective.

The well-known American military historian, Richard A. Gabriel in his book, *Operation Peace for Galilee—The Israeli-PLO War in Lebanon* (Hill and Wang, New York, 1984), described the role of the IDF artillery during the 1982 Lebanon War, as follows:

Artillery is the newest combat arm of the IDF, created out of whole cloth after the 1973 War. In 1973, the IDF had about 300 artillery guns, most of which

were towed pieces. By 1982, the number of guns had increased to more than 958, most of which were self-propelled, large-caliber artillery.

Prior to 1973, artillery played essentially a support role, with limited mobility in support of the tank. Today [1984] IDF artillery is completely mobile to keep up with the rapid advance of tanks and armored personnel carriers; it has become a full partner in the combined-arms team.

Its weaponry is comprised mostly of M109s and M107s, added to a number of locally produced Soltam M71s and L33s. In addition, it deploys a considerable number of 160-mm mortars mounted on old Sherman chassis, as well as a number of M50 105-mm guns mounted on Super Sherman chassis. Mobility is further augmented by the ability of the IDF to move artillery pieces to the battlefront on transporters.

Artillery proved effective in most instances during the Lebanon War, although to some extent its effectiveness was reduced by the terrain, which prevented its playing the highly mobile, fast-moving role envisioned for it in the new combined-arms doctrine developed since 1973. Operations were often slowed to a crawl by terrain and hostile fire in urban areas.

In the east, artillery proved effective in counterbattery fire against Syrian positions, a fact helped considerably by the Syrians' refusal to redeploy artillery rapidly with the changing tactical situation. The effectiveness of artillery in the eastern zone also was increased considerably by the Israelis' complete air superiority.

In the west, the effectiveness of artillery was reduced by self-imposed restrictions to limit property damage and civilian casualties. However, the artillery was technically very good. It made good use of new devices such as the RPVs...[and] intelligence gathered by aircraft flying over the battlefield.

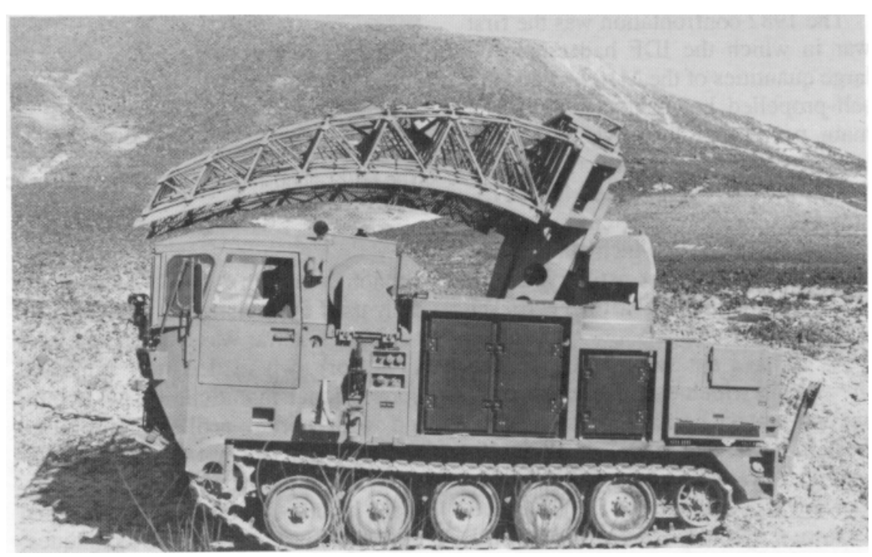
In addition, it used the new Rafael David fire-control computer system (made in Israel), which made it fairly effective at sheaving artillery and linking concentrated fires. It also deployed a number of new fire modes built around the new Telkoor M131 multi-option fuse.

In Beirut, the artillery played a crucial role in suppressing enemy fire and destroying PLO strongpoints within the camps and the city. Often, in responding to PLO Katyusha and mortar fire, the IDF was able to sheave its artillery rapidly and respond almost immediately by pouring scores of shells on a single area....During the siege of Beirut, the IDF seems to have discovered the technique of "sniping" with large-caliber artillery pieces by firing single rounds into PLO military targets at point-blank range.

Artillery performed well in Lebanon with no major problems. However, battle conditions presented it with considerable advantages that it may not have on a different battlefield in the future. The conditions of battle in Lebanon did not allow for a true test of the artillery and structure envisioned in 1973. Its new role was to deploy in support of rapidly moving armored infantry forces in a closely coordinated combined-arms attack. A test of that role will have to wait for the future.

Many subjects regarding the performance of the artillery in 1982 would interest American Redlegs. However in

An enemy Syrian gun sits damaged after being hit by Israeli artillery in Lebanon.



Smart Antenna Vehicle. The Smart fire-control radar proved to be a significant force multiplier during the War in Lebanon.

this article, I'll concentrate on three significant issues: direct fire for self defence, battery deployment and survivability and large concentrations of fires.

Direct Fire for Self Defence

In the 1973 War, the IDF had only 23 short-barrel M109 SPHs. I was serving as an M109 battalion commander in the Golan Heights, and one of my batteries (Battery B) was deployed in the southern part of the Golan—right on the main axis of the Syrian armor penetration route.

That place, known as the Tel-Fares Gap, was defended by an Israeli armored brigade that had already faced two Syrian divisions. The artillery ratio was 15:1, with our being greatly outnumbered by the Syrians.

In the first seven hours, from 1400 until about 2100, Battery B fired more than 1,000 rounds on various targets. In the evening, a Syrian T-55 tank company attacked it from a range of about 40 meters. Three of our four howitzers were destroyed and so was the M113 fire direction center (FDC).

The immediate lesson we learned from that battle was we urgently needed to improve the ability of our crews to defend themselves. We increased our survivability by better using the section's main weapon—the howitzer—for defence purposes.

To fulfill such an objective, we developed direct-fire techniques dealing with such issues as fighting enemy tanks at various ranges, maximizing the duration of our stay in firing positions and commanding and controlling battery fire. We also developed a new 3,000-meter telescope capable of firing with a charge 9 propellant (US—203).

From 1976 to 1982, we dedicated a large percentage of our training time and ammunition to direct-fire drills. To encourage our crews, we even conducted some tests on the effects of 155-mm fire against T-62 tanks.

The results of these technique, tactic and training efforts were indeed apparent in the Lebanon War. We used M109A2 and 8-inch M110 battalions very effectively in direct-fire missions. It was natural for our crews to use direct fire whenever needed—for battery self defence as well as against strongholds, and particularly in built-up areas.

Better Deployment and Survivability

At the start of the 1973 Yom Kippur War in the Golan Heights, the Israeli artillery was heavily outnumbered (15:1) by the Syrian artillery forces. The ratio improved to 7:1 after we mobilized our reserve forces, a ratio we maintained throughout the 1974 War of Attrition (which has the same name as the 1970 War) in the Golan Heights. The name of the game was, thus, ***survivability.***

During the 1974 War of Attrition, my Battery C was deployed near the forward edge of the battle area (FEBA) approximately 35 kilometers from Damascus in an area that had been captured from the Syrians in 1973.

The entire area had been well observed by the Syrian forces situated on the highlands, and "Shoot and Scoot" tactics were not effective. The enemy forces would accompany our leapfrogging with counterbattery fires and make sure that such fires would "welcome" us in our new positions. Because our mission was to provide close support for our front-line forces, we had no choice but to remain in the same positions and keep on firing.

The Battery Commander devised a way to increase our survivability by deploying his SPHs in deserted Syrian trenches with the hulls and turrets almost concealed. For each SPH, the tube was practically the only part that wasn't in the trench, allowing us to fire full-circle (360 degrees).

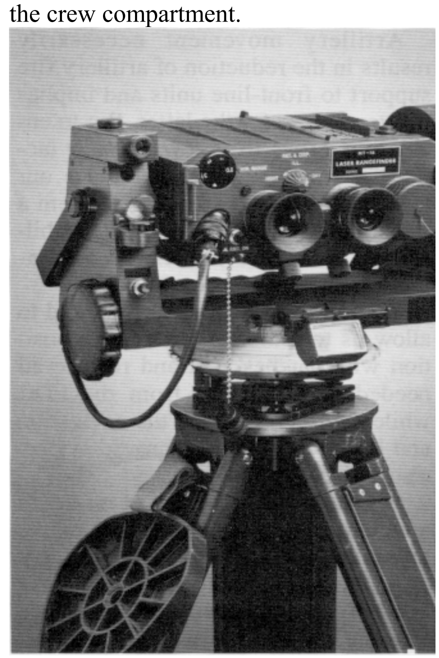
We solved the ammunition supply problem by converting one of the howitzers into a Field Artillery ammunition support vehicle (FAASV). We also put 70 to 80 rounds on the floor of each SPH.

The M109, thus, was completely shut, using distant reference points instead of aiming rods. All the crew members wore armored vests. The Battery remained in the same position for three weeks, continuously providing effective fire support with no casualties during that period.

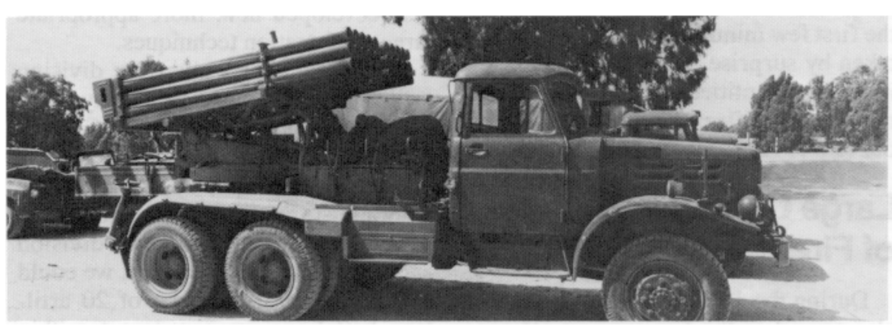
The outcomes of this lesson were two—we changed our tactics and improved our howitzers.

New Tactics

We began using new deployment techniques that came to be known as "deployment in accordance with terrain features." We taught our section chiefs to exercise independence in the selection of their positions. The battery deployment area covered some 400 to 600 meters, with each section chief's having to find his own trench, cover and concealment. We deployed the M109 with all hatches shut and all activities and procedures carried out from within the crew compartment.



Used in Lebanon, the Israelis developed the MT 18/19 laser range finder for both forward and firing echelons.



The Palestine Liberation Organization used this Soviet-made Katyusha rocket launcher in Lebanon.

The data from the FDC were sent separately to each specific gun, due to the different muzzle velocities (MVs), and was computed by the battery computer, which included the different gun positions in its computations. We thus enhanced survivability by taking advantage of the capabilities of the M109 and battery computer.

Howitzer Improvements

Artillery movement necessarily results in the reduction of artillery fire support to front-line units and implies greater danger for the latter. But to enable our crews to follow the new tactics, we had to further reduce our vulnerabilities. We had to give them a system that would increase survivability and allow our artillery to accomplish its mission successfully.

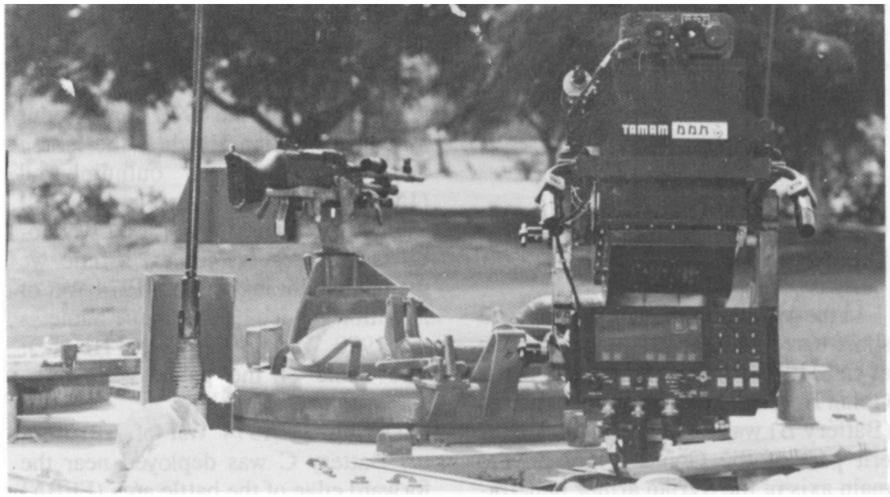
An improved weapon system had to allow us to remain in one firing position with hatches shut and receive all needed data digitally from the FDC while the SPH provided the navigation and laying data. The improved system also had to—

- Increase the quantity of on-board ammunition, allowing crew members to remain in the crew compartment throughout the firing process.
- Improve the rate of fire and reduce the time it takes to shift from one target to the next, allowing us to engage the large number of targets we faced as we were severely outnumbered.

One should remember that, statistically, ammunition is most effective in the first few minutes while the enemy is taken by surprise. This entails our firing large quantities in a short time and requires significant improvements in our rate of fire.

Large Concentrations of Fires

During the 1973 Yom Kippur War, I also served as the fire support officer (FSO) of the 7th Armored Brigade in the Golan Heights. One of the most severe problems we encountered in the defence was the ratio between enemy tank quantities and our own.



One of the Israelis' locally developed systems is their version of a position and azimuth determining system (PADS).

On the most crucial day of battle, we were at a quantitative disadvantage of 150 enemy tanks to our 10, which at that time were still undamaged. The enemy tanks had assaulted us in a final attempt to break through our defence line.

Our solution was to concentrate the fires of 21 artillery batteries, which were at my disposal at the time, together with the fires of an additional artillery 240-mm rocket battalion. The shock created by such a massive concentration of fires—especially the distressing effect the 144 240-mm rockets caused on enemy morale—forced some of the enemy units to stop and the rest to at least slow their progress. We gained much-needed time that allowed our tanks to reach their positions and receive reinforcements. The enemy withdrew and the battle was decided.

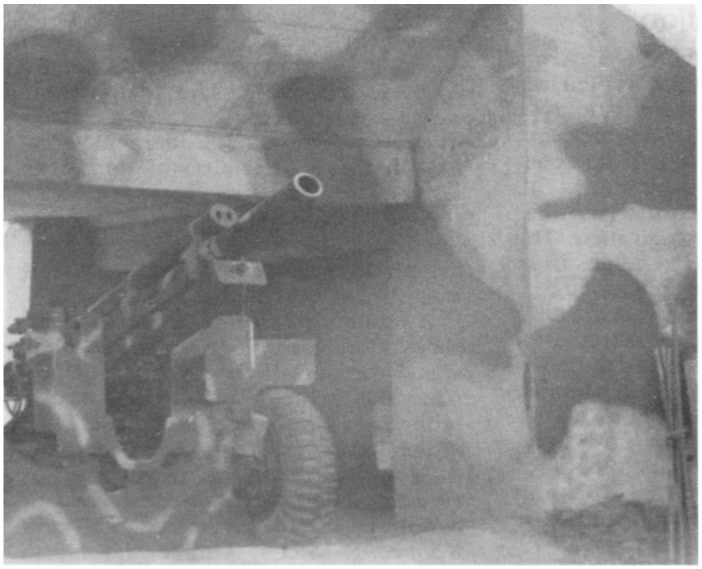
As a result of that battle, we better understood the importance of firing accurately and taking the enemy by surprise to cause maximum damage. We also developed new, more appropriate target registration techniques. These techniques allow the division artillery the maximum flexibility when concentrating fires. We simplified the techniques by using the battery fire computer, which quickly and automatically adjusts the fires of a single gun, to adjust the fires of the entire division artillery. In the Lebanon War, we could concentrate the firepower of 20 artillery battalions on one target within minutes, without having to adjust.

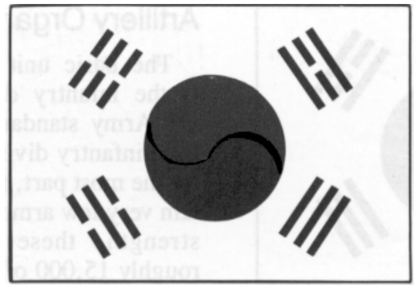
The device we developed for this purpose is the Smart system. Smart is a fire-control radar system whose range allows us to use it far behind firing artillery pieces. Smart's range and accuracy proved to be remarkable, exceeding our expectations. This radar enabled us to concentrate fires and exploit artillery flexibility in both mountainous and built-up areas.

Summary

The lessons of the 1973 War emerged into operational requirements, which led to our developing new tactics, techniques and weapon systems to accommodate those requirements. By 1982, the IDF artillery could exploit its potential fully and became a decisive arm on the battlefield.

Brigadier General (Reserves) Arie Mizrachi is President of a consulting firm he started in Ganei Tiqva, Israel. He spent 24 years in the Israel Defence Forces and was Chief Artillery Officer when he was released in 1983. General Mizrachi's combat experience includes serving as a combat officer (S3) and battery commander during the Six-Day War (1967), as a battery commander and deputy battalion commander in the War of Attrition (1970), as battalion commander and armoured brigade commander for fire support in the Yom Kippur War (1973) and as Artillery Corps Commander in the Lebanese War (1982). He also served as Artillery Commander of the Israeli Northern Command and as the Commanding Officer of the IDF Artillery School. General Mizrachi is an honor graduate of the US Army Field Artillery Officer Advanced Course (1975), Fort Sill, Oklahoma.





ROK Artillery—Present and Future

by Major John Gordon IV

It may come as a surprise that of all America's allies, the nation that maintains the largest amount of artillery is not a NATO nation, but the Republic of Korea, commonly referred to as South Korea. In this article, I examine the organization of the Republic of Korea Army (ROKA) artillery and its weapons and tactics. In addition, I review the future trends of the ROKA artillery toward reorganizing its force and modernizing its equipment. To put the ROKA situation into the proper perspective, I first briefly examine the Threat fit faces.

North Korean Threat

The Democratic People's Republic of Korea, usually referred to as North Korea, maintains the third largest standing army in Asia, with an active-duty strength of about 750,000 men. Only the armies of the People's Republic of China and Vietnam are larger. The North Korean Army consists of 25 active-duty infantry divisions and 35 armored and mechanized brigades, some of which are subordinated to infantry corps while others are formed into four armored or mechanized corps, each of which is larger than an American armored division.

Supporting these ground forces is a huge artillery organization. The total artillery weapons available to the North Korean Army's divisional and non-divisional artillery units number roughly 4,000 guns and howitzers and about 2,500 multiple rocket launchers (MRLs). Many of these weapons are now produced in North Korea.

The North's army is by any standard large and is a huge drain on a nation of only 22 million people. It's organized and deployed for a short-notice offensive against South Korea, and its artillery would be a major factor in such an offensive, particularly in the initial phases of any attack. North Korean forces are large, but much of its equipment, particularly its tanks and certainly its air force, is obsolescent. When faced with the prospect of breaking through well-organized ROKA defensive positions along the 150-mile Demilitarized Zone (DMZ), the North would have to rely primarily on its massive artillery organization.

HARTS

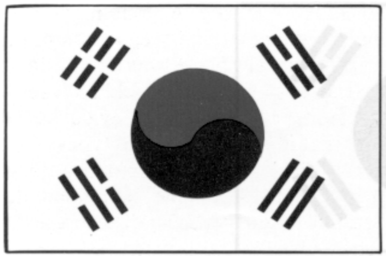
Just north of the DMZ are hundreds of hardened artillery sites (HARTS) that have been constructed since the end of open hostilities in August 1953. During the first phase of an attack against the South, the North Korean artillery would be able to find shelter in these sites, some of which are bunkers and others tunnels in hillsides. For the first 10 to 15 kilometers of an advance against the South, the vast majority of the North Korean artillery would be able to fire from these well-protected positions.

If the attack were successful and the advance continued, the North's artillery would have to leave its protected positions to follow and support the advancing armored and infantry units. However, the advantage the HARTS provide in the early phases of an attack can't be overstated. These positions, as I discuss later, represent a major challenge to the ROKA artillery.

Artillery Upgrades

The North has spent the past few years transforming much of its artillery from 1940s to 1950s-style Soviet towed weapons into a self-propelled force. It has accomplished this by mounting 122-mm, 130-mm and 152-mm weapons on armored personnel and tractor chassis, usually with limited crew protection and traverse capabilities. Nevertheless, these conversions have greatly increased the North Korean artillery's ability to follow and support advancing maneuver units. In addition, the North has deployed a number of long-range, self-propelled 180-mm guns, which would certainly be used very early in any war to terror-shell Seoul for propaganda purposes.(There is disagreement about the caliber of guns; some sources say they're 170 or 175-mm.)

North Korea is a major threat to the Republic of Korea. The North's army is large, apparently well-trained and armed with a large number of serviceable

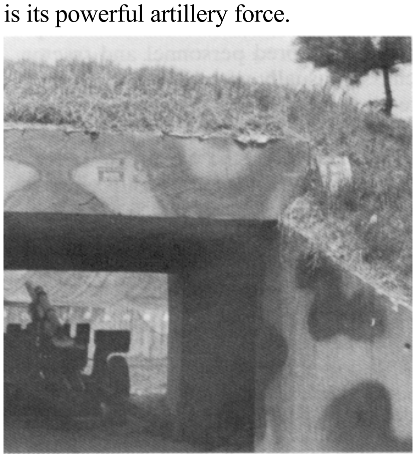


but increasingly outmoded weapons. The artillery arm of its army is formidable, with the ability to generate the massive firepower needed to crack ROKA defensive positions along the DMZ.

ROK Army

In June 1950 when the North Korean Army swept across the 38th Parallel, the ROK artillery was very poorly armed and trained. Its heaviest weapons were a few hundred US World War II-vintage 105-mm towed howitzers. This force wasn't prepared to deal with the well-equipped forces of the North. For many years after the Korean War, the ROKA's dependence on US Army hand-me-downs was to continue. Today that situation is rapidly changing.

The ROK Army currently consists of approximately 540,000 men on active duty organized into two mechanized divisions, 19 infantry divisions and a number of non-divisional infantry, armor and artillery brigades. Backing up this force, which is larger than that of any of our NATO allies, is a reserve structure that includes 23 reserve infantry divisions of various types and several million reservists. A prominent part of this army is its powerful artillery force.



This ROKA 105-mm howitzer in a concrete bunker is aimed at the DMZ. Notice the thickness of the overhead cover.

Artillery Organization

The basic unit in the ROK Army is the infantry division. By current US Army standards, these would be light infantry divisions since they are, for the most part, foot-mobile and contain very few armored vehicles. At full strength, these divisions number roughly 15,000 officers and men. The majority of their firepower comes from their organic artillery regiments.

Figure 1 shows the typical artillery organization in a ROKA infantry division. All battalions consist of three firing batteries and a total of 18 cannons. As currently organized, three battalions have towed 105-mm howitzers, either US- or ROK-made M101s or ROK-produced KH-178s 105-mm howitzers, which are superior to the US M101s.

These direct-support battalions are habitually associated with one of the three infantry regiments of the infantry division. The fourth battalion is the divisional general-support battalion, which is armed with either American-made M114 or Korean-produced KH-179 155-mm howitzers. The total number of weapons in the Korean artillery regiment is 72, which compares favorably with its North Korean counterpart. A North Korean division usually has four, 18-gun battalions.

Division Artillery. The artillery organization of the two ROKA mechanized infantry divisions is shown in Figure 2. The Capital and 20th Mechanized Divisions are elite forces in the ROK Army and are much more heavily armed than are the regular infantry divisions. It's here that the modern, South Korean-produced K-88 tanks are found.

The artillery regiment consists entirely of self-propelled weapons. The 8-inch howitzers are short-tube M110 weapons, which were dropped from US active-force service roughly a decade ago. But the M109A2s have the same capabilities as the M109-series howitzers found in American mechanized and armored units. The M109A2 is also the direct-support weapon in the artillery battalions of the ROKA non-divisional armored brigades.

Corps Artillery Brigades. In addition to its divisional artillery force, the ROKA maintains a large number of separate artillery organizations. The ROKA has several artillery brigades assigned to the corps that are positioned along the DMZ. The number of artillery brigades in each corps varies, depending on the part of the DMZ the corps is defending. Unlike the divisional artillery regiments that are fixed in structure, there's considerable variation in the organization of the corps artillery brigades.

Figure 3 shows a typical organization of a corps artillery brigade. Note the number of battalions will vary considerably, as will the type of weapon.

A number of artillery systems at the corps level don't show up in the divisional organizations. These include American-made M107 175-mm self-propelled, long-range guns and M115 8-inch towed howitzers. Each corps artillery brigade also has a two-launcher Honest John rocket battery and a battalion of Korean-made 130-mm *Kooryong* MRLs. Unlike the North Korean Army, the ROKA doesn't usually assign MRLs to divisions.

A ROKA M110 howitzer moves through a typical Korean town.

The ROKA M109A2 howitzers of the elite Capital Mechanized Division line up after Team Spirit 89.

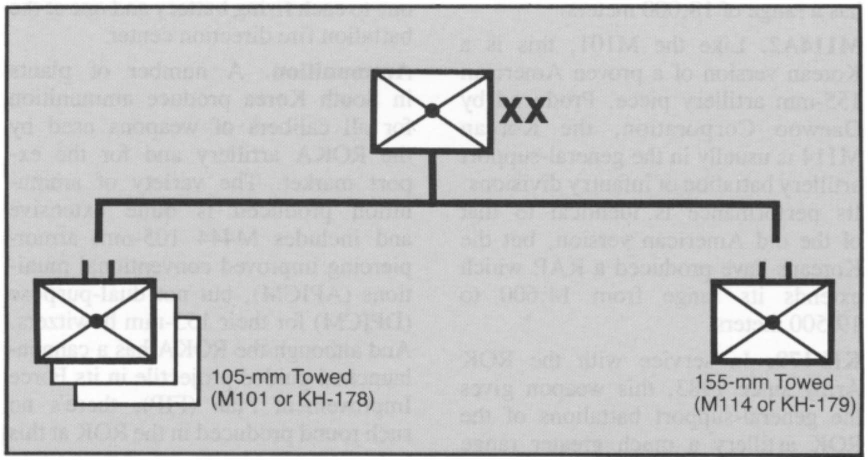


Figure 1: The Typical Organization of a ROKA Infantry Division Artillery

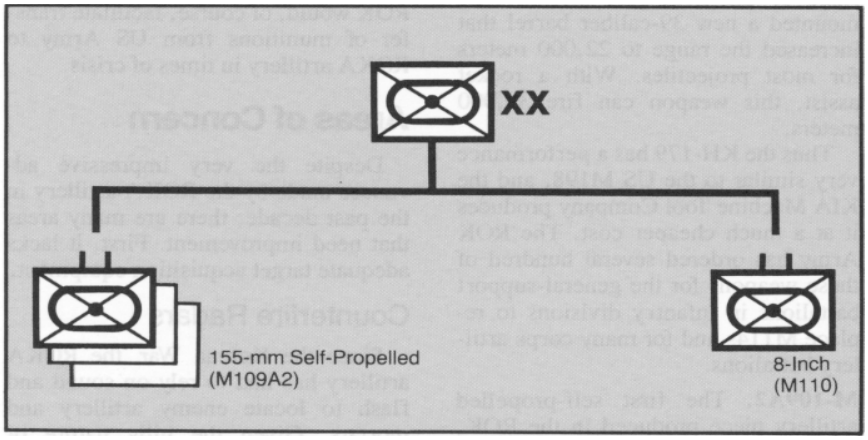


Figure 2: The Organization of the Two Elite ROKA Mechanized Infantry Divisions Artilleries—The Capital and 20th Divisions

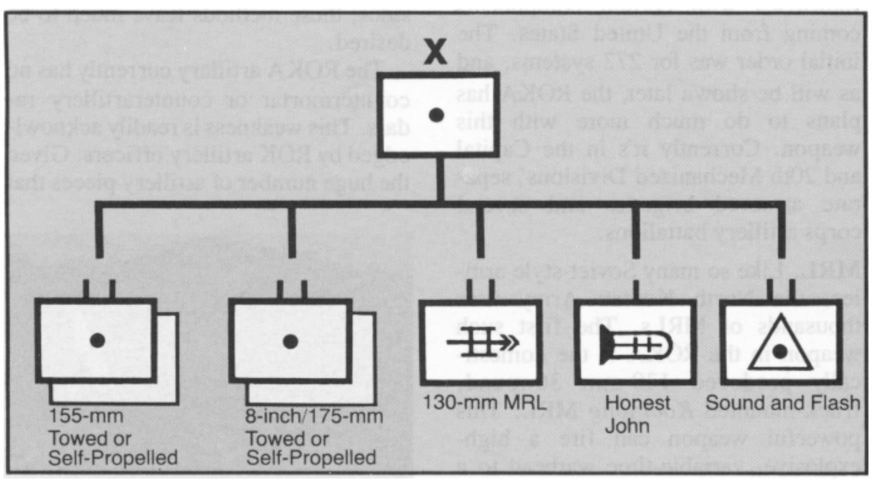


Figure 3: The Organization of a ROKA Corps Field Artillery Brigade, Though the Number of Battalions Varies

	ROKA	United Kingdom	France	West Germany
Number of Guns/Howitzers	3,300(+)	550	786	1,223

Figure 4: Comparison of Selected NATO Armies and ROKA Field Artillery

Reserve Artillery. As was mentioned earlier, the active-duty elements of the ROKA are supported by a very large reserve system that can field 23 reserve divisions in a matter of a few days after mobilization. There're two types of reserve divisions: mobilization reserve divisions (MRDs) and homeland defense divisions (HDDs). These vary in function and organization.

The MRDs are organized in a similar manner to the standard active-duty infantry divisions, and their artillery includes the usual mix of 105-mm and 155-mm weapons found in the active army. These formations are able to take their place in the front line beside active-duty forces several days after mobilization.

The HDDs. however, are designed primarily for rear-area defense. This is no small task considering the massive North Korean Special Purpose Forces dedicated to infiltrating the ROKA rear area throughout the depth of the ROK.

The HDDs are weak in artillery. Some divisions have only one battalion of artillery, 105-mm. This organization is in keeping with the mission of these divisions.

Figure 4 shows a comparison of the total artillery strength of the ROKA, including the reserves, compared to that of selected NATO armies. The artillery of the ROK Army is very formidable, even though outnumbered by its potential North Korean enemies.

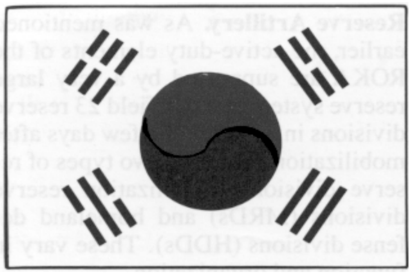
Artillery Doctrine

Due to its long, close association with the United States Army, it isn't surprising that ROKA artillery doctrine is very similar to ours. In fact, the ROKA artillery Field Manual 6-20, is virtually a copy of the American *FM 6-20 Fire Support.* There are, however, several differences between how the US artillery and ROKA would fight.

In terms of artillery missions, there's no difference between the two armies. Direct support, reinforcing, general-support reinforcing and general support are concepts both armies share. This greatly facilitates coordination among US and ROK artillery commanders.

Some of the important differences at the tactical and operational levels are—

- The ROKA tends to move artillery battalions in one bound.
- The role of the corps artillery staff is similar to that of a US corps artillery during World War II. Because frontages



are much smaller for divisions in Korea than they would be for us in Europe, the ROKA corps artillery headquarters can effectively retain tactical control of a considerable amount of artillery. Some front-line ROKA corps have frontages about the same as a US Army division would have in Europe. This means the corps artillery headquarters can control the counterfire battle and retain control of a significant number of firing battalions.

- The ROKA artillery retains the forward observer concept, as opposed to a US fire support team.
- The ROKA artillery doesn't emphasize deep battle, as does the US artillery. It pays a great deal of attention to the close-support mission.

Artillery Equipment

The days are rapidly passing when the ROKA has to rely on US hand-outs for its artillery. South Korea is now capable of producing a variety of artillery systems for its own forces and for export.

M101. For some years now, the ROK has produced this split-trail 105-mm towed weapon. It's still the most common artillery piece in the ROK Army. Produced by Daewoo Corporation, it's identical to the M101 howitzer made for the US Army for many years. The ROKA recognizes that this weapon is rapidly becoming outmoded and is taking steps to change the situation.

KH-178. A much more modern 105-mm weapon is this howitzer, designed and produced in Korea. The KIA Machine Tool Company took samples of the excellent British 105-mm light gun and the experimental West German Rheinmetall version of the M101 and incorporated the better points of each into its KH-178.

This towed weapon, in production since 1984, can fire current 105-mm ammunition to 14,700 meters, nearly a 30 percent increase in range over the M101 howitzer. If it fires a rocket-assisted projectile (RAP), the KH-178 has a range of 18,000 meters.

M114A2. Like the M101, this is a Korean version of a proven American 155-mm artillery piece. Produced by Daewoo Corporation, the Korean M114 is usually in the general-support artillery battalion of infantry divisions. Its performance is identical to that of the old American version, but the Koreans have produced a RAP, which extends its range from 14,600 to 19,500 meters.

KH-179. In service with the ROK Army since 1983, this weapon gives the general-support battalions of the ROK artillery a much greater range than they had before. Using the carriage of the M114A1, the Koreans mounted a new 39-caliber barrel that increased the range to 22,000 meters for most projectiles. With a rocket assist, this weapon can fire 30,000 meters.

Thus the KH-179 has a performance very similar to the US M198, and the KIA Machine Tool Company produces it at a much cheaper cost. The ROK Army has ordered several hundred of these weapons for the general-support battalions in infantry divisions to replace M114s and for many corps artillery battalions.

M-109A2. The first self-propelled artillery piece produced in the ROK, this weapon is built under license by Samsung Shipbuilding and Heavy Industries with certain components coming from the United States. The initial order was for 272 systems, and as will be shown later, the ROKA has plans to do much more with this weapon. Currently it's in the Capital and 20th Mechanized Divisions' separate armored brigades and several corps artillery battalions.

MRL. Like so many Soviet-style armies, the North Korean Army uses thousands of MRLs. The first such weapon in the ROKA is the domestically produced 130-mm 36-round, truck-mounted *Kooryong* MRL. This powerful weapon can fire a high-explosive, variable-time warhead to a range of 32 kilometers. Reloading takes about 10 minutes. Currently, these weapons are in 18-launcher MRL battalions at the corps level. It's produced by Daewoo Heavy Industries.

Computerized Firing Data. At the battalion and battery levels, the artillery now uses a computer to determine firing data. Currently, these are issued one to each firing battery and one at the battalion fire direction center.

Ammunition. A number of plants in South Korea produce ammunition for all calibers of weapons used by the ROKA artillery and for the export market. The variety of ammunition produced is quite extensive and includes M444 105-mm armor-piercing improved conventional munitions (APICM), but not dual-purpose (DPICM) for their 155-mm howitzers. And although the ROKA has a cannon-launched guided projectile in its Force Improvement Plan (FIP), there's no such round produced in the ROK at this time. Commonality of ammunition with US Army units stationed in the ROK would, of course, facilitate transfer of munitions from US Army to ROKA artillery in times of crisis.

Areas of Concern

Despite the very impressive advances made by the ROKA artillery in the past decade, there are many areas that need improvement. First, it lacks adequate target acquisition equipment.

Counterfire Radars

Since the Korean War, the ROKA artillery has had to rely on sound and flash to locate enemy artillery and mortars. Given the hilly nature of the terrain, which provides ample reverse-slope firing positions for both sides, these methods leave much to be desired.

The ROKA artillery currently has no countermortar or counterartillery radars. This weakness is readily acknowledged by ROK artillery officers. Given the huge number of artillery pieces that

ROKA soldiers receive instructions for the Korean-produced KH-179 towed howitzer during a training exercise.

This ROKA fire direction computer is used at the battery and battalion levels.

the North Koreans would employ in an offensive against the South, the rapid detection and destruction of the enemy's artillery is a ***must*** for the ROKA. The lack of counterfire radars is the most serious weakness in the ROKA artillery.

Enemy HARTS

As was mentioned earlier, the presence north of the DMZ of literally hundreds of HARTS presents a very serious threat to ROKA artillery and maneuver units. This threat is magnified by the ROKA's mission of stopping an attack as close to the DMZ as possible, which by definition means ROKA forces will be exposed to intense artillery fire from heavily fortified enemy positions.

There is constant discussion among the US and ROK fire support communities as to how to effectively deal with this threat. A solution probably will be a combination of hardware and doctrine. But at least for the present, the burden of combating the HARTS will fall on the already outnumbered ROKA artillery, much of which also has its own hardened positions. This could prove to be a substantial drain on ROKA artillery resources that also will be heavily tasked to provide close support for maneuver forces. The result almost certainly would be an epic artillery duel, the likes of which has not been seen since World War I.

Munitions

While the ROKA artillery is supported by a growing defense industry that can provide the vast majority of its needs, it still needs more advanced munitions. As compared to 1950, the North Korean Army is a much more mobile armored force. Despite the fact that most of its forces are infantry, it can field more than 5,000 tanks and armored personnel carriers. As was mentioned earlier, much of the North's artillery is now mounted on self-propelled chassis, which are at least partly armored. The ROKA artillery's lack of significant anti-armor munitions is an area that should be addressed.

As mentioned earlier, the ROKA FIP specifies a requirement for a cannon-launched projectile that can engage armored targets. The support requirements and cost of such a system are, however, formidable.

A more feasible solution would be for the ROKA to add a large reserve of DPICM and anti-armor family of scatterable mines (FASCAM) that the artillery could employ with very little additional training. Ammunition production facilities in South Korea are certainly capable of producing such munitions.

Future Trends

Some of ROKA's plans to improve its artillery focus on organization, others on equipment.

Heavy Division

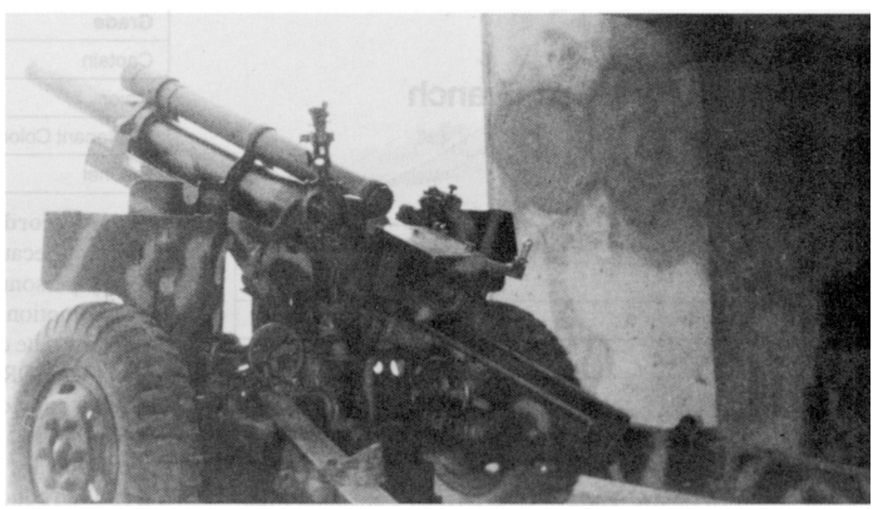
As mentioned earlier, the ROK Army is predominently a light infantry force with the 105-mm howitzer its primary direct-support artillery weapon. There's a possibility that this will change in the next decade.

Recently, the ROK Army converted one of its 19 light infantry divisions into an experimental heavy infantry division. The implications of this change for the artillery of the ROK Army are profound. In place of the 54 105-mm howitzers currently found in the light infantry division, this new formation has three battalions of 54 M109A2 self-propelled 155-mm howitzers. The divisional general-support battalions are armed with 18 KH-179 155-mm howitzers, which have a longer range than the M109.

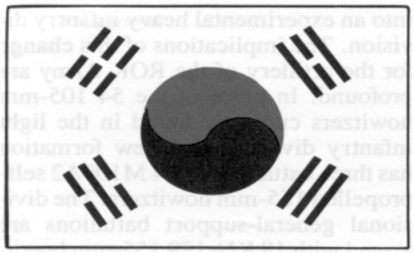
Strengthen Reserves

Should the ROK Army decide the heavy infantry division is a better, more affordable successor to the current light infantry division, the artillery will require many hundreds of additional M109s over a period of years to convert to the new organization. An additional 17 division's worth of M109s means the ROKA would have to buy more than 900 more self-propelled weapons. The South Korean defense industry can produce that quantity, should the Army decide it wants the weapons. Such a decision would also have great implications for the reserve infantry divisions in the ROK Army.

As M109s would replace the existing M101s and KH-178s in the direct-support battalions of active-duty ROKA infantry divisions, those older weapons would be passed down to the MRDs and HDDs in the reserves. To a limited extent, this process has already been taking place as KH-179s replace the older M114 howitzers in the general-support battalions of divisions and corps artillery. Such a transition would strengthen the reserve divisions



A ROKA 105-mm howitzer, produced by Daewoo Corporation, is identical to the US M101.



that make up a considerable portion of the ROK Army's combat power.

Artillery-Locating Radars

Of almost equal importance is the need to buy modern target acquisition equipment. After several years of indecision, the ROK Artillery seems ready to make its move.

In terms of the number of howitzers it fields, the US 2d Infantry Division is a negligible addition to the artillery of the ROK Army. What the US 2d Infantry Division Artillery does have that the ROKA needs is artillery-locating radars.

For several years, the US Army has tried to interest the ROK artillery in the Firefinder Q36 and Q37 radars, but several in-country tests didn't satisfy the ROK Army. The most recent testing was conducted in late 1988 with US-trained ROKA crews manning the systems.

It now appears the ROK Army has decided to buy a number of these radars. At some point in the near future, the Q36 and or Q37 will begin to be fielded, probably in the corps target acquisition battalions.

The addition of those modern radars will greatly improve the efficiency of the ROK artillery and will remove its dependence on the US to provide such capabilities. The ROK artillery will then gain the ability to detect North Korean artillery, once it leaves the HARTS.

Guided Munitions

Farther in the future, there's the possibility of the ROKA artillery's buying guided munitions. The ROKA artillery needs a guided anti-armor artillery projectile in its FIP, but it hasn't decided on such a round.

The South Koreans occasionally have requested information on our Copperhead. But the expense of the round and the requirement for supporting systems such as the ground-vehicular laser locator designator (GVLLD) and its past reliability problems have kept ROK interest well short of a decision to buy. Possibly, the ROK artillery will wait several years to see if its domestic arms industry can develop such a munition.

Conclusion

The rise in the capabilities of the ROK domestic arms industry and a recent South Korean desire to shop around for non-American weapons will noticeably change past practices of accepting ex-American weapons. In recent years, the South Korean Air Force and Navy have been showing much more interest in European systems, and it's possible the ROK Army will begin to broaden its market also.

The ROKA is considering significant organizational and equipment changes for its artillery. But with the vast majority of its artillery equipment US-produced or Korean-built weapons similar to American systems, it probably will take a number of years for this trend to affect the ROKA artillery.

Major John Gordon IV, a frequent contributor to *Field Artillery,* is a Training and Doctrine Command (TRADOC) Systems Staff Officer in the Firepower Directorate, Combat Developments, at TRADOC Headquarters, Fort Monroe, Virginia. He recently completed his second tour in South Korea, where he was the Fire Support Officer for the 1st Brigade, 2d Infantry Division. Major Gordon has also served in the 82d Airborne Division, Fort Bragg, North Carolina, and the 5th Recruiting Brigade, San Antonio, Texas, and as a Gunnery Instructor at the Field Artillery School, Fort Sill, Oklahoma. He's a graduate of The Citadel, Charleston, South Carolina, and holds a master's in International Relations from Saint Mary's University, San Antonio. Major Gordon also has published in *Army,* Naval Institute *Proceedings* and *Military Review* magazines.

Redleg News

ITEMS OF GENERAL INTEREST

PERSCOM Update: Field Artillery Officer Branch

Promotions

Upcoming Selection Boards	
Captain	27 Feb-30 Mar
Colonel	3-27 Apr
Lieutenant Colonel	12 Jun-6 Jul
Major	5 Sep-19 Oct

Promotion Pin-on Points. The current promotion pin-on points for officers selected in the primary zone of consideration is shown below. The Defense Officer Personnel Management Act (DOPMA) "goal" is shown for comparison.

Grade	DOPMA Goal	Projection
Captain	4 yrs	4 yrs, 4 mos
Major	10 yrs +/- 12 mos	11 yrs, 10 mos
Lieutenant Colonel	16 yrs +/- 12 mos	17 yrs, 10 mos
Colonel	22 yrs +/- 12 mos	22 yrs, 8 mos

Officer Record Brief. Your record brief (ORB) is extremely important because it serves as your resume. The servicing military personnel office (MILPO) will receive and review your promotion ORB approximately one month before the convening date of the board. You should not wait until then to correct your ORB. Initiate corrections *well* in advance. You can get a copy of your ORB at the same time you request a microfiche.

Traditionally, the biggest problem on the ORB is correcting civilian education data. You can forward a short note and appropriate documentation (transcripts) to Branch to input the correct data. The young soldiers at the MILPOs simply don't have all the input data for civilian education updates.

If you have experience at one of our Combat Training Centers, notify your MILPO of this fact. MILPO message number 89-42 was sent to the field in December 1988, providing instructions to annotate this experience. Comments on your officer efficiency report (OER) or on signed, verified copies of the OER Support Form 67-8-1 documents this experience. These data will be in Section X of the ORB.

Official Military Personnel File (OMPF). You can order a current copy of your microfiche and ORB by forwarding a request to: US Army Personnel Command (PERSCOM), ATTN: TAPC-MSR-S, 200 Stovall Street, Alexandria, Virginia 22332-0444.

Send a signed request, including your name, social security number and current mailing address. The average turnaround time is six weeks, so don't delay ordering a copy.

DA Photos. The importance of maintaining an up-to-date photograph can't be overstressed. The DA photo is the one document that branches are responsible for maintaining. The best way to ensure a photo is on file with Branch is to forward the photo directly to Branch. Assignment officers will acknowledge receipt of photos by sending you a 209 card.

Many posts or MILPOs insist on forwarding the photo directly to the PERSCOM records section. In this case, request additional "personal" copies from the photo lab and send one of these to Branch.

A photo is out of date if it's more than three years older than the current year and month. Unfortunately, some officers aren't keeping photos up to date.

Files submitted to the majors' promotion board had a substantial number of missing or outdated photos. The primary zone had more than 5 percent and the below-the-zone had more than 22 percent of the files with outdated or missing photos. Your photo isn't only considered by promotion boards, it's also used in nearly all actions taken by Branch.

Command and Staff College (CSC)

The 1989 CSC board met from 1 May to 6 June 1989. Those officers selected for promotion to major on the 1988 promotion list (FY 79) had their first look during this board. In addition, officers in Year Groups 76, 77 and 78 who hadn't been previously selected were eligible.

During the four years of eligibility, approximately 45 to 50 percent of a given year group will be selected for CSC resident attendance. The chart depicts the statistical breakout of selectees from Year Groups 76 (last look) through 79 (first look).

The figures indicate that the first two looks are the best. The number of seats available for CSC drives the selection rates of each year group.

It's ***strongly*** recommended that you start nonresident CGSC if you're not selected for the resident course after the second look. This will give you enough time to complete the nonresident requirements and also increase your assignment opportunities. The most important thing is to finish the course before going before the selection board for lieutenant colonel. Don't wait until the last minute to get serious about it!

Branch Qualification as a Major

There's much confusion about this subject in the field. To enhance the probability of being selected for 0-5 in the future, all artillerymen should strive to become branch qualified as an O-4.

There are two requirements for this to occur. First, you must complete a CSC school, either resident or nonresident. Failure to meet this requirement will mean almost certain non-selection to 0-5.

The second requirement is to spend time with troops as a major. This is defined as spending a minimum of 12 months as a brigade fire support officer of a direct-support battalion, battalion S3, battalion executive officer or being in a command billet as a major.

TACFIRE Fire Support Schooling

In the past, Field Artillery Advanced Course (FAOAC) graduates who were destined for fire support jobs in the next unit were scheduled for the Tactical Fire Direction System (TACFIRE) Fire Support Element (FSE) Course. TACFIRE FSE is an all-ranks course that teaches 13F skills.

A new course has now been created at Fort Sill—the Automated Fire Support Leader's Course. The Course is offered four times a year coincidental with the end dates of each FAOAC. It provides fire support, liaison and tactical operations center (TOC) officers the knowledge and skills required to supervise variable-format message entry device (VFMED)-equipped fire support and liaison sections, TOCs and electronic tactical display (ETD)-equipped counterfire cells. The Course is five weeks, four days long.

Conclusion

If you have questions about any of this information, call Branch: Field Grade—AUTOVON 221-0118 or 7817 or commercial (202) 325-0118 or 7817; Company Grade—AUTOVON 221-0116 or 0187 or commercial (202) 325-0116 or 0187.

YG	Previous Select	Sel This Board	Approximate # Remaining	Total Selected	Approximate Percent Select
76	90	13	0	103	48%
77	90	33	5	128	47%
78	52	69	25	146	45%
79	32	37	55	124	47%

Cynthia Boggess Stewart

The Art of Leadership

by David G. Halloran

In a serene setting in the Santa Ynez Hills in California, a retired AT&T executive named Art Leazenby was teaching management to charges whose companies had sent them off to school for a week. In these young men and women resided the skills of engineering, science, manufacturing and quality control, finance and sales (we didn't call it marketing then, and I wish we didn't today). In 1958 as now in industry, academe and the military, our greater need was in the skills of our managers—our leaders—more so than in our workers, soldiers and professors. Like parenthood, leadership is a difficult art, supported by some scientific data.

Art Leazenby opened his seminar: "Management, like sales, is the art of allowing the other guy to have your way." What he said affected my professional and personal life from then on.

Art came from the telephone company, which was important because it represented a midpoint between industry in the private sector (which emulates the characteristics of democracy in our society) and the military in the government sector (which, by necessity of combat, is autocratic). From democracy to autocracy, "management [leadership in any institution] is the art of allowing the other guy [your trooper] to have your way."

Worth Defined

Embodied in those words is the fundamental distinction between a free and democratic society and a totalitarian society. That distinction is democracy's universal recognition of the fundamental worth of every member of our society—our group, our battery, our ball club. Everyone has talents, hopes and desires worth something, and we're bound by our ideals, the Constitution and law to respect that worth.

Do we show that respect all the time? Sadly, not as some of our racially driven tragedies have shown. But we're working toward that goal, and nowhere has it been shown better than on the battlefield. The heroics of Grenada, Vietnam, Korea, the World Wars and those conflicts throughout the history of our great country are replete with stories of troopers who died for their friends. Why? Because others have worth.

Worth Comes Full Circle

A good leader follows that principle early in his career. And when he asks his followers to act, there's no hesitation. The leader has *allowed* his followers to conclude they want to do what he has asked. By showing he values his followers, the key principle comes full circle—they find him worthy to be their leader.

For example in the industrial world, take the perennial case of the proposal that's due immediately after the Christmas holidays. Those of us in government and industry who have to generate our business via proposals have all experienced the sinking sensation when we learn the proposal is due December 31.

How do you motivate yourself and your group to give up the most joyous time of the year for families because a proposal is due? How do you do that without generating doubt that you, the leader, really see the worth of that time to your people and their families for their religious and social activities?

First, you appeal the schedule on the grounds of personal and family interest, asking for a one- or two-week delay. Some have been successful at that; it doesn't occur to many even to try.

If the first step fails, the second is to "tell it like it is" to the whole group, with regret, but no apologies. When people know their leader works on their behalf and "pulls no punches," no problem is insurmountable for his team.

Another example—during the late sixties in Los Angeles, the Greater Los Angeles AUSA Chapter and the Veterans Administration set up a program to help young soldiers returning from Vietnam find jobs. Jobs were scarce, and the returning Vietnam Vet wasn't given the breaks of his predecessors from the Korean War or World War II.

Most came from the infantry, artillery or armor whose skills didn't fit readily into the civilian work force. Further, we were working in Watts and East Los Angeles, Black and Hispanic communities, where the walls of prejudice had not exactly come tumbling down.

The challenge, simply stated, was to find Vietnam Vets jobs in a recessionary economy. Because we told it like it was in a number of large group meetings and counselled them on how to capitalize on the leads we developed, we met the challenge. The Vets teased us about our comments on their shoeshines, haircuts and "f" words, but they followed our lead.

Joey Wilkins, who epitomized the Vet description, said it best, "Hey man, all we want is a chance!" They got it, and most took advantage of it. The leaders believed in worth and laid it out straight, and the followers chimed in and were allowed to have the leaders' way. When you think about it, it was really their way.

Do or Die

There are the times in combat (military or the warfare of the marketplace) when the only solution is "...not to reason why...but to do and die" ("Charge of the Light Brigade" by Alfred, Lord Tennyson). We must follow orders for the common good, even though we think them wrong or, worse still, stupid. We trust our Commander-in-Chief and his delegates.

There will be mistakes because we're human. But, when timing and responsiveness are crucial for gaining the objective, we must follow orders. Such discipline makes our military mighty and the strategic deterrent that it is.

Know When to Fold 'Em

Good leaders, however, recognize that autocratic leadership is rarely necessary, can be dehumanizing and can utterly discourage good people. The great leaders know the difference, or as Kenny Rogers says, "Know when to hold 'em and know when to fold 'em."

The image of the Army today, for those of us in the Army Industry Family, is there are many good leaders. People like the Army. Soldiers are getting a chance to "be all they can be."

The quality of today's soldiers is superior, and their motivation toward excelling is second to none. That's the result of leaders who recognize worth, who allow the troopers to have "their" way.

Communicate Via Humor

Finally, a leader is only as good as his ability to communicate. And communication is not just what's said, but what's understood and acted upon. *How* the leader says things to his followers is as important as *what* he says.

Crosby, Stills and Nash popularized a wonderful song 20 years ago, "Sweet Judy Blue Eyes," with a lyric that goes, "Fear is the lock, and laughter is the key to her heart." Communicate via humor. Lighten up—everyone will listen much better.

The "Be-All-You-Can-Be" General, Max Thurman, is one of our better communicators, even as he places rigorous demands on staff, industry and the world at large. During a recent symposium when one of his points was being challenged for the second or third time, he quipped, "Read my lips, Sir," while he passed his right hand over the four stars on his left shoulder.

There are thousands more great communicators like him who are masters of humor. Former President Reagan is probably the best communicator via humor. After being seriously wounded and while being rolled into surgery, he joked with the doctors, "I hope you guys are all Republicans!"

George Bush, as a Presidential candidate and not known for his command of humor, addressed the gathering at the Republican Convention and said he had been advised to keep his "charisma in check." Many think that was the turning point for the American people.

Talk Straight

Art Leazenby has been gone for many years. But like my long-departed father, he's vivid in my memory. My father, one of the pioneers of the US Navy Seabees and the principal executive of a heavy construction company, taught us to communicate straight and in real time.

He stated his leadership principles: "Don't play games with your people—that's an insult! And don't worry about getting credit for something because, sooner or later, you'll get your due."

Be Worthy

Leadership talents show up in the most humble and the most exalted. But don't confuse titles and leadership, for the latter needs no title. A leader is one who focuses on the objective but still takes care of his people—one who seeks not personal gain and knows the Good Lord gave each of us worth.

He who recognizes others' worth, that person, Sir, is the leader we'll follow into the arena. And he's worthy of our followership.

David G. Halloran is Managing Director and Founder of a strategic market analysis and planning firm, Altamonte Springs, Florida, focused on directing applications of technologies developed by private industry and universities to tactical weapons and communications systems. He has been Vice President for International Operations for a major defense corporation involved in tactical systems and Strategic Defense Initiatives (SDI) and Vice President for Sales for a corporation specializing in sounding rockets and scientific payload integration and tactical decoy devices. David Halloran is a former Navy fighter pilot and, with more than 30 years of doing business with all facets of the Army, currently is a member of the Association of the US Army (AUSA) Council of Trustees, serving on the Land-power Committee. He's the founder and past President of the AUSA Sunshine Chapter, Orlando, Florida, and in 1986, he received the Secretary of the Army Leadership Award for service to the Army through AUSA.

The Evolution of the French Field Artillery

by Lieutenant General Daniel Valery, *Artillerie Francaise*

After the considerable equipment modernization effort started in the 1970s, the French artillery is efficient and well-adapted to the current combat requirements in central Europe with our Allies and for its overseas operations. The new technologies being incorporated in several weapons systems in cooperation with the United States and other allied nations are preparing the way for the next modernization step. This new effort promises to be completed more quickly and have an even greater impact. All aspects of artillery will change, and its role in combat will increase considerably.

To get a clear idea of where the French Field Artillery is going, we first have to look at where it stands today. See the chart "Major Systems in French Field Artillery Fielded 1970-1990" on Page 21. Then see the chart "Major Systems in French Field Artillery Modernization, 1990-1996" on Page 22, itemizing the systems to be fielded from 1990 through 1996. We must consider where the French Field Artillery will be at the end of the century to foresee the problems it will face. Because of space limitations, this article discusses only conventional Field Artillery and target acquisition.

New Capabilities—New Missions

Within the next eight years, the artillery will be operating 10 new sophisticated weapons systems. They'll remarkably increase our firepower, range, ability to respond quickly, combat readiness, all-weather capability, mobility and durability.

The traditional direct-support weapons for combat units will be an always-necessary but smaller portion of our weapons inventory. At that time, we'll have weapons capable of carrying out other missions efficiently—in-depth target acquisition and tracking, counterbattery and in-depth strikes that neutralize or destroy the enemy command and other second-echelon units vital to maneuver pursuits.

Extended Battlefield

New technologies will change the way we deal with a threat and result in new tactics. Ground combat, which for a long time was limited to the forward battle area, will reach deeper and into airspace. This extension of the battlefield will cause a correlative evolution in general operations and modify the criticality and balance of various arms in our forces. On a pragmatic level, this will result in new organizations, changes in our tactics and operations and, above all, in the way we think about war.

Joint Operations

Our increased ability to gather intelligence and fire deeply will be major assets for the joint commander, as well as for combat units at other levels. The concept of maneuver and the conduct of operations will be more complex and will entail continual dialogue between the artillerymen and the joint commander. Our planning will be more accurate and our abilities to respond to unexpected situations swiftly and decisively will increase. Thus, large-scale joint operations will be more feasible, either independently or with the Allied armed forces in Europe.

New Personnel Policies

The personnel consequences of these developments are twofold: the requirement to increase the quality and quantity of our soldiers.

Quantitatively, the extension of firing, artillery target acquisition and maneuver intelligence missions will require more highly trained personnel. Even technological efficiencies won't be able to prevent that completely. Simultaneously, personnel managers will face the inescapable increase in the number of specialties required to operate the new weapons systems. However, only a limited number of personnel in each branch will be affected by the increase in these sophisticated specialties.

Qualitatively, we'll feel the repercussions on two levels: recruiting personnel and training our cadre. The artillery, just as any arm that incorporates technological advances, needs young officers and bright, motivated NCOs who are attracted by the career advantages it offers.

New Mindset

The evolution of artillery materiel implies a necessary evolution in the way we think about war. Of course with the introduction of certain weapons systems, the artillery has already gained a great deal of technical experience. But today, the entire Branch is committed to that path.

The inescapable evolution of attitudes in the artillery is based on the following principles:

- The artilleryman is an elite fighter as well as a valuable and competent technician.
- The new systems require increased technical precision that we can acquire only through extensive specialty training involving the use of simulators.
- The technological environment calls for a new style of command, which entails everyone's participation to reach a precise operational objective.

Training

We'll train our soldiers to be technically competent and add it to the soldier's more traditional combat skills. These two dimensions are perfectly compatible.

As a matter of fact, developing technical competence causes soldiers to pay more attention to detail in handling equipment. The priority given to training as well as the traditional methods of instruction and evaluation should improve as new sophisticated systems become operational.

Style of Command

The presence of advanced and diversified techniques to operate the new armaments produces individualized tasks and disperses our teams. This could weaken the "esprit de corps" and the solidarity among soldiers, which are more characteristic of operations with the old, simpler equipment.

But our pragmatic, goal-oriented participative command in the French artillery will reinforce the operational efficiency of the units and build the cohesion and morale of our teams. This new spirit will produce an inescapable evolution of the Army's style of commanding and leading the modernized forces at all levels.

New Systems

The recent technological improvements essentially are in—

- Data-processing and electronic equipment for computing firing data and controlling fire missions.
- Range increase through tube and powder improvements.
- Control of ballistic and meteorological parameters.
- Topographical accuracy, using laser range finders and land navigation equipment.
- Ammunition lethality.

Major Systems in French Field Artillery 1970-1990

Weapons	
AU F1	*Automoteur F1*—a 155-mm self-propelled howitzer used with ATILA and RATAC in armoured divisions. It carries 42 rounds and can fire 6 rounds in 45 seconds because of its gun display unit and automated loading sequence. The AU F1 receives fire orders through a remote display and has a range of 24 kms and up to 30 kms with the French base-bleed round.
BF 50	*BiFleche 50*—a 155-mm towed howitzer used in infantry divisions. It has a range of 18 kms and fires 3 rounds per minute and was fielded in the 1950s.
Pluton	A pre-strategic nuclear missile system equivalent to the US Lance. It's a corps-level asset.
Hawk	The US-made air defense missile system, which is a corps-and army-level asset.
Target Acquisition	
RATAC	*Radar d'Acquisition et de Tir de l'Artillerie de Campagne*—a radar mounted on the VAB (armoured personnel carrier) used at the battalion level. It acquires moving targets out to 25 kms.
CL 89	A reconnaissance airborne drone that has a range of 140 kms. It's a corps asset.
VIT	*Vehicule d' Implantation Topographique*—position location vehicle that looks like a VAB without the radar. It's used at the battery level to provide survey data and lay the battery.
Command, Control and Communications	
ATILA	*Automatisation des Tirs et des Liaisons d'Artillerie*—an artillery data processing and communications system with capabilities between that of the US tactical fire direction system (TACFIRE) and the advanced Field Artillery tactical data system (AFATDS). It's used in the forward observer vehicle (VOA) and the battery and battalion command posts.

Major Systems in French Field Artillery Modernization, 1990-1996

Weapons

AU F1 CTI — *Conduite de Tir Inertielle*—an improved AU F1 howitzer. It has an on-board navigation system, automatic laying and individual fire control capabilities. The improvements increase the howitzer's autonomy and survivability for 3x8 battalion operations. The AU F1 CTI howitzer looks like the AU F1 on the outside. Fielding will begin at the end of 1990.

TR F1 — *Tracte F1*—a 155-mm towed howitzer, currently being fielded, to replace the BF 50. It delivers 6 rounds per minute and has a range of 24 kms and up to 30 kms with the French base-bleed round. The TR F1 is towed by a 48-round-capacity ammunition truck, fitted with a special hydraulic crane to handle several kinds of ammunition.

MLRS — The jointly-developed US-made multiple launch rocket system (MLRS) to be fielded in 3 battalions in the French Army, starting in 1991. The battalions will have grenade rockets, TGW rockets and, possibly, the US-made Army TACMS.

Hades — A long-range nuclear missile system to replace the aging Pluton, starting in 1992. It'll have a range of under 500 kms.

Target Acquisition

Orchidee — A heliborne radar with an acquisition range of 150 kms. It'll be an army-level asset, with fielding to begin in 1995.

CL 289 — A battlefield surveillance drone to replace the CL 89, which will have a range of more than 400 kms. Being jointly developed with Allies, it'll be a corps-level asset.

Brevel — A remotely piloted vehicle (RPV) being developed jointly with West Germany. It'll have a range of more than 30 kms and a flight time of more than 3 hours. The Brevel will be an army-level asset.

COBRA — A counterbattery radar with a range of more than 30 kms. It'll be used mainly in the MLRS battalions.

VOA — *Vehicule d'Observation de l'Artillerie*—an armoured forward observer vehicle similar to the French infantry fighting vehicle, currently being fielded in the batteries of all Field Artillery battalions. It has a periscope, laser range finder, thermal camera and a digital message device. The VOA requires a crew of four, including one officer.

Command, Control, Communications and Intelligence

SATIS — *Systeme Automatique de Traitement des Informations de Surveillance*—a computerized data processing surveillance system. It'll be a division-, army- and corps-level asset.

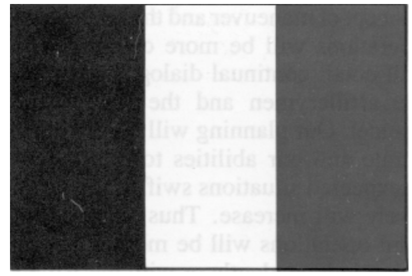
ATLAS — *Automatisation des Tirs et des Liaisons d'Artillerie sol-sol*—a tactical data system equating to the US AFATDS. The ATLAS will replace the ATILA and be used in battalions.

Weapons and Organization

The coordinated use of these technological advances has made possible the development of the first system using a combination of command, control, communications and intelligence assets with a high-rate-of-fire gun. The system allows us to deliver accurate fires for effect, day or night, in real time without adjusting them.

Already fielded in the maneuver forces, the combined system is characterized by its quick responsiveness, firepower and high rate of fire, and a remarkable accompanying observation vehicle (VOA). The VOA can keep up with the combat tempo of an armoured division across the roughest terrain.

The armoured divisions are receiving the 155 AU F1 (155-mm self-propelled howitzer) and the VOA (the equivalent of your fire support team vehicle—FISTV, minus a laser designator). During the next few months, the infantry divisions will receive the 155 TR F1 (155-mm towed). The VIT (a topographic location vehicle), the RATAC (radar) mounted on the VAB (armored personnel carrier) and the Castor (thermal camera) mounted on the VOA will equip both types of divisions.



The VOA, currently being fielded in Field Artillery batteries, has a laser range finder, thermal camera and digital message device.

With its fielding in 1990, the new AU F1 CTI will look like the AU F1 on the outside.

The 155-mm TR F1 towed by a TRM 10,000 is replacing the BF 50.

The inertial navigation equipment mounted on the VOA and VIT as well as on the radars supply the command post computer the instantaneous position location information to disperse the guns widely, thus increasing our chances of survival against the enemy's counterbattery fires.

The near-term artillery development is mainly the fielding of the multiple launch rocket system (MLRS) and, thereby, the reaffirmation of the artillery's objective—to deliver heavy and accurate in-depth fires.

The equipment changes will result in—

- The creation of MLRS battalions at the corps level armed with grenades rockets, terminal guidance warhead (TGW) rockets and, possibly, the US Army tactical missile system (Army TACMS).
- The reorganization of all the artillery battalions into three batteries, each with two four-gun platoons (3x8).

The new inertial fire control devices on the 155 AU F1 will reduce its vulnerability and time to respond after movement. The installation of a computer on each gun will increase its autonomy. These improvements and others will change the AU F1 howitzer into the AU F1 CTI, to be fielded in late 1990.

The introduction of the MLRS in the maneuver forces drastically changes artillery warfare. As a matter of fact, one launcher firing 12 rockets is the firepower equivalent of two 155 batteries, each simultaneously firing six rounds per gun. Though the MLRS and the 155 AU F1 characteristics regarding readiness, accuracy and flexibility are different, these systems will complement each other perfectly as they play their respective roles.

With increased range and power, the MLRS will provide decisive and in-depth fires. It will become a major efficient and flexible asset for the combined-arms commander. Coupled with the COBRA (battery locating radar), it'll add a new dimension to counterbattery operations.

Command, Control, Communications and Intelligence

Future acquisition devices will provide a number of targets exceeding our current capabilities to engage them. Choices will have to be made in selecting targets and weapons (guns or MLRS). Therefore, it seems necessary to establish an army, corps and division field firepower management system to optimize artillery warfare and guarantee the combined-arms commander a permanent, instantaneous and decisive firing capability.

The ATLAS, an artillery data processing and communications system and the successor to the ATILA, will accomplish this task at the corps and division levels and will be interoperable with all the Allied command, control, communications and intelligence (C^3I) artillery systems. It will also interface with our national command computerized system (SIC).

Combined-Arms Operations

The MLRS' ability to fire the Army TACMS at a range greater than 100 kilometers invites new thoughts about the use of this in-depth capability and urges us to design a global firepower warfare concept by assessing the role of each weapon system and munitions. Specifically, we need to assess the—

- Laser-guided projectiles that will be available at the end of this century.
- Zone-effect munitions that will significantly improve fire efficiency.
- Anti-radiation munitions that will destroy radars, thereby creating air corridors, and neutralize the communication networks, allowing us to paralyze the enemy's command and control system.

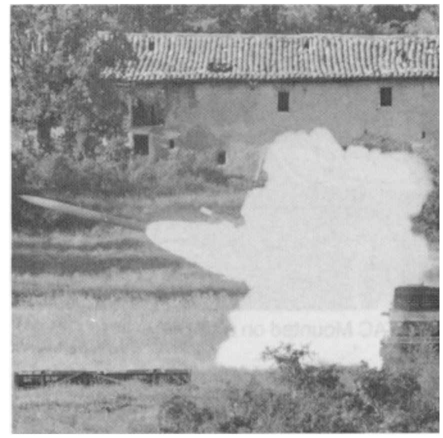
Logistics

The major artillery developments require us to design a new approach to logistical resupply. We can achieve maximum firing capability as long as the launchers have the number and type of ammunitions required at the right time and place. A functional supply chain has, therefore, been established from the ammunition depot to the supply point, requiring specialized vehicles (VTL—logistical transport vehicle) and using computers on a large scale.

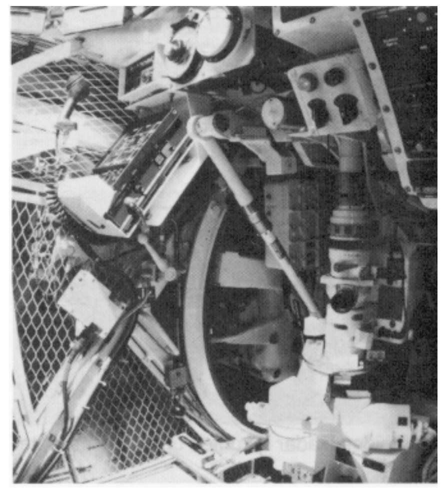
Intelligence

Intelligence gathering is a traditional artillery mission. During World Wars I and II, we widely used sound ranging as well as land and air surveillance. The radars, then the drones, took over this task.

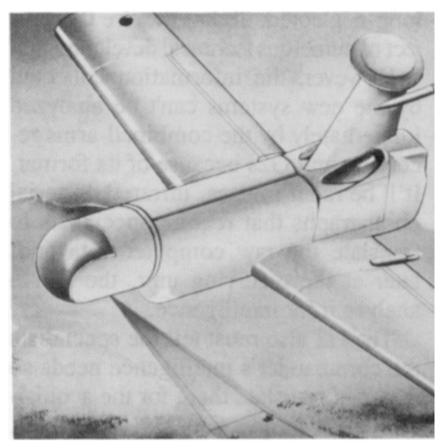
Intelligence gathering will undergo dramatic changes through the new technical resources available. As far as artillery is concerned, intelligence gathering and target acquisition tasks will be handled by the Orchidee (helicopter-borne radar), the CL 289 (long-range drone) and the COBRA. To this corps equipment, one should



The near-term artillery development is the MLRS, shown firing on the French Riviera.

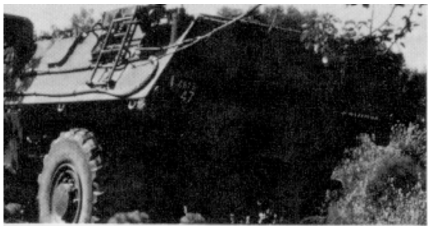


The AU F1 CTI (inside) has on-board navigation, automatic laying and individual fire control.



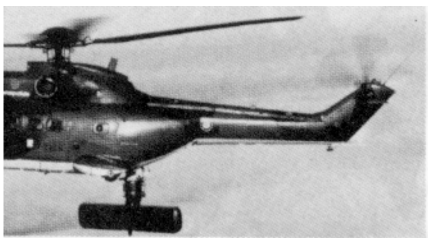
The Army-level Brevel RPV will have a range of more than 30 kilometers.

add the divisions' assets, which will include the updated RATAC equipped with an inertial tracking and guiding station, and the Brevel (light remotely controlled aerodyne, jointly manufactured with the Federal Republic of Germany).



RATAC Mounted on a VAB

CL 289 Surveillance Drone



Orchidee Radar Mounted under a Helicopter

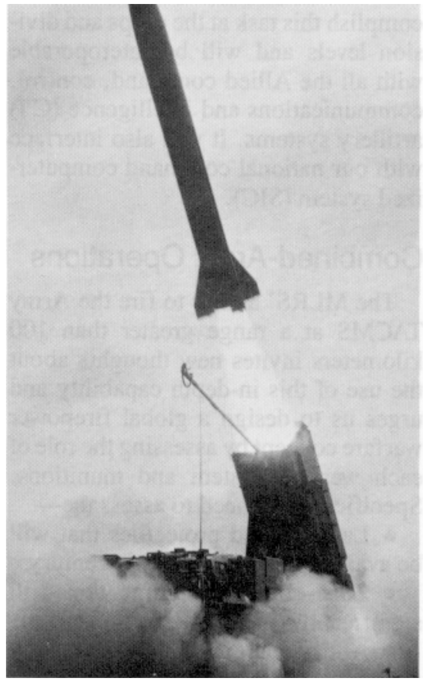
The ground forces target acquisition capabilities have, unfortunately, been long-neglected. Today, they're the subject of numerous technical developments.

However, the information collected by the new systems can't be analyzed immediately by the combined-arms receiving unit G2s because of its format. It'll be radar images, infrared or aerial photographs that require specialists to translate the raw computer data and, later at the receiving unit, the G2 to analyze it for intelligence.

The G2 also must tell the specialists the commander's intelligence needs so they can translate them for the acquisition units (e.g., CL 289, Orchidee, Brevel, etc.).

Target Acquisition

The volume and importance of enemy intelligence require two types of analysis. The first improves our knowledge of the enemy's deployment and actions; the other determines enemy targets to fire on immediately. This second, most-compelling analysis requires a good target locating capability and, above all, great responsiveness.



Pluton, the French Equivalent to the Lance

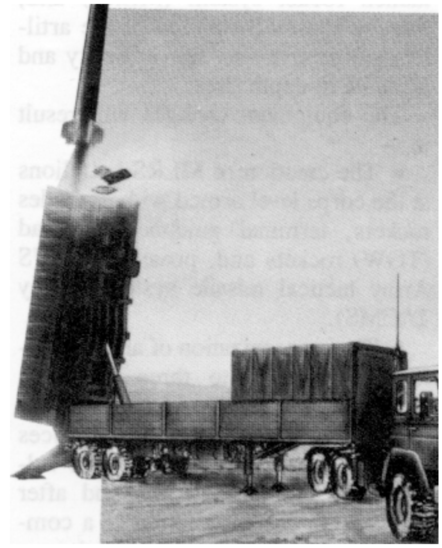
Current studies on the organization and operation of the corps' future intelligence and acquisition systems establish a computerized data-processing surveillance system (SATIS) at the division, corps and army levels. The SATIS will be interoperable with the national and Allied command computerized systems.

Conclusion

The extent of the changes dictates major modifications in our structure, management, personnel training and attitudes.

We're developing high-performing weapons, but progress will be most significant in our computerized command systems. They'll be interoperable with the Allied systems and capable of communicating and processing information, selecting targets and fire assets, as well as helping in fire preparation and control.

The process is difficult but stimulating. It requires objectivity, open-mindedness, imagination, dialogue among the different branches and determination. In the artillery, it calls for the convergence of energies along multiple paths.

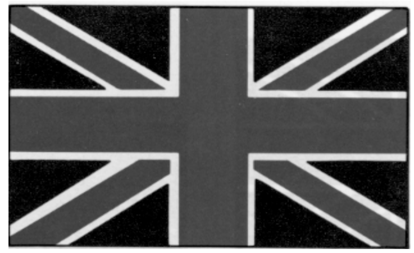


Hades, to Replace the Aging Pluton

All artillerymen, wherever they serve, are facing such technological challenges. Each is aware of and participates in the evolution of the artillery to new dimensions.

Thus, the artilleryman will be an elite fighter who has mastered the new technologies and can adapt to any situation in a sustained battle fought in a harsh environment. If needed, he'll be able—thanks to his intensive, improved training on traditional procedures and methods—to resort to older procedures, should technological resources fail. He'll remain loyal to his motto—***Ultima Ratio Regum.***

Lieutenant General Daniel Valery is Military Governor of Paris and Commander of the 1st Military Region in France. Just prior to his assignment, he served as Inspector of the French Artillery for two years, also in Paris. General Valery commanded the 3d French Armored Division in Frelbourg, West Germany, and the 12th French Artillery Regiment, Oberhoffen, in France. He also served as Deputy Commander of the 10th Armored Division in Chalons-sur-Marne, France. On the French Army Staff in Paris, he served as Chief of Staff for Research, Planning and Finance and Chief of the Plans and Finance Office. General Valery is a graduate of the French Military Academy, Saint Cyr; Military Advanced Scientific and Technical Institute, Paris; and the French Army Command and General Staff College, also in Paris.



Fighting the Field Artillery in the British Corps Battle of the 1990s

by Major General T.D.G. Quayle, Royal Artillery

In examining the contributions of the Royal Artillery's field branch to the British Corps battle, the first point to bear in mind is the very limited quantity involved compared to that of other allied corps and, indeed, to that of the potential opposition.

Following the comprehensive reequipment program of the late 1980s and early 1990s, the quality of the Royal Artillery's equipment will be second to none. But we'll still field only about one-third the number of delivery means available to the III (US) Corps and less than one-fourth the assets we could expect to see in a reinforced Soviet shock army committed against us on a major axis.

This relative shortage of artillery (only some nine percent of the British Army is artillery, and that includes air defence) is the result of historical factors. Until very recently, indirect fire by Field Artillery had little effect against massed armour, the principal threat from the Warsaw Pact as it was generally perceived. This led to an obsession with direct-fire antitank weapons, principally tanks.

The other historical factor is that since 1945, the British Army has been constantly engaged in very low-level operations, consisting (with the brief exceptions of the Korean and Falklands Wars) largely of counterinsurgency or internal security operations where the enemy rarely massed in sufficient numbers to present a worthwhile target for artillery. The demand was always for large numbers of infantry soldiers.

Such a historically based balance of arms is very hard to alter—vested cap-badge [branch] interests don't always yield readily to the logic of changing circumstances.

Principles of Employment

This shortage means I can't afford to hold any Field Artillery delivery means in reserve and must make the most efficient use possible of all my assets. As a result, I retain command of a greater portion of the total Corps artillery than some other corps artillery commanders and am able to allocate less to each divisional artillery commander than he would wish.

Since tasks must match resources, I therefore retain responsibility for most counterbattery (CB) and follow-on forces attack (FOFA) activities and leave only the conduct of the contact battle to the divisional artillery commanders.

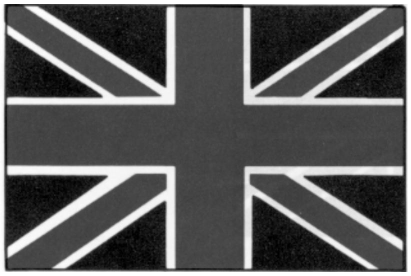
Although I retain *command* at corps level, it's a long-established principle of British artillery that *control* (i.e., deciding exactly when and where to strike the enemy) is exercised at the lowest practicable level. This results in the *flexibility* to *concentrate* the *shock effect* of massed artillery on the *most important targets* at the *critical time* when this will have the greatest effect on the battle. It goes without saying that we must deploy and fire in such a way as to ensure the *survivability* of our batteries, their command and control systems and their logistical support.

Fighting the Contact Battle

The tasks of the Field Artillery in the contact (close) battle are to (1) destroy light armoured fighting vehicles (AFVs) and anti-armour weapons, mortars, dismounted infantrymen and tanks (as new munitions are deployed); (2) neutralize armour (through shock effect and damage to optics, antennae and external fittings) and defensive positions; and (3) disrupt the cohesion of enemy operations.

Forward Divisional Artillery Groups

By the mid-1990s, each of our forward divisions will have more than 100 guns of 155-mm calibre. The majority

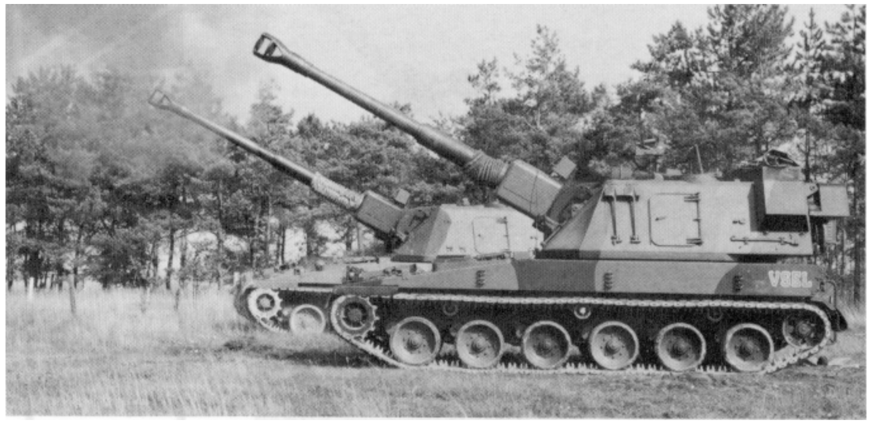


will be the new AS90 self-propelled gun with an autonomous gun laying system (AGLS), a dramatic burst-fire capability and range considerably greater than that of M109A2. They'll be grouped into batteries of eight guns (six in the case of FH 70, our 155-mm towed howitzer). Three batteries make a regiment (or battalion in US parlance).

Command and Control. Control will be exercised by forward observation officers (FOOs), who are captains living within tank or infantry companies and operating from specialist variants of Warrior mechanized infantry fighting vehicles where all the observation and target acquisition devices they require are mounted under armour. At the next level, the battery commanders, also mounted in a specialist variant of Warrior, are collocated with tank or infantry battalion commanders, ready to organise the fire support they require.

In the armoured brigade, the commanding officer of the field regiment plans the fire support for brigade-level operations. He also may be allowed to exercise command (i.e., to order the redeployment of guns from one artillery manoeuvre area to another) over specified batteries for particular phases of the battle. Exercising overall command from divisional headquarters will be the Commander Artillery, a brigadier general.

Logistics. These are largely run on a divisional basis, but there's an ammunition control point (ACP) in each regiment that regulates the supply of ammunition to the batteries in accordance with expenditure and the forecast needs of the next phase of the battle. This ammunition will be carried on the new demountable rack off-load and pick-up system (DROPS). Each DROPS delivers a flat rack of 170 complete rounds of ammunition without any requirement to cross-load or repack them between the ammunition storage depot and the gun.



The new AS90 155-mm howitzer has a range of 40 kilometers with RAP and can fire four rounds in 15 seconds. It carries 48 complete rounds and has systems to automatically lay the gun, navigate and handle ammunition. First deliveries of the AS90 to the British Army will begin in mid-1991, replacing the 105-mm self-propelled Abbot and the M109U howitzers.

This FOO's variant of the Warrior mechanized infantry fighting vehicle has observation and target acquisition devices mounted under armour.

Using DROPS, one man can deliver 170 complete rounds of 155-mm ammunition.

Target Engagement. All these elements—from FOO or individual gun through fire direction centres (FDCs) and commanders at battery and regimental levels, through to the Commander Artillery and his staff at divisional headquarters and on to Corps—will be linked by the battlefield artillery target engagement system (BATES). This uses secure data transmission to pass fire orders and related information to all involved. It also selects the most appropriate guns and ammunition for the location, type and size of the target; allocates priorities in accordance with the commander's declared wishes and calculates the firing data and transmits it to the guns, keeping account of the ammunition expenditure as it does so.

The machine isn't allowed to dictate to man, however. At each stage, it recommends a preferred option or offers a calculation for gross error checking, but positive decision of the operator always is required before action is taken.

Infantry Division's Artillery Group

In the infantry division responsible for the Corps rear area, the organization is the same. But since it's usually based in England and deploys to Germany during transition to war, its equipment is necessarily lighter and wheeled rather than tracked. The FOOs, battery and battalion commanders and FDCs all work from Landrovers.

This artillery group has two battalions, each with 24 of the excellent 105-mm light guns, which we used in the Falklands War. These fire high-explosive (HE), smoke and illuminating rounds.

Though they have an effective antiarmour round for direct fire in self defence, their capability in the indirect role against a massed armoured breakthrough could be limited. However, their relatively lightweight shell would be an advantage in the close-range confused fighting that would inevitably follow any parachute or heliborne attack by a lightly equipped enemy in the Corps rear areas.

Engagement of Targets

Operational analysis calculations determine that the optimum target effects are achieved by high concentrations of fire for short periods of time before the enemy can react. Fire for effect from three batteries for one minute is more effective than that from one battery for three minutes, even if the target must be re-engaged later.

It's exceptional for missions to be undertaken with less than three batteries, and depending on the size and nature of the target, it's often desirable to employ up to 12. This philosophy is the foundation of the British close-support concept and would not be feasible without a command and control system that permits the rapid switching of fire between targets in accordance with identified priorities. The BATES is designed to do exactly that.

Survivability

The battery's ability to survive the sophisticated CB threat most influences the choice of deployment configurations. Batteries have two four-gun troops (which you call platoons).

Although each troop can operate independently using its own FDC, thus providing maximum flexibility for fire and manoeuvre, one FDC usually controls all eight guns. This allows one FDC to rest and so ensures 24-hour-a-day effectiveness. Figure 1 depicts various battery deployment options relative to the degree of threat.

At one end of the spectrum in response to a limited CB threat, all eight guns can deploy in a tight 100-metre by 200-metre area. This configuration provides optimum control and might be adopted during mobile offensive operations that require frequent battery moves. At the other end of the scale is the fully dispersed layout with up to 500 metres between guns; this provides maximum CB protection but generates considerable control problems.

The British philosophy is to train for the full spectrum of deployment options. However, for reasons of control and local defence, we usually select a compromise solution, as illustrated in Figure 2. A battery will have a frontage of one to three kilometres with guns deployed 50 to 100 metres apart in pairs (which we call a section—very

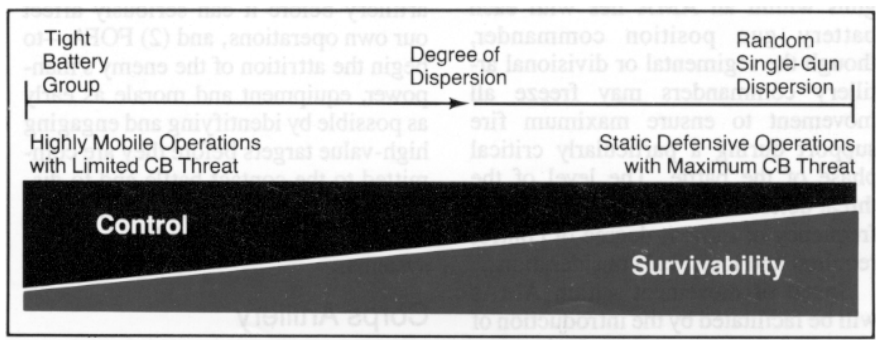


Figure 1: Battery Deployment Options and Consequences of Dispersion

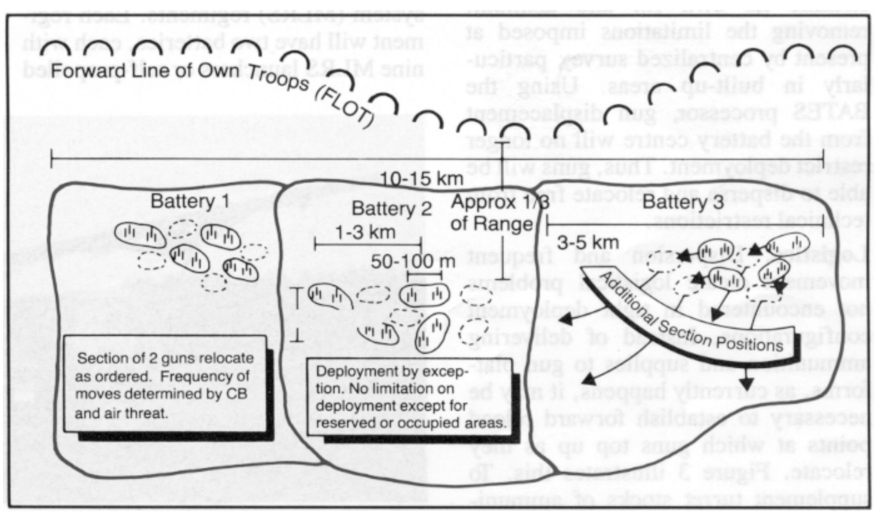
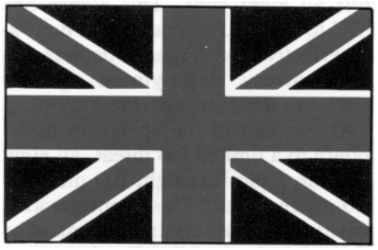


Figure 2: Regimental AMA with Batteries Deployed in Two-Gun Sections—A Compromise Between Battery Control and Survivability.



confusing since an individual gun is a section to you but a sub-section to us).

Artillery manoeuvre areas dispersion and concealment are not enough to ensure survival, and we believe in frequent moves within a battery area, accepting that up to 25 percent of the guns may be on the move at any one time. To permit this, we designate artillery manoeuvre areas (AMAs).

Deployment. Figure 2 illustrates a regimental area subidvided into battery AMAs, each of which has enough room for a number of deployment options. Authority for the relocation of guns within an AMA lies with each battery gun position commander, though the regimental or divisional artillery commanders may freeze all movement to ensure maximum fire support during a particularly critical phase of the battle. The level of the threat determines the size of gun areas, frequency of moves, degree of control required and logistical considerations.

Speed of movement within AMAs will be facilitated by the introduction of the AS90 autonomous gun laying system, which will allow each gun to determine its own fix and azimuth, removing the limitations imposed at present by centralized survey, particularly in built-up areas. Using the BATES processor, gun displacement from the battery centre will no longer restrict deployment. Thus, guns will be able to disperse and relocate free from technical restrictions.

Logistics. Dispersion and frequent movement create logistical problems not encountered in tight deployment configurations. Instead of delivering ammunition and supplies to gun platforms, as currently happens, it may be necessary to establish forward reload points at which guns top up as they relocate. Figure 3 illustrates this. To supplement turret stocks of ammunition, each gun or section can be accompanied by a DROPS limber vehicle.

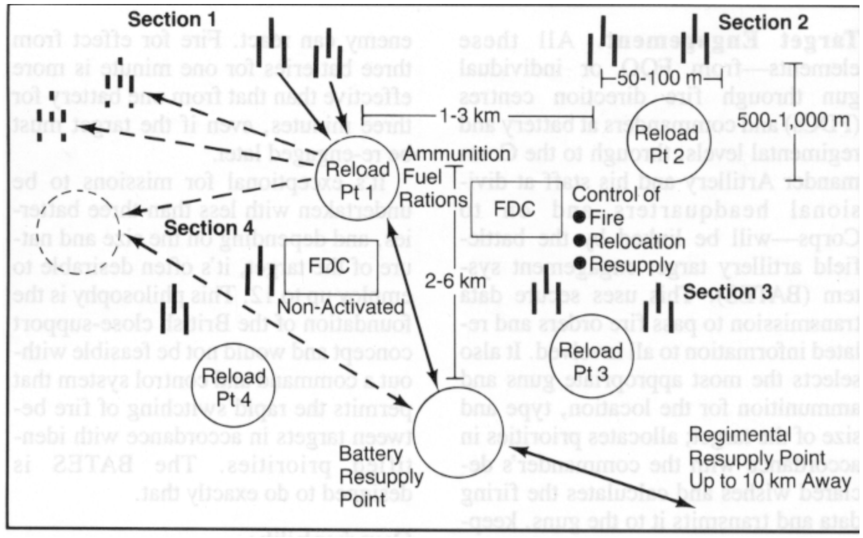


Figure 3: Battery Resupply—Forward Reload Point Option

Fighting the Depth Battle

Turning now to the depth battle, which covers CB and FOFA, we move from the divisional to the corps battle and from guns to rockets. In the depth battle, the tasks of the artillery are (1) CB—to locate and destroy the enemy artillery before it can seriously affect our own operations, and (2) FOFA—to begin the attrition of the enemy's manpower, equipment and morale as early as possible by identifying and engaging high-value targets before they are committed to the contact battle and to disrupt the enemy's design for battle by neutralizing his command and control systems.

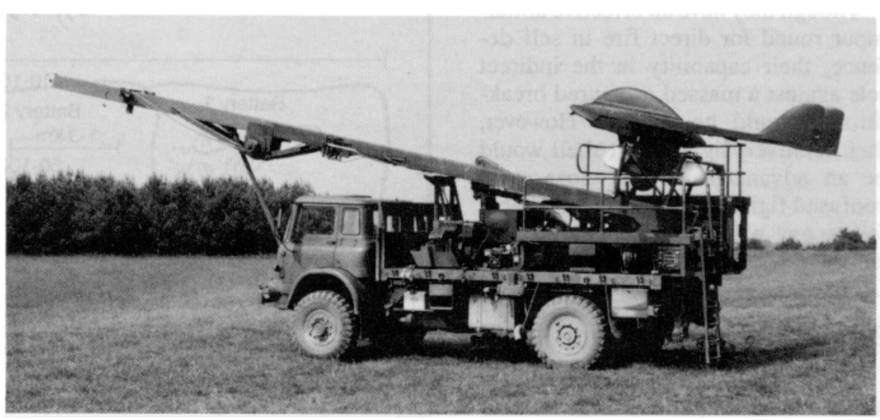
Corps Artillery

The Corps general-support artillery will have three multiple launch rocket system (MLRS) regiments. Each regiment will have two batteries, each with nine MLRS launchers or self-propelled launcher loaders (SPLLs). As the decade proceeds, they'll be able to fire the Phase I munitions (bomblet), Phase II (mines) and Phase III (terminally guided, antiarmour submunitions), enabling them to attack an increasing variety of targets.

In addition, the regiments already have locating batteries. These consist of a meteorological section, providing meteorological messages for all Field Artillery assets; a sound-ranging troop for locating hostile batteries (later to be augmented by the counterbattery radar, COBRA); and a Phoenix target acquisition troop.

The Phoenix remotely piloted vehicle (RPV) provides real-time surveillance and target acquisition by day, at night and in poor visibility to beyond the limits of MLRS range, thus providing the essential information with which to fight the depth battle.

The Phoenix troop is most effective when cued to a particular area by some



The Phoenix RPV provides real-time surveillance and target acquisition thermal imagery far beyond the FEBA.

other intelligence source, such as stand-off airborne radar. The BATES will link the depth fire target acquisition and delivery means as it does in the divisional artillery groups.

Command and Control

The general-support regiments are necessarily based in the forward divisional areas and may be made available to supplement the fire of the divisional artillery groups. However, they remain firmly a corps-level asset, commanded on my behalf by a colonel, commander general support.

By retaining command at that level and issuing very strict priorities for the engagement of targets, I can ensure we use the most effective long-range systems against targets that are truly important, as opposed to momentarily urgent.

Concept of Operations

Tasks for Phoenix are passed to the Phoenix troop command posts where they are further allocated to ground control stations (GCSs). In the ground control stations, tasks are assembled into Phoenix flight missions. Targets acquired by Phoenix are passed to the headquarters of the general-support regiment for subsequent engagement. To optimise the flexibility of this system, certain high-priority targets will be predesignated for immediate engagement by the ground control station, should they be acquired during a Phoenix mission. Figure 4 shows the Phoenix concept of operations.

The COBRA (which comes into service during the period), sound-ranging and other systems will acquire counterbattery targets to complement Phoenix in the target acquisition role in the depth battle. The FDC of the general-support regiment issues orders to selected SPLLs to engage targets.

Deployment

The autonomy of each SPLL allows for a deployment concept to maximise survivability. Batteries are organised into three troops, each with three SPLLs. Within a troop manoeuvre area (TMA), each SPLL operates individually with a number of predesignated firing and reload points. The troop commander is responsible for siting reload points and for reconnoitering close hides adjacent to firing points.

Ammunition is brought forward to reload points on DROPS vehicles controlled from the battery ACP. All three types of MLRS munitions are stocked at the battery ACP and delivered forward to reload points, as dictated by the tactical situation. Figure 5 shows the firing mission sequence of events and Figure 6, MLRS battery deployment.

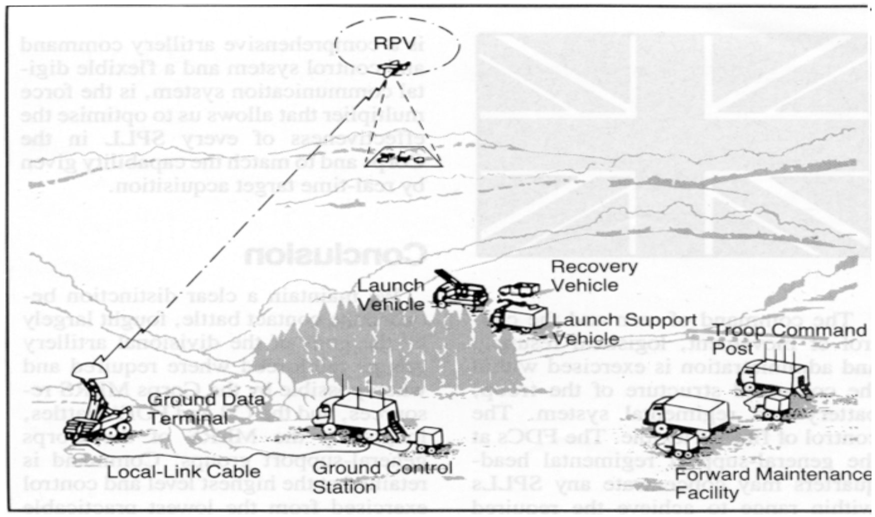


Figure 4: Phoenix Concept of Operations

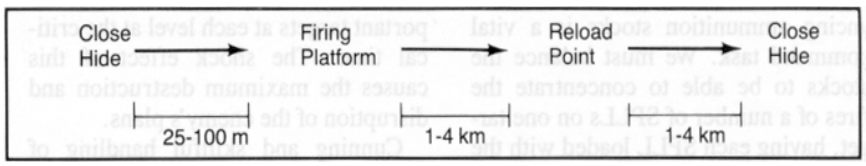


Figure 5: An MLRS Fire Mission Sequence of Events

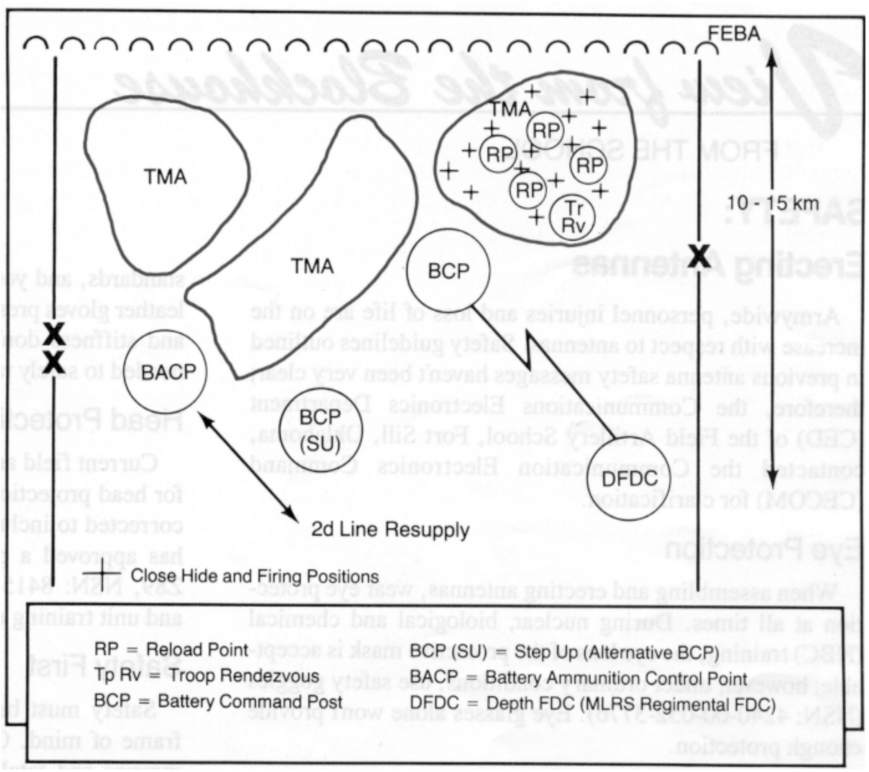
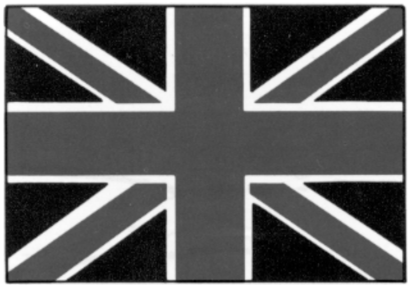


Figure 6: MLRS Battery Deployment



The command of men and the control of movement, logistical resupply and administration is exercised within the command structure of the troop, battery and regimental system. The control of fire is flexible. The FDCs at the general-support regimental headquarters may concentrate any SPLLs within range to achieve the required target mass.

With three different munitions, balancing ammunition stocks is a vital command task. We must balance the stocks to be able to concentrate the fires of a number of SPLLs on one target, having each SPLL loaded with the required munition. The BATES, which is a comprehensive artillery command and control system and a flexible digital communication system, is the force multiplier that allows us to optimise the effectiveness of every SPLL in the Corps and to match the capability given by real-time target acquisition.

Conclusion

We maintain a clear distinction between the contact battle, fought largely by the guns of the divisional artillery groups reinforced where required and when possible by the Corps MLRS resources, and the CB and FOFA battles, fought by the MLRS of the Corps general-support groups. Command is retained at the highest level and control exercised from the lowest practicable level, thus allowing the concentration of massed artillery fire on the most important targets at each level at the critical time. The shock effect of this causes the maximum destruction and disruption of the enemy's plans.

Cunning and skillful handling of guns and launchers will assist their survivability against the Warsaw Pact counterbattery threat. In this way, we shall play an ever-increasing part in the defeat of an enemy opposing the 1st British Corps.

Major General T.D.G. Quayle, Royal Artillery, is Commander Artillery of the 1st British Corps in West Germany. Prior to assuming his command, he served as the Defence Attache for the British Embassy in Bonn, West Germany. General Quayle also served as Commander Artillery of the 4th Armoured Division and Herford Garrison; Commanding Officer of the 40th Field Regiment, Royal Artillery; and Battery Commander in the 1st Regiment, Royal Horse Artillery, all in West Germany. He's a graduate of the Indian Army Staff College and Trinity College, Oxford. In 1980, General Quayle spent several weeks in the US while Chief Instructor, Tactics, from the School of Artillery, Larkhill, England.

View from the Blockhouse

FROM THE SCHOOL

SAFETY:

Erecting Antennas

Armywide, personnel injuries and loss of life are on the increase with respect to antennas. Safety guidelines outlined in previous antenna safety messages haven't been very clear; therefore, the Communications Electronics Department (CED) of the Field Artillery School, Fort Sill, Oklahoma, contacted the Communication Electronics Command (CECOM) for clarification.

Eye Protection

When assembling and erecting antennas, wear eye protection at all times. During nuclear, biological and chemical (NBC) training, the eye lens of the protective mask is acceptable; however, under ordinary conditions, use safety goggles (NSN: 4240-00-052-3776). Eye glasses alone won't provide enough protection.

Hand Protection

The CECOM told CED that the black gloves (NSN: 8415-00-269-5700) issued to military personnel and the leather gloves (men's work, NSN: 8415-00-268-7868) meet safety standards, and you may use either to erect antennas. Heavy leather gloves present a safety hazard because their thickness and stiffness don't provide the "feel-sensitivity" and grip needed to safely raise and lower antennas.

Head Protection

Current field and technical manuals specify helmet liners for head protection. The wording in these manuals is being corrected to include the new kevlar helmet. Also, CECOM has approved a plastic orange helmet, (ANSI inscription Z89, NSN: 8415-00-935-3136) for use in military school and unit training environments.

Safety First

Safety must be more than a set of rules—it must be a frame of mind. Otherwise we'll suffer more self-inflicted injuries and fatalities. Take that extra time to make every operation a safe one.

If soldiers have questions about antenna safety, call CED at AUTOVON 639-5107 or 3419 or commercial (405) 351-5107 or 3419.

MOS 13B Gunner's Test

Our 13B Cannoneers' basic artillery skills need improving. At least that's what the gunner's test given to cannon Advanced NCO Course (ANCOC) and Basic NCO Course (BNCOC) students at the Fort Sill NCO Academy indicates. The Commandant of the Field Artillery School directed the Academy incorporate the gunner's test into ANCOC and BNCOC for MOS 13B to help reverse this trend.

The gunner's test, found in *TC 6-50 The Field Artillery Cannon Battery,* and a diagnostic test evaluate skills basic to cannoneers worldwide. Poor results on the gunner's test coupled with low scores on the diagnostic test indicate a lack of proficiency in lower skill-level tasks. The test currently is given outside of normal academic time; however, it'll be included in the FY 90 revisions to the programs of instruction.

Soldiers who fail to achieve the minimum acceptable score on these tests will not get academic time to improve their performance. The senior instructor will assign study materials and remedial training for the student during nonacademic time. Soldiers who don't show the necessary improvement will be counselled and will have an entry made on their academic efficiency report (AER).

Army Regulation 351-1 Individual Military Education and Training states soldiers attending ANCOC or BNCOC must be proficient in lower skill-level tasks. The Regulation directs the unit commander to ensure the selectee is prepared to attend the course.

If soldiers have questions, call the Program Management Division, Directorate of Training and Doctrine, Field Artillery School, Fort Sill, Oklahoma, at AUTOVON 639-5740 or 3611 or commercial (405) 351-5740 or 3611.

Firefinder Foreign Military Sales

The Firefinder weapon-locating radars (AN/TPQ-36 and AN/TPQ-37) are manufactured by Hughes Aircraft Company (HAC), Fullerton, California. We fielded these radars to the active Army beginning in 1981 and started selling them to our Allies in 1982. These radars primarily locate hostile mortar, artillery and rocket positions accurately enough to permit immediate counterfire by friendly weapons.

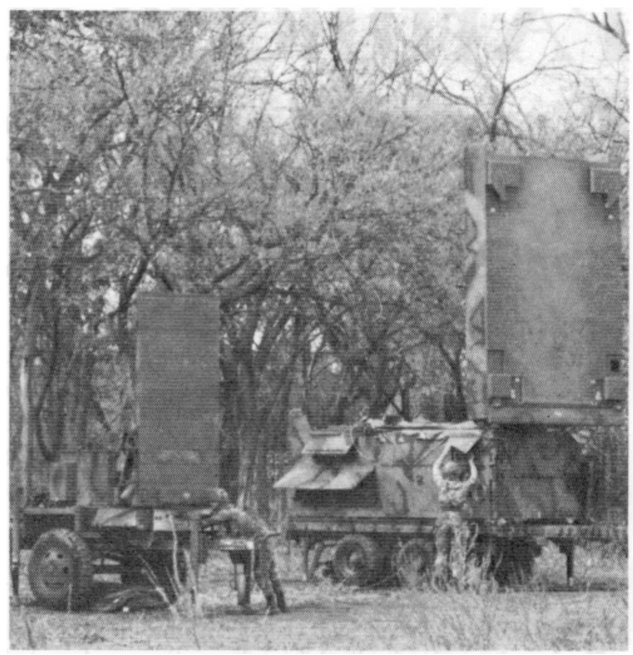
The Q36 radar locates short-range, high-trajectory weapons, such as mortars. However, it also can locate artillery and rockets. The antenna electronically scans a sector of 230 to 1,600 mils in width. The Q36 is highly mobile, is usually positioned three to six kilometers behind the forward edge of the battle area (FEBA) and can be emplaced and ready for operation within 20 minutes.

The Q37 radar locates long-range, low-trajectory weapons between three and 50 kilometers away. It also locates short-range, high-trajectory weapons, complementing the Q36. We can position the Q37 radar within 30 minutes.

Sales and Training

Because of the accuracy, reliability and success of these radar systems, many of our Allies have bought them. The first to receive the radars was the Netherlands in 1982.

The Target Acquisition Department (TAD), US Army Field Artillery School (USAFAS), Fort Sill, Oklahoma, is the proponent for training Firefinder operators, organizational maintenance personnel and direct-support repairers. During the last several years, TAD has trained hundreds of foreign radar operators and organizational maintainers, as well as 77 direct-support repairers, for foreign military sales (FMS) customers who have bought the radars. Countries that have bought the radars and had personnel trained by TAD instructors include the Netherlands, Israel, Jordan, Pakistan, Saudi Arabia, Singapore, Taiwan, Thailand, China, Egypt, Greece, Australia and Turkey.



TAD has trained hundreds of foreign military sales customers on the Q36 and Q37 radars.

Training personnel for Firefinder FMS customers is ongoing at TAD and is expected to continue through the 1990s. The projected student input varies each year, based on the number of systems sold. The TAD also sends mobile training teams to some FMS customers to train their personnel on Firefinder.

Conclusion

If readers have questions about Firefinder FMS or training, call the New Systems Division, TAD, at AUTOVON 639-4787 or 6486 or commercial (405) 351-4787 or 6486.

l'Artillerie royal Canadienne/The Royal Canadian Artillery

by Colonel L.T.B. Mintz, RCA

It's often suggested that Americans are very comfortable visiting Canada because it's like the United States in many respects. However, as might be expected, there are also differences. One probably needs to be a sociologist with a host of academic qualifications to begin to adequately compare and contrast our nations. Soldiers, though, define things in their own sphere.

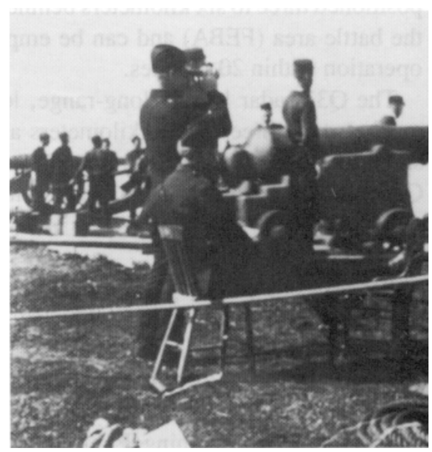
The United States and Canada have been closely allied throughout much of our history, and in the event of war, we can expect to fight shoulder to shoulder. It is, thus, very important that we, the military, understand one another. The aim of this article is to introduce you to the Royal Regiment of Canadian Artillery and to describe aspects of our operations that vary from those of the United States Field Artillery.

History

Canada's historical evolution has been very different from that of the United States. This has led to some of the military philosophy and organizations we have today.

Confederation united four British colonies into Canada in 1867. At the time, Britain was attempting to reduce expenditures on defence (a situation familiar to all), and within a short time, the first regular units of the Canadian Forces—A and B Batteries of garrison artillery—were formed in 1871. Those two serve today as batteries in the 1st Regiment, Royal Canadian Horse Artillery, which is in Lahr, West Germany, as part of Canada's commitment to NATO.

One of those original colonies was French-speaking Quebec, and today Canada is a bilingual nation. Our regiment, as you can tell from the title of this article, functions in both French and English.



In 1889, a battery of 64-pounder, rifled muzzle-loading guns of the Montreal Garrison Artillery trains in Quebec.

The Royal Regiment of Canadian Artillery, our official title, usually is abbreviated to the Royal Canadian Artillery (RCA). The RCA has fought in all Canada's military actions since Confederation, including the Northwest Rebellion of 1885, South African War of 1898, World Wars I and II and the Korean War. Since then, we've contributed both formed units and individuals for the many peacekeeping tasks undertaken by Canada. The Royal Regiment—a phrase we use to signify all gunners, both field and air defence artillery—was awarded the distinction "Ubique" (Everywhere) after World War I in lieu of Battle Honours. We wear this motto on our cap badges, which you see reproduced at the beginning of this article.

RCA Overview

We're a small army with two independent brigades for territorial defence and Canada-US (CANUS) operations and the 1 Canadian Division tasked to NATO's Central Army Group (CENTAG) in West Germany, as of November 1989. The Division is stationed partly in Germany and Canada in the same manner as some dual-based formations in the US Army.

Canada also contributes a battalion group, which includes a light battery, either to the Allied Command Europe Mobile Force (Land) or AMF(L) or the NATO Composite Force for operations in the NATO Northern Region. In times of tension or crisis, about three-quarters of our regular Field Artillery could be deployed to Europe.

Our air defence artillery has two tasks; to defend the 1 Canadian Division and to protect the two airfields in Germany from which the 1 Canadian Air Division and some US Air Force fighter squadrons will operate. All our regular air defence batteries would be deployed in Europe to carry out these tasks.

For the 1990s, the challenge to the artillery, as with the rest of the Army, is to pursue actively the integration of our militia and regular units to produce a total force with compatible equipment, training and career patterns.

Operational Differences

One of the most obvious differences between our artilleries is based on differences in operational philosophies. In the RCA, it's important that the battery commander (BC), a major, be forward with the supported arm to advise and assist the armour or infantry commanding officer (CO). At all levels, the artillery commander is collocated with the infantry or armour commander. We also believe the same units should habitually work together, so we strive to ensure each battery commander is always affiliated with his infantry CO, and so on.

Included in this basic organizational philosophy is the notion that—other things being equal—the infantry or armour unit should be able to call on its direct-support battery without the approval of a higher authority. Thus, the observers and the BC can order fire from that direct-support battery. Should the battery be insufficient for the task, the artillery CO can delegate to the BC authority to use more guns.

The BC is an experienced officer, and his place with the infantry or armour in contact permits him to provide vital information to his superiors to ensure higher headquarters is well aware of the battle as it develops. Likewise, it permits higher headquarters to adjust the allotment of artillery to match the development of the battle. The same command and control procedures exist for the CO located with the brigade commander and the commander divisional artillery (CDA) with the divisional commander.

This aspect of our procedures has often caused difficulty for American gunners who have found it hard to understand, but this should not be so. As a matter of principle, the command of artillery is centralized at the highest level at which it can effectively be exercised. Routinely this is the divisional level. Thus, it's the CDA who is in charge. At the same time, we decentralize the control of fires, so the officer on-the-spot with the unit in contact can do his job as effectively as possible.

When required by the nature of the battle, the CDA and his staff can take over, and it's quite normal for them to impose restrictions on ammunition, types of targets to engage, etc. In any action involving more than one brigade, the CDA would control the entire artillery of the division to ensure the most critical area of the battle receives adequate support.

Our aims are the same though we take different roads to the objective. This system allows us a great degree of flexibility and responsiveness to the needs of the other arms. The fire plan is but one aspect of the commander's plan, and thus, we must be with him to ensure the plan is fully coordinated.

Another operational difference is that the gunners (field, locating and air defence) form one of the three combat arms in Canadian service. We believe it's essential to have these three elements in any combat action to be successful.

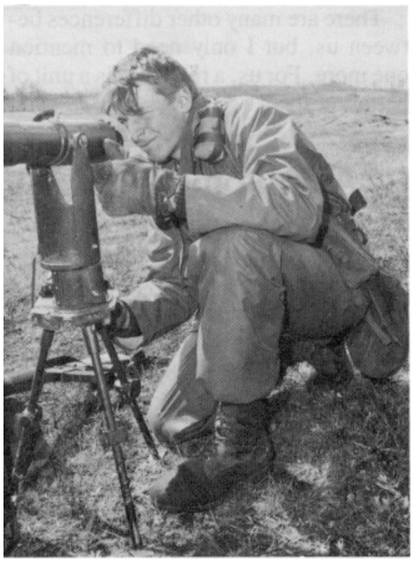
There are many other differences between us, but I only need to mention one more. For us, a regiment is a unit of battalion size.

RCA Equipment

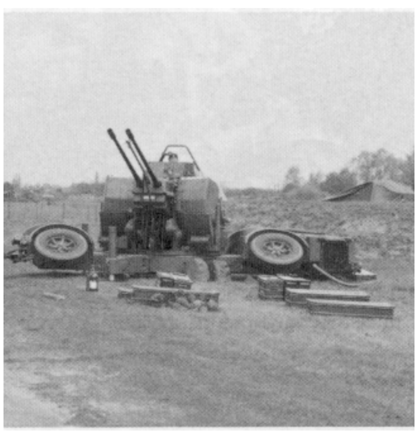
Forces committed to NATO use the M109A2/A3 howitzers, with the exception of one battery committed to AMF(L) that has the 105-mm C1 howitzer, a derivative of the 105-mm M2A2. Our airborne battery uses the Italian manufactured L5 105-mm pack howitzer. Our air defence artillery is committed to NATO and uses the air defence antitank system (ADATS) with missiles, the Blowpipe man-portable air defence system (MANPADS) and the twin 35-mm gun by Oerlikon.

Sergeant D.C. Goodfellow of F Battery, 2 RCHA, supervises Gunner Patey's recording the azimuth of the L5 pack howitzer during Exercise Rendezvous 89 at Alberta, Canada.

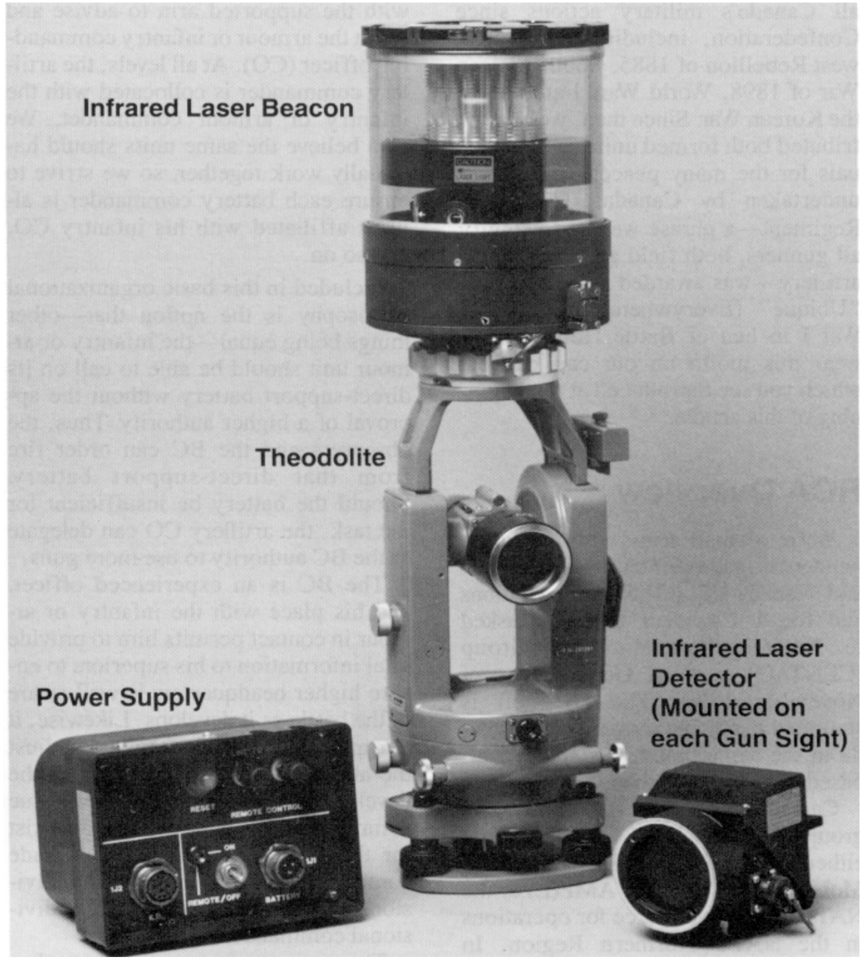
ADATS will deploy with Canadian Air Defence units beginning in 1990. With laser guidance, a high-velocity missile and high-kill probability, ADATS is a formidable opponent.



Gunner Plante of 5e Regiment d'artillerie legere du Canada adjusts the collimator used with his M109A3.



The Oerlikon, a twin 35-mm air defence gun, came into service in 1988 to defend airfields.



The Alignment Group of GACS. The infrared beacon mounted on a tripod in the field sends out signals to detectors mounted on the guns. The detectors pass the signals to the gun display units in the howitzers to process, providing precise north alignment in seconds.

Fire Direction Systems

At the field battery level, the AN/GSG-502(V) gun alignment and control system (GACS) is in the process of being brought into service. It's an old idea that's just now being fielded. The GACS integrates three systems to rapidly orient the howitzers, receive firing data from the battery computer and provide an inter-communications voice system on the gun position.

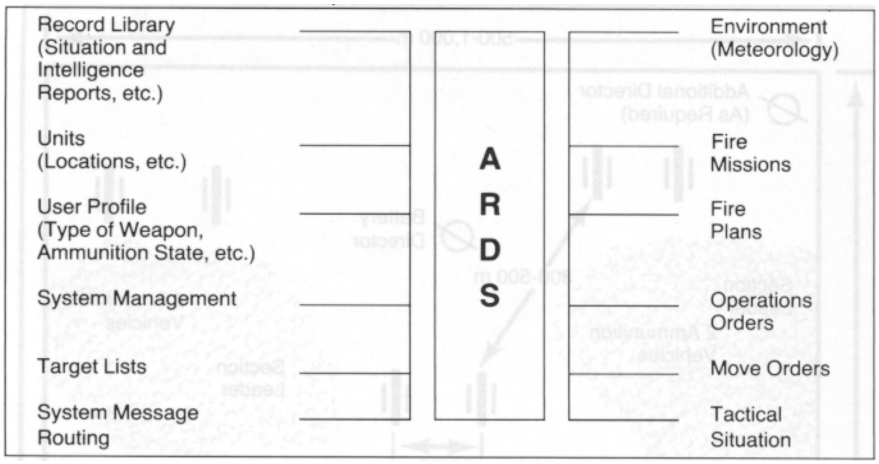
The most interesting feature of the system is its rapid alignment element. An infrared beacon mounted on top of the battery aiming circle or director emits signals detected by a special receiver at the gun. The gun display unit processes these signals to produce a reference angle, which is then applied to the sight, and normal orientation is completed in very short order. A detachable shield screens the beacon from enemy view.

At the battery command post or CP (what you would call a fire direction center or FDC), data received from the observer are turned into gun data by MiliPAC, our military portable artillery computer. The MiliPAC is a rugged, stand-alone computer that provides ballistic firing data for the 155-mm howitzer M109A3, 105-mm howitzer C1 and 105-mm howitzer L5. MiliPAC interfaces with GACS and the Honeywell Teletypewriter (TTY). It entered service in 1984 and has greatly enhanced our ability to produce accurate firing data in a timely manner.

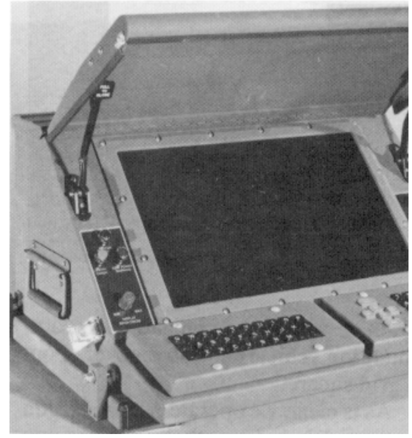
All the computations are done at the CP and transmitted via GACS to the gun. The system's operation thus falls in between current US procedures and those that will be employed with the HIP howitzer.

Command and Control System

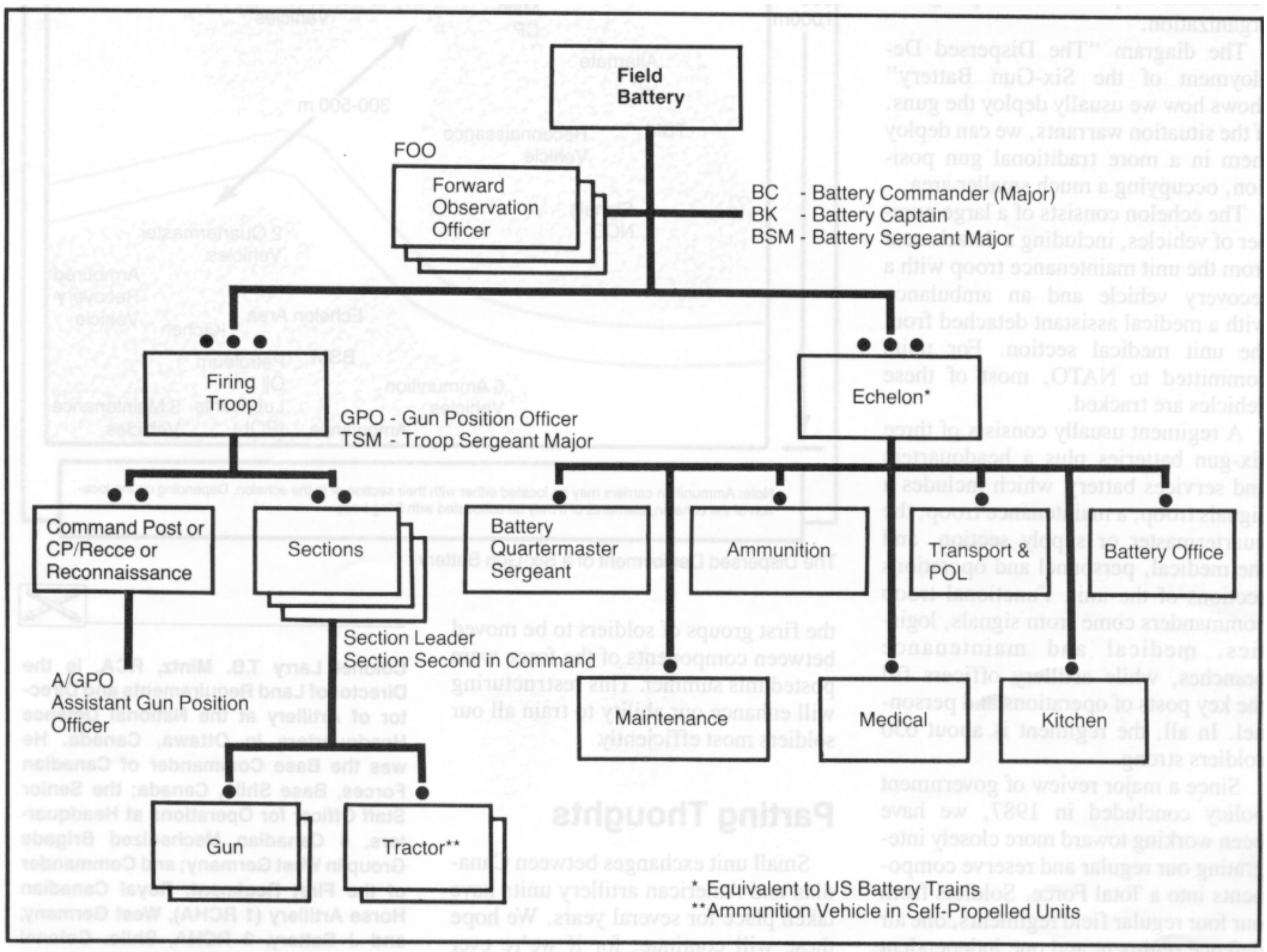
Plans are well underway to begin developing an automated command and control system for Field Artillery regiments. The artillery regimental data system (ARDS) will provide rapid target analysis, automated record keeping and efficient fire planning and fire mission execution.



The ARDS automated command and control system being developed will perform these artillery functions.



At the CP, the MiliPAC computes the data received from the observers into ballistic firing data for the howitzers.



A Close-Support Medium Battery, RCA

Employment and Organization

The CDA (a brigadier general) commands all artillery allotted to the divisional artillery brigade. It's his responsibility to allot tasks to the artillery to support the divisional commander's plan.

I described earlier that we centralize command and decentralize control of artillery. Our procedures vary, but our aims are the same. The aim of the CDA is to use the artillery under his command to assist the divisional commander to achieve his goal. Our normal method of deployment is to disperse the six guns of a battery in pairs and spread

all the associated command posts, ammunition vehicles and so on over about a grid square.

As is clear, we operate with a six-gun battery. We believe that an eight-gun battery is a better organization and would like to adopt it, but budgetary constraints keep us from adopting that organization.

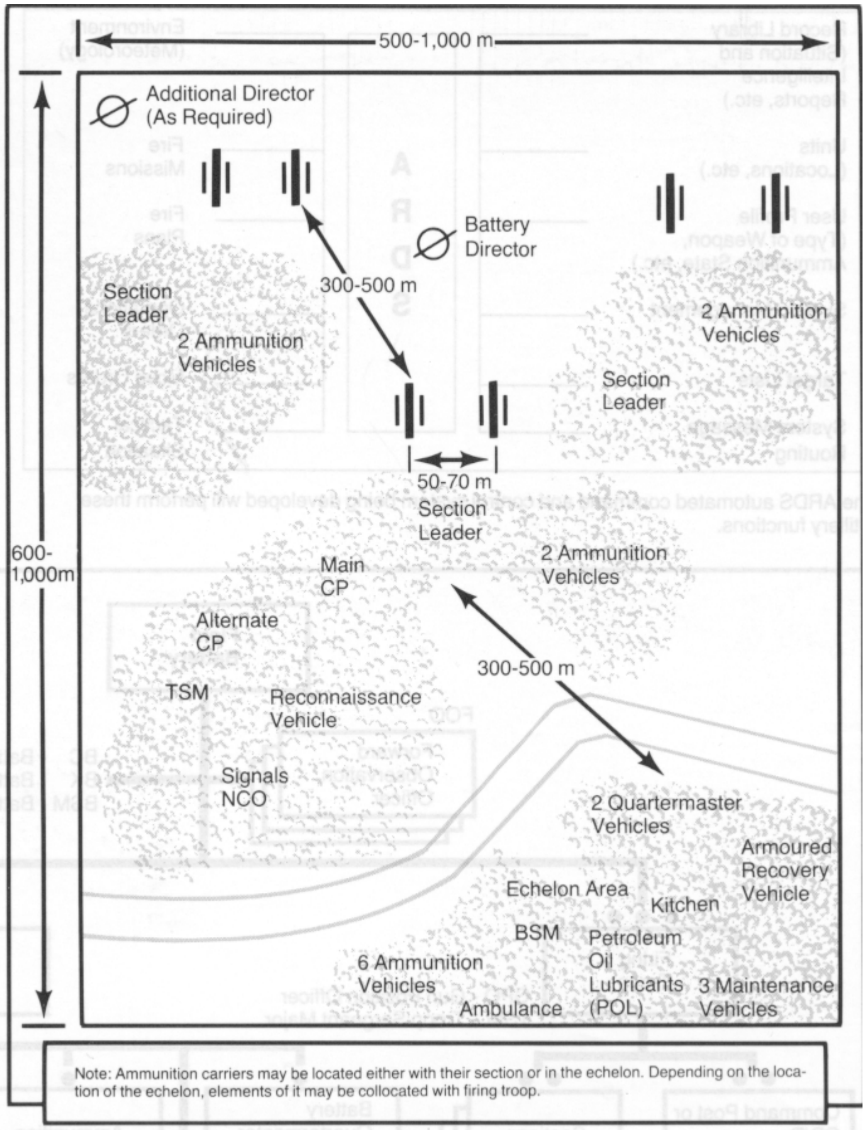
The diagram "The Dispersed Deployment of the Six-Gun Battery" shows how we usually deploy the guns. If the situation warrants, we can deploy them in a more traditional gun position, occupying a much smaller area.

The echelon consists of a large number of vehicles, including a detachment from the unit maintenance troop with a recovery vehicle and an ambulance with a medical assistant detached from the unit medical section. For units committed to NATO, most of these vehicles are tracked.

A regiment usually consists of three six-gun batteries plus a headquarters and services battery, which includes a signals troop, a maintenance troop, the quartermaster or supply section, and the medical, personnel and operations sections of the unit. Functional troop commanders come from signals, logistics, medical and maintenance branches, while artillery officers fill the key posts of operations and personnel. In all, the regiment is about 650 soldiers strong.

Since a major review of government policy concluded in 1987, we have been working toward more closely integrating our regular and reserve components into a Total Force. Soldiers from our four regular field regiments, one air defence regiment and one independent air defence battery may be posted to any of our 14 reserve regiments and four independent reserve batteries as full-time components of those units. Reserve soldiers may likewise be posted as part-time components of a regular unit in their geographical area.

A great deal of staff work is underway



The Dispersed Deployment of a Six-Gun Battery

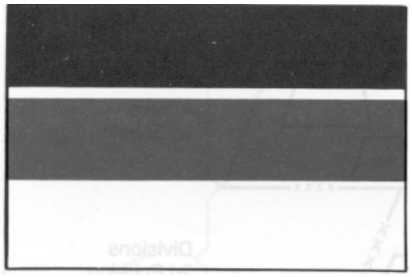
now to implement this plan, and the first groups of soldiers to be moved between components of the force were posted this summer. This restructuring will enhance our ability to train all our soldiers most efficiently.

Parting Thoughts

Small unit exchanges between Canadian and American artillery units have taken place for several years. We hope these will continue, for if we're ever called upon to participate in operations, we must be able to do so effectively with our Allies.

Should you ever find yourself on a Canadian artillery net calling for fire, just tell us the basics about the target—who, what, where, when and why. We'll take care of getting you the rounds on the ground.

Colonel Larry T.B. Mintz, RCA, is the Director of Land Requirements and Director of Artillery at the National Defence Headquarters in Ottawa, Canada. He was the Base Commander of Canadian Forces, Base Shilo, Canada; the Senior Staff Officer for Operations at Headquarters, 4 Canadian Mechanized Brigade Group in West Germany; and Commander of the First Regiment, Royal Canadian Horse Artillery (1 RCHA), West Germany, and J Battery, 3 RCHA, Shilo. Colonel Mintz was the Artillery Officers' Career Manager and the Defence Minister's Staff Officer in Ottawa and an Instructor in Gunnery for Artillery in the Combat Arms School in Gagetown, Canada. He's a graduate of the National Defence College in Kingston, Ontario; British Army Staff Course in Camberley, England; and the Canadian Land Forces Staff Course at Kingston.



Editor's Note: This article is an edited version of one published by the same name in *Soldat und Technik,* November 1989.

Quo Vadis Artillery?

by Lieutenant Colonel Werner Klingenberg, *Deutsche Bundeswehr*

In a military conflict, the *Deutsche Bundeswehr,* fighting side-by-side with our Allies, will have to, by and large, defend its assigned sectors independently. To do this, we have to stop the attacker and destroy him as far forward as possible by conducting mobile operations.

The artillery is and will continue to be the mainstay of that fire fight conducted primarily against attacking enemy combat troops and their combat support troops. It's decisively important to neutralize the numerically superior enemy fire support weapons by counterbattery fire to retain the freedom of action necessary for friendly combat arms.

In this article, I briefly discuss the German Artillery's mission, the Threat we face and where we're going to modernize our forces by the year 2000. My discussion is limited to conventional artillery.

Artillery Mission and Requirements

Up to a depth of 100 kilometers forward of the forward line of own troops (FLOT), the artillery mission is (1) to bring area-coverage fires to bear against all types of targets with minimum delay and emphasis on direct fire support and (2) to destroy mechanized reserves, as well as artillery, command and control and logistical installations.

To fulfill this mission, we must have real-time artillery intelligence precise enough for target engagement and an efficient, jam-resistant command and control and information system. In addition, we must have a delivery means that's effective against small-and large-area targets of all degrees of hardness.

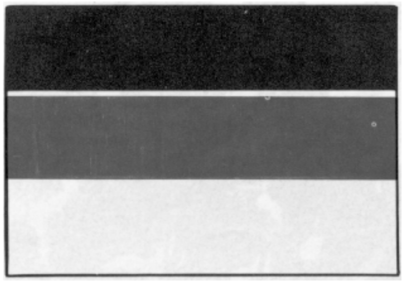
To achieve these capabilities, we must further develop our artillery to—

- Add a target-location capability effective under all conditions of weather and visibility within the corps area of interest.
- Reduce our response times between reconnaissance of and firing on targets.
- Improve the capability and mobility of smaller fire units to enhance the flexibility and availability of artillery.
- Add the capability to deliver operational fires out to a range of 100 kilometers forward of the FLOT, using weapons with different damage mechanisms (e.g., top-attack munitions, etc.).

The Threat

Armored combat arms will continue to be the backbone of the Warsaw Pact (WP) Land Forces. The WP training, equipment, organization and operational doctrine allow its forces to attack by echelons on a wide front after a short artillery preparation period, concentrate the main body along the main axis of advance while accepting open flanks and conduct combined-arms operations down to the regimental level, with massive close air support.

In addition to superiority in combat troops, the WP also has a five- to seven-fold superiority in artillery units. This numerical advantage enables them to provide new forms of fire support. At the operational level, they'll form reconnaissance and strike complexes (RUKs), while at the tactical level they'll use reconnaissance and fire complexes (ROKs). With these forces, they can destroy reconnoitered enemy artillery within five minutes with a concentration of fire. In addition, the WP is pressing ahead with the development of homing ammunition and is continually improving its night-fighting capabilities.



Target Spectrum

Technological progress is causing the Warsaw Pact (WP) to develop new tactical approaches and operational principles for the battlefield of the future. We can expect to see both sides with increased reconnaissance and target-location capabilities, mobile forces with reduced times of exposure and more lethal weapons to destroy targets and target elements.

Therefore in the future, we can subdivide targets into categories of range, behavior, size and hardness. These categories place special demands on our artillery delivery means and ammunition.

Range of Targets

The WP tactical and operational doctrine dictates their forces' attacking in echelons. (See Figure 1.)

The combat and combat support troops of the first echelon of an attacking WP division will operate in a zone of up to *10 kilometers in depth* forward of our FLOT. Command and control installations and a large number of artillery groups will operate in this zone.

Regiments of the second echelon and reserves of the attacking divisions will operate in a zone of *10 to 40 kilometers* in depth, including more combat support troops, logistical installations and command posts.

Divisions of the second army echelon are expected to operate at ranges from *40 to 120 kilometers* forward of the FLOT. The armies of the second front echelon will initially be kept ready at ranges between *120 and 270 kilometers* forward of the FLOT.

Target Behaviour and Size

Movement of enemy forces is an important prerequisite for our successful reconnaissance and target location. With each move, the enemy loses his protection from cover and concealment, thus becoming recognizable during reconnaissance.

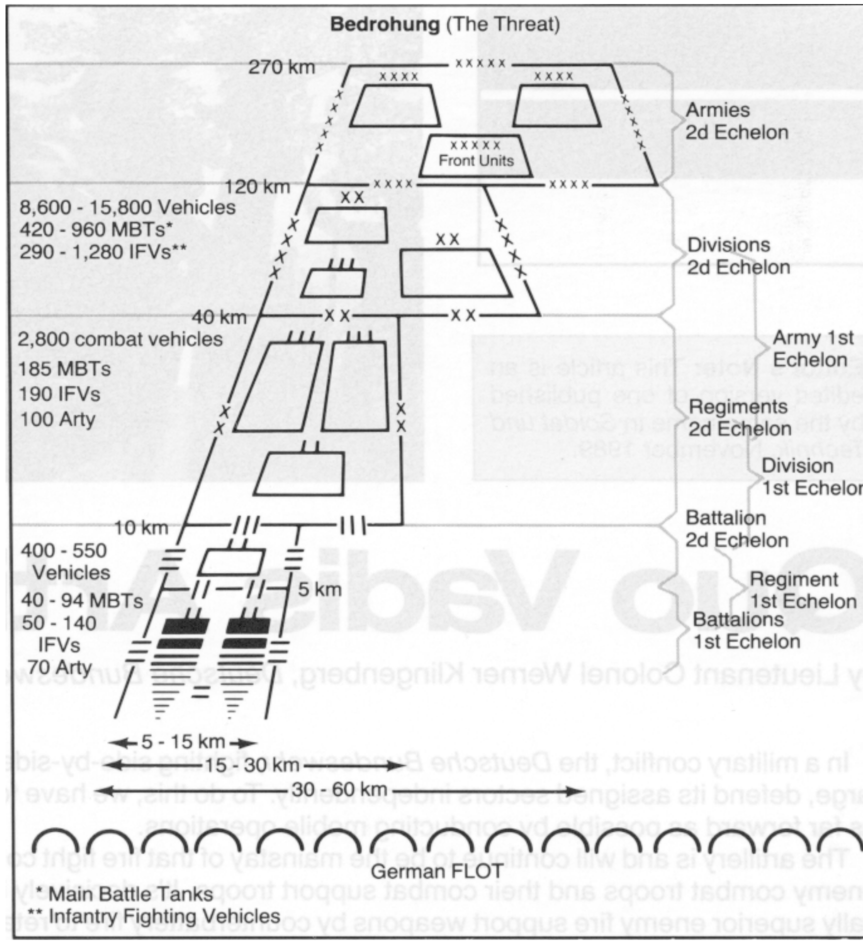
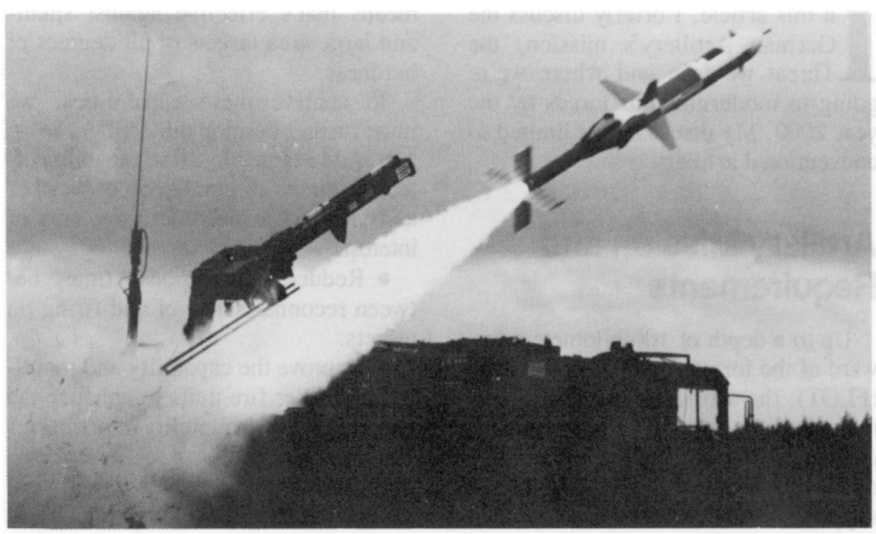


Figure 1: The WP organizational and operational doctrine for attacking dictates the range and type of targets we would face.



The German's CL 289 drone is fired for a reconnaisance mission.

His preparation for attack, as well as the introduction of a new echelon, will lead to his concentrating forces, primarily at distances of up to 30 kilometers forward of our FLOT. At distances between 30 and 100 kilometers forward of the FLOT, our targets will, for the most part, be stationary ones (protected by cover and concealment) and mobile maneuvering units.

Systems for Artillery Structure 2000

Command, Control, Information and Fire Control

This network makes up *ArtfueinFELSys* and consists of several subsystems. These new systems not only guarantee rapid transmission of situation and target reports, but also interface with the Army HEROS and the fire control systems of our Allies.

ADLER	Artillery command, control, information and fire direction system at the regimental and battalion levels. This system is the equivalent to the US advanced Field Artillery tactical data system (AFATDS).
IFAB	Brigade artillery battery fire direction system for armored artillery units.
ABACUS	Artillery battery fire direction system for Field Artillery units.
ARES	Artillery rocket engagement system for rocket artillery units.
ATMAS	Atmospheric surveillance and evaluation systems.

Target Acquisition and Intelligence

These new systems will replace our current target acquisition systems and significantly increase our position-location capabilities.

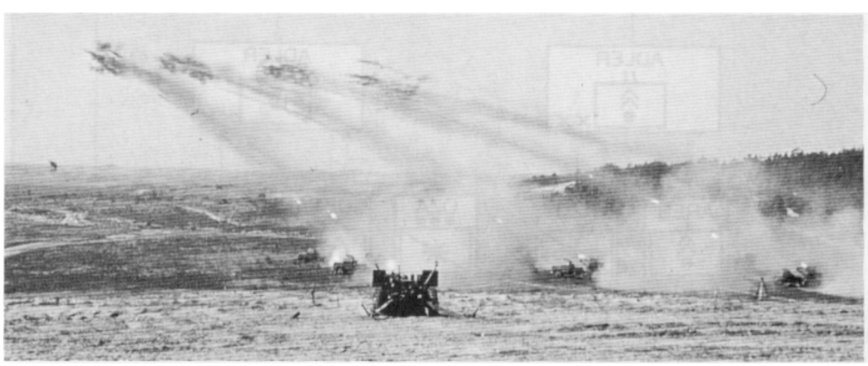
CL 289	Reconnaissance drone.
OZA	Optronic target location device, a passive target location system.
AOR	Artillery target acquisition radar, an active target location means.
COBRA	Counterbattery radar.
KZO	An unmanned aerial vehicle (UAV) for reconnaissance that has a range of about 30 kms.
LAPAS	An airborne, standoff primary reconnaissance system with imaging sensors, which will provide the artillery basic deployment data. This future system is comparable to the US joint surveillance and target attack radar system (Joint STARS).

Weapons

In the late 1990s, we'll phase out the light artillery rocket system, 110-mm launcher, our M110 weapons and the FH 70 towed field howitzers with these systems.

Howitzer 2000	Self-propelled, armored howitzer under development, to be fielded at the brigade and division levels beginning in late 1996. The Howitzer 2000 will have a range of 30 kms and 40 kms with base-bleed munitions. It can fire 3 rounds in 10 seconds or 8 rounds in 1 minute and can change positions in 1 minute, firing in 30 seconds after the move.
MARS	Multiple artillery rocket system to be fielded at the division level, starting in 1990.
Combat Drone	This corps-level asset locates and attacks targets and will be fielded starting in 1998. It can attack moving armored targets at a range of 100 kms.
M109 Howitzer	This self-propelled howitzer will be in service well into the year 2000. We've already increased the howitzer's range to 24 kms and to 30 kms firing base-bleed rounds. Further, we'll retrofit it with the AURORA vehicle navigation system for automatic position location. This system will increase the mobility of the gun platoon considerably.

Figure 2: The reorganization of the artillery into Structure 2000 adds new systems and upgrades current ones to ensure the German artillery can neutralize or destroy attacking enemy forces.



The 110-mm light rocket launchers fire; the MARS will start replacing them in 1990.

Enemy forces deployed for attack will initially present a large area target which, depending on the terrain and corresponding unit dispersal, only can be located as a large number of small target elements. Only units in assembly areas, such as command posts, logistical installations or artillery in closed firing positions, still will present classical area targets.

Degree of Target Hardness

At the present time, it's assumed we can categorize targets presented by a WP army into 35 percent hard (e.g., main battle tanks), 45 percent semi-hard (e.g., armored self-propelled howitzers) and 20 percent soft (e.g., field howitzers, unarmored wheeled vehicles and unprotected personnel). The number of WP hard and semi-hard targets will increase with its progressive modernization and use of reactive armor.

The mission of the artillery, in conjunction with the military capabilities of the WP and the spectrum of targets the WP presents, demands an artillery system of command and control, reconnaissance, information processing, fire control and target engagement. Together these individual elements form the artillery system. (See Figure 2.)

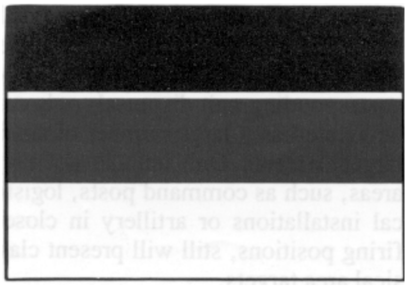
ArtFueinFELSys

Command and control, information processing and fire control will be coordinated in a network of subsystems, called the *ArtFueinFELSys*. Reports of targets then can be translated into fires with a minimum delay. (See Figure 3.)

The network must allow major commanders and artillery commanders to retain their decision-making authority in their areas of responsibility. It also must interface with our higher-level Army command and control, communications and information system (HEROS) and the automated corps communications network and exchange data with neighbors and Allied command and control systems.

Target Acquisition and Intelligence

To provide effective fire support, artillery subsystems for situation development



and target acquisition are required to cover the whole battlefield with different sensors for surveillance in all conditions of weather and visibility. Our artillery systems only guarantee to meet the special acquisition needs of the artillery, such as providing accurate location data and transmitting it without delay to effectively engage reconnoitered targets.

Reconnaissance systems of other Army branches and services must be used for collecting other intelligence information. The further development of the reconnaissance complex—while exploiting ***all*** possibilities—will be decisively important in the future.

Weapons

To fulfill its mission, the artillery also requires enough threat-adequate weapon systems. These systems must complement each other to cover an area up to a depth of 100 kilometers.

Our weapons must comply with the requirements of modern combined-arms combat by having high rates of fire, lethal firepower and autonomous navigation and laying equipment. They must offer effective protection against enemy fire and chemical agents and be operated by small crews. Further, our weapons must be able to carry a large load of ammunition. We must have enough to respond quickly with the best type and model of ammunition for the target.

These artillery weapons must be able to—

- Destroy mobile and stationary targets of all degrees of hardness at differing ranges.
- Block terrain sections for limited periods.
- Deny enemy observation and weapon effects for limited periods.
- Defend themselves in duels, a capability that is frequently omitted in other such lists.

Munitions

Ammunition for hard targets, or the so-called "smart munition," is currently under development. Introduction of this munition will enhance our kill probability against stationary and moving targets. Firing efficiently over longer ranges will involve our deploying trajectory-tracking devices with the appropriate software.

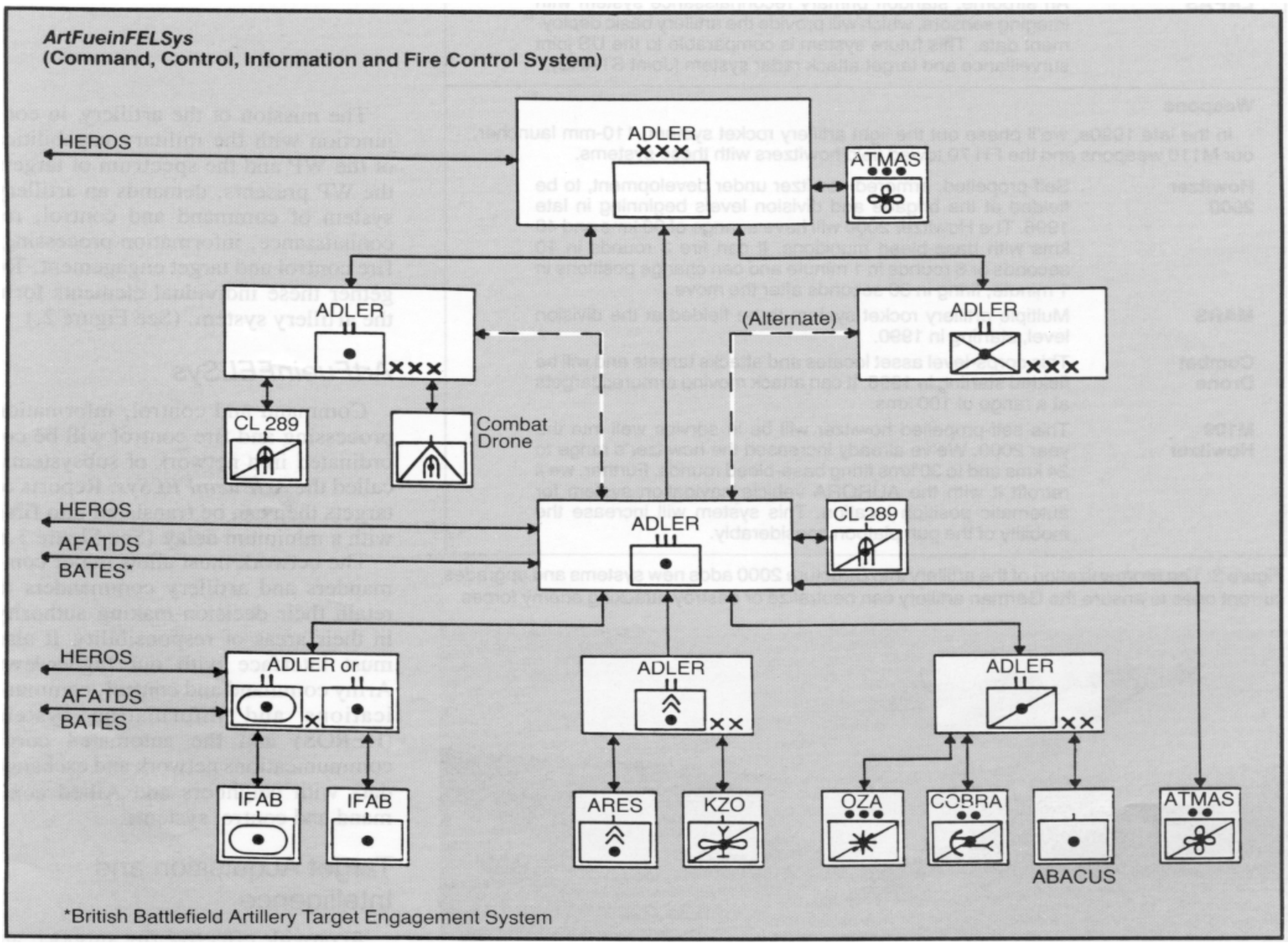


Figure 3: A Network of Subsystems, Part of the Artillery Structure 2000

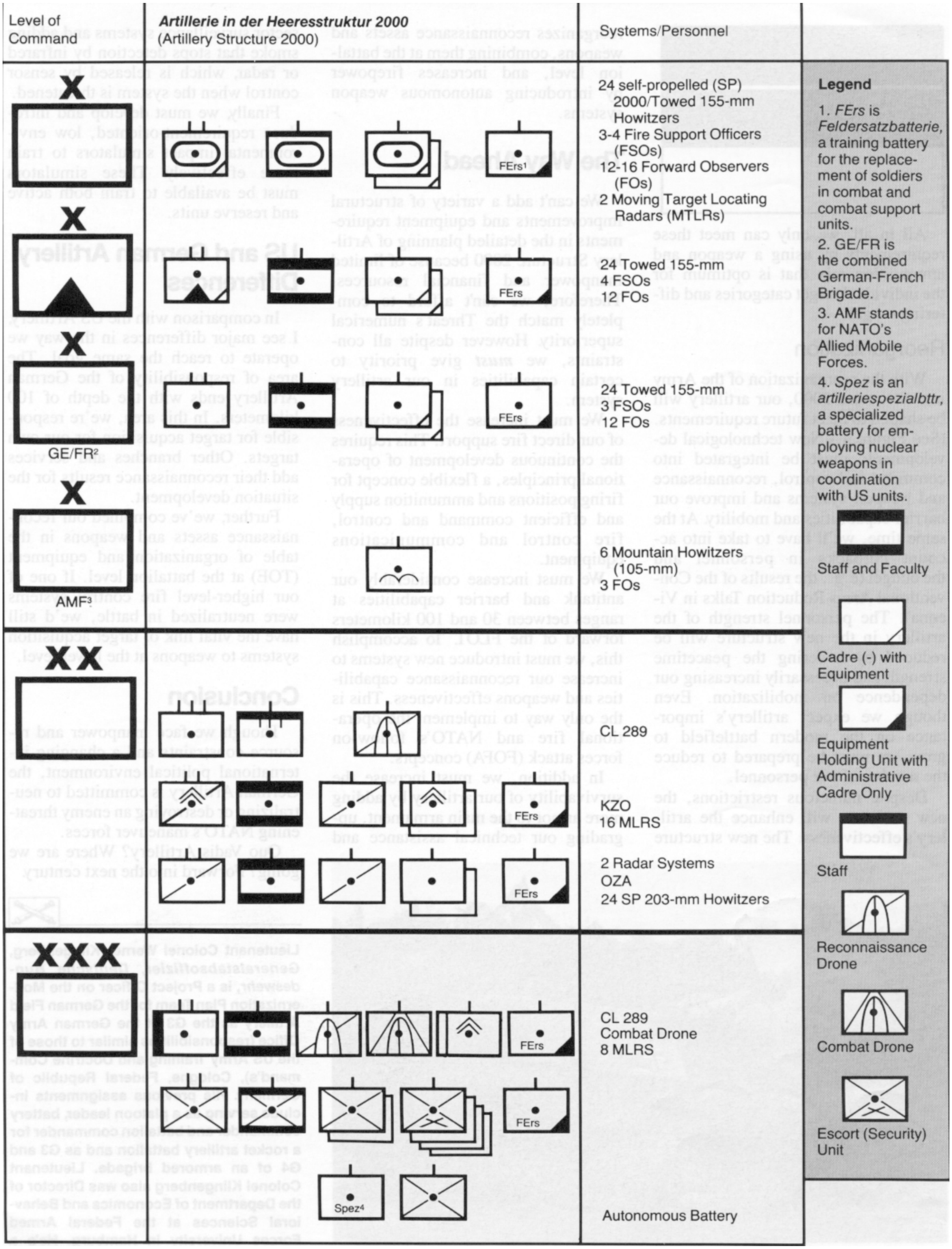
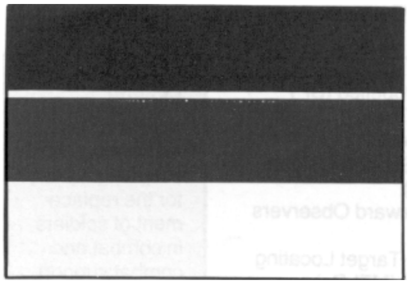


Figure 4: The reorganization of artillery combines reconnaissance assets and weapons at the battalion level and introduces autonomous howitzers.



All in all, we only can meet these requirements by using a weapon and ammunition mix that is optimum for the individual target categories and differing ranges.

Reorganization

With the reorganization of the Army into Structure 2000, our artillery will be shaped to meet future requirements. (See Figure 4.) New technological developments must be integrated into command and control, reconnaissance and weapon systems and improve our barrier capabilities and mobility. At the same time, we'll have to take into account cutbacks in personnel and the budget (e.g., the results of the Conventional Arms Reduction Talks in Vienna). The personnel strength of the artillery in the new structure will be reduced by lowering the peacetime strength and necessarily increasing our dependence on mobilization. Even though we expect artillery's importance on the modern battlefield to grow, we must be prepared to reduce the number of our personnel.

Despite numerous restrictions, the new structure will enhance the artillery's effectiveness. The new structure reorganizes reconnaissance assets and weapons, combining them at the battalion level, and increases firepower by introducing autonomous weapon systems.

The Way Ahead

We can't add a variety of structural improvements and equipment requirements in the detailed planning of Artillery Structure 2000 because of limited manpower and financial resources. Therefore, we can't afford to completely match the Threat's numerical superiority. However despite all constraints, we ***must*** give priority to certain capabilities in our artillery system.

We must increase the effectiveness of our direct fire support. This requires the continuous development of operational principles, a flexible concept for firing positions and ammunition supply and efficient command and control, fire control and communications equipment.

We must increase considerably our antitank and barrier capabilities at ranges between 30 and 100 kilometers forward of the FLOT. To accomplish this, we must introduce new systems to increase our reconnaissance capabilities and weapons effectiveness. This is the only way to implement the operational fire and NATO's follow-on forces attack (FOFA) concepts.

In addition, we must increase the survivability of our artillery by adding more armor to the main armament, upgrading our technical assistance and sector surveillance systems and adding smoke that stops detection by infrared or radar, which is released by sensor control when the system is threatened.

Finally, we must develop and introduce requirement-oriented, low environmental impact simulators to train more effectively. These simulators must be available to train both active and reserve units.

US and German Artillery Differences

In comparison with the US Artillery, I see major differences in the way we operate to reach the same goal. The area of responsibility of the German Artillery ends with the depth of 100 kilometers. In this area, we're responsible for target acquisition for our own targets. Other branches and services add their reconnaissance results for the situation development.

Further, we've combined our reconnaissance assets and weapons in the table of organization and equipment (TOE) at the battalion level. If one of our higher-level fire control systems were neutralized in battle, we'd still have the vital link of target acquisition systems to weapons at the lower level.

Conclusion

Though we face manpower and resource constraints and a changing international political environment, the German Artillery is committed to neutralizing or destroying an enemy threatening NATO's maneuver forces.

Quo Vadis Artillery? Where are we going? Forward into the next century.

This M109 howitzer will be in service well beyond the year 2000. We've increased the range to 24 kms (30 kms firing base bleed) and will retrofit it with the AURORA navigation system.

Lieutenant Colonel Werner Klingenberg, *Generalstabsoffizier, Deutsche Bundeswehr,* is a Project Officer on the Modernization Plan Team for the German Field Artillery as the G3 of the German Army Office (responsibilities similar to those of the US Army Training and Doctrine Command's), Cologne, Federal Republic of Germany. His previous assignments include serving as a platoon leader, battery commander and battalion commander for a rocket artillery battalion and as G3 and G4 of an armored brigade. Lieutenant Colonel Klingenberg also was Director of the Department of Economics and Behavioral Sciences at the Federal Armed Forces University in Hamburg. He's a graduate of the 24th General Staff Officer Course at Hamburg-Blankenese.

Arctic Thunder at 60° Below

by Captain Patrick J. Sweeney

Exercise Brimfrost 89 proved the Arctic Redlegs of the 6th Infantry Division (Light) in Alaska can perform their mission and survive in temperatures of 60 degrees below zero and lower. This article focuses on the weather-induced problems the Arctic Thunder Redlegs experienced and the actions taken to overcome these obstacles.

Brimfrost is a biannual, joint readiness exercise conducted by Forces Command (FORSCOM). The purpose of this exercise is to train joint forces in arctic warfare, including the Army, Air Force, Navy, Marines, Coast Guard, National Guard and Canadian forces.

The culmination of Brimfrost 89 was a three-day, force-on-force exercise held in the Tanana Flats. The Flats, 10 miles south of Fairbanks, is arctic tundra vegetated by scrub bushes as well as sparse groves of birch and spruce trees.

Brimfrost 89 occurred during one of Alaska's record cold spells. Temperatures during the two-week exercise averaged 50 degrees below zero F, and exceedingly thick ice fog reduced visibility to one-quarter of a mile.

The extreme temperatures during Brimfrost were about the same as those the Germans and Soviets experienced on the Russian front in the terrible winter of 1941-42. During this harsh winter, the German's inadequate cold-weather training and improper clothing cost them more than a quarter of a million casualties from frostbite.

Harsh weather is an enemy we must plan for and counter—as surely as any other enemy force. Failure to properly train and prepare our soldiers will result in injury and death on a scale equal to the losses from the most intense fighting.

Obstacle 1: Soldier Fear

Fear of the unknown and the human survival instinct were the first major obstacles we had to overcome. Soldiers were apprehensive about deploying during Brimfrost because most of them had never experienced such severe conditions.

With no experience, the human mind tends to exaggerate the difficult possibilities as it tries to comprehend the unknown. The soldiers' distorted views of operations in a -60 degree environment and doubts of their abilities to survive created great stress.

To alleviate this stress, we conducted cold-weather indoctrination (CWI) refresher training two days before deployment. Also, the chain of command repeatedly reassured the soldiers that their safety was top priority.

Obstacle 2: NCO Leadership

The NCOs are critical to our successfully accomplishing missions in cold-weather operations. They must thoroughly train their soldiers in the basic skills required to function and survive in a cold climate. Furthermore, during cold-weather operations, the NCOs must constantly check to ensure their soldiers are following basic survival skills (eating, hydration and hygiene), wearing their clothing properly and getting warmed-up on a regular basis. Well-trained soldiers and concerned NCOs will limit cold weather casualties, which will give the unit the personnel necessary to accomplish the mission.

Obstacle 3: Leader Stress

Operating in extremely cold weather places an excessive stress on leaders, causing them to fatigue more quickly. This stress is induced by being responsible for the survival of subordinates, mission accomplishment and their own survival. Also, every decision a leader makes under these harsh conditions puts his soldiers' lives in jeopardy.

Thus, to operate at maximum proficiency, the leaders require a greater amount of rest. They should be aware of this strain, so they can be prepared to use their individual stress-coping mechanisms.

Obstacle 4: Decreased Efficiency

Leaders also must be aware that soldiers will operate at about 50 to 60 percent efficiency in temperatures of 50 degrees below. This is a critical consideration in planning. The simplest task could take up to five times longer to perform in the extreme cold.

Obstacle 5: Modified SOPs

Several modifications to standing operating procedures (SOPs) were necessary to prevent injury and ensure survival. A M1008 civilian utility cargo vehicle (CUCV), with a fuel heater for personnel in the rear cab, accompanied the advance party and main body on all movements to provide a heat source in case a vehicle broke down.

The M973 small unit support vehicle (SUSV) has a coolant heater that's minimally effective at -25 degrees or below. Further, the SUSV's heaters will provide heat only when the vehicle is moving or the engine is idling at 1,200 rpms. So if a SUSV engine quits on a movement, the crew would be at risk for cold-weather injuries in 15 to 30 minutes. The M1008 prevented cold weather injuries on several occasions when SUSVs broke down on the trail.

The advance party's priorities were to ensure security and set up warming tents and the position area. The M1008 provided a heat source for the soldiers while the warming tents were set up. Units must plan for the extra time required to erect the tents to give the advance party time to be prepared to receive the main body.

Obstacle 6: Fuel Resupply

Planning and executing logistical resupply become critical to accomplishing the mission and surviving. Operating in the extreme cold will greatly increase the use of mogas and diesel. Each Yukon stove burned an average of about 17.5 gallons of mogas every 24 hours. Idling the SUSVs greatly increases the use of diesel. The units' increased use of fuel stretched the battalion's petroleum, oil and lubricants (POL) resupply capability to its limits.

This problem was compounded by the fact that the battalion's POL trucks didn't have the cross-country mobility to reach some of the battery positions. We used a five-gallon can shuttle system to meet the battery's fuel demands. Every vehicle that left the battery returning

Redlegs of the 6th Infantry Div Arty operate a G/VLLD in sub-zero temperatures.

to the battalion trains shuttled empty fuel cans back to get topped off. Also, empty fuel cans were brought to the logistical resupply point (LRP) and filled when Class I was delivered.

Obstacle 7: Maintenance and Equipment

The following is a list of maintenance problems and equipment limitations caused by the extreme cold.

Ice Crystals In Diesel

Discussion. Condensation formed in the fuel tanks, pumps and lines because of the great temperature difference (100 degrees) between the indoor motor pool and the outside. After three hours of operation, the ice crystals built up around the injectors, cutting off the fuel supply and causing the engines to stop.

Solution. Add ethylene glycol monomethyl ether (icing inhibitor, NSN: 6850-00-753-5061) to the diesel to prevent the crystals from forming. Add the inhibitor one pint per 40 gallons of fuel.

Hoses, Cables and Belts Break

Discussion. At -60 degrees F, rubber loses its elasticity and becomes very brittle. Brittle rubber cracks or breaks when the slightest amount of pressure is applied.

The hydraulic damper line, rear radiator lines and IV cables (between the SUSV cabs) cracked and broke because of the bending caused by turning the vehicle. Engine belts broke on several vehicles. The rubber insulation on the RC-292 cable cracked when setting up the antenna. The Yukon stove's rubber gasoline line broke at the fuel can adapter when changing fuel cans. Also, the fuel can gasket broke when the adapter was tightened.

Solutions. Purchase locally a hose made of rubber designed to operate in the arctic environment for the SUSV damper hose and buy preformed hose insulation wraps for the IV radiator lines. Also secure the IV cable to the rear cab with nylon (550) cord. This limits the bending of the cable.

Inspect and replace cracked or frayed engine belts before deploying to a cold climate. Also, ensure engine belts on the prescribed load list (PLL) are at 100 percent stockage before deploying.

Keep the RC-292 cable warm until the antenna is ready to be erected and be sure the cable is warmed before bending or folding it.

For the Yukon stove fuel hose and fuel can gasket, have two men change the fuel can. One man handles the fuel can, and the other keeps the hose from bending by rotating the adapter's swivel.

Another solution is to have two complete fuel systems (burner plate, fuel hose and adapter) and just rotate them. When you have to change the fuel can, bring the warm system out and the brittle hose in to warm up.

Finally, you can replace the standard rubber hose with an arctic hose (NSN: 4220-00-542-3304) designed to remain flexible down to -50 degrees F. Also, an arctic fuel can gasket (NSN: 7240-00-132-6431) is available through the Army's supply channels.

Vehicle Batteries Stop

Discussion. At -40 degrees, current output is zero on a vehicle battery. Therefore to start a vehicle, you must use a heating source, either swingfire or Herman Nelson, to heat the batteries. It takes about 15 to 30 minutes to heat a battery to start the vehicle. In a field environment, this is impractical, taking too much time and equipment.

Solution. Idle vehicles in neutral at 1,200 rpms for two-hour periods. At the end of the two hours, turn them off for 15 minutes to perform preventive maintenance checks and services (PMCS).

Elevating and Traversing Mechanisms Inoperable

Discussion. During Brimfrost, temperatures approached and exceeded the lower limit (-65 degrees F) of the operating range of the grease (GAA) used to lubricate the elevating and traversing mechanisms. The howitzers were very hard to operate or stopped elevating or traversing because of the increased viscosity of the GAA.

Solution. Remove all snow and frost from arcs and pinions with a stiff brush before trying to elevate or traverse the howitzer. If they're frozen, use a heating source to gradually heat the elevating and traversing mechanism gear housing until movement is possible. Continue to elevate and traverse the tube until you get the full range of motion. In extremely cold weather, you must exercise the elevating and traversing mechanisms at regular intervals to prevent their freezing.

Breech Blocks Freeze Shut

Discussion. The severe temperature froze several breech blocks shut and made the others difficult to operate.

Solutions. Use a blow torch or heating device to thaw the breech block. After thawing, completely disassemble and clean all parts and apply a light coat of lubricating oil, weapons (LAW NSN: 9150-00-292-9689).

To prevent a breech block from becoming inoperable because of the cold, clean it and apply a light coat of LAW before deploying. Furthermore, you must exercise the breech at regular intervals when not in use to keep it operating smoothly. Cover the breech to prevent frost buildup when not in use or while traveling. Frost will break down the lubricating properties of your lubricant oil.

A SUSV pulls an M101A1 howitzer. The IV cable and radiator hoses between the cabs are susceptible to damage due to extremely cold weather.

Radios Freeze

Discussion. The coolant heater in the front cab of the SUSV could not produce enough heat to keep the VRC-46 radios from freezing when the temperature dropped below -25 degrees F.

Solution. Rotate the radios every two hours from the vehicle to the warm-up tent.

Push-to-Talk Switches Freeze

Discussion. After 30 minutes exposure to the extreme cold, several advance party soldiers' TA-312 push-to-talk switches froze, making the TA-312s unserviceable.

Solution. Have the advance party soldier put his TA 312 inside his parka after receiving his initial data. Then, re-hook the TA-312 after emplacing the howitzer.

Lost Current in Dry-Cell Batteries

Discussion. At -40 degrees F and below, all dry-cell batteries will freeze and lose all current in a matter of minutes.

Solution. Keep your batteries warm by placing them inside a parka until you need them. If you must keep equipment outside, rotate the batteries every 15 minutes.

Overview

We encountered and overcame all these maintenance and equipment problems on Brimfrost 89. Units deploying or operating in a cold-weather climate will find *FM 9-207 Operation and Maintenance of Ordnance Material in Cold Weather (0 to -65 F)* an invaluable reference. This excellent manual outlines how to prepare and operate equipment in extremely cold weather. Every unit library should have a copy.

Conclusion

Brimfrost 89 was successful, though it tested the limits of the Arctic Redlegs and our equipment. We learned many new lessons and re-learned some old ones. One lesson we learned is well-trained and well-led soldiers are more dependable and resilient in extreme temperatures than their equipment.

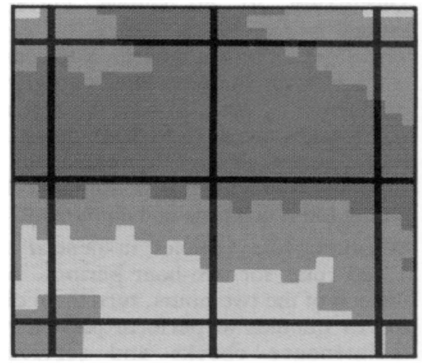
The knowledge and experience gained by our operating in temperatures below -60 degrees F enables the Arctic Artillerymen of the 6th Infantry Division to perform their mission better in the future. We are ***Arctic Thunder.***

Captain Patrick J. Sweeney is the Fire Support Officer for the 4th Battalion, 9th Infantry, at Fort Wainwright, Alaska. Until recently, he commanded A Battery, 5th Battalion, 11th Field Artillery, Fort Wainwright, a new COHORT battery he had commanded since before its official activation in June 1988. Captain Sweeney has served as the Battalion Motor Officer, a battery executive officer and fire direction officer and company fire support officer for 1st Battalion, 10th Field Artillery, Schweinfurt, West Germany. He's a graduate of the Combined-Arms and Services Staff School, Fort Leavenworth, Kansas; Ranger and Airborne Schools, both at Fort Benning, Georgia; the Field Artillery Officer Advanced Course, Fort Sill, Oklahoma; and the US Military Academy at West Point.

FOST: Innovative Training for Tomorrow's Battlefield

By Captains Joseph P. Nizolak, Jr., and William T. Drummond, Jr., and Dr. Michael J. Zyda

*This article kicks off **Field Artillery's** Simulation Series. In the coming editions, the Series will include articles on the Army's Family of Simulations (FAMSIM) managed by the Combined Arms Center, Fort Leavenworth, Kansas, and Field Artillery lessons learned in the Battle Command Training Program (BCTP) in heavy and light divisions and corps, among others.*



Simulation Series

The forward observer (FO) on the AirLand battlefield faces challenges as no FO before. Fluid battle lines, rapidly changing situations and a highly mobile, numerically superior enemy all dictate a need for the FO to plan quickly. These young soldiers must execute missions rapidly and on target while on the move. Instead of the classic infantry platoon in the open, their targets are mechanized forces swiftly moving over the battleground. The FO's ability to bring accurate suppressive fires to bear on this enemy is critical to the success of the maneuver element he supports.

Training for the Future Battlefield

Throughout the Army, we have two forums for training our FOs for the next battle. One is live-fire and the other is live-fire simulation, principally on the training set fire observation (TSFO). Let's examine how each of these meets the training requirements for the AirLand Battle.

Live Fire

There is no doubt that a live-fire exercise is beneficial training for the next battle. During a live-fire exercise, the entire fire support system gets hands-on training: guns, fire direction centers (FDCs). FOs and their fire support teams (FISTs).

But firing is expensive in all classes of supply, as well as in time and training-area requirements. There are few, if any, FOs who can consider themselves ready for combat based on their live-fire training.

Live fire has other training limitations. Our potential enemies are highly mobile. We must train our FOs to plan and responsively adjust fires on *moving* targets. This skill is a repetitive weakness during rotations at the National Training Center (NTC), Fort Irwin, California. And no wonder—the car bodies and dumpsters in the impact areas only move when they receive direct hits!

Safety requirements in our impact areas also cause constrained training by reducing the types of munitions the FO can request. Because of safety considerations in calling fire missions on the move and danger-close, as he will in the next conflict, the FO rarely, if ever, practices these precision missions.

Finally, and most obviously, local impact areas aren't like our future battlefield. Therefore, our FOs are not becoming familiar with the terrain on which they could fight.

The TSFO

The TSFO is a computer-synchronized array of slide projectors that gives FOs a two-dimensional view of terrain. By providing the ability to call for and adjust indirect fires on multiple terrains (a screen), the TSFO picks up where live fire leaves off.

Because of relatively low resource requirements, we can train on the TSFO virtually every day. This makes live-fire exercises more cost-effective by drilling the FOs and FISTs on the basics before they fire a round. It also offers a safe, controlled training environment so the FIST NCO can concentrate on his soldiers' training weaknesses.

The TSFO, however, has some serious training deficiencies. Regardless of efforts to make the 35-mm slide show seem real, the bottom line is the TSFO is two-dimensional.

The FO's greatest challenge is to adjust the range, but the TSFO doesn't allow him to use his depth perception. It prohibits shooting on the move and only displays an approximate 6x6-kilometer training area. Even a cursory glance at AirLand Battle doctrine tells us we won't stay in a 6x6 area very long, and shooting on the move is how we'll fight. Very few terrain depictions are available, and none is available for potential hostile areas such as Warsaw Pact nations or the Middle East.

Compounding the deficiency of the small area of operations is having moving targets limited to a total of eight vehicles. Trainers must plan these vehicles a day before training and can't change the programmed routes during training.

A final problem is the tactical fire direction system (TACFIRE) can't interface with the TSFO, though many enterprising units have come up with modifications to allow the TSFO to communicate with TACFIRE. We're an automated artillery, and our training systems should reflect that fact.

There are modifications to the TSFO that will enhance its training value. The project management office for the TSFO is monitoring the fielding of a ground-vehicular laser locator designator (G/VLLD) enhancement that replicates a G/VLLD in appearance and function. Another modification being considered is the ability to interface with multiple digital message devices so FOs can conduct simultaneous fire missions.

These modifications to the TSFO are good and do enhance its training value. But preparing for battle requires training techniques now prohibited by safety considerations and cost and that are not included in our current simulation systems. We must close the gap between what the TSFO provides and what we need.

FOST—A Better Way

Advancements in three-dimensional visual simulation software and "expert" systems can provide a better way to train FOs for the next battle. (An expert system is one capable of providing intelligent analyses and decision-making advice versus just "number crunching.") At the Naval Postgraduate School (NPS), Monterey, California, we worked on a prototype FO trainer we call the forward observer simulation trainer (FOST). Its basic requirements are a low-cost, off-the-shelf graphics workstation and the program code. A system like this holds many answers to the question of how we can best train our soldiers to be ready when our country calls.

Moving Platform Simulator

Graduate students at NPS began developing a software program called the moving platform simulator (MPS) in 1988. The MPS is a real-time, three-dimensional graphics simulation of vehicles and missiles moving over digital terrain. It uses Defense Mapping Agency (DMA) elevation data, the same used by TACFIRE, to depict actual terrain. The MPS displays a variety of vehicles (jeeps, trucks and tanks) and the fiber-optic guided missile (FOG-M).

Limited only by the terrain data base that's on hand, an operator can simulate occupying and driving vehicles anywhere in the world. Operators also can simulate flying a FOG-M to engage and destroy any land vehicles.

Networking computers allows multiple users on separate workstations to participate in the same situation. While networking, each operator drives his own vehicle. The monitor acts as a windshield so each operator can observe vehicles other network users are driving.

Research on MPS generated interest at the US Army Combat Developments Experimentation Center (CDEC), Fort Ord, California. Researchers at CDEC are interested in computer recordings of actual vehicle locations during unit training exercises. Using a system such as MPS, they can either display the vehicles in "real time" on a graphics workstation or replay the events at a later time.

The FOG-M capability provides researchers an aerial platform to view entire unit maneuvers. Commanders and staffs can then use these data to review and analyze their unit's actions, down to individual vehicle operations.

To develop an FO trainer, we used the MPS terrain and vehicle drawing algorithms. By depicting an on-screen digital message device (DMD) simulator to send fire missions, as well as other enhancements, we soon had a prototype for a three-dimensional FO trainer. The trainer runs on a state-of-the-art graphics workstation called the IRIS 4D/70GT manufactured by Silicon Graphics, Inc.

Graphics Workstation

The IRIS 4D-series graphics workstations include a library of graphic routines for drawing, coloring and lighting two- and three-dimensional objects (see Figure 1). In six months. we wrote the routines and the program code for FOST in the C programming language using the IRIS' graphics library.

The IRIS 4D/70GT's peak integer performance is 10 million instructions per second (10 MIPS), and it draws up to 40,000 shaded quadrilaterals per second. Because FOST is not solely a graphics program, the IRIS must perform additional calculations for non-graphics routines, such as DMD operations. Consequently, FOST displays an average of 17,500 polygons per second.

Despite these additional calculations, IRIS' high-speed performance allows FOST to operate at about seven frames each second. This means our on-screen picture is redrawn seven times a second. This rate is enough for smooth vehicle movement and no visible degradation of picture quality. In comparison, a television operates at about 30 frames per second.

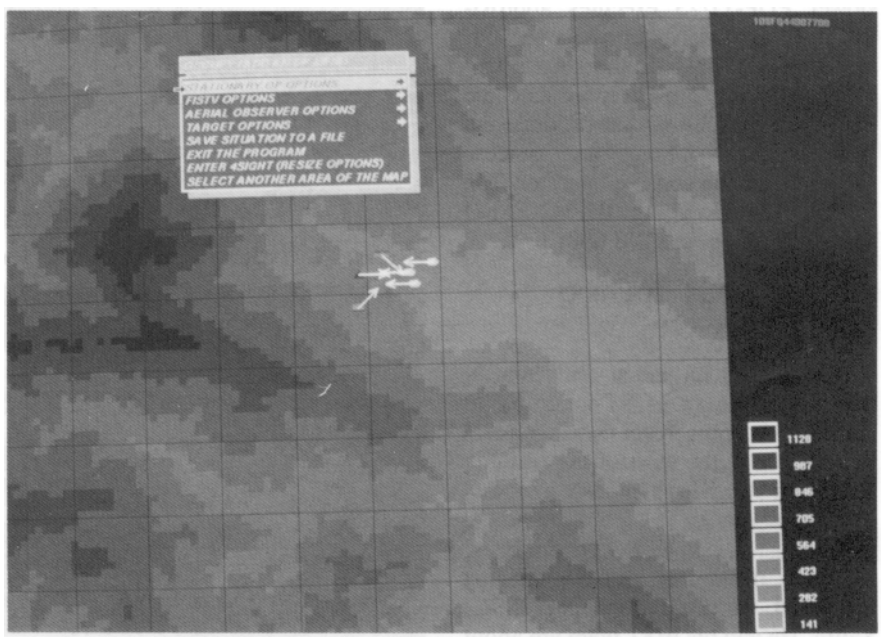
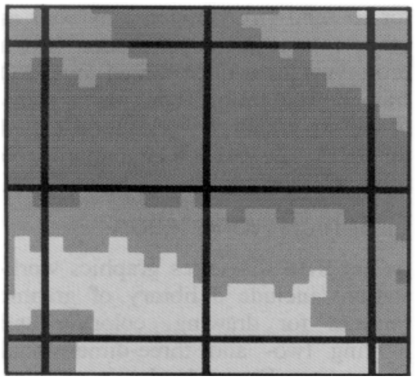


Figure 1: The FOST computer generates two- and three-dimensional objects.



Simulation Series

These IRIS workstations are available for approximately $65,000 each. You can train two FOs per computer and network them or buy a large-screen display for about $15,000 more and train several FOs at the same time.

More Power for the Money

State-of-the-art processor capability is absent from the PDP-11/23, an early 1970-technology computer that controls the TSFO. To get a better feel for the power available in today's computer systems, let's briefly compare the IRIS with the PDP-11/23.

The IRIS's rapid computational ability allows it to *dynamically* draw the moving screen images and process all input *directly* from the FO (driving or flying, calls for fire, networking with other computers, etc.). The much slower PDP-11/23 executes approximately 33,000 instructions per second. As currently fielded, the PDP's primary functions are to coordinate the nine slide projectors that produce the two-dimensional image and process FO input via the console operator. The TSFO, not including the G/VLLD trainer, costs about $120,000.

Current FOST Training Capabilities

Because of its menu and mouse-driven technology, FOST is simple to operate. An on-screen users' manual is available at the start of the training session that reviews mouse and dial operations.

To illustrate how FOST operates, let's look in on a typical fire support team led by Staff Sergeant (SSG) Smith. He and his FIST team are about to begin a training session using FOST.

Initial Setup. SSG Smith creates a training scenario to fit his team's needs. He begins by selecting the terrain data base for the area of operations, which could be any standard DMA elevation data file. (A standard DMA data file is one degree in latitude by one degree in longitude. An area this size covers approximately 3,600 square miles.) This is a very simple operation consisting of pop-up menu selections using a standard computer mouse.

The FOST now displays the data base SSG Smith selected in a very familiar format, a two-dimensional map with Universal Transverse Mercator grid lines. A red box outlines the center 10x10-kilometer area and another pop-up menu automatically appears (see Figure 2). SSG Smith again uses a mouse click to select an option of using either the center area as his initial area of operations or to move the highlighted box to any other 10x10 area on the map.

After selection of the initial area of operations, FOST expands this area to full screen size. This allows easier placement of vehicles and observation posts (OPs). SSG Smith is now ready to input the tactical scenario.

The initial tactical situation is SSG Smith's decision. A series of pop-up menus guide SSG Smith through placing friendly and enemy vehicles, stationary OPs, fire support vehicles (FISTVs) and OH58D helicopters, setting their initial locations, directions and speeds. (See Figures 3 and 4 for FOST menus on target selection and OP options).

SSG Smith can load stored situations or create new situations he can store for later use. Storing tactical situations allows repetitive training to build strengths or correct any shortcomings of a previous session. The focus of the training is the trainer's call.

Supporting maneuvering forces while they close with and destroy the enemy is arguably the most important fire support mission. SSG Smith knows this, and FOST allows him to realistically train his soldiers on fluid situations. Because he positions friendly vehicles as well as enemy, his team can practice adjusting on the enemy while they advance with their supported unit. The FO can see the "friendlies" rather than imagine them.

Challenge the Individual. SSG Smith has his new soldiers simulate occupying

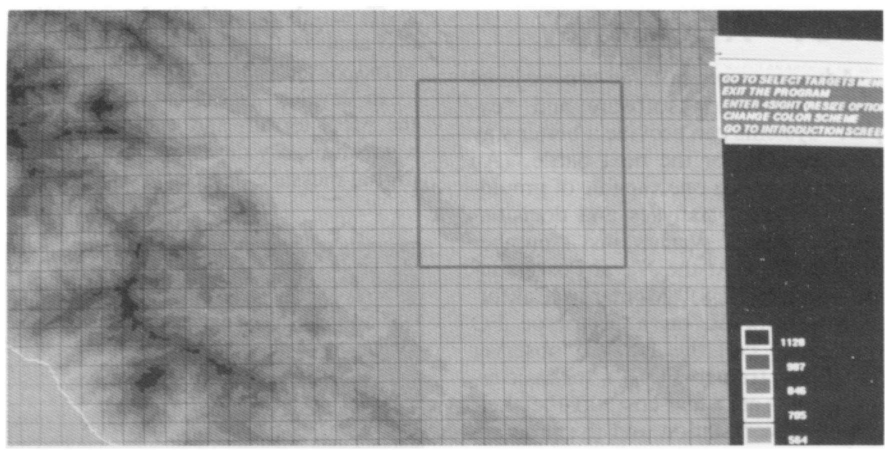


Figure 2: FOST operators select the initial 10x10 operation area.

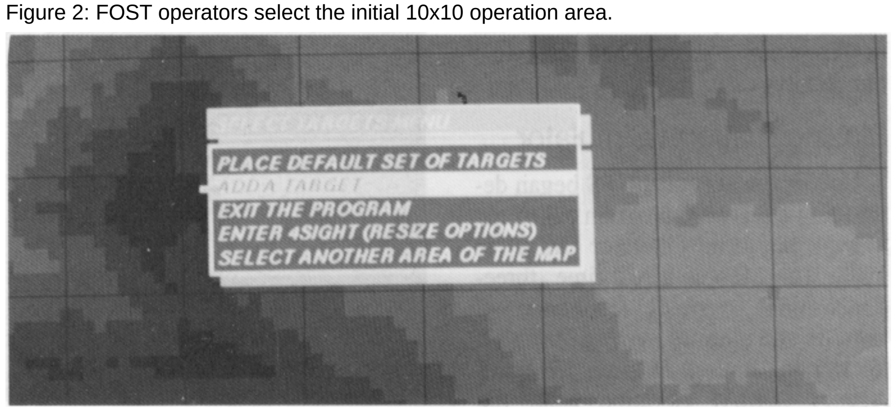


Figure 3: The Menu for Selecting Targets

stationary OPs and directs them to engage the stationary targets on the battleground. His more seasoned team members simulate occupying FISTVs, while the advanced FOs get to adjust from a scenario that simulates an aerial observer in an OH58D. The moving OPs are easier to control with two team members: one to drive or fly using a simple set of dials to regulate speed and direction, the other to operate the DMD.

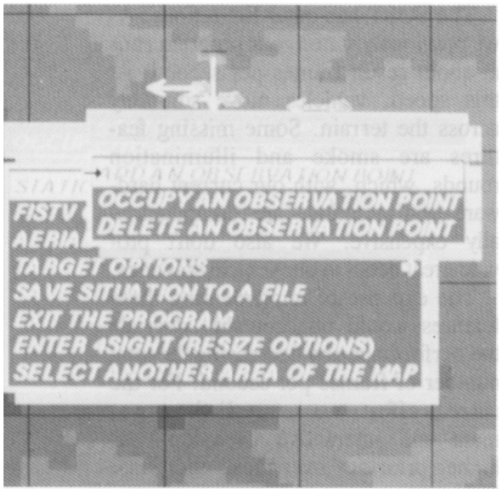


Figure 4: The "Roll Off" Menu for OP Options

SSG Smith challenges the FOs in moving OPs (FISTV and OH58D) with moving targets. He knows that with this type of individual training, his team can get ready for Lieutenant Jones' FIST exercise, which will use FOST's networking capabilities.

Training Realism. "Live-fire" training begins with occupation of the simulated OP. SSG Smith supervises and assesses all the actions of his FIST while it fights the battle.

The main window of the screen display shows the three-dimensional terrain that SSG Smith selected. Because FOST produces this terrain from DMA data, the FOs use their standard military maps to orient themselves and locate targets. Although FOs "never get lost," FOST still provides reference information, such as compass headings and current grid locations in the right margin of the screen.

The functional, on-screen DMD appears in the lower right corner (see Figure 5). The FOs conduct fire missions with the DMD by "pressing" the onscreen keys, using the mouse cursor. SSG Smith's team is now ready to engage targets.

FOST allows SSG Smith to train his team with a dynamic and realistic situation. The FOs input fire missions via the on-screen DMD to adjust fire or fire for effect.

The team attacks targets with appropriate high-explosive ammunition and receives clear feedback of a target destroyed when the adjustment is within 50 meters (see Figure 6). We currently have the following shell-fuze combinations: high-explosive/point-detonating (HE/PT), high-explosive/variable-time (HE/VT) and improved conventional munitions (ICM).

Knowing FO training wouldn't be realistic without binoculars, FOST provides a magnified view, complete with reticle pattern, at the click of a mouse button. SSG Smith also can change the area of operation, add more targets or switch assigned OPs with pop-up menu selections.

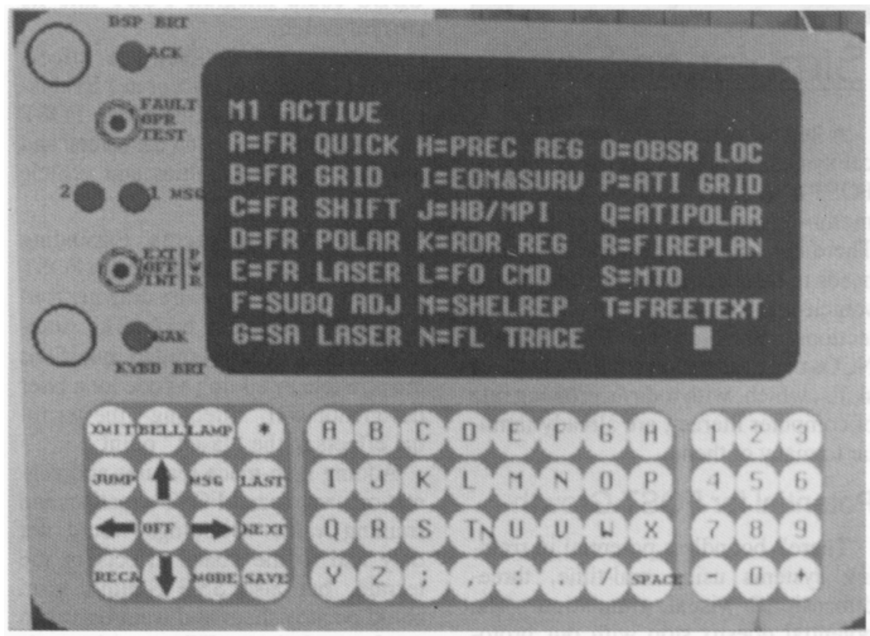


Figure 5: FOST's DMD menu selection is identical to the actual DMD's.

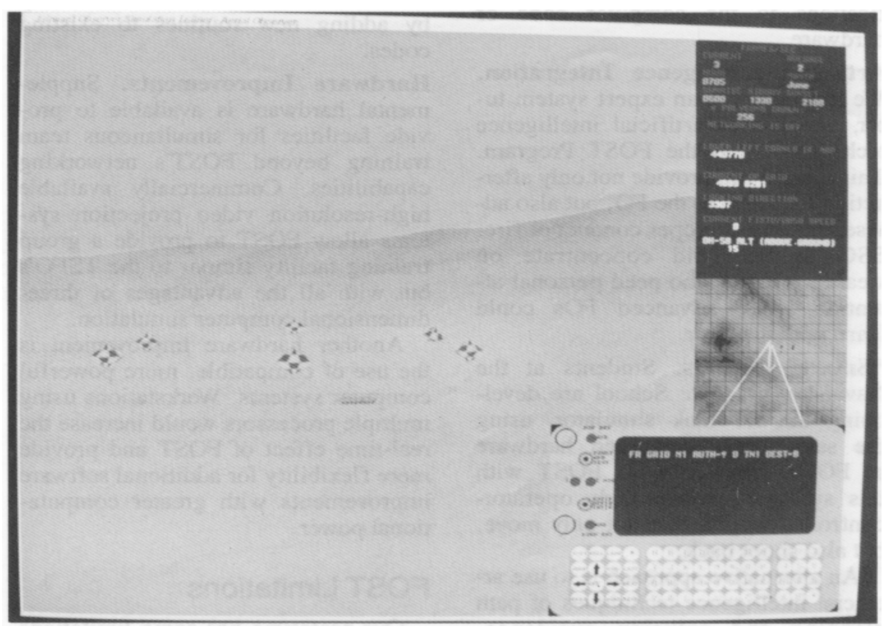
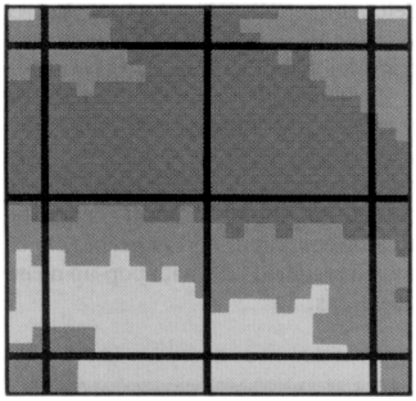


Figure 6: FOST shows a fire for effect on a tank (one six-gun battery), using the standard battery computer system pattern.



Simulation Series

A key concern for any highly technical system is that of user-friendliness. FOST's program setup is completely menu-driven and self-explanatory. There are only two devices the soldier needs to handle: the dials to control his vehicle and a mouse to make DMD selections and adjust his "binoculars." NCOs can easily train soldiers on these skills, which, with today's growing rate of computer literacy, are already familiar to many of them.

Potential for FOST Growth

There's boundless potential in training systems using real-time, three-dimensional visual simulation. The potential doesn't stop with our prototype or even the hardware used. Many other features are possible with modifications to the computer code or hardware.

Artificial Intelligence Integration. We can integrate an expert system tutor, which uses artificial intelligence techniques, into the FOST Program. This system can provide not only after-action feedback to the FO, but also advise him on the proper conduct of fire. SSG Smith could concentrate on weaker soldiers who need personal attention while advanced FOs could learn with the tutor.

"Smart" Targets. Students at the Naval Postgraduate School are developing an M1 tank simulator, using the same basic code and hardware as FOST. Integration of FOST with this system would provide operator-controlled targets that not only move, but also shoot back.

An alternative approach is to use artificial intelligence techniques of path planning and collision avoidance. "Smart" enemy vehicles could autonomously attack and maneuver on the FO's position. Tying all of this together results in a combined-arms training system: armor and mechanized infantry firing and maneuvering with artillery providing fire support.

Fire Support Assessment. We briefly mentioned how the CDEC is using FOST's predecessor to depict and record exercise vehicle maneuvers. By expanding FOST to include firing unit positions, munition effects tables and other gunnery related parameters, CDEC could integrate FOST into its current system.

Evaluation of indirect fire effects would become more accurate. Evaluators could observe effects that FOST realistically simulates on the screen and assess accurate casualties and vehicle losses.

Graphics Enhancements. Expanding the current types of munitions in FOST is a matter of adding more drawing routines to the computer code. The simulated effects of laser-guided munitions are possible by adding a code for a laser designator and "directing" the terminal effects to the "lased" point.

Adding man-made features and vegetation can expand FOST's realism and training value. Buildings would not only add to the visual effects of the terrain, but also SSG Smith's team could occupy them and train on urban warfare techniques. Whatever demands FOs face, a computer graphics system, such as FOST, can simulate them easily by adding new routines to existing codes.

Hardware Improvements. Supplemental hardware is available to provide facilities for simultaneous team training beyond FOST's networking capabilities. Commercially available high-resolution video projection systems allow FOST to provide a group training facility similar to the TSFO's but with all the advantages of three-dimensional computer simulation.

Another hardware improvement is the use of compatible, more powerful computer systems. Workstations using multiple processors would increase the real-time effect of FOST and provide more flexibility for additional software improvements with greater computational power.

FOST Limitations

Our prototype has some limitations that require further developments. The majority of these limitations flow from our desire to produce a basic trainer within the time constraints of our graduate program. The DMD isn't yet fully operational because we haven't implemented all the menus, missions and functions included in a real DMD. Terminal effects don't take into account data from munitions effects tables, since our main thrust is to provide the FO visual feedback on the accuracy of his calls for fire. We draw only a limited number of US vehicles and don't depict vehicles of other nationalities.

The FOST has other limitations. As we previously stated, our program runs at about seven frames per second. At this speed, vehicles move smoothly across the terrain. Some missing features are smoke and illumination rounds, which, with our current hardware configuration, are computationally expensive. We also don't provide great detail in our vehicle drawings.

The expense of implementing these features would unacceptably degrade the performance by decreasing the total number of frames per second. For the current effort, we set realistic movement and interactive user input as higher priorities over these additional features.

Conclusion

FOST is a flexible system of seemingly boundless potential for growth and development. We aren't suggesting the Field Artillery replace live-fire exercises with simulation training, but we can make live-fire training more cost-effective in the same way the Unit Conduct of Fire Trainer aids armor and mechanized units.

Realistic and innovative training must be the keystone of all future artillery training systems. By taking advantage of current technology, FOST meets this challenge. Low cost and availability of in-house assets warrant continued work on this type of training system.

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HIP—Visions and Reality

by Lieutenant Colonel (Retired) William W. Breen


Sam Orr

The advanced Field Artillery system, cannon (AFAS-C) is scheduled to reach the field in about 10 years. The Field Artillery community (including user and development commands), with the help of segments of the defense industry, is examining the mission of a future howitzer, the tactics to accomplish it and the technologies to use those tactics. The "organism" to bring forth the howitzer of the future is coming to life.

It's appropriate to review the recent history of that same community's efforts to develop, test and field a revolutionary Field Artillery system, the soon-to-be produced M109A6, referred to as HIP for howitzer improvement program. It was 10 years ago that we were at the same point in the HIP program as we are today for the AFAS-C. By comparing our expectations of a decade ago to the capabilities we're likely to realize with the HIP, we might gain some insights to shape and schedule the work ahead.

Just as the AFAS-C isn't fully defined today, the howitzer of the future had no officially sanctioned description in the late 1970s. But concepts existed, especially among those who were witnessing the early development of the components that could be exploited in the new Field Artillery system.

As the baseline for this retrospective, I use two articles from that era I wrote for ***Field Artillery,*** both dealing with changes in equipment and doctrine that would have to be in place by 1990 to meet the anticipated threat. The first, "Survivable, Affordable and Lonely" (November-December 1977) offered a concept of operation using a randomly distributed force of autonomous howitzers. By 1980, the equipment to make the concept a reality began to emerge. My article "Direct Support Field Artillery Beyond 1990" (July-August 1980) identified the building blocks of a direct support system whose centerpiece was to be "the autonomous self-propelled howitzer." (The ideas for both articles came from observations of Human Engineering Laboratory's Battalion Artillery Test or the HELBAT Series and participation in the Legal Mix Study. The ideas, therefore, were not uniquely mine, but were shared by many who took part in those projects.)

The purpose of this article is to determine if we now have the capabilities in HIP that seemed within reach at the beginning of its long development process. Where did we exceed expectations or fall short and why?

The Need

The 1977 piece cited the counterfire odds in Europe and pointed to the introduction of "self-propelled, crew-protected Soviet howitzers" as motivation for a new approach to direct support Field Artillery concepts and hardware. In their April 1989 article in *Army* magazine titled, "We're Being Outgunned in the Field of Fire Support," General (Retired) Glenn K. Otis and Brigadier General (Retired) Paul F. Pearson cite "NATO's chronic inferiority in the weight of artillery deployed in Europe...." A recent US Army Field Artillery School (USAFAS) briefing credited the Soviets with 50,000 fire support weapons, nearly a 10 to 1 advantage over the US.

Expectations Fulfilled

What kind of system is about to arrive, and how does it compare to the plans of 10 years ago? At the direct-support echelon, we can measure expected capabilities against those delivered by the development of the HIP. That howitzer and the tactics and systems that will support it will be the backbone of our direct-support artillery for many years to come.

Semiautonomous Operations

The 1980 article called for a weapon "capable of locating and orienting itself, processing its own gunnery solution..." with "processors for orientation/navigation, fire control and communications." The automatic fire control system (AFCS) and modular azimuth positioning system (MAPS) on the HIP prototypes meet that requirement.

The organization and operation plan calls for howitzers to be widely deployed in pairs, as opposed to the single, "lonely" arrangement suggested in the articles. The newer idea is the better one; considerations of local defense and reciprocal lay in the reversionary mode, in addition to simplified logistical support, are strong arguments that a pair beats one-of-a-kind.

Enhanced Survivability

Even when facing the most sophisticated enemy, a howitzer should have at least two minutes of safety from exposing itself by firing before counterfire arrives. It was expected that our new weapon would be able to fire eight rounds and displace 300 meters in that time. As now equipped, a *pair* of HIPs could do this. Not only will a HIP displace beyond the counterfire footprint in the time allowed, it can be ready to fire again within 75 seconds, thanks to AFCS and MAPS.

The HIP will include means of survivability beyond simply "scooting." Kevlar and steel plates will supplement the aluminum armor found on earlier M109s. Hydraulic components have been collected and isolated with fuses installed in hydraulic lines. The probability of hitting a propellant container has been reduced; USAFAS plans other means of isolating propellant as a product improvement.

By contrast, the earlier articles envisioned that *agility* would be enough—that we should eschew armor in favor of rapid acceleration, thus realizing the "survivable, *affordable"* howitzer. All things considered, I believe most artillerymen would rather fight in a HIP than rely on a soft-top "dragster" for survival.

Better RAM

We hoped that, given the complexity of the equipment being added to the howitzer, it could at least match the reliability, availability and maintainability (RAM) figures of the M109A2 howitzer. Because of improvements specifically aimed at replacing unreliable components, predicting or detecting failures and easing maintenance chores, the HIP version *should* outperform its older brother in these areas. To meet the HIP goals, however, the reduction in failures by the old components must more than compensate for failures in the new components. The jury is still out.

Longer Range

The HIP will generate greater range than its predecessors—24 kilometers unassisted and 30 kilometers with a rocket-assisted projectile (RAP). It's capable of improving those numbers to 30 and 40 kilometers, respectively, if the 52-caliber cannon adopted by the Quadrilateral Ballistics Working Group is added as a product improvement. (The Quadrilateral Group—US, Great Britain, Federal Republic of Germany and Italy, with France as an observer—helps to standardize howitzer systems in NATO.)

Today it's a bit hard to believe that the ***need*** for longer range was an issue for debate during the first half of this decade. Despite apparent benefits from shooting more deeply (or positioning deeply) and better lateral support, analysis couldn't prove that more range was cost-effective. Weapon system improvements were to be limited to those affecting RAM only! Fortunately, General Maxwell R. Thurman decided range for its own sake was a requirement.

Better Battery-Level Ammunition Supply

The 1977 article stated that of all the systems and processes that might affect the performance of a new howitzer, "ammunition resupply will become the greatest inhibitor of effectiveness...."


TEXCOM Field Artillery Board

HIP has a greater range than its predecessors —24 kms or 30 kms with RAP.

In the same *Journal* issue, the Commandant of USAFAS, Major General Donald Keith, wrote that his successor would "have his hands full...correcting the ammunition distribution and handling system."

Fortunately, a lot *has* been done at the "retail" end of that system, particularly due to the development and fielding of the M992 Field Artillery ammunition support vehicle (FAASV). But the continued expansion of the 155-mm projectile family and intractable problems at the "wholesale" level assure that artillery ammunition resupply will be a continuing challenge, perhaps still the "greatest inhibitor."

Not Yet

A number of howitzer capabilities and support systems anticipated in the 70s won't be realized in the early 90s. Some equipment lacks priority for funding. Some operational ideas simply haven't caught on.

High Rate of Fire

As mentioned earlier, we saw firing rate as a survivability feature as well as an effectiveness improvement. Rounds delivered more quickly are inherently more effective against most targets, so an individual howitzer might need to fire one or two less rounds on a given mission. Because fewer rounds could be fired more quickly, counterfire would be avoided without disrupting the mission. Eight rounds and scoot was the rule of thumb to be used to increase chances of escape.

The not-to-exceed production price for HIP precluded inclusion of a loader-assist in HIP. Fortunately, a parallel howitzer development for the Israeli Defense Forces (IDF) and work by Army laboratories and industry have made an improved firing rate available as an enhancement to the HIP. Recent testing of a loader-assist and an automatic primer feed have shown we can achieve the desired rate-of-fire today. Funding and analyses will determine when and if we can add this key capability.

Crew Reduction

Since the manpower-saving devices expected in 1980 were not included in the developed system, we didn't meet this goal. Note that even if we had achieved some reduction in the howitzer crew, it wouldn't have led to fewer Field Artillery "slots." The demands of the ammunition resupply mission and crew rotation would permit only functional reassignments, not reductions.

This factor deserves continued consideration as AFAS-C renews the promise of manpower savings. We shouldn't give up cannoneer positions until we know the full impact of extremely high firing rates.

Data Distribution System

Although HIP will operate in data nets via the single-channel ground and airborne radio system (SINCGARS), the original goal for data distribution was more ambitious. An Army data distribution system (ADDS), probably a hybrid of the position-locating reporting system (PLRS) and joint tactical information distribution system (JTIDS), would provide a dedicated net for communication *and* position. The advantages to tactical fire control are obvious, but ADDS also would subtly enhance technical fire control.

Since all weapons, target acquisition systems and, by extension, targets, would be on a common electronic grid, they also would be on a common gunnery grid. Even an error in locating the central system would not change the relationship of the "members of the grid." Thus additional data distribution capabilities would improve overall system accuracy.

But howitzers must point as well as locate, so a direction-finding system was required for each weapon. And any system capable of determining accurate direction can become a navigator as well. Thus, the howitzer would have an independent backup to ADDS.

The backup soon became the primary position location system. We developed MAPS while the development of ADDS has lagged. So each HIP will have an accurate, fast, on-board navigation system, but we haven't realized the advantages of a common grid.

Sensors and Setters

A whole range of passive and active sensors and fuze setters seemed possible and practical during the early planning stage. The 1980 article listed "on-and off-board fuze setters" and "sensors for inventory, powder temperature, muzzle velocity, cant, etc." Of all of these, the HIP will have only a cant sensor embedded in MAPS and be able to accommodate a muzzle velocimeter.

Automatic fuze setting saves time and reduces errors. Off-board, "post-launch" fuze setting also improves accuracy by accounting for velocity errors, assuming muzzle velocity is measured concurrently. If those factors combine with accurate relative location, we can *derive* rather than measure meteorological corrections, enhancing accuracy.

But once again, funding constraints and the complexities of interdependent development programs, as well as the judicious application of the keep-it-simple-stupid principle, have kept these intriguing possibilities on the wish list.

Centralized Control, Decentralized Execution

Given fully autonomous howitzers and a fire control system that would operate primarily in an all-digital net via ADDS, a 1990s battery "slice" was proposed in the 1980 article. Battalion fire direction centers (FDCs) were to conduct the fire fight, mostly by assigning howitzers directly to acquisition systems for dedicated service during a mission or even a battle.

Meanwhile, the battery operations center (BOC) and the battery officers were to manage the resupply of the howitzers and to conduct unit moves (as opposed to the local "scooting" the section chief would conduct within designated areas). All unit-level resupply was to be centered on well-camouflaged and protected battery support areas.

On-board ballistic solutions and use of battery support areas will be key elements of direct fire support in the 1990s. However, the lack of a dedicated, centralized digital data system and a general reluctance to dedicate weapons (the "golden gun" syndrome) have limited changes to tactical fire control procedures and responsibilities.

Back to the Future

This 10-year retrospective shows a development process that has been conservative but successful. Most of the equipment and ideas envisioned in the late 70s are about to become realities. Especially important is the opportunity to exploit these developments by using tactics that can offset numerical disadvantages. As for the expectations that didn't work out. we replaced some with better ideas, others felt the budget ax and still others will have to wait for the AFAS-C.

Given our track record of the last decade, what then should we expect of the AFAS-C? The list of technologies to be applied is impressive, but the goals remain strikingly familiar: greater range, higher firing rates, improved accuracy, signature reduction, enhanced survivability, etc.

If the past is prologue, we should expect to meet many of these goals, but only if the Field Artillery community works continually and intelligently to achieve them. In addition, we must be ready to accept and overcome a few disappointments along the way.

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