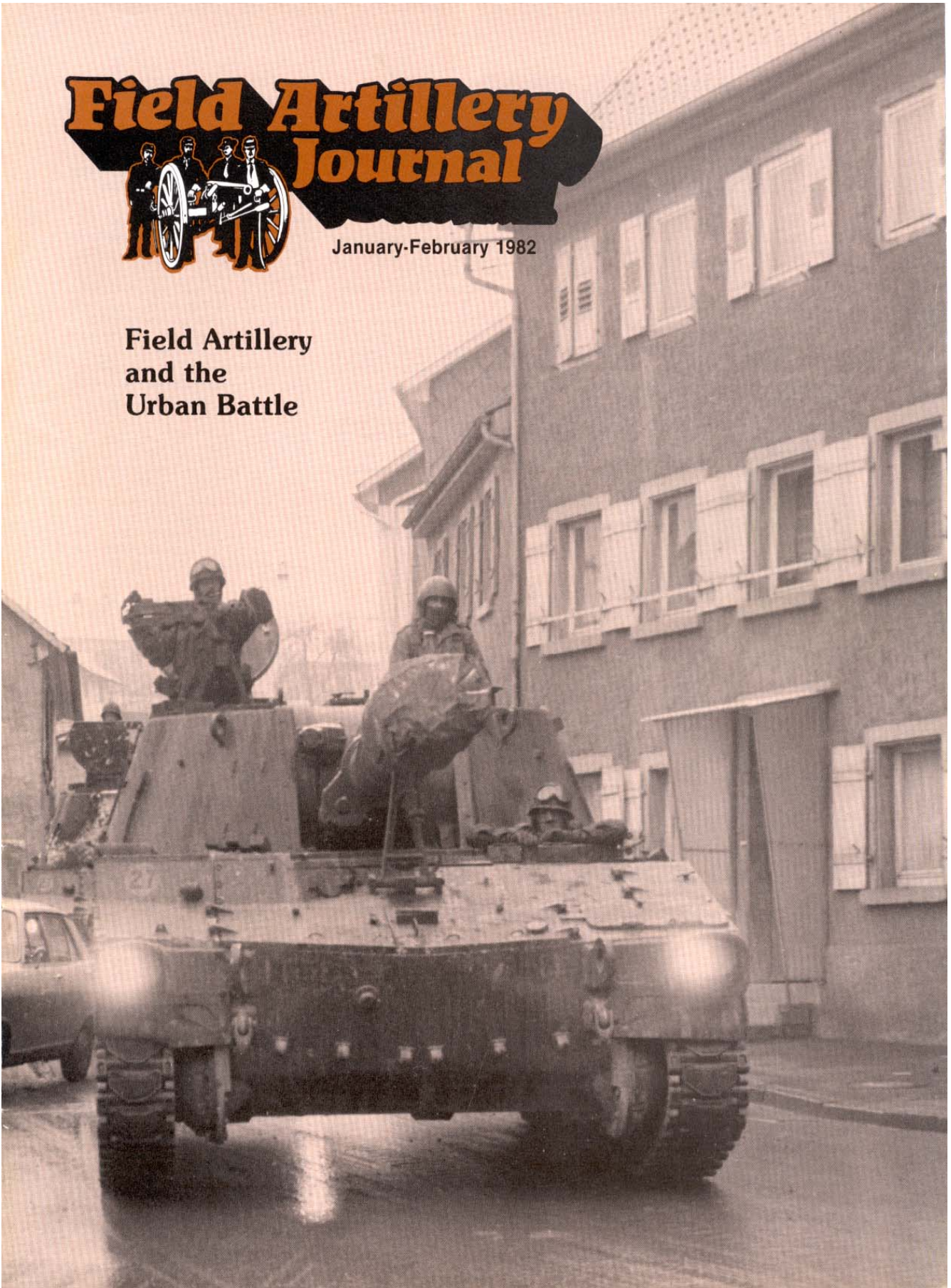


# Field Artillery Journal



January-February 1982

## Field Artillery and the Urban Battle





Volume 50

January-February 1982

Number 1

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# On the Move

MG EDWARD A. DINGES

The Army Training and Evaluation Programs (ARTEPs) are designed to serve as a management *tool*, but I am concerned that many field artillerymen may view the ARTEP as a form of management "club"—in other words, another test to be "crammed" for and retaken if not successfully passed. If this perception is correct, we then have a serious flaw in our understanding of the program and its application to the future battlefield.

When the ARTEP first entered the training arena as a replacement for the Army Training Program (ATP) and the Army Training Test (ATT), there was initial confusion and question as to its real purpose. For example, some asked, "How can the ARTEP replace the ATP and ATT when it is not a test that a unit can either pass or fail? Others voiced that the ARTEP was merely another version of the ATT cleverly hidden behind a new acronym or "buzz word." Through experience and education, we answered those concerns in varying degrees, but I sense we need to briefly refresh our thinking on the ARTEP's purpose and goal.

## The ARTEP

The Army Training and Evaluation Program places the commander in total charge of the training in his unit. He and his trainers—down to first-line supervisors—are provided training objectives, aids in determining training proficiency, and aids to manage resources so that the unit can accomplish its mission. Basically, the ARTEP provides answers to three obvious questions:

- Where is the unit now in training proficiency?
- Where should the unit be in training proficiency?
- Where should the unit put training emphasis?

For the trainer, the ARTEP describes the task, the combat conditions under which the task will be performed, and the standard of performance that must be achieved. Last, but not least, it outlines the training support requirements, such as devices or items of equipment, which

will assist in accomplishing performance-oriented training.

Clearly then, the environment of the ARTEP should be a continuous cycle of identifying unit needs followed by subsequent training and evaluation with the objective of building and maintaining a combat ready unit. The real key here is *continuous* rather than annual, semiannual, or other less frequent analysis of training goals. For instance, on a day-to-day basis, if a commander determines that his unit is not achieving the performance-oriented training standards set forth in the appropriate ARTEP, he then has the ability to develop and carry out immediate corrective training to meet those standards.

## ARTEPs Revised

Field Artillery ARTEPs have recently undergone a complete reanalysis based on the TRADOC Battlefield Development Plan and the Field Artillery School's Fire Support Mission Area Analysis. Resulting revisions incorporate new doctrinal concepts, use of new and improved equipment, and invaluable feedback received from field units. These ARTEPs are now reaching the field or will be shortly. See this month's "View From The Blockhouse" for more details on when to expect the revised ARTEP for your specific type unit.

In general, these new ARTEPs have been:

- Designed to support maneuver tactics.
- Organized by force field artillery headquarters, battalion, battery, platoon, and section.
- Cross-referenced by listing the supporting subordinate element mission numbers under battalion and battery tasks. Further, they list supporting soldier's manual task numbers under section-level tasks.
- Expanded to include training objectives for new equipment; e.g., Firefinder, position azimuth determining system, ground laser locator designator, and Copperhead.
- Expanded to include information for training and evaluation exercise planning; training objectives for



operating in an active NBC environment; command group tasks at all echelons to aid in training leaders to plan, coordinate, and supervise their units; guidance on the use of fire mission standards; a list of approved crew drills and procedures included in the Army-wide standardization program; and a "threat overview" applicable to the type of field artillery organization to be trained.

At the same time, we are still working hard on how to train to ARTEP standards in an ammunition scarce environment. I intend to share our thinking and the good ideas from the field on this issue in one of my next columns.

## Conclusion

In conclusion, the ARTEP should be an effective management tool rather than a periodic unit motivator. It is designed *solely* as a *diagnostic aid* for the commander's use in planning and evaluating unit training. When used correctly, the ARTEP allows us to simultaneously and continuously plan, execute, and evaluate the training of our units. In this way we can meet the Army's number one priority—maintaining cohesive, combat-ready units that will survive on the modern battlefield. ☒

# Incoming

## LETTERS TO THE EDITOR

### Speak Out

The *Journal* welcomes and encourages letters from our readers. Of particular interest are opinions, ideas, and innovations pertinent to the betterment of the Field Artillery and the total force. Also welcomed are thoughts on how to improve the magazine.—*Ed.*

### Finished at 40?

"PT test coming up next week chief, are you ready?"

The chief grunted and the chair groaned as he adjusted his bulk and turned to answer. "Ready? I don't have to worry about that stuff anymore, I'm finished. I had my 40th birthday last month."

That's exactly the way many senior soldiers seem to feel about physical fitness. Unfortunately, that also seems to be the general attitude of Army personnel. Sergeants, warrant officers, and officers over 40 years of age, many grossly overweight, are excused from PT programs and PT tests. But why?

After closely examining and analyzing all the facts, I find it difficult to cite a valid or logical reason for excluding soldiers over 40. The people involved come up with a multitude of reasons for non-participation — the majority of which are weak rationalizations to justify their indifference, lack of initiative, and laziness. "Gee I'm pushing 50, why should I be expected to keep up with those young healthy kids?" "I'm over 230 pounds and I can't be expected to run that far or do that many pushups." "I have these fantastic lower back pains and my ankles just won't take that running." "I'm too busy." Sound familiar? Of course, you have heard these excuses and many like them.

What does the Army have to say about this over-the-hill group? AR 600-9, paragraph 7b states: "All military personnel 40 years of age and over are responsible for maintaining a level of physical conditioning that will enable them to perform their current duties and prepare them to

perform more rigorous duties if required." Let's take a look at that very vague and general statement, "Level of conditioning to perform current duties." Just what type of duties are these soldiers required to perform? The majority are supervisors, have staff jobs, or are engaged in jobs that require very little physical exertion at all. However, in the next part of the sentence we have the ringer, "And prepare them to perform more rigorous duties if required."

As soldiers or fighting men we are pledged to defend our country and may find ourselves in a combat situation where we will be called upon to perform more rigorous duties. One of the primary responsibilities of a soldier is to be prepared physically to meet the requirements of direct involvement in combat. Today's highly mobile and fluid battlefield situations have made such terms as noncombatant archaic. There were many situations in Vietnam where noncombatants and soldiers over 40 had to fight; even in hand to hand conditions. Many of these people died because they couldn't "perform the more rigorous duties."

The over-40 group provides a majority of the Army's leaders and supervisors who are required to set the example. It's common knowledge that the days of "Don't do as I do, do as I say," are over. As such, how can leaders and supervisors expect today's young soldiers to understand the importance of physical fitness unless they set the example? In many cases, they will be serving in positions which will require them to supervise and hopefully lead PT programs. FM 21-20, paragraph 35, states: "Your strength, endurance, posture, and skill should set the example. This does not mean you must excel, as your men do not expect championship performance; at the same time they do expect, and deserve, a creditable showing of fitness for the job."

As stated previously, the very nature of a military environment and the demands that it can impress on all members should be enough to provide the incentive for them to maintain a high level of physical fitness.

Unfortunately, the over-40 group does very little on their own to keep fit, and four out of five are good candidates for illness and disease. It's time the Army in general and the leaders in particular take a good hard realistic approach to the situation. With a majority of the over-40 military population in the deconditioned state, something is obviously wrong.

At the present time there is no way the Army can determine just exactly how physically fit are personnel 40 years of age and over. AR 600-9, paragraph 9d, states: "Personnel 40 years of age or over may elect but are not required to take the minimum physical fitness test." Even if they elect to take the test, and very few do, there are no standards established for this age group.

There seems to be only one logical approach to solve this problem. A standardized physical training and testing program must be initiated to include the over-40 group. Coordination should be made with our medical facilities so that personnel with profiles can be included, perhaps on a modified basis, in the program.

Introduction of a program should be preceded by, and supplemented with, a good comprehensive publicity campaign. Education and awareness of the dividends and benefits that can be realized from such a program will help provide the individual incentive and motivation required for positive participation.

The Army is extremely concerned about resource management and maintenance of equipment — preventive maintenance to insure that our equipment doesn't break down when we need it and a multitude of operational tests to insure that it will perform when we need it.

There is no doubt that the concern for, and care of one of our most important resources has been sadly neglected — the over-40 soldier. They should not be finished at 40; they should be entering into the most productive and rewarding phase of their military career.

CW4 Peter D. Cosgrove  
CFD, USAFAS  
Fort Sill, OK

## Extending the battlefield

Since the Vietnam War, the *Journal* has published articles emphasizing that the "battle will be fought at the division level."

- Corps artillery headquarters has been reduced to a section.
- Counterbattery responsibility has been transferred to division artillery.

Such thinking and action can be termed "the Vietnam Syndrome." It stems in part from the action in Vietnam where a corps headquarters served additionally as a territorial headquarters. Recent developments in acquisition, targeting, and weapons systems have changed all this! If you don't think so, just read two articles in September-October 1981 issue of the *Journal* titled "Extending the Battlefield" and "Implementing the AirLand Battle."

The technological developments outlined hold promise of our ability to blunt the enemy attack before it reaches the division level.

The conception, planning, and execution of the requisite integrated air-ground fire plan will be the responsibility of the corps. Reestablishment of the corps artillery headquarters is a *must!*

The table of organization and equipment, in addition to adequate command and staff, must also provide the required assets—command and control, communications, intelligence, target acquisition, etc.

The rank of the commander should be commensurate with this new responsibility.

Roland P. Shugg  
BG (Ret), USA  
Oakland, CA

*Your belief, Sir, in the necessity of a viable corps headquarters is currently shared by many throughout the Army and a return to such a headquarters is planned as a part of the Corps '86 organization. The de-emphasis on the corps itself was due primarily to the new requirements of the division. For example, a division of today deployed as per the AirLand Battle concept occupies an area 10 times larger than that of a division in World War II. Many of the recent changes in how we operate were necessitated by the realities of the capabilities and numbers of our artillery systems. As new equipment with expanded capabilities enters the inventory, we will be able to*

*focus on a different part of the overall battlefield. Here long-range heavy firepower such as Multiple Launch Rocket System and the future Corps Support Weapons System (CSWS) renew not only the viability but the need for a corps artillery headquarters. Detailed Army and Air Force interface to coordinate offensive air support will also require a larger field artillery as well as maneuver complement at the corps level and at echelons above corps (EAC).—Ed.*

## A reasonable doubt in fire support

On the recently completed V Corps Exercise "Certain Encounter," I was selected to be a fire support umpire for an armor battalion. To complete our mission, my company FIST umpires and I were made part of the "maneuver umpire packet." This packet was headed by an armor battalion commander from our habitually supported maneuver brigade and was composed of his S3 Officer and company commanders. From the outset of this temporary relationship (I being a battery commander and my assistant being the actual fire support officer for the packet chief in real life), I detected the most fundamental distrust of my intentions and capabilities. My gut reaction was to attribute their attitude to a lack of combined-arms indoctrination and a false security, born from riding around in tanks. But the good reputation of this armor battalion made me reconsider my quick, harsh judgement; and, in the free hours of that exercise — of which there were many for our packet — I began to examine the issue.

The beginnings of the answer lay in the first element of my examination — my assistant, the battalion fire support officer, was a second lieutenant.

Now, LT E., we'll call him, was an outstanding officer. He was confident, well-groomed, well-educated, physically fit, jump-qualified, maintenance-conscious, and as well-versed in fire support planning and coordination as any graduate of the Field Artillery Officer Basic Course. Although he was articulate and able, he was, nevertheless, a second lieutenant filling a captain's slot at the critical interface between maneuver and fire support. As such, in the eyes of that armor battalion commander, field artillery stock dropped 50 points when they were introduced. Indeed, the amount of emphasis that the field artillery seems to place on fire

support must have come to light in a most alarming way when this same battalion commander realized how many captains in division artillery could be filling his fire support officer slot and truly ramrodding his fire support element (FSE).

I am not saying that artillery commanders are guilty of withholding qualified officers from fire support. There is, however, a tendency to put our quality/senior officer eggs into one basket marked "Field Artillery Organizations" and to feed the basket marked "Fire Support Organizations" only when the first is loaded to capacity. This tendency is Army-wide.

What is the origin of this harmful tendency? Perhaps a part of it is what I term "the romance of the guns," that seemingly harmless affection that most artillery officers have for the cannons, the cannoneers, and the units into which they are organized. They are indeed lovable, these units; and no one is about to say that they should be deprived of care or qualified officers. What I am saying is that the romance of the guns has permeated the thinking of the highest level of field artillery officer management and has forced division artillery and battalion commanders to load up the wrong basket in order not to harm the careers of company and junior field-grade officers. As a result, from MILPERCEN to the remotest FIST chief, we have convinced ourselves that, like our ground-gaining brethren, the essence of our careers lies in command of our branch's units. This is not so.

The essence of our careers as field artillery officers lies in fire support planning and coordination. Army doctrine makes us responsible to the maneuver commander for organizing his fire support element and for orchestrating what amounts to the lion's share of available firepower to that maneuver element. To be brutally honest, field artillery organizations exist to have their firepower funneled through the able hands of some fire support coordinator in support of a scheme of maneuver, just as other indirect fire means are applied. If we fail to recognize this ultimate mission of ours, that mission will be carried out in wartime by green lieutenants, new captains "waiting for a battery," and new majors and lieutenant colonels marking time "until . . ."

How do we answer this high calling of fire support coordination

## Incoming

(FSCOORD) in terms of our officer manning? Some older, wiser and more experienced heads than mine, from MILPERCEN to battalion level, will have to provide the ultimate answers. But I owe it to our readers to offer an alternative to the career progression that is now putting fire support slots in the back seat. My alternative will apply to cannon officers only, with regard to the junior grades, since missile and target acquisition officers normally have a somewhat different and varied career pattern.

The new cannon second lieutenant, fresh out of Field Artillery Cannon Basic Officer Course (FACBOC), is pumped full of gunnery skills and belongs in a battery FDC (platoon FDC under the 3x8 concept). Here he may also become familiar with firing battery operations and be exposed to and practice small unit leadership.

Next, the officer is ready for the position of battery executive officer (3x8: platoon leader). Here, he will fully develop his small unit leadership skills, as a result of dealing with a small corps of NCOs and managing a fleet of motor vehicles under the tutelage of his battery commander — hopefully, a captain.

Only after fulfilling his duties as a lieutenant *within* a field artillery organization should the officer be entrusted with the awesome responsibility of FIST chief/fire support coordinator for an entire company team. Only then would he be charged with what will likely be the most dizzying and overwhelmingly fast-paced FSCOORD job on the battlefield.

After his tenure as a FIST chief, the officer, now a senior first lieutenant on the list for promotion to captain, is headed for battery command, the Field Artillery Officer Advanced Course, or a battalion staff job. But only after *all three* of these positions have been successfully held is the captain considered for battalion fire support officer. This captain is *worth* something to the maneuver battalion commander; he is an experienced, seasoned career artilleryman whom the battalion commander and his S3 truly rely upon and whom they do not feel compelled to spoon-feed requirements to—he is the genuine and undoubted officer-in-charge of the fire support element.

Next, the now-senior captain would perform duties as a battalion S3 officer. Following this assignment, the officer

would be promoted to major, perhaps attend Leavenworth or its equivalent, perform staff assignments at various levels throughout the Army or Department of Defense, and start developing his other specialty, all in some order. His last two jobs as a major, however, would be a battalion executive officer and a brigade fire support officer, in that order, I would hope.

My constraints on a division FSCOORD's qualifications are limited to the requirement that he be a former battalion commander. Diversity in career patterns at this level limits me to that one sizeable qualification.

Where shall we find all these captains and majors that this new commitment would require? In the long term, we may all hope that officer procurement and retention will improve to the point that such a painful question need never be asked. In the short term, however, no such pipe dream will suffice. We must, as the saying goes, bite the bullet. By that I mean that we must be willing to make the difficult decision to give up our 03 battery commanders and our 03 promotable/04 S3 officers in order to start filling the vital fire support officer slots and give up our 02 Battery XO's in order to move them into FIST chief positions. The disaster that some think would precipitate from such moves would probably not occur at all, given the NCO depth in both our batteries and our S3 sections.

Close Support Study Groups I and II, in delineating the true fire support personnel and materiel needs, made giant strides forward, *conceptually*. It is now time to make giant strides *actually*. It is time to put our field artillery officer money where our fire support mouth is. If anyone out there agrees or disagrees, speak up! I'm anxious to get this subject out into the open, even to be shown that, for good, combined-arms reasons, what I have laid out is simplistic, uninformed, or whatever. Sound off, Redlegs!

John B. Gavalas

CPT, FA

Commanding

BTRY B, 1st Bn, 22d FA

APO New York

## Hand-held Calculator

The hand-held calculator (HHC) has greatly advanced the ability of fire direction center (FDC) personnel to generate timely, accurate firing data.

The FDC of Howitzer Battery, 1st

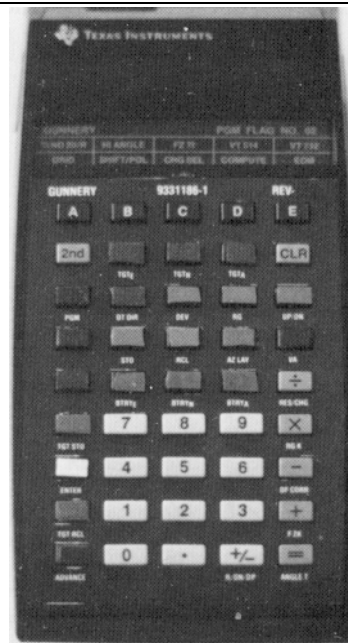
Battalion, 163d Armored Cavalry, Montana National Guard, has used the TI-59 HHC as an adjunctive computing means since the Gunnery Department wrote the first program in early 1978. During field testing against FADAC and manual data, however, several limitations were noted; e.g., dust caused severe problems with reading the magnetic cards containing the program.

During the 1976 (summer camp) Annual Training (AT) the HHC was used in a fully operational battery operations center (BOC) with a chart and manual system for safety and checking. Since both the FDC and BOC were fully operational, shifts were rotated so that personnel could rest and attend to personal needs. Also multiple missions were split down to no more than two each for the FDC and BOC.

The second generation program for the HHC, the first published version, expanded the capabilities but still required magnetic cards with associated problems.

The issue version of the HHC with its software modules made terrific advances in the capabilities, solved the card reader problems, and speeded the setup tremendously.

The overlay simplified the input, but made the key face marking confusing. It was suggested that we blank out the non-numeric keys (which we did) with black electrical



Keys on hand-held calculator are color-coded.

tape. We encountered errors on about one-third of our missions, by hitting either the key above or below the ENTER. This error required shutting off the HHC and starting over with the additional delay. As such, white electrical tape was put on the ENTER key which almost totally eliminated this error. Additional colored electrical tape was used to color code groups of keys: battery data in green, target data in red, corrections in yellow, store and recall in orange, and target store and recall in blue. The color coding appreciably increased speed and reduced errors.

SSG Stewart Haegen  
How Btry, 1-163d AC,  
MTARNG  
Lewistown, MT

### National Guard training

The September-October 1981 issue of the *Journal* (pages 33 and 34) contains an article, "Reserve Component Training," describing a potentially valuable tool, the Special Configuration Project (SCP). This project will undoubtedly be of interest to

all concerned with the education of soldiers; however, the title of this article indicates Reserve Component, yet omits any reference as to the availability of this material to National Guard units. While USAR schools have done a fine job for National Guard officer education, they are not always a practical course to follow for the MOS training of our enlisted personnel.

If the final product of the SCP is as complete as this article describes, it could prove to be of inestimable value to the National Guard trainer as well as to the USAR school instructor. Therefore, I urge that these materials, when developed, be made available to all Reserve Components. At the very least, one set of each MOS packet should be sent to each division artillery and battalion S3.

If the above request can be fulfilled, the last sentence of the article could then (in the best spirit of the One-Army concept) be corrected to read "These packets will enable Reserve Component enlisted personnel an opportunity to become MOS-qualified in selected Field

Artillery areas."

James W. Russell  
LTC, FA (MAARNG)  
S3, 26th Inf Div Arty  
Westwood, MA

*The Special Configuration Project materials now being developed under TRADOC directive specifically for US Army Reserve School use will be available to National Guard units on an "on demand" order basis. The materials will, when available, replace the "off the shelf" resident course materials now provided by USAFAS (listed on page 30 of the USAFAS 1980-81 List of Instructional Material as "MOS Packets for Field Artillery Skill Level 1").—Ed.*

### Reunion

**141st Field Arty Bn (WW II)**—April 22-25, Williamsburg, VA. Details: COL J. P. O'Connor Jr, 102 North-point Drive, Williamsburg, VA 23185, (804) 229-9515.

# Hot Off the Hotline

**Your "Redleg Hotline" is waiting around the clock to answer your questions or provide advice on problems. Call AUTOVON 639-4020 or commercial (405) 351-4020. Calls will be electronically recorded 24 hours a day and queries referred to the appropriate department for a quick response. Be sure to give name, rank, unit address, and telephone number.**

**Please do not use this system to order publications. Consult your FA Catalog of Instructional Material for this purpose.**

**Question:** What is a 45D MOS required to know about the duties of a 13B MOS? Where is he supposed to be slotted in the firing battery and what are his duties?

**Answer:** A person with a 45D MOS is not required to have any knowledge of the 13B MOS. The 45D is slotted in the maintenance section in the battery, and his duties are those of an artillery turret mechanic as well as other organizational maintenance duties which may be

required.

**Question:** In what position should the towing pintle on the M102 howitzer be placed when stored?

**Answer:** The towing pintle can be stored in either the up or down position. It is recommended that the pintle be left in the position appropriate to the towing vehicle; i.e., 2½-ton truck or 5/4-ton truck.

**Question:** Reference Redleg Hotline question number six in the July-August 1981 *FA Journal*. When firing illuminating projectile, M485 green bag propellant, what data is used? Does this question refer to the M114A1 howitzer? Also, is there any difference in ballistics between the M110A1 and M110A2 in regard to the muzzle brake?

**Answer:** The question in the July-August 1981 *FA Journal* does apply to the M114A1. The M114A1 is the only weapon using the referenced firing table. The difference in muzzle velocity between the M110A1 and the M110A2 with standard charges is 0.2 feet per second. The muzzle brake allows the M110A2 to

fire charge 9 which the M110A1 cannot do.

**Question:** Is there an acceptable substitute for the OHT type petroleum based hydraulic fluid, MIL-H-6083, used in M109A2 howitzers?

**Answer:** Lubrication Order 9-2350-303-12 for the M109A2 howitzer authorizes the use of either OHT or OHC. Both are manufactured to military specifications MIL-H-6083 and are interchangeable.

**Question:** Reference laying of the M109A3 howitzer: when looking at it with the aiming circle we have trouble seeing through the lens of the ballistic shield. Has this been encountered before and is there a fix available?

**Answer:** Place a piece of white tape on the M17 sight head or paint the sight head white (being careful not to get paint on the lens of the sight). Paint the inside of the ballistic shield white, thus contrasting the olive drab color of the M17 sight head against the white background of the ballistic shield.

## Hotline

**Question:** Please describe the proper method of carrying the new Woodland camouflage net on a 5-ton truck.

**Answer:** There is no published standard method for transporting the nets; however, there are several options for solving the problem.

1) Case the net and transport it in the cargo body of the vehicle.

2) Case the net and place it on top of the cargo body canvas.

3) Leave the net out of the case and roll it lengthwise on top of the cargo body.

Each of these options have been tried by various units at Fort Sill. Options 1 and 2 provide the best protection for the camouflage nets but increase emplacement and displacement times. Option 3 reduces emplacement/displacement time but increases wear and tear on the camouflage nets and bows and canvas.

If you elect to use option 3, the following procedures should be followed:

- Emplace the net lengthwise on top of the cargo body, centered on top of the crossbows and extending over the cab.

- When displacing, fold the portion of the net over the cab back onto the cargo body. Roll the remaining portion of the net to the top of the cargo truck and secure it for transport.

- A strip of plywood may be placed under the canvas and on top of the bows. This will provide a stronger platform for the net but may increase the wear and tear of the canvas unless you bevel the edges.

**Question:** My question concerns the M90 velocimeter. My unit does not have the appropriate publication to convert muzzle velocity determined by the velocimeter to absolute muzzle velocity. How do we obtain these particular tables?

**Answer:** Appropriate conversion tables are identified as follows:

- MVCT M90-1.
- Muzzle Velocity Tables (to compensate for difference in projectile weight and propellant temperature for radar chronograph (velocimeter) M90 (November 1979).

These conversion tables can be obtained by writing to:

Director  
US Army Ballistic Research  
Laboratory  
ATTN: DRDAR-ELL-FT  
Aberdeen Proving Ground, MD  
21005

**Question:** What fuze is to be used with shell, smoke, M116A1? TM 43-0001-28, Change 10, page 3-94, states only fuze M565 can be used. However, on page A-4, it mentions that both M565 and 577 can be used. TM 9-1220-221-10-2, June 1981, states only fuze M501 can be used. What is the answer?

**Answer:** The M501 fuze must be used with the old series of M116 smoke projectiles (D548) since it is the only one that will fit the fuze well. The new series of M116A1 smoke projectiles must use either the M565 or M577 time fuze. The M501 will not fit the new series. The old series smoke projectiles and M501 fuzes will drop from the inventory after they have been exhausted.

**Question:** How does one compute safety for the HC smoke round firing the M501 fuze? FM 6-40 tells how to compute it but this differs from the conversion factor in Table M of the tabular firing tables (TFT).

**Answer:** The procedures outlined in FM 6-40 are for computation of firing data only. The conversion factor in the TFT is correct for determining safety.

**Question:** How is the radio data link, AN/GRA-114 deployed?

**Answer:** See Figure 1.

**Question:** When firing illumination shells and the first round bursts on the ground, what is the correction you send to the fire direction center? Is it UP 50, UP 100, or UP 150?

**Answer:** This question appeared in the 13F SQT Notice, Level 2. Of the choices presented as answers (UP 50, UP 100, UP 150), none is correct, as there is no standard UP correction for illumination. Further, if the shell was fired with the standard M565 fuze, it would not burst on the ground since the M565 does not have a point-detonating backup (only the old M501 series would have had this backup and have been fired with shell illumination). If the question had stated that the round burned on the ground, then a correction could have been made by multiplying the number of seconds burned on the ground by the rate of fall of the illumination shell and expressing the result to the nearest 50 meters. If the round were indeed to burst on the ground, it would be most logical to suspect FDC computation error or an incorrect timer setting made by the gun crew. If this did not prove the reason, a malfunction of the fuze or projectile would be suspected. In any case, there exists no standard UP correction for a fuze bursting on the ground.

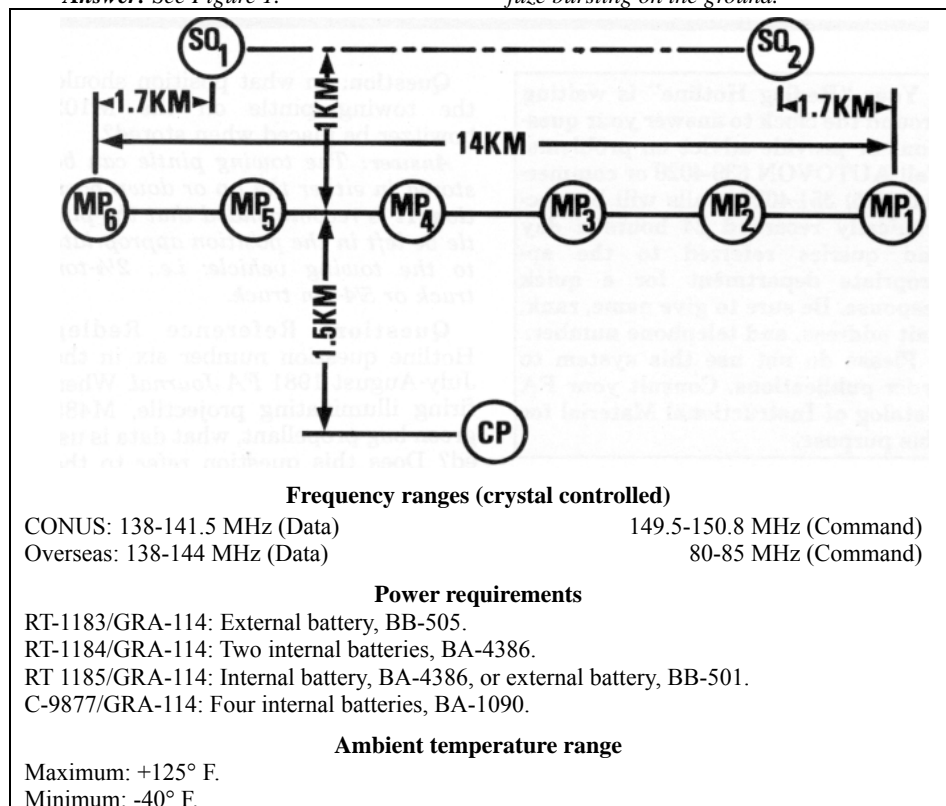


Figure 1. Typical AN/GRA-114 deployment.



**Question:** My unit (M101A1) will conduct annual training this winter for the first time. We need to know how to dig in artillery in frozen ground. Is there any reference we can use on emplacement of artillery under cold weather conditions?

**Answer:** *Neither the technical manual for your weapon system nor FM 6-50 provide specific details in this area. Information provided by Mr. James B. Storey of the Cold Region Test Center indicates that unless you are operating in extreme arctic conditions, only the first few inches of ground freezes. To dig spade holes, use the organic shovels and picks provided in the basic issue items for your howitzer. To provide additional stability, you can use the dirt removed from the spade hole or some other blocking material to place between the level of the ground and the top of the spade. Should additional technical information be required from the Cold Region Test Center, their address is:*

*Cold Region Text Center  
ATTN: Chief, Weapons Test  
Division  
APO Seattle 98733*

**Question:** Reference Soldier's Manual FM 6-13B3, Task 061-266-3320, "Issue of Fire Order for Direct Fire." The method of announcing subsequent commands for range changing is discussed in paragraph 5-D of the performance measured; however, subsequent commands for lead changes

are not discussed. The references, "-10," "-12," and "6-50," do not address subsequent commands clearly and can be interpreted to mean the subsequent lead to the total lead. Does the subsequent command for a change in lead apply to the initial or previous lead or is it the total lead the gunner should set off?

**Answer:** *A lead correction in direct fire is applied for current target location and speed. Lead is not an accumulative correction. The correction is determined by the section chief and announced to the gunner for the fire mission as the target moves.*

**Question:** What firing tables are used with the M198 howitzer?

**Answer:** *The M198 howitzer uses the same firing tables as the M109A1/A2/A3 (FT 155-AM-1 series).*

**Question:** Are there any 8-inch rounds with FASCAM (field artillery scatterable mines) capabilities?

**Answer:** *There are no 8-inch rounds with FASCAM capabilities. The replacement for the antipersonnel M404 improved conventional munitions (ICM) projectile will be the dual-purpose ICM M509A1.*

**Question:** Where can I find some information on hardened gun position sites constructed by combat engineers for the 155-mm towed and/or 8-inch self-propelled gun?

**Answer:** *The information requested is contained in FM 5-15 (Field Fortifications). Though still valid, the methods of construction are time consuming and require much hard labor, extensive timbering, sandbags, etc.*

*The Corps of Engineers is currently working on several projects to ease the construction burden of hardened artillery positions. Some of these prospects include prefabricated plastic walls, PSP type matting, and other materials that are easy to erect and are reusable. There is no near-time solution to the artillery emplacement construction problem; however, efforts are underway to provide one or more small bulldozers in each FA battalion to aid in the construction of emplacements but, again, this is a long term solution.*

*Your best bet is to obtain engineer support for the basic construction. In the case of the M110A2, a bulldozer can dig out an emplacement equal to one blade width (5 meters) and three times the length of the vehicle in approximately 30 minutes. This will accommodate both the weapon and the M548.*

**Question:** Our FY82 ammunition forecast was approved with a D513 155-mm round and we do not know what this is. Can you help?

**Answer:** *The Department of Defense Ammunition Code (DODAC) 1320-D 513 155-mm round is the new low cost indirect fire training round (LITR) M804.*

## Notice

The 1982 Field Artillery Conference and Senior Field Artillery Commander's Conference will be held during the week of 5 April 1982. Additionally, a general membership meeting of the US Field Artillery Association will be conducted in conjunction with these important events.

Further details concerning both conferences and the Association meeting will be announced in the March-April 1982 issue of the *Journal*, by message and through individual correspondence.

**T**he role of field artillery fighting in built-up areas often brings visions of large siege weapons knocking down a city's walls to prepare the way for infantrymen to take on the defenders in an intense block-by-block, hand-to-hand combat fight. Here, the artillery pounds the city's defenses from relatively secure positions out of range of all but the defender's heaviest weapons, doling out considerable damage but not receiving much in return. A similar scene comes to mind when considering the defense of a modern city and, while these visions are not completely accurate, they do contain a measure of fact. Urban is simply another type of terrain requiring special adaptations to the tactics used.

The manner of the fight in this scenario normally requires the supporting field artillery to be physically separated from the maneuver units that are engaged. (Obviously if cannoneers are locked in hand-to-hand mortal combat fighting for survival, the quality of fire support received by maneuver units is seriously degraded.) Field Manual 90-10 describes the offensive and defensive tasks for field artillery in the same general mold—basically providing support from outside the city involved whether the supported force is attacking or defending. The field artillery is faced with three basic variations when supporting operations in or near urban sprawls.

- First, is an attack on a built-up area. Initially, the field artillery supports from outside that built-up area but, depending on the size of the area attacked, may be required to enter and occupy some of that same built-up area to provide responsive fires. This, we are prepared to do!

- The second situation involves defending a built-up area. If practical, the field artillery would support the defense from positions located outside the city. At times, however, the field artillery must occupy and support from within the same or from an adjacent built-up area.



# Field Artillery and the Urban Battle

by COL Paul A. Slater

*The Field Artillery was criticized recently by other professionals who stated that the Field Artillery Community had contributed little toward Military Operations in Urbanized Terrain (MOUT) and had lost its capability to effectively support major operations in urban areas. In an effort to dispel those critics, COL Paul A. Slater, Director of the Tactics, Combined Arms and Doctrine Department, US Army Field Artillery School, briefed the Military Operations Research Society's (MORS) 47th Symposium on "Field Artillery and the Urban Battle" in July this year. Colonel Slater presented the Field Artillery School's best current efforts to bring together existing doctrine and procedures with respect to MOUT.—Ed.*

- The final situation involves attacks *from* an urban location on a bypassing enemy force in which neither side relishes attacking a defended city. Both sides will avoid the battle and bypass the urban obstacle whenever possible and, in this respect, NATO and Warsaw Pact tactics appear to mirror each other.

In those cases where artillery locates elsewhere and fires into the built-up area, everyday tactics are used except that the field artillery must shoot more high angle, requiring a change in many of our fuze choices. Thus, for most of this article, those situations which deal with field artillery operations *within* built-up areas will be addressed.

The post World War II population explosion has changed the demographics of many areas, particularly in Western Europe where the density of built-up areas is so great. No longer can built-up areas be ignored in offensive or defensive operations, so the battlefield commander must be prepared to deal with these unique challenges. During World War II, some 40 percent of combat was in built-up areas. Today, however, we anticipate that combat in urbanized areas will consume about 60 percent of our efforts. The population sprawl in West Germany has formed huge urban complexes joined by densely populated strip areas. In fact, there are more than 22,000 such localities in West Germany, with 90 percent of these complexes having less than 3,000 population.

What does this mean to the military commander? Put simply, a brigade commander with a sector of 12 by 25 kilometers can expect to have an average of 25 towns in his sector; therefore, he must consider these terrain features in planning his defense and counterattack. In certain areas the defense will, of necessity, be anchored on or conducted within the urban sprawl. It is in this light that field artillery operations in built-up areas take on significant dimensions.

In World Wars I and II, field

artillery support within built-up areas was principally through direct or assault fire on enemy positions. Based on current and evolving doctrine, force structure, and materiel developments, today we believe that built-up areas provide battlefield commanders a great deal of flexibility in structuring defenses and positioning artillery assets, particularly the field artillery cannon battery.

The decision to fight in or near built-up areas normally will be made by the division commander. Then the artillery battalion commander will issue orders to his battery commanders to occupy specific areas based on size, shape, density, location, and condition of the urban area and also on the maneuver commander's mission and scheme of maneuver or his conduct of the defense. The authority to choose that position which best allows for the accomplishment of the fire support mission lies, as always, with the battery commander; the only difference being that the battery would be occupying in or near a built-up area—which we have tended to avoid until recently.

There are positive and negative aspects of locating in built-up areas which directly affect the decision. The specifics of occupying a built-up area as a firing position requires that field artillery battalion and battery commanders evaluate a vast array of potential advantages and disadvantages. The following are some of the tactical and technical considerations of built-up areas deemed most essential to the successful accomplishment of the unit's mission.

### **Advantages**

- The built-up area provides fortified positions and reduces the effects of all enemy direct and indirect fires. It is also an obstacle to enemy armor.
- All aspects of enemy detection capability are degraded. Tracked vehicles leave little or no signature on hard surface roads. Enemy

side-locating airborne radar and infrared detection systems will have difficulty discerning between civilian and military signatures.

- Buildings provide overhead protection not only from the elements, but also from enemy fires and thickened persistent chemical agents.
- Established road networks favor rapid occupation and displacement and aid in ammunition resupply and stockpiling.
- Clean, dry storage is available.
- Numerous service support facilities and materiel may be available for personnel and logistical needs.
- Use of existing civilian telephone, telegraph, and other communication systems enhances tactical communication ability.
- Use of built-up areas reduces the competition for open terrain or forested areas within the supported unit's sector.

### **Disadvantages**

- The built-up area is usually located along likely avenues of approach.
- The general area is easily located and is subject to being engaged by enemy artillery and aircraft.
- Emplacement of howitzers is critical—site to mask problems abound (we must clear the buildings to the immediate front) and, of course, spades may not be emplaced on concrete.
- Personnel are vulnerable to human intelligence and unconventional warfare.
- Rubble may hamper movement within the built-up area. Towed artillery is especially susceptible to restrictions caused by rubble.
- Magnetic orienting of the weapons may be impaired by the effects of electrical and telephone lines on compasses and aiming circles.
- Radio signals may be severely attenuated by buildings.
- The built-up area may be bypassed and isolated by the enemy.

- Opportunities and locations for training are limited. (Even the new National Training Center has no facilities for MOUT training.)

### **Reconnaissance, selection, and occupation of positions**

The field artillery commander who must occupy a built-up area as a firing position is faced with terrain different from that experienced in most of his training. He must adapt to the situation by modifying his operational techniques to overcome limitations of the urban terrain by turning them to his advantage as well as enhancing some of the advantages peculiar to the area.

Depending on how much space the battery commander has been given to reconnoiter and select his firing position, he may find that the choices include several towns or villages as well as the more conventional positions. When a small built-up area is selected, the battery commander may save valuable time (needed for security operations and selection of howitzer positions) by considering the following:

- Select a position away from the center of the built-up area—target planners tend to target the centers of the built-up areas. Also, the older inner portions of a built-up area often consist of nonframed construction which can easily be reduced to rubble by enemy bombardment. Once this happens, the rubble reduces trafficability to the point that elements of the battery may become trapped. Additionally, building congestion in the center of town will require the battery to use much higher minimum quadrant elevation to clear obstacles to the immediate front; these obstacles also complicate laying the battery. By selecting a position in or near a newer, steel-framed construction or in an industrial area, the unit gains maximum cover and concealment with reduced effects of rubble. The spacing of peripheral buildings usually permits lower minimum quadrant elevation and better perimeter security.



**During World War II, approximately 40 percent of the combat was in built up areas.**

- Particular advantages accrue if the unit can locate in buildings with large double doors, such as warehouses, rail yards, barns, or auto repair shops. If these doors are oriented on or near the battery azimuth of fire, the buildings might be used as concealed firing positions. If not, the buildings still provide excellent hide positions.

- The battery area should have a good road network and yet be off the main high-speed avenues.

- Built-up areas that are free of civilians are particularly desirable. It is easier to secure the area, the enemy's capability for use of human intelligence to reveal the unit location is less, and it limits the urge of soldiers to fraternize.

Once the general area has been selected, the battery commander must consider what type of formation to use. Here his primary consideration must be for an irregular signature to make all forms of detection and acquisition more difficult. The star and diamond formations best meet this requirement and are easy to apply in small villages, towns, and even in large urban centers. In a strip area, however, a modified "Lazy W" is best suited.

After the general area and basic formation are determined, the advance

party must clear the area and prepare the site for occupation. If the location contains several buildings, clearing by the reconnaissance party will be a time-consuming task. If the supported unit is on the offense, enemy stay-behind snipers and sappers are high-level threats to the reconnaissance party. This fact alone makes the occupation of a built-up area, previously held by an enemy, a very unattractive proposition. Even in the defense, a built-up area provides enemy commandos with covered and concealed routes for easy infiltration into or near the battery position. In this case, the reconnaissance party must use the techniques developed by the infantry for house-to-house fighting to clear and check the buildings.

Prior to determining individual piece locations, the battery commander must consider the location of the aiming circle and locate the howitzers where intervisibility with the circle is possible. Should that be impossible, some form of hasty survey must be conducted. Two hasty survey operations which can be performed in a built-up area are resection and scaling of azimuth from a map.

The battery commander should capitalize on the advantages of a

built-up area. For example, since wooden frame structures are vulnerable to incendiary shells (WP), they should be avoided. The protection afforded by buildings must be balanced against the mission, enemy acquisition and counterfire capabilities, and the condition of troops and equipment.

Besides structural consideration, the choice of individual howitzer positions will depend on the battery commander's decision as to the type of occupation the battery will make. In a built-up area the battery commander has three basic choices:

- All howitzers in firing positions.
- All howitzers in hide positions.
- A combination of the above.

The type of occupation is affected by the type of howitzer. The short emplacement time and mobility of the M109 series 155-mm self-propelled howitzer provide it with much needed flexibility. Hiding within a building, it can move upon the receipt of a warning order of a fire mission and occupy a prepared firing position within 50 to 100 meters of its hide position in approximately 30 seconds. But, if the entire battery is in this configuration, it will be less responsive delivering final protective fires, dedicated battery fires, immediate smoke/suppression, and fire for effect on targets of opportunity because of time required to occupy and lay the battery. *These* missions are extremely important, but, in a built-up environment, the majority of the missions will be adjust-fire missions—supporting the infantry as it advances or, in the defense, responding to enemy targets as they develop.

The battery operations center (BOC) and fire direction center (FDC) give added flexibility in controlling a single platoon or the entire battery, thereby allowing one battery to engage two targets simultaneously. Buildings provide the FDC with cover, concealment, adequate space for operations, and lower noise levels.

Cellars, however, seem to offer the greatest promise for FDC and BOC operations.

Another prime consideration is radio communications. The coaxial cable of the RC-292 antenna is 60 feet in length which limits placement of the FDC/BOC to the third floor (or lower) of a building. The use of coaxial cables longer than 60 feet will produce significant power loss; therefore, soldiers must be taught field expedient techniques that can be used to elevate antennas above other obstructions to line of sight and to make the antennas highly directional.

The support elements of the battery should be placed in structures which allow mess, communication, maintenance, and ammunition facilities to accomplish their support mission while contributing to the physical security of the battery.

Field artillery units also must be able to engage in close combat and to defend against air attack. The perimeter defense plan then should designate positions for all machineguns and antitank weapons organic to the battery and take maximum advantage of the protection provided by the reinforced structures. Wooden frame houses can be reinforced with sand bags. Observation posts established in the upper floors of buildings cover major avenues of approach with significantly increased distance for observation and, of course, improve the battery's survivability. Wire and radio communications with the battery command post also provide early warning.

Supplementary positions are assigned and prepared for all howitzers to insure direct-fire coverage of critical routes into the battery position. The care with which howitzers are emplaced should also apply to automatic and other crew-served weapons. The integration of all of the battery's firepower into a cohesive plan is the key to a strong position defense.

In a built-up area, coordination

with local law enforcement personnel may provide invaluable assistance. Also, local citizens can be extremely helpful in providing information concerning the enemy's whereabouts and in controlling the flow of displaced persons through the area. A warning system may even be established using existing police and fire department alarm systems.

The commander must also coordinate the installation, marking, and reporting of all obstacles which should be covered by the fire of cannons, antitank weapons, or automatic weapons. All available material in the built-up areas should be used to construct obstacles and provide additional cover. For example, turn over a rail boxcar and you have a near-permanent obstacle.

A most challenging and certainly most politically sensitive field artillery aspect of fighting in or from a built-up area is the proper security of nuclear weapons. With respect to storage and security, a drive-in garage type facility is a good solution. In any case, the battery must focus its security plan around these weapons.

Camouflage and concealment are greatly aided by the fact that most of the elements of the battery can be located inside structures away from both air and ground observers.

### **Field artillery support**

The objective of everything mentioned up to now is to enable the field artillery to accomplish its mission of providing close and continuous fire support to the maneuver elements of the force. From conventional support by indirect fires to the special situations of adding direct fire from artillery weapons, the field artillery's mission is uppermost.

To support the defense or attack of urban terrain, the commander can apply the whole array of weapons and ammunition available from the artillery. New types of ammunition such as artillery delivered antipersonnel and antitank mines (ADAM and



**Narrow defiles between villages make good engagement areas for artillery fires.**

RAAMS) and the Copperhead guided projectile can assist greatly by enabling long range engagement of enemy formations; by assisting in the delay, disruption, and canalization of attacking forces; and by providing an effective means to attack all types of point targets.

Within the built-up areas, high explosive ammunition can reduce enemy positions or cause rubble. Roof tops and open areas can be cleared using improved conventional munitions or high explosives with variable time fuzes. Other munitions such as smoke and illumination can provide screening/obscuration or light as the situation requires. High angle fire from howitzers and mortars can provide extremely effective fires into defiladed areas.

Soviet strategy canalizes their forces through the gaps between villages as they bypass larger cities. The relatively narrow defiles between the villages make good engagement areas for artillery firing from positions within the suburbs or villages near a city.

Special techniques are available to provide precision fire from artillery weapons on hard targets or obstacles. One such technique, assault fire, is an

indirect fire procedure to attack the vertical face of a target from fairly short ranges while still allowing the howitzer the protection of a concealed position. For example, a single howitzer section and a one- or two-man FDC move forward to the designated position where its mission is controlled by a field artillery observer using modified observed fire procedures. A high explosive projectile equipped with conventional or concrete-piercing fuze is the standard ammunition for these missions. Although an assault fire mission may be time-consuming, it does provide a means of placing accurate and destructive firepower on hard targets without exposing the weapon to the effects of enemy direct fires.

At times, an enemy position or obstacle must be reduced at almost any cost. In such a situation, artillery weapons may be employed in the direct fire role; for example, in the absence of a suitable engineer vehicle or the relative ineffectiveness of tank ammunition against certain structures. One or two howitzer sections can be detached from the battery and join a maneuver element until the completion of the direct fire

assignment.

High explosive projectiles are usually the most effective ammunition in this situation. The 155-mm projectile can penetrate up to 38 inches of reinforced concrete in a direct fire role, while the 8-inch can penetrate 56 inches. Concrete piercing fuzes are required in most urban direct fire situations; therefore, adequate planning is needed to insure that units have enough of these very limited assets.

A final note on direct fire: A HOWITZER IS NOT A TANK. A howitzer cannot fire as rapidly or as accurately as a tank can in the direct fire mode, nor does it have the direct fire range or armor protection to engage in a tank battle. Direct fire missions for howitzers then must be kept to a minimum to insure that adequate field artillery fire is available for its primary roles of indirect fire and assault fire.

### **The future**

The future trends of the Field Artillery, both in terms of new equipment and force structure, favor the employment of cannon units in built-up areas. All ongoing

actions are too numerous to discuss here, but the following represent a few:

- An eight-gun battery operating from two locations with four guns each is being implemented in our doctrine and force structure. A battalion of three such cannon batteries fires from six separate locations, offering increased firepower and survivability. In the not-too-distant future, our artillery will have the capability to operate from single gun positions since each weapon will have on-board a navigation and direction-finding system, a fire direction computer, digital communications, and an automatic gun-laying system. The Multiple Launch Rocket System (MLRS) already has these capabilities.

- The introduction of the Position Azimuth Determining System (PADS) will expedite the rapid transfer of survey control over wide areas, alleviating one of our greatest problems.

- The fielding of the Small Unit Transceiver (SUT) to the firing battery will improve communications

throughout battery positions. In a fluid, shoot-and-move environment, the SUT is particularly valuable in speeding up such functions as laying the battery and passing fire commands to remote pieces. (The Small Unit Transceiver is used only until internal wire is in place, not as a substitute for it.)

- The introduction of the Battery Computer System (BCS) will increase the speed and accuracy of our firing computations as well as provide direct digital communications between the battery and the artillery observers. It will allow terrain positioning of weapons and it will be able to tailor effects patterns to correspond with the shape of the target, thereby greatly increasing lethality.

### Conclusion

The concept of cannon batteries occupying built-up areas is a good one, but further investigation and testing is needed. The marked increases offered by this concept in all aspects of survivability and responsiveness of fires are significant

enough to demand the attention of the entire Field Artillery Community.

By putting artillery batteries in built-up areas, the open and forested terrain can be used by other elements of the combined arms team. This may prove particularly critical in offensive operations when a division or corps commander may concentrate forces in a narrow sector to achieve desired force ratios.

Success in this environment is limited only by the imagination and flexible attitude of the field artillery commander. The commander who is aware of the potential that occupation of a built-up area offers will find this concept to be a significant addition to his tactical options and he should train his unit to maximize its benefits. ✉

**COL Paul A. Slater is the Director of the Tactics, Combined Arms and Doctrine Department, US Army Field Artillery School.**

## The First Battalion, 230th "Infantry"?!?!

During World War II, many strange and unusual things took place, all part and parcel of the greatest war the world has ever seen. On 22 August 1944, one of the stranger happenings involved the 1st Battalion, 230th Field Artillery during the "Battle of Gauciel" in France.

On that date, the battalion was leapfrogging forward in two echelons; A and B Batteries and part of the command group were in front with C Battery, an attached 743d Armored Battalion assault gun battery, and the remainder of the command group in the rear. Late in the day the battalion began "settling down" for the night, when around 2400, evidence of German activity was detected directly to their front. After a challenge, the outposts of the battalion exchanged fire with the Germans and at 0300 an unsuccessful attempt was made to get the Germans to surrender.

Lacking available infantry, Lieutenant Colonel Vieman, the battalion commander, made the decision to assault the Germans with his own battalion at dawn. As a result, A Battery on the east and B Battery on the west each assaulted with forty men, while C Battery provided fire support.

The attack was preceded by a fierce barrage from C Battery, directed by Lieutenant Colonel Vieman from the attic of his battalion command post. The two assault batteries advanced in the face of heavy enemy fire, with A Battery encountering stiff resistance from the bulk of the German troops who happened to be located on A Battery's objective. It was over quickly, and the final tally was 5 Germans killed, 99 taken prisoner with few US casualties.

This may be the only time in the entire war that an artillery battalion conducted a highly successful infantry assault, complete with borrowed armor and fire support.

Today, the 1st Battalion, 230th Field Artillery, forms the long range punch of the 48th Infantry Brigade, with its M109A1 155-mm howitzers. It still has the "Can Do" attitude, and, judging from past history, the battalion will make any sacrifice to perform its mission — even becoming "Infantry" on occasion.

CPT George W. Olney  
GAARNG

# FIST Training in Berlin: A MOUT Perspective

by SSG Patrick J. Coyle

Based on the fact that Europe, as a potential battlefield, has become increasingly urbanized has caused an increased emphasis on Military Operations in Urbanized Terrain (MOUT). In Berlin (West Germany) we have a special interest in MOUT and recently have taken a hard look at our employment of indirect fire assets. Since an integral part of this study was directed at the operations of fire support team (FIST) personnel in our "unique" situation, this article will address some of the problems identified and our solutions.

In order to effectively study the terrain effects of MOUT on FIST operations one must first define the terrain characteristics in the area of operation. First one must realize that urbanized areas are not a homogenous mass. Rather, there are distinguishable terrain groupings and individually definable types of unique terrain features which are a result of the evolutionary growth of urban areas and are similar throughout the world. Six geographical regions in a generalized urban model as defined in FM 90-10-1 (final draft) include:

- *The city core*—the modern urban renewal areas and the high land values in the heart of the city, characterized by high rise buildings, wide boulevards, and park-like open areas between buildings.
- *The core periphery*—the remnants of the older city center consisting of closely spaced brick buildings, usually four to seven stories tall.
- *The residential sprawl*—those dwellings, single family through small apartments, that surround the core periphery, consisting of stand-alone buildings of varying sizes, seldom more than four floors.
- *The commercial ribbons*—construction growing out of the older core along major areas to provide retail sales outlets closer to the consumer. The buildings are closely spaced brick construction, one to two stories taller than the adjacent residences.
- *The outlying high rise area*—similar in physical layout to the city core areas, resulting from the need to duplicate many of the services of the city center in the areas further from the city core.
- *The outlying industrial areas*—generally large, stand alone buildings with large open areas dedicated to parking lots, open air storage, rail lines, canals, and heavy duty roads.

Within the geographic regions, the different terrain features, which are predominantly buildings, must also be considered. Buildings, characterized by their height and type of construction, fall into two general categories: mass



and frame construction. Mass construction includes all buildings with exterior walls that bear the weight of the building. The various subclasses of this type construction are defined by the material which makes up those load-bearing walls; e.g., stone, brick and concrete. Framed construction refers to those buildings where the weight is borne by a frame or steel or concrete beams. The subclasses of this type building are generally defined by the type of cladding: heavy or light.

Insofar as military characteristics are concerned, those buildings which mask or offer potential targets are the most important. Masking terrain features are a primary consideration in engaging targets at ground level. As such, in the city, this "canyon" effect will place difficult constraints on FIST operations.

Something that must be considered in MOUT operations is indirect fire dead space, defined as that area which cannot be engaged by indirect fire weapons due to a combination of the height of a masking terrain feature and the angle of fall of the projectile (figure 1). Mathematically, the size of the dead space (D) can be determined by multiplying the cotangent of the angle of fall (cot F) by the difference in height (dH) of the masking terrain and the height of the target (cot F x dH=D).



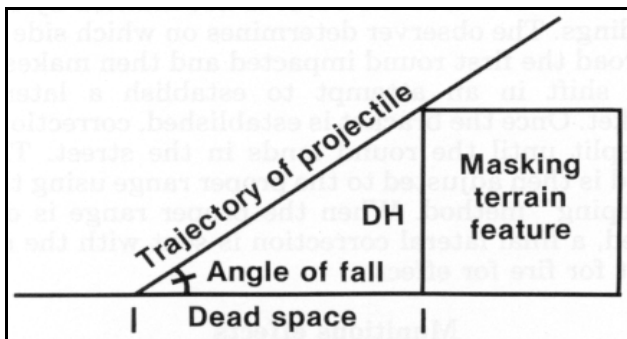


Figure 1. Dead space definition.

FIRING ELEVATION	HEIGHT OF MASKING TERRAIN			
	COT $\angle$ F	15m	30m	45m
1156 mils	0.3	4.5m	9.0m	13.5m
1017 mils	0.5	7.5m	16.0m	23.5m
0746 mils	0.7	10.5m	20.0m	30.5m
0665 mils	0.9	13.5m	27.0m	40.5m
0615 mils	1.0	15.0m	30.0m	45.0m
0226 mils	3.0	45.0m	90.0m	135.0m
0145 mils	5.0	75.0m	150.0m	225.0m
0082 mils	10.0	150.0m	300.0m	450.0m

Figure 2. M109A1 dead space.

The magnitude of the problem can be seen in the dead space for the M109A1 howitzer as listed in figure 2, based on the widths (12 to 20 meters) of streets normally found in core periphery areas. If one assumes that each floor of a building averages three meters in height, then it is easy to see the difficulty that indirect fire weapons will have in engaging targets in the street. Mortars may be used to fill the gap, but even mortars have difficulty in overcoming the masking problem with taller buildings.

Obviously, members of the FIST at the maneuver company level cannot be expected to know the firing elevations of supporting weapons or to be carrying necessary firing tables to extract the appropriate cotangent of the angle of fall. Therefore, FIST personnel need some rule of thumb for fire planning purposes to determine which weapons are capable of engaging specific targets. To simplify these rules to the maximum extent, the observer need only to remember that the dead space for standard artillery fires is about five times the height of the building, while for mortar and high angle artillery fires the deadspace is the height of the building divided by two. (It must be remembered that if high angle artillery fire is to be used, it must be specifically requested.)

Further analysis of the masking problem shows another possible solution. As the gun-target line gets closer to the attitude of the street, the masking problem decreases since the effective width of the street increases as the angle of incidence decreases. To take advantage of this effect, FIST personnel must know the locations of all supporting

weapons, particularly in the offense when an urban area is being encircled; proper positioning of firing batteries insures better engagement of targets at street level. In linear type operations, support from mortar elements of adjacent units may also serve this purpose.

Even when it is theoretically possible to hit a target in the street over a masking terrain feature another problem arises because of range probable error (PE). This is because only 50 percent of the rounds fired at the same data can be expected to fall within one range probable error of the expected point of impact. Effectively, this means that if the width of the target minus the dead space is less than two range probable errors (one PE long of the expected point of impact and one PE short), then less than 50 percent of the rounds fired can be expected to land on target. Rounds that miss may have a residual effect on the target in the form of flying debris; however, effect may vary because of such factors as shell weight, fuze action, and the target.

Traditionally, fire direction centers (FDCs) have had various rules about the number of rounds at various combinations of shell and fuze actions required to engage various types of targets. These means have been refined through the years and are predicated on the assumption that nothing will interfere with the flight of the round other than conventional ballistic factors. In a city environment, it will be necessary to double the normal ammunition expenditure to overcome the problem of a reduced-size target area in relation to the probable error for the M109A1 howitzer.

Next, looking at buildings as targets, the characteristic which most affects target engagement is the kind of construction of the exterior walls, interior walls, and roofs and ceilings. The exterior and interior walls of a brick construction are strong while the strength of ceilings and roofs vary according to the age of the building and roof construction. Peaked roofs in Germany are made of tile-covered wood slats, while the flat-top roofs, common in North America, are thin wood planking with waterproofing fabric. Both types are weak and can be easily penetrated. Additionally, top floor ceilings are weak in almost all buildings with strength increasing on lower floors in newer buildings. In pre-World War II construction, a large number of buildings have wooden floors that are relatively weak.

Concrete slab construction of the type found in single story warehouses and factories, called tilt-up construction, has exterior walls made of reinforced concrete. Interior walls are normally nothing more than partitions and are extremely weak with vulnerable roof.

The other type of concrete construction is the box-wall type normally found in modern apartment buildings and motels. Since these are constructed in cells made of five slabs of reinforced concrete, this type of construction presents great strength to attack from above and on both ends. The long faces of

these buildings present the weakest walls, since they are normally made of glass or other light materials. (Most interior walls, floors, and ceilings are of reinforced concrete construction.)

Framed construction offers an entirely different situation since none of the walls are load bearing and their strength is greatly reduced. In many instances there will be no interior partitions; thus only the floor and ceiling will affect the lateral area of the blast.

For indirect fire to be effective on targets in buildings, either extreme accuracy or extensive ammunition expenditure will be required. Also vertical probable error (PE) becomes a problem. The amount of vertical probable error can be determined by dividing the normal range probable error by the cotangent of the angle of fall. Figure 4 shows the computation of vertical probable error for selected firing elevations for the 155-mm howitzer.

We now have two apparently conflicting elevation requirements: to eliminate or minimize indirect fire dead space, we must fire at higher elevations; to reduce ammunition expenditure while engaging targets in buildings, we must fire at lower elevations. These requirements are not necessarily mutually exclusive. When determining indirect fire dead space, it is important to remember that dH is the difference between the height of the target and the height of the blocking terrain. (Very seldom will indirect fire weapons be directed against an isolated infantry weapon.)

FIRING ELEVATION	PE	+	COT $\angle F$	=	PE <sub>v</sub>
1156 mils	18m		0.3		60m
1017 mils	21m		0.5		42m
0878 mils	22m		0.6		37m
0715 mils	20m		0.8		25m
0341 mils	15m		1.9		8m
0236 mils	13m		2.8		5m
0153 mils	10m		4.6		2m

Figure 3. Determining vertical probable error.

The next problem that FIST teams must be able to solve is the adjustment of indirect fire since the observer cannot see the impact of the round when it lands behind buildings. Additionally, determining the appropriate range corrections to be applied when the round impacts on the side of a building which is not the target will be difficult and time-consuming at best. Another restriction is that almost all missions will be dangerously close.

There is an old adjustment technique, known as the "ladder method of adjustment," which may be used to overcome these difficulties. First, the impact of the round is adjusted laterally until it falls into a street running approximately perpendicular to the forward edge of the battle area (FEBA). Normally the impact of the round will not be observed; therefore FIST personnel must rely on

sound to determine whether the round impacts left or right of the road. This can be simplified by using airbursts so that the sound of the burst is not muffled by the buildings. The observer determines on which side of the road the first round impacted and then makes a bold shift in an attempt to establish a lateral bracket. Once the bracket is established, corrections are split until the round lands in the street. The round is then adjusted to the proper range using the "creeping" method. When the proper range is obtained, a final lateral correction is sent with the request for fire for effect.

### Munitions effects

Next, we must consider how urban characteristics affect the employment of different types of munitions. While to date there have been few in-depth studies on the effects of artillery and mortar ammunition on the different types of buildings in urban areas, certain general effects are easily noted and will be discussed here.

High explosive ammunition will have a generally reduced effective blast area when used against buildings. Delay fuzing of high angle fire should have good effect on the upper floors of weak roofed buildings while the concrete roofs of framed constructions and box wall buildings will be fairly impervious to light mortars. Data published by the US Army Human Engineering Laboratories showed that in Beirut, Lebanon, mortars of less than 100 millimeters were generally ineffective against modern buildings and super quick fuzing caused the rubble to be thrown into the building. Delay fuzing then should cause rubble to be forced outward.

The utilization of smoke will depend on a number of factors. First, the tactical reason for employment is important. In the offense smoke will be used to conceal movement of friendly forces across danger areas while in the defense it will be used to conceal defensive positions from observation and, thus, attack by heavy direct fire weapons, including artillery. Almost all long range observation at ground level is along streets and, as such, the width of the smoke screen will be seldom larger than 50 meters and will be usually less than 30 meters. The wind is also an important consideration; at ground level, the winds tend to blow along streets, thus providing depth to any screen fired in the middle of the block. The unpredictable eddies and vortexes at intersections make them a poor place to try to establish smoke screens.

Defensive screens should be closely coordinated with defending troops. The Soviet tactic of supporting dismounted infantry assault of known defensive positions with tank and direct fire artillery fires provides a formidable attack. To properly defeat it, the infantry needs to engage the dismounted troops with small arms fire, the forward tanks and armored fighting vehicles with organic antitank weapons, while the artillery seals off the combat area from further support with smoke; all of the preceding happening almost simultaneously. Close FIST coordination is required.

The "canyons" of the city will also have a significant effect on the utilization of battlefield illumination. The shadows cast by buildings will greatly reduce the time of adequate illumination on the street if there is any wind at all. In addition, an initial altitude correction will have to be given to preclude the cartridge from starting unwanted fires. Another important consideration is the fact that US forces enjoy a measurable superiority in night vision technology, a factor that is normally degraded by the utilization of battlefield illumination.

There are instances when battlefield illumination can be used to improve the capabilities of current night vision devices, especially when there is not enough ambient light to see inside the buildings. Thus, illumination fired behind friendly positions will shine into the various apertures of enemy-held buildings to provide adequate light. This will also have a tendency to degrade the enemy's night vision capabilities, both natural and technological. Thus it is important that the illumination be adjusted to burst well behind friendly positions.

When conducting the adjustment, the observer will not be able to see the burning flare to adjust it; rather the adjustment will be made viewing the area to be illuminated. When adjusting in this manner, the observer must remember that the corrections sent will be exactly opposite from the spotting. If the light needs to be shifted right, the round needs to be shifted left. If the illumination is not reaching far enough into the street, the correction "UP" needs to be sent. Lateral corrections of less than 200 meters will often be required.

Improved conventional munitions (ICM) will have reduced effectiveness due to the interruption of the dispersion pattern by buildings. Thus, only a limited number of the submunitions will reach the ground, but this can be overcome by firing ICM at high angle, thus reducing the cross section of the dispersion cone. However, when ICM is requested, an altitude correction must be given to compensate for the height of the near side building. Since it is base-ejecting, ICM is a valuable round for engaging targets in the indirect fire dead space behind a building and also to clear routes for helicopter nap-of-the-earth flight in city canyons. In the city, the most dangerous antihelicopter weapons will be roof-mounted machineguns and man-portable antiaircraft missiles, as well as antiaircraft guns like the ZSU-23-4 and ZSU-57-2.

Military Operations in Urbanized Terrain require that FIST personnel acquire an additional set of skills if they are going to maintain the effectiveness of indirect fire support on the urban battlefield. The effects of building mask and reduced target size, as well as the reinforced nature of targets inside buildings, require additional target engagement techniques that are unique to the urban environment.

**SSG Patrick J. Coyle is currently assigned to the Berlin Brigade as the MOUT NCO.**

## Exhortation to Artillerymen

A note by the Minister of Defense:

Renown awaits the commander who first in this war restores artillery to its prime importance upon the battlefield, from which it has been ousted by heavily armoured tanks. For this purpose three rules are necessary:

- Every field gun or mobile AA gun should carry a plentiful supply of solid armour-piercing tracer shot; thus, every mobile gun will become an antitank gun, and every battery possess its own antitank protection.

- When guns are attacked by tanks they must welcome the occasion. The guns should be fought to the muzzle. Until the approaching tanks are within close range, batteries should engage them at a rapid rate of fire with HE. During this phase, the tracks of the tanks are the most vulnerable target. At close quarters, solid AP shot should be fired; this should be continued so long as any of the detachments survive. The last shot should be fired at not more than 10 yards range. It may be that some gun crews could affect to be out of action or withhold their fire, so as to have the superb opportunity of firing AP at the closest range.

- It may often happen as a result of the above tactics, especially when artillery is working with tanks, that guns may be overrun and lost. Provided they have been fought to the muzzle, this should not at all be considered a disaster, but on the contrary, the highest honour to the battery concerned. The destruction of tanks more than repays the loss of field guns or mobile AA guns. The Germans have no use for our captured guns, as they have a plethora of their own types, which they prefer. Our own supplies are sufficient to make good the deficiencies.

The principle must be established by the Royal Artillery that it is not good enough for tanks to attack a group of British batteries properly posted and that these batteries will always await their attack in order to destroy a good proportion of tanks. Our guns must no more retreat on the approach of tanks than Wellington's squares at Waterloo on the approach of hostile cavalry.

General Montgomery was not one of those to whom this paper was sent, and it was not till after I met him in Tripoli in 1943, after the victory of the Eighth Army at Alamein 18 months later, that I chanced to show him a copy. "It is as true now," he wrote, "as when it was written." Renown by then, he had certainly attended his restoration of artillery to its position upon the battlefield.

Winston Churchill, 1941

# The Four Day War: TCADD's Response to Field Commanders

by CPT Steve Boyer

Since 1977, the Three Day War (TR12FZ) exercise has offered the most intensive training of any field exercise sponsored by the Field Artillery School. Here, each student of the Field Artillery Cannon Battery Officer Course (FACBOC) has the opportunity to use skills learned over the preceding 17 weeks of training during a grueling exercise simulating a mid-intensity combat. More than 25 instructors from all academic departments assist in training more than 100 Field Artillery Officer Basic Course (FAOBC) students that participate in each exercise.

The Three Day Wars are supported by alternating III Corps Artillery elements—normally a field artillery battery. This support effort includes the commitment of all administrative, logistical, and equipment resources.

During this field training, students work with the M109A3 155-mm howitzer. To get a feel for realistic battery operations, as well as how hard their enlisted soldiers must work, each student rotates through numerous job positions ranging from forward observer/RTO (radiotelephone operator) to student battery commander.

The students conduct RSOPs (reconnaissance, selection, and occupation of position) and hipshoots, operate under a split battery concept, conduct aerial observations, shoot various types of fire missions, and perform simultaneous survey observations; in short, they participate in the finest field artillery training available in the US Army today. Additionally, students lay the battery, prepare the howitzers to fire, install battery communications, and plan and coordinate fires. The only jobs not undertaken by the students are those of drivers, cooks, mechanics, and ammunition/POL resuppliers which are performed by III Corps Artillery support personnel.

To add training realism, opposing forces (OPFOR), dressed in Warsaw Pact style uniforms, attack the perimeter defense, use tear gas, and provide an opportunity for students to exercise prisoner of war handling procedures. In addition to performing operational functions, students perform the weapons check, accountability of personnel, and required maintenance. In other words, the students' days are long and hard.





In addition to the firepower delivered by the student battery, the 2d Battalion, 2d Field Artillery, provides three M102 105-mm howitzers for company mortar simulation; and the 4th Battalion, 31st Infantry (Mech), Fort Sill's only maneuver battalion, provides two 107-mm mortars. Thus the fire support team (FIST) chiefs receive training and experience in selecting the most economical fire support asset to accomplish each mission.

Recently, the School's Tactics, Combined Arms and Doctrine Department (TCADD) improved the exercise by incorporating several changes. The Three Day War has been good, but not good enough. Personal contact with field commanders revealed that they favored more dynamic training. The most common points addressed were:

- Lieutenants were not receiving enough training in the jobs they were required to perform shortly after departing the school; specifically, battery commander, executive officer, FIST chief, battery fire direction officer, and battalion fire support officer.

- Since all FACBOC student examinations were completed prior to the exercise, some students were apparently trying to "sleep on their feet"; i.e., doing just enough to get by.

- Not enough RSOP training was being conducted with only five occupations taking place during the three-day period.

- Too much administrative time was being allowed for critiques and phase changes.

- The exercise terminated too early—just at the time the students were becoming familiar with battery operations.

With a new program of instruction coming into effect for FY82 (incorporating FAOBC and FACBOC into one 17-week, 3-day course), Colonel Paul A. Slater, TCADD Director, saw the opportunity to revise the current exercise. Based on a variety of input from other School departments and field commanders throughout the Army and repeated consultations with the instructor staff, Colonel Slater decided to incorporate the following changes in the scenario:

- Switch to more intensive instructor participation.

- Establish an evaluation system of key leadership positions based on a portion of the student's total academic points (50 out of 1,000 for the course total).

- Lengthen the exercise to four days.

- Occupy 16 or more firing positions (some deliberate and some hasty occupations) with phase changes/critiques occurring within the particular section at each new position.

- Conduct survivability moves.

- Place more emphasis on direct fire techniques and emergency missions.

- Increase the ammunition allocation by 25 percent.

- Conduct ammunition resupply in the field.

- Teach ARTEP standards.



- Conduct defensive NBC (nuclear, chemical, biological) operations (mission oriented protection posture for four hours).

- Employ two four-gun platoons as portrayed by the 3x8 concept.

Revising a high visibility exercise of this magnitude took intense coordination with instructors from TCADD and other departments within USAFAS. During the subsequent meetings, adjustments were made for equipment requirements, instructor responsibilities were refined, and the new scenario was completed.

These changes were definitely needed. The administrative hold of the war for two hours in order to shave, feed, and critique is gone. Now, critiques will be conducted and job changing done at the section where the students are employed, with major shifts occurring only every 24 hours. Thus, "Lieutenant Hindsight" may be the fire direction officer during one iteration and the FADAC operator in the next. At 0800 the next morning, he may move to the firing battery and work at as many different jobs as possible in that howitzer section during the following 24 hours. The section instructors will provide guidance and critique on the spot. The administrative break for the evening meal will also be eliminated. Now the students will eat tactically while missions are being fired.

Instructors involved with the new Four Day War are

enthusiastic and will motivate the students to do their highest level of performance possible without actually doing the job for them. The noncommissioned officers supervising the howitzers play a crucial role in the war since from past experience most delays in shooting have been howitzer-related, due to safety or lack of student familiarity with equipment.

Senior 13F MOS noncommissioned officers will supervise the FISTs. These professionals know their jobs thoroughly and are prime candidates for brigade fire support NCOs when they return to troop duty. To round out the expertise, officers from TCADD and the Weapons, Gunnery, and Communications/Electronics Departments will participate throughout the field training exercise.

FAOBC 1-82 will be the first class to participate in the Four Day War (in March 1982). In the meantime, several changes have been added to the present Three Day War Exercise (a practice evaluation system, increased number of RSOPs, and direct fire) which will prepare the instructors for a smooth transition. Positive instructor attitudes, the high quality of today's officer student, and the continued backing of USAFAS's senior officers coupled with the use of the finest equipment available in the US Army will assure success. ❏

**CPT Steve Boyer is Commander of Bravo Battery, 4th Battalion, 4th Field Artillery.**

# View from the Blockhouse

## FROM THE SCHOOL

### Fire Support Conference

The Field Artillery School hosted the annual Fire Support Conference during the period 17-19 November 1981. More than 115 representatives attended from the Department of the Army, US Army Training and Doctrine Command, US Army Forces Command, major Army commands, TRADOC service schools, readiness regions, ROTC regions, and US Marine Corps commands. A Target Acquisition Battery Commanders Conference, hosted by the Counterfire Department, was conducted concurrently.

The Field Artillery School presented a series of briefings on the latest developments in combined arms doctrine and the changes occurring in field artillery weapons, tactics, and training. Special briefings also were presented by representatives from the 17th Field Artillery Brigade, the US Army Engineer School, and the Foreign Science and Technology Center.

### M16 subtense table

In recent years the field artillery has utilized several methods of determining piece displacement. Although obtaining the angle from the aiming circle to the pantel stake is not difficult, judging the distance to the pantel marking stake has been a challenge for more than one executive officer. Since this information is necessary to determine better terrain gun position corrections, one may use the M17 plotting board or the simplified graphical terrain gun position correction tables (GTGPCT) mentioned in the November-December 1981 *Journal*.

Executive officers have also measured these distances with steel tape, paced the distance, or used the 60-meter subtensed distance; however, the easiest method is to use the 2-meter bar to measure the distance. (One measures the number of mils from one end of the bar to the other and

then enters the subtense table with this figure and extracts the distance.)

There have, however, been some problems with this system:

- No table of organization and equipment authorizes the 2-meter subtense bar; therefore, local fabrication is required.

- Batteries normally have only one bar, requiring a cannoneer to run from piece to piece to determine the distance from the aiming circle which becomes increasingly difficult with extended battery fronts and eight-gun batteries.

To correct these shortcomings, a subtense table was developed (figure 1) using an Apple II computer. The computer program (figure 2), in basic computer language, should work on most home computers, thus allowing any person to redetermine the program if necessary, using a different length bar. The program is based on the length of an M16 rifle, since this is the personal weapon of the advance party guides. The distance was determined to be 0.975 of a meter (975/mils = distance in meters). Other lengths could be used by replacing 975 with the new figure.

The figures were tested against the distances measured with a steel tape over both hilly and gently rolling terrain. No variance over 0.3 mil was identified.

A typical scenario is presented: The advance party sweeps the area in accordance with the standing operating procedure. The instrument operator sets up the aiming circle and establishes communications with each gun guide. The gun guide stands behind the pantel marking stake, facing the aiming circle, and holds his rifle chest high. The instrument operator measures the deflection to the pantel marking stake and records it. He uses the reticle pattern

THESE VALUES ARE ACCEPTABLE FOR USE WITH TGPC							
MEASURE THE LENGTH OF AN M16 RIFLE FROM THE RIFLE BUTT TO THE END OF THE FLASH SUPPRESSOR							
ENTER THE TABLE WITH THE MILS MEASURED AND EXTRACT THE DISTANCE (MEASURED IN METERS)							
MILS	DISTANCE	MILS	DISTANCE	MILS	DISTANCE	MILS	DISTANCE
.5	1950	10.5	92.8571	20.5	47.561	30.5	31.9672
1	975	11	88.6364	21	46.4256	31	31.4516
1.5	650	11.5	84.7926	21.5	45.3458	31.5	30.9524
2	487.5	12	81.25	22	44.3152	32	30.4688
2.5	390	12.5	78	22.5	43.3333	32.5	30
3	325	13	75	23	42.3913	33	29.5455
3.5	278.571	13.5	72.2222	23.5	41.4894	33.5	29.1045
4	243.75	14	69.6429	24	40.625	34	28.6745
4.5	216.667	14.5	67.2414	24.5	39.7959	34.5	28.2609
5	195	15	65	25	39	35	27.8571
5.5	177.273	15.5	62.9032	25.5	38.2353	35.5	27.4648
6	162.5	16	60.9375	26	37.5	36	27.0833
6.5	150	16.5	59.0909	26.5	36.7925	36.5	26.7123
7	139.286	17	57.3529	27	36.1111	37	26.3514
7.5	130	17.5	55.7143	27.5	35.4545	37.5	26
8	121.875	18	54.1667	28	34.8214	38	25.6579
8.5	114.706	18.5	52.7027	28.5	34.2105	38.5	25.3247
9	108.333	19	51.3158	29	33.6207	39	25
9.5	102.632	19.5	50	29.5	33.0508	39.5	24.6835
10	97.5	20	48.75	30	32.5	40	24.375

Figure 1. Subtense table.

## View From The Blockhouse

```
110 REM WORM FORMULA
120 LPRINT "THESE VALUES ARE ACCEPTABLE FOR USE WITH TGPC"
130 LPRINT "MEASURE THE LENGTH OF AN M16 RIFLE FROM THE RIFLE BUTT
    TO THE END OF THE FLASH SUPPRESSOR"
140 LPRINT "ENTER THE TABLE WITH THE MILS MEASURED AND EXTRACT THE
    DISTANCE (MEASURED IN METERS)"
150 M=0.5:M1=10.5:M2=20.5:M3=30.5
160 LPRINT "MILS", "DISTANCE", "MILS", "DISTANCE", "MILS", "DISTANCE",
    "MILS", "DISTANCE"
170 D=975/M:D1=975/M1:D2=975/M2:D3=975/M3
180 LPRINT M,D,M1,D1,M2,D2,M3,D3
190 M=M+.5:M1=M1+.5:M2=M2+.5:M3=M3+.5
200 IF M3>40 THEN GOTO 220
210 GOTO 170
```

Figure 2. Computer program.

of the aiming circle to measure in mils the M16 from rifle butt to the end of the flash suppressor. He tells the gun guide the deflection and the gun guide goes to the assembly area to meet his weapon. The instrument operator continues this procedure with the rest of the battery gun guides. Now the instrument operator has the mil value to enter the tables and extract the distance to each piece. Once this is accomplished, he can give the FDC representative piece distribution by deflection and distance from the aiming circle. The FDC representative can then compute terrain gun position corrections (TGPC) before the main body arrives. (CPT Teeples, WD)

### Rationalization, standardization and interoperability notes

The following is extracted from a report/article by Dr. Eugene L. O'Brien, US member of the Ammunition Interchangeability Working Party:

"During the past several years, the United States has not only made significant progress to identify where it stands with respect to interoperability, but has also learned to appreciate the value of a close association with scientists and engineers from other NATO nations. The result has been the establishment of mutual trust in the abilities of each other and a willingness to make things work.

"Up to now, the US has talked about interoperability of hardware and associated software; however, much of what was accomplished in bulk ammunition was done after national programs were well into development. Despite the degree of success achieved, this is *not* the way it should be done in the future. In fact, it is *not* the way it will be done (this is to be insured by program and management initiatives).

"Much of our recent progress started as bilateral efforts. Here, the US Army Test and Evaluation Command has done an outstanding job in arriving at safety test agreements in this manner.

"The approach taken was a "tailoring" process which permitted consideration of alternative methods of arriving at the desired acceptable procedure. Agreements were signed with the United Kingdom and Germany which identified procedures describing the conduct of a specific test and, if used, will allow the data of one nation to be acceptable to the other without requiring a large testing program.

"An excellent example of innovative management was the negotiation of the Quadrilateral Ballistics Memorandum of Agreement signed by the United States, Germany, Italy, and the United Kingdom. This document describes the 155-mm ballistics parameters governing the design of ammunition for the FH70 and M198. The result was a Quadrilateral Safety Agreement, signed in 1980. Shortly after its signing, the safety agreement, backed up by documentation of test procedures, was introduced into NATO for consideration as a Standardization Agreement (STANAG). Although the original Quadrilateral Safety Agreement was specific to the 155-mm, its content with minor changes is applicable to all artillery and, furthermore, to all tube-launched ballistic ammunition, including naval guns. The Memorandum of Understanding (MOU) itself is being considered as the basis for a STANAG describing the design parameters of projectiles and propelling charges for fielded NATO 155-mm howitzers through the 1980 time frame. The MOU will be expanded to include the French Automoteur (self-propelled) FI, as well as new weapons/ammunition, being considered by other NATO nations.

"Beyond the year 2000, NATO is looking for major improvements to the entire artillery system that will provide the interoperability required to satisfy the NATO/JCS priorities. There has not yet been an artillery system, designed by any country, which was influenced by NATO from the beginning. Recognizing that such a system would lead to the ultimate in interoperability, NATO Panel IV (Surface-to-Surface Artillery) requested the US to



present an information briefing on the artillery approach to satisfy the Mission Element Need Statement for the Division Support Weapon System (DSWS). It is the desire to use the DSWS as the system model on which a NATO requirement could be established. While a national decision by the US has not been made on the artillery solution to DSWS, it is expected that if the decision is affirmative, consideration would be given to making DSWS a NATO program."

•The US Army Field Artillery School provided a representative to the 31st meeting of NATO Panel IV-Surface-to Surface Artillery, during the period 23-27 November 1981 at NATO headquarters. Major John M. Shanitoltzer was the USAFAS delegate. Principal discussion included STANAG 4130, "Interoperability of Artillery (ADP) Systems and Artillery ADP Systems in Service."

•Preparations are under way for US participation in the 11th meeting of the Quadripartite (ABCA) Working Group on Surface-to-Surface Artillery, scheduled (proposed) for May 1982 in the UK (London Area).

•Implementative of US ratified STANAGs/QSTAGs (Quadripartite Standardization Agreements) that affect US Field Artillery interoperability with other NATO national artillery is the responsibility of the US Army Field Artillery School. A composite listing of all STANAGs/QSTAGs implemented in US Army Field Artillery School training literature will appear in a future issue of the *Journal*. (Mr. B. M. Berkowick, USAFAS International Standardization Coordinator NATO/ABCA)

## Antimateriel

### GMET

The Joint Munitions Effectiveness Manual for Surface-to-Surface Methodology and Evaluations Working Group (JMEM/SS-MEWG) has recently completed work on an antimateriel graphical munitions effects table (GMET) for the 155-mm howitzer. The new GMET is a set

of two rules and should be initially ordered as such. (The rules are classified CONFIDENTIAL.)

Each rule of the set contains a different array of representative threat vehicles and equipment (six total; three per rule). The number of volleys (one battery volley, two battery volleys, and battalion volleys) required to achieve 5 and 10 percent average fractional damage and the effects produced by one of each of the three volley types is presented for shell/fuze combinations HE/PD, HE/VT, and DPICM, while using the delivery techniques of observer adjusted MET + VEØTLE, MET + VE 75 TLE, and MET + VE 150 TLE.

The antimateriel GMET is designed as a guide for use by fire direction officers and fire planners to determine the volume of fire required to achieve the commander's desired effects against materiel targets. It is based on data contained in FM 101-60-14 and is used when time and situation constraints do not allow the user to refer to the manual itself.

The Joint Technical Coordinating Group for Munitions Effectiveness (JTCG/ME), of which JMEM/SS is a subgroup, was organized in 1965 and is composed of civilian and military experts in weapon and munition activities throughout the defense establishment. JTCG/ME produces scientifically valid data related to specific weapons, munitions, and appropriate targets. In this process, the group devises mathematical models to assist in analyzing the effectiveness of selected weapons against specific targets. This effort has resulted in a library of Joint Munitions Effectiveness Manuals on air-to-air, surface-to-surface, and air-to-surface weapons, technical publications on target vulnerability, weapon characteristics, delivery accuracy, and numerous specialized reports. Figure 1 lists the national stock numbers (NSNs) for the current GMETs. Organizations desiring to order GMETs should initiate a requisition through their unit supply section using CTA 50-970 as the authority. (CPT Salyers, GD)

CALIBER	DESCRIPTION	CLASSIFICATION	NSN	PART NO.	NO. RULES
*4.2	TRAINING	U	1220-01-116-4297	11785379	1
*4.2	ANTIPERSONNEL	C	1220-01-116-4298	11785380	1
155	TRAINING	U	1220-01-021-7277	11748391	1
105	ANTIPERSONNEL	C	1220-01-021-7278	11748393	1
155	AP(M449 ONLY)	C	1220-01-021-7279	11748395	1
**155	AP(M449 & M483)	C	1220-01-098-3627	11785246	1
*155	ANTIMATERIEL	C	1220-01-118-1444	11785381	SET OF 2
	RULE 1	C	1220-01-120-0807	11785382	
	RULE 2	C	1220-01-120-0808	11785383	
8"	ANTIPERSONNEL	(M404) C	1220-01-021-7276	11748397	1

\*New item  
 \*\*155 AP GMET (-3627) is replacing 155 AP GMET (-7279)

Figure 1. Nomenclature and national stock numbers for graphical munition effects table.

**Field Artillery ARTEPs being revised**

Several Field Artillery ARTEPs (Army Training and Evaluation Programs) have been revised or are undergoing revision. As such, units can expect to start receiving the new family of ARTEPs beginning with ARTEP 6-365 (FA Battalions of the Armored/Infantry Division (Mech), Separate Armored/Infantry Brigades (Mech), and Howitzer Batteries of the Armored Cavalry Squadron) which is applicable to:

- TOE 6-037H—FA Battery, 155-mm Self-Propelled Armored Cavalry Squadron, Armored Cavalry Regiment.
- TOE 6-365H—FA Battalion, 155-mm Self-Propelled Armored Division of FA Battalion, 155-mm Self-Propelled Infantry Division (Mechanized).
- TOE 6-375H—FA Battalion, 155-mm Self-Propelled, Separate Armored Brigade of FA Battalion, 155-mm Self-Propelled Separate Infantry Brigade (Mechanized).
- TOE 6-395H—FA Battalion (203-mm Self-Propelled) Armored Division of FA Battalion (203-mm Self-Propelled) Infantry Division (Mechanized).

The estimated distribution dates to the field of other ARTEPs are listed below:

<b>ARTEP No.</b>	<b>Title</b>	<b>Estimated distribution date</b>
6-185	FA Battalions of the Infantry Division and the Separate Infantry Brigade, applicable to: TOE 6-115H, FA Battalion, 105-mm Towed.	2d Qtr FY82
6-445	FA Battalions-Nondivisional, applicable to: TOE 6-425H, FA Battalion, 155-mm Towed. TOE 6-445H, FA Battalion, 8-Inch Self-Propelled. TOE 6-445H, FA Battalion, 155-mm Self-Propelled.	2d Qtr FY82
6-595	Field Artillery Battalions, Lance, applicable to: TOE 6-595H, FA Battalion Lance.	3d Qtr FY82
6-300	Corps Field Artillery Section, Division Artillery and Field Artillery Brigade, applicable to: TOE 6-300, Division Artillery. TOE 6-307, Target Acquisition Battery. TOE 6-401, FA Brigade Headquarters and Headquarters Battery. TOE 52-2, Corps Field Artillery Section.	2d Qtr FY82
6-700	Air Assault Division Artillery, applicable to: TOE 6-700J, Air Assault Division Artillery.	3d Qtr FY82

	TOE 6-797J, Aviation/Target acquisition Battery, Assault Division.	
6-205	FA Battalions of the Airborne Division, applicable to: TOE 6-205, FA Battalion, 105-mm, Airborne Division/Separate Airborne Brigade.	4th Qtr FY82
6-705	FA Battalions of the Air Assault Division (formerly known as 6-125), applicable to: TOE 6-705H, FA Battalion 105-mm Towed Airmobile (Air Assault Division).	4th Qtr FY82
6-200	Airborne Corps Field Artillery Section, Division Artillery, and Field Artillery Brigade, applicable to: TOE 6-200H, Airborne Division Artillery. TOE 6-201H, HHB Division Artillery. TOE 6-307H, Target Acquisition Battery, Airborne Division. (TAB organizations should continue to use ARTEP 6-307 until the revised applicable ARTEP is received.) TOE 6-401H, HHB Field Artillery Brigade. TOE 52-002H, HHC, Corps.	1st Qtr FY83

The following ARTEPs, which include tasks for both TACFIRE and the Battery Computer System (BCS), will be prepared and distributed to those units which are TACFIRE equipped or scheduled to receive TACFIRE/BCS in the next 18 months. These ARTEPs, in Test Edition form, are to validate the training objectives relating to TACFIRE and BCS.

<b>ARTEP No.</b>	<b>Title</b>	<b>Estimated distribution date</b>
6-300-1	Corps Field Artillery Section, Division Artillery (TACFIRE), and Field Artillery Brigade (TACFIRE).	2d Qtr FY82
6-365-1	FA Battalions (TACFIRE) of the Armored/Infantry Divisions (Mech), Separate Armored/Infantry Brigades (Mech) (TACFIRE), and the Howitzer Battalions of the Armored Cavalry Squadron.	2d Qtr FY82
6-445-1	FA Battalions (TACFIRE)—Nondivisional.	3d Qtr FY82
6-185-1	FA Battalions of the Infantry Division and Separate Infantry Brigades (TACFIRE).	4th Qtr FY82

All Field Artillery ARTEP users may request additional information by calling the ARTEP hotline (AUTOVON 639-2064), which is available 24 hours a day. A 90-second voice tape will record your message. First please state your name and telephone number so that you may be contacted in case the call is disconnected before completion. Units without access to AUTOVON can call commercial 1-405-351-5004/2064, during duty hours. The USAFAS 24-hour "Hotline" is also available at AUTOVON 639-4020, or commercial 1-405-351-4020. You may also write to the following address to obtain information:

Commandant  
US Army Field Artillery School  
ATTN: ATSF-TD-CT  
Fort Sill, OK 73503

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## COUNTERFIRE



## SYSTEMS REVIEW

### TAB Conference

The fourth annual Target Acquisition Battery Commander's Conference (at Fort Sill 17-19 November 1981) was not only the largest TA conference held but it also incorporated several "firsts." For example, it was the first conference attended by representatives from all eight National Guard target acquisition batteries (TAB) and all three United States Marine Corps Artillery regiments. In addition, there were attendees from 16 of the 17 active duty TABs along with several corps and separate brigades. The conference was designed to provide a forum for those involved in target acquisition and the US Army Field Artillery School to share and discuss problems associated with TA organization, training, doctrine, and related areas.

Based on favorable feedback from previous conferences, a continuing theme in 1981 was "worldwide" target

acquisition which included presentations from liaison officers from Australia, France, Great Britain, and West Germany. Each presentation focused on equipment capabilities and general tactical employment doctrine. One additional presentation was made on "Target Acquisition in a Middle-East Environment" by an Egyptian officer currently in residence attending the Officers Advanced Course. Highlighted in the presentation were situations and difficulties which might be encountered in the Middle-East by the Rapid Deployment Force.

Another theme of the 1981 conference was "Survivability of Target Acquisition Assets." Here, an analyst from the United States Army Foreign Science and Technology Center provided in-depth briefings on "Soviet Artillery Modernization" and "Soviet Target Acquisition Capabilities."

As in the past years, the most constructive conference discussions were stimulated by presentation from individual TAB commanders. Speakers included: CPT Michael O'Rourke (1st Armd Div), MAJ Clint Miller (101st Airborne Div), CPT Thomas Campo (82d Abn Div), 1LT Chris O'Connor (4th Inf Div), CPT Steven Neely (9th Inf Div), CPT John Hartigan (2d Inf Div), CPT Mike Rose (3d Inf Div), and W02 Richard Danesi (5th Inf Div).

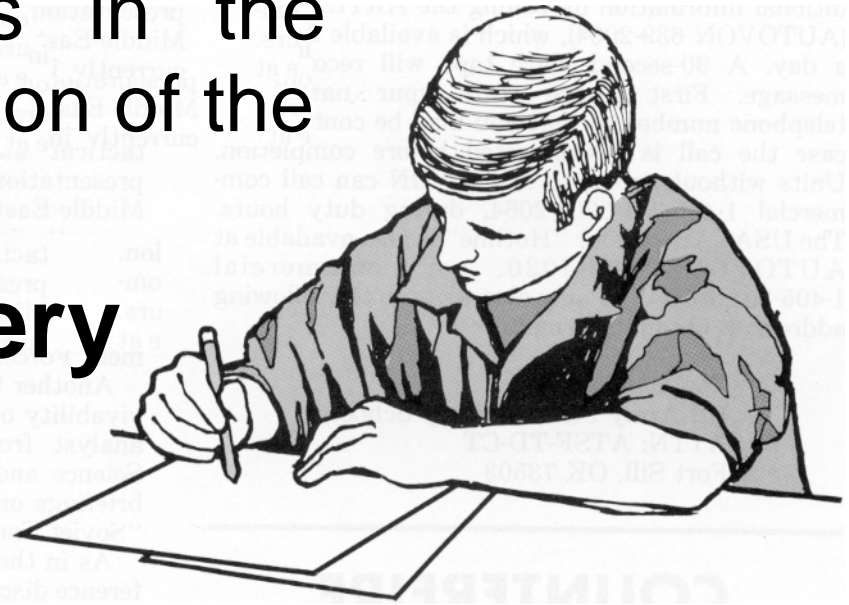
Based on 50 years experience in the field, COL (Ret) Arthur Hercz, Director of the Target Acquisition Department in 1943, presented his perspectives on the future of target acquisition.

The conference concluded with a round-table discussion designed to allow TAB commanders to direct questions to representatives of the Field Artillery School. Since planning is now underway for next year's conference, those with ideas or recommendations can call the Counterfire Department (CPT Gourley) AUTOVON 639-3312.

### Course expanded

Continuing in the tradition of providing the best "map interpreters" in the United States Army, the Counterfire Department has expanded the course of instruction for the Field Artillery Officer Basic Course (FAOBC) to include a graded night land navigation exercise. This was made possible by the expansion of the FAOBC to 17 weeks and 3 days and fills a gap in the complete training cycle for the Field Artillery lieutenant. The FAOBC student now receives a total of 37 periods of instruction in mapping, terrain association, and land navigation which includes 12 periods of classroom instruction and examination, 10 periods of practice land navigation and terrain association, and 15 periods of graded day and night land navigation.

# Improvements in the Manual Solution of the 6400-mil Met/Gunnery Problem



by SSG David M. Johnson

One of the most exciting developments in fire direction today is the application of improved technology such as TACFIRE and other systems. These capabilities are absolutely necessary when we consider the increasing sophistication of the modern battlefield. There are, however, several dangers inherent in this evolution. Increased technology presents, by its very nature, increased chances of failure. Extensive maintenance facilities, alternate power systems, backup systems, protective devices, and other measures often compound the problem. If Murphy's Law (if anything can go wrong, it will) applies in peacetime, imagine how much more likely it would apply on the nuclear, chemical, electronic, and highly mobile battlefield.

The "safest" method for fire direction is probably the use of manual procedures. However, the new systems create new standards of performance, and these new standards modify the expectations and requirements of all organizations using the data, to include results of fire direction. When the core of this system fails and we attempt to use procedures designed to fit an entirely different standard, results will be unsatisfactory. The critical point in military situations is that failure to meet standards has one certain result—death. Even with technological advances manual procedures will continue to be a major asset; therefore, we must continue to improve these methods so that the results will be satisfactory under all conditions.

This article presents an analysis of eight-direction meteorological (met) techniques, which may not represent the best answer, but may provide a basis for improvement.

The review of any procedure requires a look at the basic elements of the problem. In the case of met solutions the following steps occur:

- Formation of a data base—This includes receipt of the met message, target data, registration corrections, battery data, and the information necessary to apply the met data to the trajectory.
- Access of data base—This is the mechanical process of selecting the appropriate information and organizing the data for use.
- Mathematical computations—This includes all operations on the data necessary to obtain the end result.
- Application—The end result is applied to a fire mission.

This process is used in both automated and manual systems. The differences between the two procedures are ones of method and speed within the following steps:

- *Formation of data base:* In automated systems, most of the initial data is entered into the computer via keyboard, punched tape, etc. The only element that does not require input is the mathematical routine necessary to apply the data to the trajectory. This information will be located in the computer program. In manual systems, the data base is formed by handing the source documents to the personnel assigned to prepare the solution. There is a substantial difference, however, when we consider the application data. Manual systems must keep computations to a minimum; therefore, the application information is pre-computed and placed in tabular form in the firing tables. This time-saving measure expands the manual system data base considerably.

- *Access of data base:* Automated systems have two advantages in this area. First, since the application math is stored in the program, the resulting data base is smaller. Second, automated systems can retrieve data and transfer it to the core memory (for processing) at extremely fast speeds while manual systems require much more time and must

deal with a larger data base. Individual forms and tables must be selected and read and data must be obtained and transferred in writing to the met correction form.

• *Mathematical computations:* The major difference here is the degree of complexity and speed. Automated systems use much more complex procedures, but they can complete computations at very high speeds. Manual systems require less computations, but require more time for each step.

• *Application of the results:* Since automated systems operate at extremely high speeds, these systems will repeat the process for each fire mission. The result obtained will normally be accurate since the solution is prepared for that specific target. Manual systems must use the graphical firing table (GFT) to apply the results. The procedure is to construct the GFT setting and use this setting for all targets falling within agreed transfer limits. This will produce some error, but is necessary to keep computation time to a minimum.

*Note:* The TI-59 computer facilitates the computations involved in manual methods and should reduce computation to a minimum. However, since this device is oriented to the manual solution, access of data base will still be a major time factor since the GFT method must be used to apply the result to a fire mission.

When we consider the 6400-mil problem, the differences between automated and manual systems become amplified. The automated system, with its high speed and limited data base, has a built-in 6400-mil capability. Each met solution is specific for the target involved. The manual solution, however, requires pre-computation. To obtain 6400-mil coverage, the process listed above must be repeated 8 times at ranges below 10,000 meters and 16 times for ranges above 10,000 meters. The separate solutions must then be converted into GFT settings and stored for subsequent use. Since present procedures require the completion of several forms, a single form would improve the time required to locate the met solution and reduce the possibility of lost or misplaced forms.

Our unit tested a form (figure 1) during our annual training and found it to be successful in reducing the time required for the eight-direction met although further study will be necessary to set time standards. In our opinion, a concurrent met should require about 15 minutes.

Such a form should contain eight columns (the 16-direction problem will be discussed later). These columns must emphasize parallelism for ease of data entry and computation. All directions must use the same entry range. Also, non-directional factors should be grouped in a separate section.

The procedure for computing VE is as follows:

- Complete the "Non-Directional Factors" section with the exception of the "VE" and "Total" lines.
- Place the direction of fire used in the registration on line 2 of one of the eight columns.

Figure 1

- Place the total range correction on line 11, and complete lines 1 through 9.
  - Subtract line 11 from the sum of lines 8 and 9. Write this value on line 10 (the number can be used for all eight columns) and on the "Total" line of column E in the "Non-Directional Factors" section.
  - Determine the VE range correction by subtracting this total from the sum of all values listed in column E.
  - Determine VE by dividing the result by the proper correction factor in column D and record the result in column C.
- Position correction is calculated in the following manner:
- Complete the "Deflection Correction" section (lines 12 through 19).
  - Place the total correction on line 21.
  - Subtract line 21 from the sum of lines 17, 18, and 19.
  - Record the result on line 20. This value may be used for all eight columns.

Figure 2

Fuze corrections are computed in a similar manner using the "Time Correction" section. An example of a completed form is shown in figure 2. The data on the form is taken from the Concurrent Met example used in FM 6-40 dated 1 December 1978. It should be noted that the form assumes (and requires) that the range to center of sector be the same for all sectors. If there is a requirement for a different range for one or more of the sectors, care must be exercised that the range difference falls within the one plot transfer limit. Single plot GFT settings are considered valid over the following ranges:

Charge	Minimum range (meters)	Maximum range (meters)
8	9,600	17,500
7W	8,600	13,500
6W	7,200	12,000
5G	6,000	9,600
4G	2,800	8,000
2G	1,200	4,800

If these range limitations will not cover the requirements for one or more sectors, additional computations may be required. Subsequent met procedures are similar to the concurrent met. In this case the VE and position corrections are transferred from the concurrent met. An example of a subsequent met solution is given in figure 3. The colored areas indicate transfers from the previous solution. If we consider the time allowed for this procedure in the 13E Soldier's Manual, we have the following results:

Eight-Direction met solution = 45 minutes  
 Eight GFT settings at two minutes each = 16 minutes  
 Total = 61 minutes

We could expect that the 16-direction solution would take approximately twice as long. (This does not consider the effects of mental fatigue.) Since a current met message is defined as one which is less than two hours old, the manual solution will provide a solution that is valid for less than one hour. If this method is to serve as a backup for automated solutions, improvement in these times is necessary. Thus, it is suggested that a multiple direction form be designed to facilitate the following:

- *Reduce access time.* This type of form would allow the operator to select the data for all directions with one step, thus reducing access time by 87 percent in the case of an eight-direction met.

- *Reduce computational time.* For example, review of the wind component table will indicate that any value selected will repeat itself. This repetition occurs every 1600 mils with each value appearing as a right cross wind, left cross wind, tail range wind, and head range wind. The resolution of a met message requires that this component be multiplied by the wind speed. In the case of an eight-direction met, this amounts to 16 computations. If the data is

Figure 3

grouped on a single form we can reduce the computations to four. In other words, each multiplication would provide four answers. This same method would provide reductions in the area of rotation range corrections. In this case the use of a single latitude modifier would allow the eight computations to be reduced to four (one set of positive answers and one set of negative answers). Additional savings will occur in the multiplication of data by Table F and Table J components.

- *Save transcription time and prevent duplicate work.* Since non-directional factors, such as air temperature, air density, powder temperature, and velocity error (VE) values will not change as we change the direction of fire, the computations involved could be grouped and completed once. The sum of all the values would then be applied to the different directions.

- *Less chance for manual errors.* Internal relationships in the firing table data can be used to insure that selection errors are not made. Parallel computations will present a check on math error.

- *Improve application of the results to fire missions.* As noted earlier, ranges beyond 10,000 meters have a current requirement for a 16-direction solution. Interpolation of an eight-direction solution can eliminate this requirement.

The difficulty of interpolating met solutions rests with wind corrections since the wind components may appear to be very similar between two 800-mil sectors; however, the intermediate values may be very different. This will be the case when the intermediate directions contain minimum or maximum values. This problem can be eliminated, however, by setting the ballistic wind at 0, 800, 1600, 2400, 3200, 4000, 4800, and 5600 mils which will select all points with minimum and maximum values. If these directions are held constant, the direction of fire must be computed using the ballistic wind. Thus, each subsequent change in wind direction would result in a change in the eight directions of fire.

The remaining error in wind computations will be due to the fact that the wind component values are non-linear (cross wind = sine of ballistic wind direction; range wind = cosine of ballistic wind direction). Analysis of this condition indicates that the average error that will occur from linear interpolation of these functions will equal a wind component of 0.036. The maximum error will be 0.069. If maximum error is applied to the correction factor at maximum range, the wind velocity necessary to produce a three-mil error in deflection is:

Charge	Wind speed (knots)
2G	153
4G	126
5G	87
6W	65
7W	58
8	52

A similar review of range wind components will indicate that the wind speed necessary to produce a 50-meter error in range at maximum range (with maximum interpolation error) equals:

Charge	Wind speed head wind (knots)	Wind speed tail wind (knots)
2G	264	310
4G	74	137
5G	46	49
6W	39	43
7W	35	39
8	29	34

At ranges less than maximum, these wind speeds increase dramatically. Thus, it can be concluded that linear interpolation from an eight-direction met would under most conditions result in a satisfactory correction. An additional benefit is that this method would eliminate one table from the review process and shorten the computation process. Figure 4 shows the extent that a form could be filled out in advance and to what extent certain computations could be eliminated.

If interpolation is undesirable for a specific direction, an alternate procedure can be used with the help of any calculator with trig functions.

- Enter wind direction; subtract direction of fire.
- Divide result by 17.777 (to convert mils to degrees). Omit this step if a military slide rule or TM 6-230 is used.
- Compute sine. (Note: A negative value will indicate a left correction; a positive value will indicate a right correction.)
- Multiply result by wind speed listed on line 14.
- Multiply result by correction factor listed on line 16 for the same type of cross wind.
- Add the value on lines 18, 19, and 20 (equals deflection correction for the specific direction desired).



Figure 4

A similar procedure can be used for computing range corrections. The range wind correction is determined by using cosine functions (a positive value equals a head wind; a negative value equals a tail wind). If refinement is desired in rotation range corrections, the procedure is to compute the sine of the direction of fire and multiply this result by the value at 1600 or 4800 mils. If the sign of this result is changed and multiplied by the latitude modifier, a specific correction will be obtained. (Note: The latitude modifier = cosine of latitude).

The advantage of these two methods (interpolation and specific computation) is that specific application data can be obtained without consulting the firing tables. This also provides an alternative to the GFT transfer zone method. The result should be improved first round data obtainable in a relatively short time.

In conclusion, presented herein is one potential improvement in manual computations—the 6400-mil met problem. There are a number of other areas where change may improve the performance of manual methods. This does not mean, however, that current procedures are faulty or stagnant. These methods, the backbone of fire direction, have been improved as needed and presently satisfy the needs for backup of FADAC. TACFIRE and its related systems will, however, change the standards of performance for fire direction and will require substantial change in manual methods as a backup to avoid technological dependence.

**SSG David M. Johnson is assigned to Headquarters and Headquarters Battery, 1st Battalion, 147th Field Artillery Bde, South Dakota Army National Guard, Sioux Falls, South Dakota.**

# Hasty Displacement?

## A quick-release modification for the tent extension of the M577A1

by 2LT Michael C. Morton

There is a lull in firing and no missions have been called for by the fire support team (FIST) for more than 20 minutes. In the quiet, gun sections perform maintenance checks while the fire direction center (FDC) computes meteorological (met) data. All at once, without warning, the battery begins to receive incoming fire.

Immediately the executive officer calls for a hasty march order and sections spring to life. Gun crews quickly load their mission-essential equipment, lift their camouflage nets, and speed toward the pre-arranged alternate position.

The FDC, however, has more equipment to load than the gun sections, such as charts, sticks, hand-held

calculators, and communication equipment. But the single most time-consuming operation is march ordering the tent extension of the M577A1 which is usually rolled and strapped to the top of the vehicle or released by loosening the bolts which affix it to the top.

This particular FDC, however, has a modified tent extension. The radiotelephone operator steps onto the track of the vehicle and gives a rip cord a sharp pull. Nine quick-release pins snap away from studs, and the long metal plates connecting the tent to the vehicle are flipped away. The crew lifts the camouflage net and the FDC track roars away with the guns.

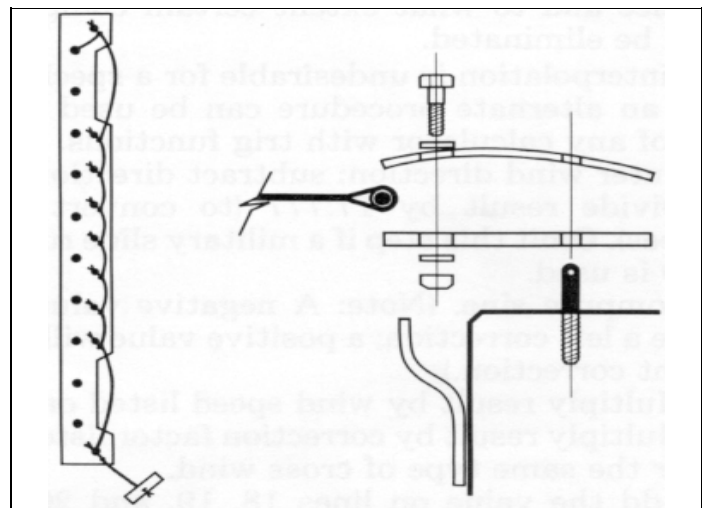


**PFC Wayne Grant pulls the quick release cord.**

Bravo Battery, 1st Bn, 77th FA, 1st Cavalry Division, at Fort Hood, TX, has installed such a quick release modification on its FDC vehicle. The modification is fabricated from readily available parts and requires no welding. The parts needed include:

Quantity	Nomenclature	National Stock Number
2	plate, retaining	5340-00-933-6939 <sup>1</sup>
9	pin, lock	5315-00-598-5808 <sup>2</sup>
9	bolt, coarse thread, 3/8" × 3 3/4"	5035-00-269-3219
10	bolt, coarse thread, 5/16" × 1 1/2"	5306-00-225-8502
10	nut, coarse thread, 5/16"	5310-00-191-3669
20	washer, 5/16"	5310-00-080-6004

<sup>1</sup>See TM 9-2300-257-20P, figure 208, number 3.  
<sup>2</sup>See TM 9-2300 257-20P, figure 131, number 18.



**Top and Side view of the retaining plate assembly.**

### Parts List





**M577A1 moves out during a hasty displacement; leaving the camouflage net and tent extension standing.  
Inset: Quick release pin.**

To construct the modification, flatten one of the retaining plates with a heavy hammer. Place the curved retaining plate on top of the flat one, aligning the cutaways and the oval holes.

Drill 10 equally spaced holes, 3/8-inch in diameter, through both plates. The holes should be two inches from the front of the curved plate. When the plates are fastened together with the ten 5/16-inch bolts and nuts, and put in position on top of the M577A1, the 5/16-inch bolts will fit into the rain gutter on the back of the vehicle and the oval holes will align with the 3/8-inch holes already in the top of the vehicle.


Drill 9/64-inch holes through the 3/8-inch bolts, two inches from the base of the shaft. Cut the heads from the bolts, and grind away any sharp edges left on the shafts. With a pipe wrench, screw these 3/8-inch studs into the 3/8-inch holes on the top of

the M577A1. Be certain that the 9/64-inch holes are aligned parallel to the rear edge of the vehicle.

Insert the quick-release pins into the 9/64-inch holes, with the open ends of the pins facing left. Tie the pins together with a strong nylon cord, leaving approximately 18 inches free on the left side of the vehicle and enough slack between the pins to facilitate their replacement into the holes once they have been pulled. The cord should be tied through the eyes of the pins so that when the cord is pulled from the right side of the vehicle, all the pins will easily disconnect.

Lay the tent extension on the ground. Fasten the retaining plates to the end of the canvas by tightening the 5/16-inch bolts. Tie a loop in the left end of the rip cord. Place the loop under the head of the left 5/16-inch bolt; then tighten the bolt so that the rip cord is attached to the retaining plates and canvas.

The entire assembly can then be lifted onto the top of the vehicle and dropped onto the studs. Insert the quick-release pins, fabricate a handle for the rip cord, and trim away any excess cord. Make certain that all section members understand how to use the modification, when to use it, and how to put it back together so that it will work again. (The pins must always face the same direction to function properly.)

This modification was developed by Bravo Battery, 1st Bn, 77th FA, and is being used successfully by that unit. Because of the increasing emphasis on hasty displacements during training exercises, other units using M577A1s as fire direction or command centers may find this modification useful. 

**2LT Michael C. Morton is the fire direction officer of Bravo Battery, 1st Battalion 77th Field Artillery.**

# Right by Piece

## NOTES FROM UNITS

### Fort Sill and Fort Riley cannoneers change places

FORT RILEY, KS—The 8-inch howitzers belonged to the 3d Battalion, 6th Field Artillery, but the soldiers firing them wore an unfamiliar patch on their left shoulders.

The men were members of Battery C, 2d Battalion, 18th Field Artillery of Fort Sill, who recently trained at Fort Riley as part of a new experimental unit swap program between the artillery organizations of the two installations.

While the Fort Sill cannoneers trained at Fort Riley, about 70 soldiers from Fort Riley's 3d Battalion, 6th Field Artillery, were wandering around on Fort Sill's East Range wearing the "Big Red One" on their left shoulders. Since both batteries are 8-inch howitzer units, they just exchanged equipment for a week. In addition to the soldiers from A Battery, 3-6th FA, several soldiers from the battalion's headquarters battery also went to Fort Sill to serve as forward observers and to evaluate the battery during the training.

The idea for the exchange came about as a result of Emergency Deployment Readiness Exercises (EDREs), explained MAJ Felix Peterson, 2-18th FA executive officer. Most Fort Sill units do not go anywhere during their EDREs, so this was a way to get more realism in their training, he said.

"This gives our soldiers a chance to train in a different environment and with different equipment," explained CPT Dennis M. Murphy, commander of A Battery, 3-6th FA, the firing battery training at Fort Sill.

"We wanted to be evaluated while at Fort Sill because we thought that the unfamiliar terrain

would provide a more realistic training environment," Murphy said. "At Fort Riley, we know the firing points by heart; we know the ins and outs of each situation that might occur, so this is more realistic."

"It teaches the men that we are all in the same Army and shows them how to use equipment effectively, whether it be here at Fort Sill or anywhere else," Murphy continued.

SGT John H. Grimes, a section chief in Battery C, 2-18th FA, said he and his men found training at Fort Riley "a totally different experience." The terrain here, he said, is different from that at Fort Sill and the ranges are smaller.

CPL Porfirio Ruiz said he was accustomed to Fort Sill's paved tank trails, and he added, "We got a wild ride coming down one of those unpaved tank trails!"

Grimes said the experience of training on unfamiliar terrain with unfamiliar equipment "is good because that's the way it would be if we went to war . . . It teaches us to be expecting anything and to accept what you get."

The staffs of the 1st Infantry Division Artillery and Fort Sill's 212th Field Artillery Brigade helped set up the exchange, Murphy said. "They were looking for a program to build better relationships between the posts and artillery units and to further training, so they pushed this."

### COHORT units

FORT RILEY, KS—Cohort was originally described as one of the 10 divisions of a Roman Legion consisting of 300 to 600 men or a group united in some struggle.

Now, according to the Army's usage, COHORT is Cohesion Operational Readiness and Training, but still a group united in some struggle.

Fort Riley soldiers learned the new meaning of COHORT when, Battery A, 1st Battalion, 7th Field Artillery, the division's first COHORT unit, arrived in October last year.

The COHORT concept grew out of a study conducted by the Army Cohesion and Stability Action Team, which showed that the current system used by the Army to replace troops individually creates a lot of stress and unit turbulence. COHORT is the new plan to increase the effectiveness of Army units.

The idea is to keep the unit together. From basic training until their arrival at their permanent duty assignment, unit members will rotate together, whether assigned stateside or overseas.



Fort Sill cannoneers prepare to fire an 8-inch howitzer on Fort Riley range. (Photo by Lucas Hutton)

Tank, infantry, field artillery and certain air defense artillery and engineer units are to be the first units in the COHORT system.

In addition to Btry A, 1-7th FA, other units participating in COHORT at Fort Riley include:

- Battery D, 1st Battalion, 5th Field Artillery.
- Battery B, 1st Battalion, 7th Field Artillery.
- Companies A, B, and C, 2d Battalion, 16th Infantry.
- Companies B and C, 4th Battalion, 63d Armor.

According to GEN Robert M. Shoemaker, Commanding General of Forces Command, "COHORT is one of the most important initiatives I've seen in 35 years of service." (Beth Howell)

### **Bravo Battery fires honor salute**

BABENHAUSEN, WEST GERMANY—It is a rare occasion when a USAREUR-based field artillery battery is allowed to fire an honor salute. Recently, however, Bravo Battery, 2d Battalion, 5th Field Artillery, was selected to participate in two such ceremonies.

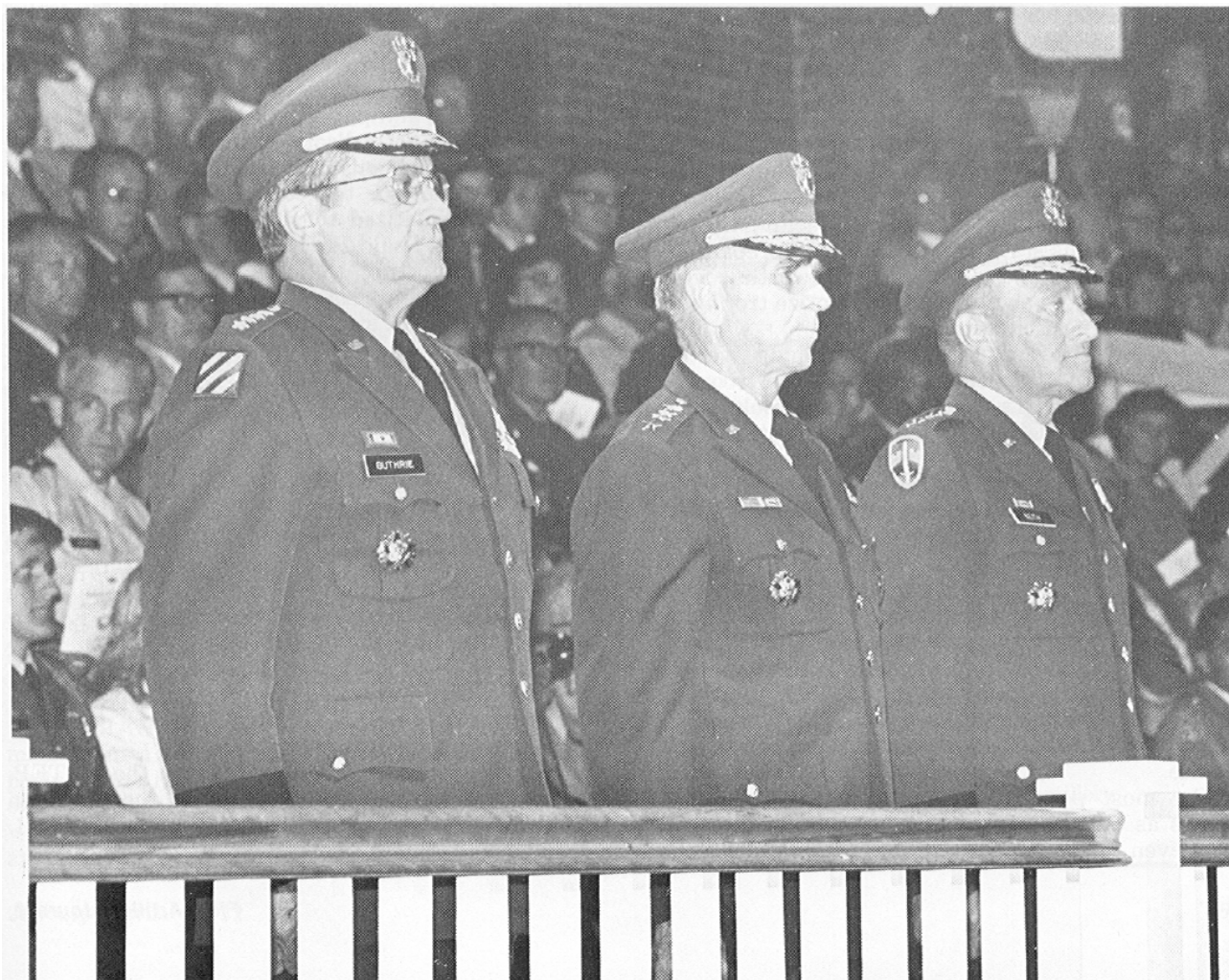
The first salute was to pay final respects to General of the Army Omar Bradley. With only a short time to prepare for the ceremony, CPT Bruce A. Brant, Bravo Battery Commander, was tasked with finding a working M101A1 howitzer, acquire blank ammunition, and train the crew. He found a World War II vintage M101A1 that was in a sad state of repair, but the crew managed to get it ready in time to fire the scheduled 19-round salute. One round per minute was fired and the entire battalion was at "Present Arms" to honor one of America's greatest World War II combat leaders.

The second occasion was an 11-round salute to honor BG Curtis F. Hoglan, V Corps Artillery Commander, upon his promotion. For this event, however, two more World War II M101A1 howitzers had to be acquired, but the battery came through.

All battalions of both V Corps Artillery brigades were represented. After the ceremony, the soldiers of Bravo Battery presented Brigadier General Hoglan with an engraved canister, commemorating the event.

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**ARLINGTON, VA—Three field artillery four-star general officers stand together during a review and change of command ceremony held on 31 August last year at Fort Meyer. General Donald R. Keith (right) assumed command of the US Army Materiel Development and Readiness Command from General John R. Guthrie (left) who retired 1 September with more than 39 years of service. Army Vice Chief of Staff, General John W. Vessey (center) took part in the ceremony.**





**A 46-man team from the 2d Battalion, 5th Field Artillery, marches through the main gate of Roussillion Barracks, Chichester, England.**

### Redlegs visit England

BABENHAUSEN, WEST GERMANY—For artillerymen serving in USAREUR, the annual calendar is normally filled with ARTEPs, TVIs, FTXs, trips to Grafenwoehr, and a host of other training events. The 2d Battalion, 5th Field Artillery, however, recently had a weekend of unusual training in Chichester, England.

The purpose of the trip was to allow a 46-man team, led by 1SG Joseph Ellis, to participate in the annual British Military Police Corps 25-Kilometer Military March. Supported by COL August M. Cianciolo, commander of 41st Field Artillery Brigade, and his staff, the planning and preparation phase took six months, but was well worth it when the Redlegs were awarded the first prize trophy for outstanding participation.

Although sore and tired after marching over the rugged terrain of southern England, the troops of the "Faithful and True" battalion later took part in a full dress parade through the streets of the city of Chichester. The cheers and expressions of genuine friendship by the local citizens made every soldier feel great pride in representing his country and battalion in this international event. (1LT Lawrence H. Saul)

### Artillery weathermen

GERMANY—Civilian weathermen are often a source of ridicule and disbelief. However, artillerymen of the 3d Armored Division Artillery, participating in exercise "Certain Encounter," think their soldier meteorologists are quite the opposite.

For most people, soldier and civilian alike, it comes as quite a surprise to learn that a weatherman even exists in the artillery.

The 10 artillery ballistic meteorologists are assigned to Headquarters and Headquarters Battery and are commanded

by CW2 John Izdepzki. They are an elite group of soldiers, sometimes referred to as "ghosts" who quite literally hold the effective performance of all field artillery batteries within their hands.

"We go for a first round hit, and it is through the efforts of my meteorologists that this is achieved," said Izdepzki. "Every time a projectile is fired, wind speed, wind direction, temperature, humidity, and air density can all affect the performance of the fired projectile. For example, if there is a five to 14 percent increase in the tail wind, the projectile could miss the target by 300 to 350 meters," concluded Izdepzki.

In a real war situation, weather readings would be taken every two hours.

"To do this," said SSG Brian Thornton, meteorologists section chief, "we employ a combination of the old and the new. We launch a balloon with a parachute and radio attached. This then relays the weather readings back to the control recorder. It is then processed and relayed directly to the various artillery batteries."

"It was not so long ago that it took five men 45 minutes to analyze the weather information and then forward it to the artillerymen. Now thanks to the modern computer, we can relay the information within five minutes," said Thornton.

Due to certain exercise restraints, however, the meteorologists did not get the opportunity to fly their balloons and put their expertise to work.

"We were a little disappointed in not being allowed to fly our balloons, but at least exercises of this nature do allow us to get together as a team and become acclimatized to what a real war situation would be like," said PFC Kevin Griffin.

It is comforting to know that, while civilian weather forecasters come under fire for their conflicting reports, the artillerymen of the 3d Armored Division can rely on their own weathermen to direct their projectiles dead on target.

### COHORT battery

FORT ORD, CA—Charlie Battery, 6th Battalion, 90th Field Artillery, became the first of the Army's COHORT units to be declared combat ready by recently completing its evaluation under the Army Training and Evaluation Program (ARTEP) at Camp Roberts, CA.

COHORT—the Cohesion, Operational Readiness, and Training Program—is the Army plan designed by Pentagon officials to keep a unit's personnel together for three years of service.

"As a result of our performance on the ARTEP, we were declared combat-ready by the battalion commander," said battery commander CPT Dale R. Endreson.

The battery was formed in April 1981, completed their basic and advanced training at Fort Sill, and then went to Fort Ord for collective training.

The unit was required to complete approximately 70 ARTEP tasks that were evaluated as any other artillery battery in the Army, and most of the tasks were rated as GO.

The 36-hour evaluation included all operations that must be achieved by an artillery battery in combat; e.g., ground and air movement of nuclear weapons, day and night occupations, and tactical operations involving NBC, camouflage, and antiaircraft.

For the artillery operations part, the unit fired several different fire missions, using radar and observers to identify targets.

Along with the cannon sections, the unit's fire direction center and communications and maintenance sections were also evaluated.

The ARTEP started at 0600 and by 0645 the battery received their first mission. Nuclear weapons were delivered to the unit's location, and after that, it was "shoot, move, and communicate."

The battery is part of the "Always Daring" Battalion, the 7th Infantry Division's only nuclear capable command. Charlie Battery successfully completed its Technical Assistance Visit (TAV) last September.

"The TAV and the results of the ARTEP gave us our internal nuclear certification," Endreson said. "From here the training and readiness can only go up, because I won't have to lose soldiers and then have to retrain new ones. These are a good bunch of troops and I wouldn't trade them for the world."

### Artillery support

STUTTGART, WEST GERMANY—The 1st Brigade, 1st Infantry Division, Fort Riley, KS, deployed for Reforger '81 without artillery to participate in the 2d German Corps Field Training Exercise (FTX) "Scharfe Klinge" (Sharp Sword). Artillery support, however, was provided by the 2d Battalion, 33d Field Artillery, 1st Infantry Division (Forward), stationed at Neu-Ulm, West Germany.

The mission of the 2-33d FA during Sharp Sword was to provide direct support to the 1st Brigade which required a close working relationship with their counterparts in the West German Army. "We had a training and operations liaison officer working directly with the German Army," said CPT Robert Hamlett, commander of C Battery, 2-33d FA. "The 2-33d did not actually work side-by-side with the German troops, however," he added.

The exercise was monitored closely by both German and American umpires. "If the umpire determined that a howitzer or a tank was hit by the opposing force, he notified them and they were put out of the game," explained Hamlett.

When a unit is put out of the game (exercise), they are listed as inoperable for a period of time, usually



**A gun section crew from Battery C, 2d Battalion, 33d Field Artillery Battalion, cleans their 155-mm howitzer during field training exercise "Scharfe Klinge" (Sharp Sword). (US Army photo by SP4 Ron May)**

about one hour. They are then reinstated back into action to continue with the exercise.

After approximately five days of training during FTX Sharp Sword, the 2-33d began its march back to their home station in Neu-Ulm. "This Reforger training has really benefited us," said SFC Kenneth Musselwhite, chief of a howitzer gun crew.

Although the battalion did not fire live ammunition, Musselwhite felt the exercise was a superb training opportunity. "We weren't actually firing live rounds here so we had more time to practice procedures," he stated. "Sharp Sword challenged our troops to find their way in unfamiliar territory."

## Commanders Update

COL Anthony G. Pokorny  
2d Infantry Division Artillery

COL Robert D. Chelberg  
(TUSLOG Det 67)  
528th Artillery Support Group

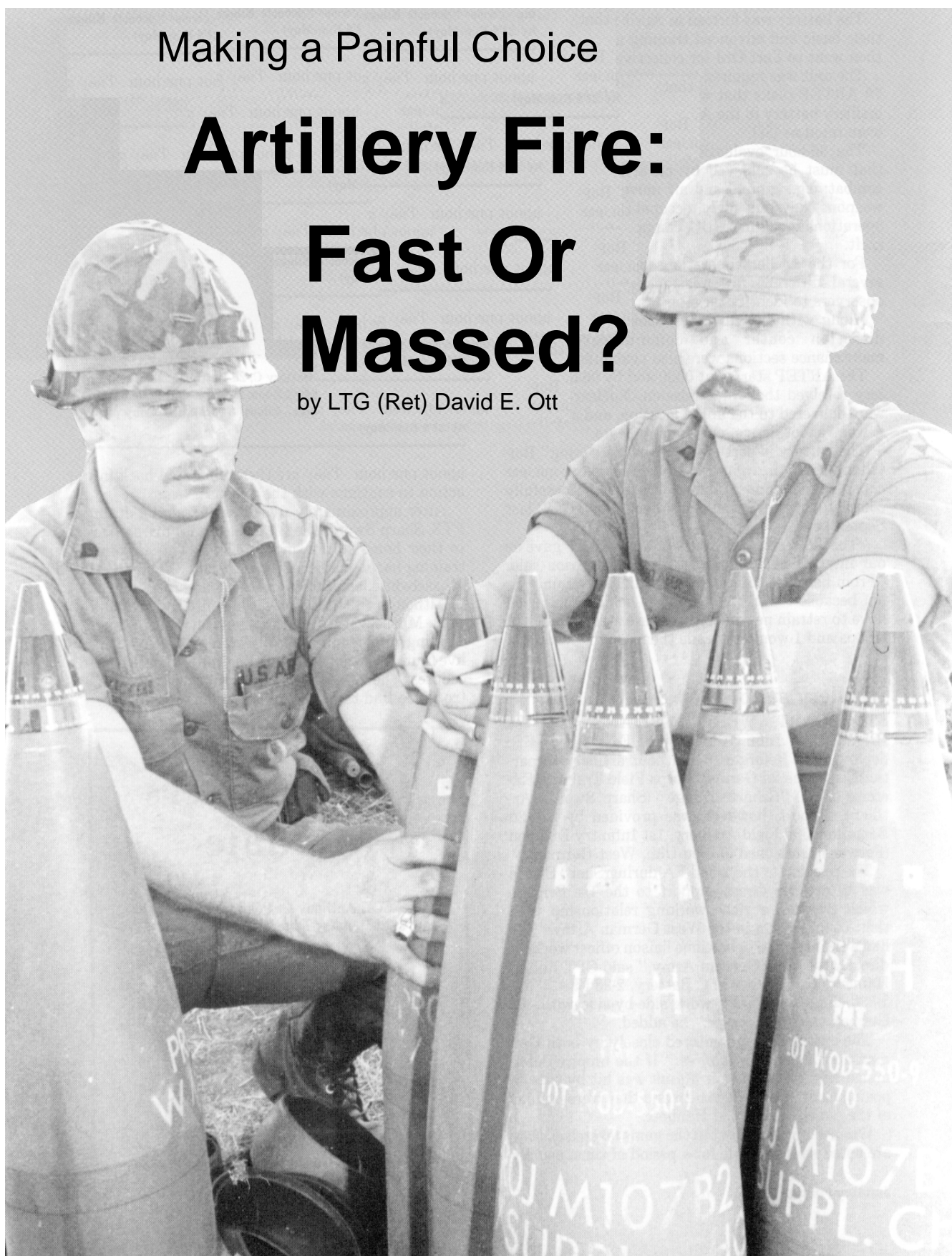
LTC Robert Offer  
3d Battalion, 9th Field Artillery

LTC Thomas Ross  
1st Battalion, 76th Field Artillery

Making a Painful Choice

# Artillery Fire: Fast Or Massed?

by LTG (Ret) David E. Ott



Human intervention often nullifies the inherent advantages of the automatic electronic field artillery fire control system now going into service, and there are times when the machines should be left to operate with pre-programmed guidance.

**D**o you want artillery fire fast or massed? You can't have both today, so take your painful choice. The conflict between speed and accuracy in the field artillery, complicated today by the conflict between speed and power, has long been with us.

Do you want the effectiveness of a "time on target" (TOT)? Of course you do—always—but it takes time. Do you need some rounds out there immediately? Sometimes you'll pay whatever the price to get the speed.

We will probably never overcome all of our conflicts, but through technology and by making some changes in our operational concepts we can do much better. We can achieve speed with accuracy and with power, but not with technology alone.

We must meet technology halfway with new operational concepts that do not strangle progress.

People are slow movers and they find inserting judgments irresistible. The judgments may be made with lightning speed, but the insertion of judgments always takes time.

My concept is basically very simple: we must take advantage of technology to pre-insert judgments and let our machines fight for us within the guidance we provide. Our machines must let us know when a situation arises that gives them a conflict—when something comes up outside of the guidance they have received from the commander.

But when the situation is one they "know" how to handle, we should keep people out of action except to observe and monitor. We must get those rounds on the way, together, as fast as possible.

First, let's look at some specifics on how to get the man "out of the loop" and, second, to consider the improvements needed in the man-machine interface. It will be apparent that there is a need for changes in technology and in operational concepts. Then let's look at an example of how it should work.

The simplest situation is a routine counterbattery mission where an AN/TPQ-37 radar has picked up a shell in flight and calculated the location of the enemy battery position from which it was fired. If you wish, you may study the location, review the tactical situation and the known enemy order of battle, and then make a judgment as to whether the shell came from a towed or self-propelled howitzer (certainly the radar does not know).

More likely the radar operator will simply verify that the location is in hostile territory and pass it to TACFIRE. The TACFIRE fire-direction officer will check the computer's proposed method of attack and pass an order on to the batteries selected to fire. He must intercede actively if a time-on-target mission is to be fired.

Why not put guidance into the radar computer to automatically

pass on locations in hostile territory—period? And why not provide guidance to TACFIRE to fire a multiple-rocket launcher load or to mass three batteries TOT on targets over six kilometers behind the lines and two batteries on nearer locations?

Let ammunition quantity in the target attack be driven by ammunition availability and effects desired. Then, TACFIRE will receive the target and match it against guns available and the programmed guidance, check time of flight to predict a TOT, and send out the order in seconds. The batteries simply fire when and what ordered, with the result that very responsive fire is massed in a TOT.

There is room for even more sophistication, as, for example, in counterbattery against a multiple-rocket launcher. The radar should be programmed to recognize the characteristic ripple fire of a multiple-rocket launcher and advise TACFIRE of the type of target.

TACFIRE, in turn, must be programmed to order fire as soon as possible—no TOT this time since the launcher will be moved as soon as possible after it delivers fire. The key is to insert the guidance desired in advance and not to cause any delay.

Another type of target that should be attacked with pre-inserted guidance is "area suppressive fire." The guidance in the TACFIRE computer should permit immediate response to attack of any target identified for suppression. The computer will need to know the location of the target, its size and, on occasion, its shape. The commander will have pre-stated the maximum amount of ammunition that can be fired for suppression without putting a man in the loop to make a judgment.

Consider a situation in which an observer has a laser range

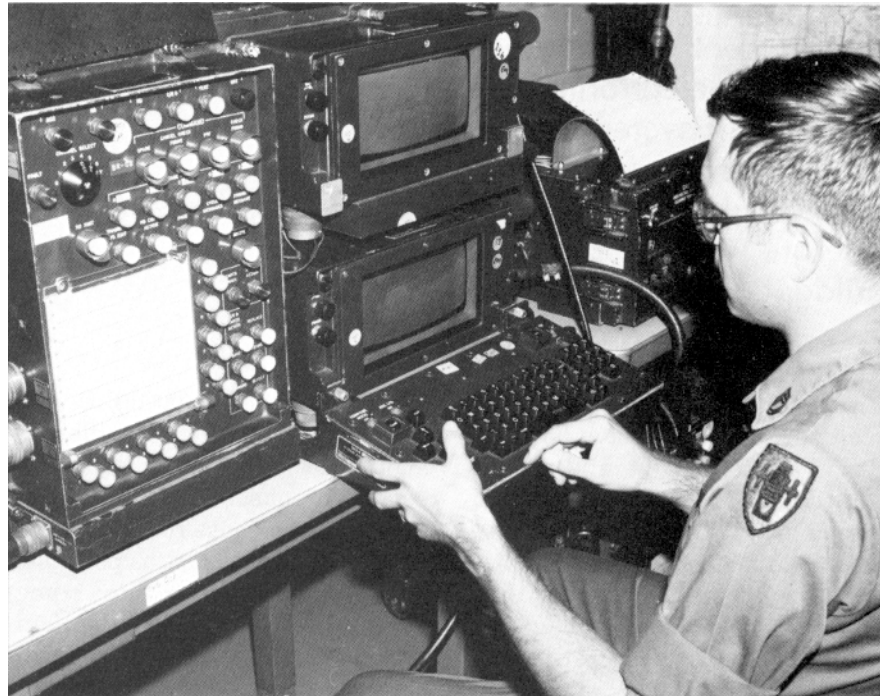
finder which connects with his digital message device. Since the man-machine interface is to be covered later, let us say he flashes back the coordinates of the left and right edge of a tree line and signals for immediate suppressive fire. (If the tree line is irregular, he can send several sets of coordinates.)

TACFIRE quickly calculates the number of batteries required to cover the area properly, assigns each battery its sector, and orders the amount of fire and the time of arrival of the first rounds. As long as the location and size fall within the commander's guidance envelope, the entire mission is flashed to the guns and a massed TOT is properly distributed very quickly on the tree line.

This is what suppression is all about, except that I have accepted a small delay in order to get time-on-target fire. The observer needs to be able to add to his request a sense of extreme urgency so that in certain situations the first rounds will be fired as quickly as possible. If the observer sees something like antitank guided missiles in the tree line and realizes that friendly elements are exposed, he should go for all the speed possible; at the same time, he should recognize that in order to get the fastest suppression he will be reducing the casualties a TOT would give.

Training and experience will teach him how much longer the TOT would take. This can be a painful choice today, but the very fast TOT fire this concept will provide may greatly impress the observer, the only person able to make a judgment.

One can visualize many more examples of fire missions that can be quickly and effectively attacked using pre-inserted guidance. We must be willing to trade precious judgments on each and every



**TACFIRE can quickly calculate the number of batteries required to cover an area properly, assign each battery its sector, and order the amount of fire and the time of arrival of the first rounds.**

target for even more precious time. Analyzing a target, applying guidance values, and ordering an attack is tactical fire control, but it can be purely mechanical and decentralized as far as one wishes, even to the computer on the individual howitzer (that is coming) or on the multiple-launch rocket system (MLRS).

The skilled field artilleryman will be busy developing and inserting guidance and analyzing the effectiveness of his fires against his ammunition availability. He will be developing fire plans to support maneuver and piecing together bits of target intelligence. He must not become an unnecessary "man in the loop" who cripples the speed of his electronic servants.

Regarding the needs for man-machine interface, this occurs throughout the future field artillery system, but becomes critical any time highly responsive firepower is required.

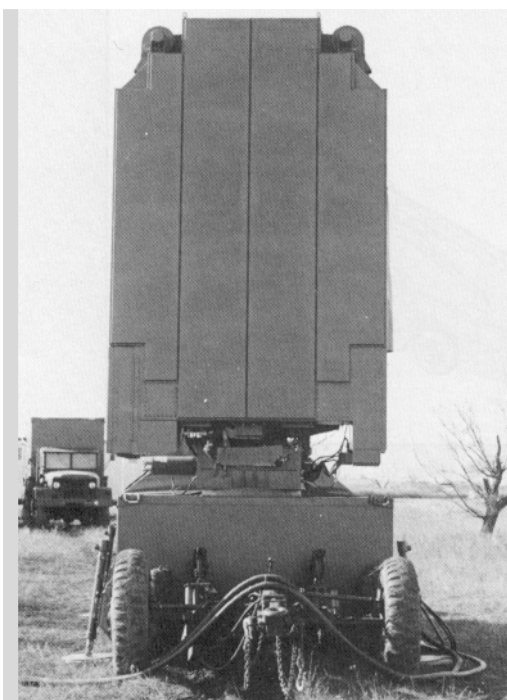
The first place to examine is the forward observer (FO) and his

digital message device (DMD). A DMD is a small, hand-held device with a weatherproof keyboard and a visual display. It permits the operator to enter many pieces of data and can receive data directly from a laser range finder. The description of a target to be attacked can be selected from a "menu" or entered through the keyboard. Once all the data are in the device, it transmits them in a "digital burst" to TACFIRE.

During the field evaluation of the restructured direct support field artillery battalion conducted at Fort Hood, TX, in July 1978, the FO/DMD received an excellent opportunity to operate under realistic conditions. In a four-day firing exercise, the FOs were required to call for fire under varying conditions; that is, with and without the DMD and with and without TACFIRE.

The findings showed that the average time to initiate a voice mission was 73 seconds and to initiate a digital (computerized) mission was 160 seconds, of which 103 seconds were required





The erected antenna of the AN/TPQ-37 artillery-locating radar.



MLRS.

to prepare a fire request for digital transmission. Furthermore, the FO did not know if his DMD fire request had been received and acknowledged for an additional 51 seconds.

Some of the delay is communications-related and is being worked on, but there is an obvious need to greatly improve the way to initiate fire missions with digital devices in urgent situations. The problem lies in having developed a DMD program that will work in every situation without adding the necessary complication of a special program for quick response. It should be easy to rig the DMD for the very few types of targets that must be hit immediately, but we need a change in our operational thinking.

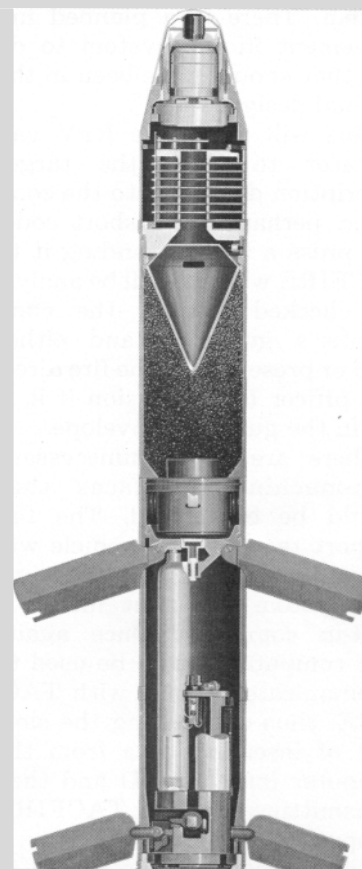
For the urgent targets, I would dispense with a target description — that can be provided later — and simply give location and size plus "suppress." Location and size can both be provided by using the laser range finder to two or more points in the target array.

Forget the judgments and the analysis; use pre-inserted guidance to get some shells out there quickly.

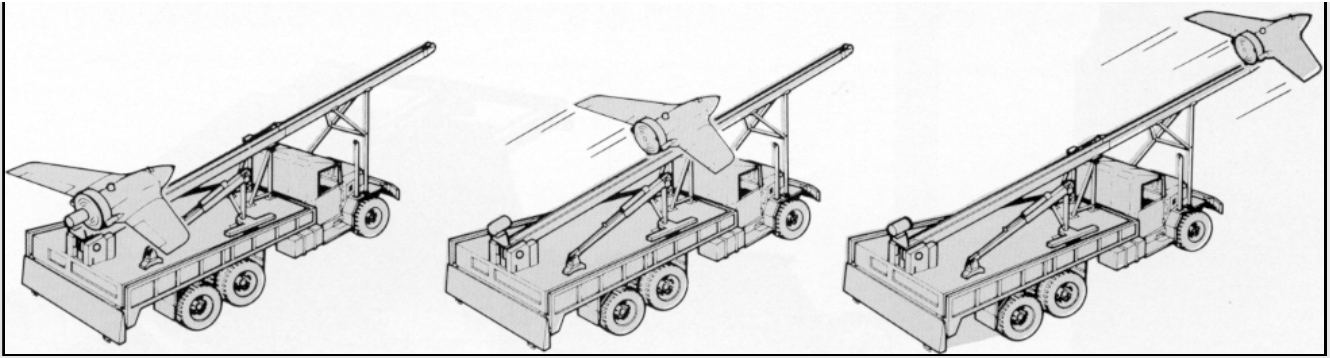
Another version of the rapid response mission might be the destruction of a moving armored vehicle by a Copperhead laser-guided projectile. Grease the skids to get a round on the way as fast as possible. If the Copperhead is in short supply and must be reserved for special targets, then modify the commander's guidance in the system and let all the FOs know.

Another man-machine interface is in the control van of the remotely piloted vehicle (RPV). The RPV is flown and controlled by computers in its airframe and in the control van. When a target is observed on the van's television screen, the RPV can be directed to provide a location by using its laser range finder in conjunction with its navigation system and computer. This location then appears in map coordinates on the operator's screen.

The operator then uses a DMD,



Copperhead laser-guided round.



The remotely piloted vehicle (RPV) can locate artillery targets with a variety of sensors and mark them for laser-guided projectiles.

just like the forward observer's, to punch in target description and location and, finally, to transmit to TACFIRE. This is slow, error-prone and unnecessary. Computers must talk to each other without human interface in a highly responsive field artillery system. There is a planned improvement in the system to do this that should have been in the original design.

This will allow the RPV van operator to enter the target description directly into the computer, perhaps by a short code, and press a button sending it to TACFIRE where it will be analyzed, checked against the commander's guidance, and either fired or presented to the fire direction officer for a decision if it is not in the guidance envelope.

There are other unnecessary man-machine interfaces that should be eliminated. The fire support team (FIST) vehicle will have some form of inertial navigation system and that means a built-in computer. Once again, that computer should be used to communicate directly with TACFIRE, thus eliminating the slow step of inserting data from the computer into a DMD and then transmitting to the TACFIRE computer.

Every place there is a man in the fire control system must be

examined to see if his duties can be changed or if equipment can be modified to expedite the transfer of data. To make this concept work we must modify the way commander's guidance is inserted into the computer array. This must be made simple and positive. And the system must accept guidance from many levels and access points.


The big job of the future field artilleryman in battle will be constantly to nullify guidance in the machines and let them run the operations. Fire support officers will insert guidance concerning friendly locations and maneuver unit priorities. This must reach every fire direction computer that may direct fire into that sector.

The division artillery commander will establish priorities for target types, ammunition expenditure rates, when to fire MLRS, and other instructions. He establishes the guidance elements to be decentralized and to whom. He must stay in close touch with the situation and the division commander's desires. He will frequently modify guidance. Others may wish to enter guidance within their areas of responsibility — all designed to simplify and expedite firing.

This is an example of how the system can perform when put together: a tank platoon leader

moves into a new position and has his tanks in defilade. His tank has inertial navigation hooked into the optics and, of course, the computer. He observes an area in enemy territory where there appears to be considerable activity, but it is too large an area for his platoon to take under fire.

He pushes a button marked "artillery" and then sets the cross hairs in his optics to the left and right of the array, each time pushing a button marked "locate," and finally another button marked "suppress." No voices are heard, no fresh judgments are made, but data flies through the combined arms system. Seconds later (time of flight plus very little), a time on target from many howitzers strikes the enemy target array.

The platoon leader got exactly what he wanted — fast, massed fire. 

*(From ARMY magazine, April 1981. Copyright 1981 by the Association of the US Army and reproduced by permission)*

**LTG (Ret) David E. Ott, USA, is a former commanding general of VII Corps and Commandant of the Field Artillery School.**

# FA Test and Development

DESIGN • DEVELOPMENT • TESTING • EVALUATION

## MULE successful in Marine Corps tests

A laser device used to pinpoint targets for laser-guided weapons and conventional artillery has recently passed rugged operational tests conducted by the US Marine Corps.

The man-portable, tripod-mounted device, called Modular Universal Laser Equipment (MULE), was evaluated under simulated combat conditions at the Marine Corps' Air/Ground Combat Training Center, Twentynine Palms, CA. During the tests, which were designed to evaluate MULE's reliability and durability and to develop initial doctrine and tactics for its use, the system successfully designated targets for Copperhead, laser-guided bombs and the Hellfire laser-guided missile.

Designed for use by forward observers, the device can designate targets for all laser-guided weapons now operational or under development. In previous tests, it successfully designated targets for the



A US Marine sights a target with Modular Universal Laser Equipment (MULE) during rugged operational tests of the laser device.

Marines' laser-guided Maverick missile and the Navy's shipboard five-inch guided projectile.

MULE consists of three modules—the laser designator/rangefinder module, a north-finding module, and a stabilized target tracker module, which is a multi-functional tripod.

The designator/rangefinder, which resembles a short-barreled rifle, can be detached from the tripod and hand-aimed for target designation or rangefinding. The tripod displays range, azimuth, and angle of elevation of targets and provides a viscous liquid damping platform for precisely tracking moving targets.

The north-finding module is a small gyro compass which locates true north to provide azimuth accuracy.

MULE has the capability of combining azimuth, elevation, and range information into a digital message that can be sent through a digital communications terminal to an automatic tactical fire control center.

## ACE game for artillery control

Mathematicians and weapon systems analysts at the Army's Ballistic Research Laboratory (BRL) have designed a computer game as a research tool. Their Artillery Control Experiment (ACE) is an interactive, real-time multiplayer computer game, designed to study field artillery fire support coordination on a simulated battlefield.

ACE consists of several distinct computer processes "piped" together under control of the Bell Telephone UNIX operation system.

With ACE, it's possible to study artillery computer loading, to contrast alternative command structures, and to compare alternative communication methods . . . all current topics of growing interest with the availability of "smart" munitions (the munitions related to the engagement of moving targets) and the ever-increasing variety of automatic data processing equipment being supplied to field artillery units.

ACE is designed to bring together the collective experience of developers and users of artillery systems by utilizing data communications over ordinary telephone lines.

Participants in a typical scenario could include BRL personnel and the Office of the Project Manager for Cannon Artillery Weapon Systems, at Dover, NJ, and a tie-in to the Field Artillery School at Fort Sill, OK, and the project manager for the TACFIRE system at Fort Monmouth, NJ. (*Army RD&A Magazine*)

### FA robot?

It is difficult to imagine a robot performing the tasks of a six-man howitzer crew. Although this sounds like an excerpt from "Star Wars," the US Army Human Engineering Laboratory (HEL), Aberdeen Proving Ground, MD, the lead agency in US Army Materiel Development Command (DAR-COM) for robotics study, is undertaking a project, termed a "feasibility study" which will determine whether a robot can perform loading tasks on the M110A2 8-inch self-propelled howitzer.

"We're going to look at the possibility of using a robotic device to improve the capability of existing Army weapons and equipment," said Charles Shoemaker, the robotics project coordinator for HEL.

Called the "Robotic Technology Demonstration Project," the goal is to demonstrate the feasibility of using robots to augment existing combat hardware, such as the howitzer.

"We'll be demonstrating that a robot can load a round onto an ammunition resupply vehicle and keep a running inventory of type, location, and lot number of each round," Shoemaker said.

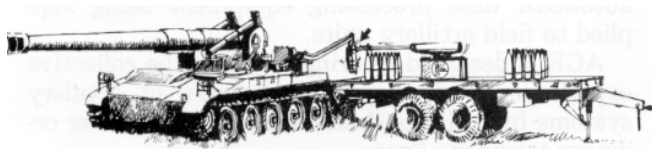
"When a crew member on the howitzer calls for a round by pushing a button indicating which type of round he wants, the robot will then search for the round, pull it out of the rack, transfer it to a fuze machine where the noseplug will be removed and a fuze inserted.

"The round will then be transferred to an existing hoist on the weapon. The crew will take over from there; they'll set the fuze, ram the round into the tube, load the propellant charge, close the breach, and fire the weapon," he said.

Working on a howitzer is not an easy job to begin with, but, when the soldiers must wear chemical protective gear, the rapid increase in body temperature while doing the job makes the work extremely difficult to carry on for any length of time.

Using a robot to relieve the pressure on the six-man crew on the ammo vehicle will solve this problem. It will also help stave off continuing manpower shortages in the Army.

The feasibility study will use a Unimation 4000 series industrial robot, a microcomputer, which will "tell" the robot how to respond to the crew's commands,



**The Human Engineering Laboratory will soon begin a study to determine whether this illustration can become a reality. The robot, in the center of the flatbed trailer, uses its "arm" to pick up the projectile and lift it up to an existing hoist on an M110A2 self-propelled howitzer (see arrow). The round is then loaded into the breach and fired by crewmembers.**

a low-boy trailer, and other existing equipment.

HEL is working with the Ammunition Equipment Office at Tooele Army Depot, UT, which has pioneered the use of robotic equipment in ammunition demilitarization.

### Cooling system tested

A microclimate personnel liquid cooling system developed jointly by the Army's Mobility Equipment Research and Development Command and Natick Laboratories was recently field tested at Fort Sill as part of the Human Engineering Laboratory Battalion Artillery Test (HELBAT) program.

The liquid cooling system, which is basically a water chiller, designed to relieve heat stress for combat vehicle crewmen, was installed in an artillery fire direction control vehicle for HELBAT 8, a field test program for evaluating new concepts.

The system transports cool liquid into a vest worn by the vehicle crewman under his clothing to provide relief from heat stress even when heavy protective overgarments are worn, such as those required for chemical and biological warfare conditions.

Each soldier's vest is connected to supply and return manifolds inside the vehicle with two relatively short, flexible, insulated liquid lines. Quick connections are available at several stations within the crew compartment so that the soldier can connect and disconnect if he has to move around or exit the vehicle.

Using an ethylene glycol and water mixture as the coolant, the system is designed to protect soldiers from heat exhaustion even when temperatures inside the vehicle reach as high as 140 degrees Fahrenheit. The system is also capable of circulating warm liquid to protect soldiers from cold temperatures.

The prototype fire direction control vehicle used in HELBAT 8 is also equipped with an air conditioner system to cool the crew compartment. A 36,000-BTU per hour, conventional, horizontal, military air conditioning unit operates in conjunction with a collective protection unit furnished by Chemical Systems Laboratory. This system provides clean filtered air to the crew compartment and maintains a positive pressure inside. The air conditioning system requires that the vehicle be sealed in a contaminated environment.

The microclimate cooling system can also be used with a sealed crew compartment, but offers the advantage of functioning equally well if the crew wears protective clothing and ventilated face masks. However, the main advantages of the liquid system are its small size and low power requirements.

During HELBAT 8, both the liquid and air conditioner cooling systems were evaluated to determine which will finally be adopted for use in the fire direction control vehicle.

# An Artilleryman's Dilemma

by COL (Ret) Robert M. Stegmaier

In 1860, the possible election of Abraham Lincoln as president caused considerable concern in the southern states, with South Carolina being the most explosive and volatile. As its governor said the day before the election, "I would earnestly recommend that in the event of Abraham Lincoln's election to the Presidency, a convention of the people of this state be immediately called to consider and determine . . . secession of South Carolina from the Federal Union . . . If . . . the government of the United States should attempt coercion, it will become our solemn duty to meet force with force."

Such strong expressions of feeling were not one-sided. In the North, when GEN Winfield Scott was told that southern secessionists might raid the Capitol if Lincoln's election were confirmed, he thundered: "I have said that any man who attempted by force . . . to obstruct or interfere with the lawful count of the electoral vote . . . should be lashed to the muzzle of a 12-pounder gun and fired out of a window of the Capitol. I would manure the hills of Arlington with fragments of his body, were he a senator or chief magistrate of my state! It is my duty to support insurrection — my duty."

During this crucial period, many individuals were in a dilemma as to which side to take. One such person was southern born MAJ Robert Anderson, 3d Artillery, who was married to a girl from Georgia. A graduate of the 1825 West Point class, Anderson was a veteran of the



**MAJ Robert Anderson**

Black Hawk, Seminole, and Mexican Wars (cited for bravery in the latter two). When he heard rumors that South Carolina was considering seceding from the Union

and taking over the Federal forts in the Charleston harbor, he felt sympathetic; yet, he had been a loyal Union officer for 35 years.

Fort Moultrie and other Federal fortifications in the Charleston harbor offered a threat to southern shipping and therefore were the subject of violent discussion among ardent "states righters." To pacify the Charlestonians, Anderson and CPT Benjamin Huger, a native of Charleston and a West Point classmate of Anderson's, were sent to the South to keep the peace. Huger was to command the arsenal and Anderson was to command the garrison at Fort Moultrie and the other forts.

Anderson's task was much more difficult, however, as he had been instructed to maintain the peace as well as hold the forts. He was to defend his post against any aggressor unless otherwise instructed. Even before assuming office, Lincoln had sent General Scott secret instructions to be prepared to either hold or retake the forts, as the case may require, at and after the inauguration. Likewise, these were the instructions Anderson received in Washington before proceeding to his new command.

Born in Kentucky, Anderson was the son of a lieutenant colonel of the Continental Line in the American Revolution and, during his 35 years of service, became known as the nation's foremost artilleryman. For example, he translated the French manual, "System of Light Artillery," to English, and in 1845 the published manual, "Instruction of Field Artillery, Horse and Foot," incorporated

much of Anderson's work. Further, as an instructor at the United States Military Academy, he became well known to the officers of the Regular Army, and while serving as an aide to GEN Winfield Scott, he became acquainted with top officials of the US Government. In the Mexican War, serving with the 3d Artillery, he displayed outstanding courage at the battle of Molino del Rey where he was wounded as he led his unit, fighting as infantry, to the attack.

Based on this successful background (and being a Southern officer by birth and by marriage), Anderson was selected by the Secretary of War to handle diplomatically the war-like atmosphere concerning the forts in and around Charleston.

Anderson, upon inspecting Fort Moultrie, discovered it to be indefensible. Sand had blown against the fort's ramparts to within four feet of the top and local beach houses, constructed in the vicinity of the fort, would enable sharpshooters to easily kill his gunners. Enemy guns could be placed on nearby sand hills to easily fire on the fort's interior. In answer to his request to eliminate the sand hills and to demolish the threatening houses he received a negative reply. There had to be another solution.

Under his control were three principal forts — Moultrie (discussed as indefensible), Sumter (located in the center of the harbor and completely dominating the shipping lanes to Charleston harbor), and Castle Pinckney (located on an island close to Charleston and capable of destroying the city if adequately garrisoned).

Realizing the futility of holding Fort Moultrie, Anderson wrote for reinforcements to garrison Castle Pinckney for "The Charlestonians would not venture to attack . . . (Moultrie) when they knew their city was at the mercy of the commander of Castle Pinckney . . ." Of Fort Sumter he stated: "It is the key to the entrance

of this harbor, its guns command . . . (Moultrie) and could soon drive out its occupants. It should be garrisoned at once."

The situation in Charleston was becoming uncontrollable. Militia units were saying most vociferously that the forts belonged to South Carolina. Captain Huger (although a Charlestonian), in the midst of the outcries for assaults on the forts, averred that if Moultrie were mobbed, he would go there and fight alongside Anderson.

To Anderson's pleas to Washington for reinforcements, Secretary of War Floyd replied negatively. The Secretary's letter further carried these instructions: ". . . your actions must be such as to be free from the charge of initiating a collision. If attacked, you are, of course, expected to defend the trust committed to you to the best of your ability."

Anderson's own personal feelings toward the present situation were expressed in a letter to Robert Gourdin, an ardent secessionist and Anderson's friend: ". . . no one will do more than I am willing to do to keep the South in the right and to avoid the shedding of blood." Despite this assertion of personal views, he considered himself duty bound to hold the forts.

On 7 December 1860, MAJ Don Carlos Buell (a future Union major general) inspected the three forts and gave Anderson these oral instructions from Secretary Floyd: "You are carefully to avoid every act which would needlessly tend to provoke aggression; and for that reason you are not, without evident and imminent necessity, to take up any position which could be construed into the assumption of a hostile attitude. But you are to hold possession of the forts in this harbor, and if attacked you are to defend yourself to the last extremity."

Fortunately, an escape route from these Alamo-like orders was permitted. Buell further concluded: "The smallness of your force will not permit you, perhaps, to occupy more than one of the three

forts, but an attack on or an attempt to take possession of any one of them will be regarded as an act of hostility, and you may then put your command into either of them which you may deem most proper to increase its power of resistance. You are also authorized to take similar steps whenever you have tangible evidence of a design to proceed to a hostile act."

Anderson then was left standing alone — all he knew was that he could not give up the forts without a battle and as long as he stayed at Fort Moultrie the subsequent battle would be short and deadly to his men. As Engineer Captain Foster wrote to his headquarters in Washington: "The defense now can only extend to keeping the gates closed and shutters fastened, and must cease when these are forced."

Anderson's eyes wandered to the large Fort Sumter, standing dominant in the harbor. That at least offered hope of a successful or prolonged resistance.

On 20 December an Ordinance of Secession in Charleston was approved without a dissenting vote and South Carolina declared itself an independent Commonwealth.

Anderson was now convinced that his position at Fort Moultrie was like "a sheep tied watching the butcher sharpening a knife to cut his throat." His dilemma was: Did secession constitute an act of hostility enabling him to transfer his troops to Fort Sumter? As such, he requested orders from Washington to occupy Fort Sumter. An answer came 23 December, avoiding the issue, stating: "It is neither expected nor desired that you should expose your own life or that of your men in a hopeless conflict in defense of these forts. If they are invested or attacked by a force so superior that resistance would, in your judgment, be a useless waste of life, it will be your duty to yield to necessity and make the best terms in your power."

The instructions were contrary

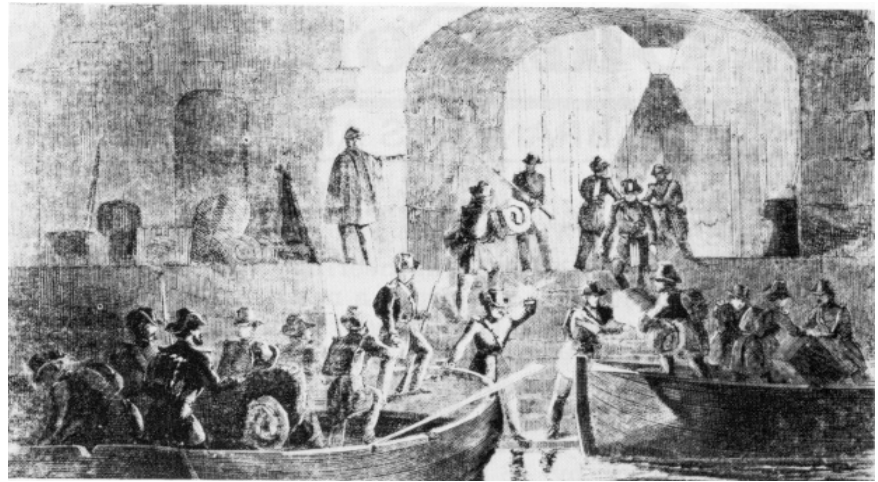
to his lifetime concept of military service — supinely surrender without a fight.

On Christmas Day, Anderson ordered boats which were supposedly to move dependents to a safer atmosphere. The purpose was a blind. On 26 December, instead of women and children occupying the crafts, the garrison (Captain Doubleday had 20 minutes notice to have his men ready) went aboard. Captain Foster, Engineer Corps, and Surgeon Crawford were left at Fort Moultrie with 11 enlisted men and two loaded cannons ready to fire upon any boat that threatened safe passage of the troops. Two trips were successfully made; Fort Sumter was secured.

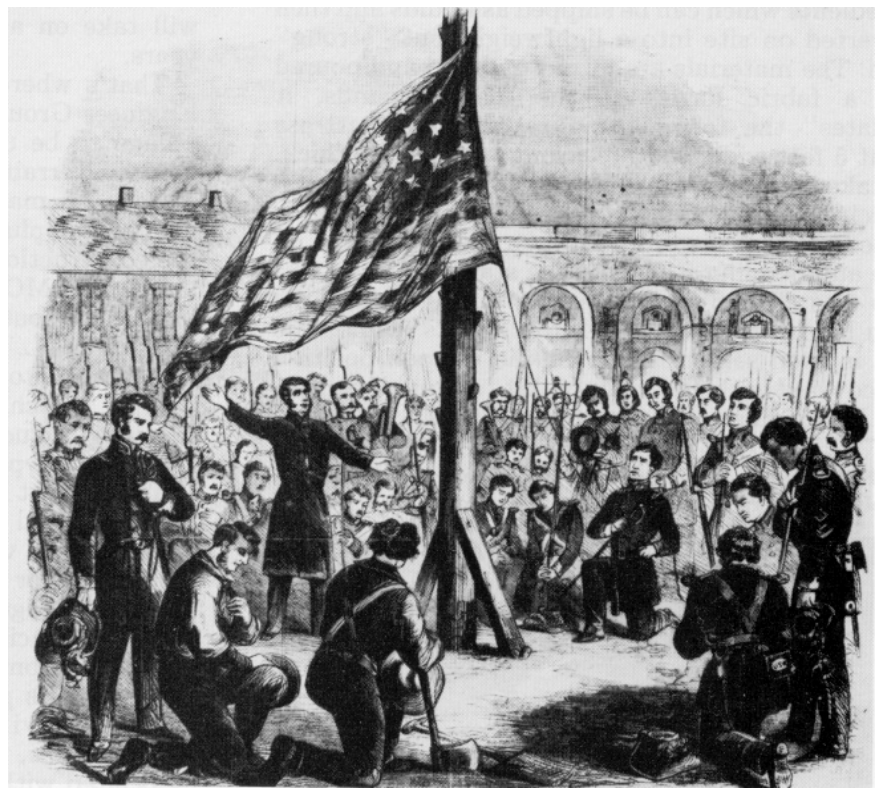
That evening, Anderson wrote the Secretary of War this amazing message: "I have the honor to report that I have just completed, by the blessing of God, the removal to this fort of all my garrison except the surgeon, four noncommissioned officers and seven men . . . I have left orders to have all the guns at Fort Moultrie spiked, and the carriages of the 32-pounders, which are old, destroyed. I have sent orders to Captain Foster, who remains at Fort Moultrie, to destroy all the ammunition which he cannot send over. The steps which I have taken were, in my opinion, necessary to prevent the effusion of blood."

Anderson's dilemma was solved. At Fort Sumter he had a chance to survive. To Charleston representatives who directed him to return the garrison to Fort Moultrie he replied: "In this controversy between the North and South my sympathies are entirely with the South." However, his duty as a commander overrode his personal feelings.

At 11:45 a.m. on 26 December, after a prayer of thanks by Chaplain Harris, Old Glory was raised over the ramparts of Fort Sumter while the band played "Hail Columbia." As SGT James Chester, a Union participant, wrote: "If any of those who



**Boats arrive with garrison from Fort Moultrie.**



**Raising the stars and stripes over Fort Sumter while the chaplain invokes a blessing and Major Anderson hoists the standard.**

doubted the loyalty to the Union of Major Anderson could have had but one glimpse of that impressive scene, they would have doubted no longer."

Duty had dominated personal preference, and another artilleryman's name went down in history for duty performed far beyond that called for in orders or expectation.

His dilemma — Southern by birth, Northern by country — had

been resolved honorably in accordance with his conscience and his 35-year commitment to the exalted concept of "Duty, Honor, and Country." ❏

**COL (Ret) Robert M. Stegmaier, a regular contributor to the *Journal*, lives in Sun City, AZ.**

# With Our Comrades in Arms

## NEWS OF OTHER BRANCHES AND SERVICES

### Foam shelter protects weapons crews

The US Army Construction Engineering Research Laboratory (CERL) has developed a new foam shelter for antitank missile (TOW) crews.

The Foam Overhead Cover Support System (FOCUS) protects soldiers and equipment from shells which hit near TOW positions. The materials for assembling FOCOS are easy to use and fit into a compact kit measuring 18 by 18 by 12 inches, weighing 100 pounds.

The researchers for FOCOS chose polyurethane ingredients which can be shipped as liquids and then converted on site into a lightweight but "strong" foam. The materials are mixed by hand and poured into a fabric form. As the foam expands, it "inflates" the form into a rectangular mattress about 5 feet wide by 13 feet long by 6 inches thick.

Stakes are driven into the ground to form a semicircle with a four-foot radius. The mattress is immediately shaped into an arch by standing it on edge and bending it around the stakes.

In less than five minutes of "curing" time, the foam becomes rigid enough to keep its shape. The arch is then set upright over the weapon position and covered with 18 inches of dirt to provide protection from ballistic fragments.

**The FOCOS arch, assembled from a kit the size of a suitcase, completely covers an antitank missile position.**



Two soldiers can erect the arch in less than 20 minutes. Building a timber or concrete cover support for a TOW position requires much heavier materials and takes considerably longer.

While CERL's field testing has demonstrated that the overhead cover cannot take direct hits, the shelter can withstand misses of about 10 feet or greater by rounds up to 155 millimeters. Fragments from near misses do not penetrate the dirt cover and foam/fabric arch support. (*Engineer Update*).

### German village being built

An area at McKenna Airstrip, Fort Benning, GA, will take on a German look within the next two years.

That's where the 43d Engineer Battalion, 36th Engineer Group, is building a replica of a German village to be used for Military Operations in Urbanized Terrain (MOUT) training.

Cost of materials, depreciation and rental of equipment, plus the cost of fuel to be used during the construction will be approximately \$5 million.

The new MOUT city will "provide realistic training for the battlefield of tomorrow," according to MG Robert L. Wetzel, post commander. Adding, "I am pleased to get the ball rolling" on the mock village, which will consist of 13 concrete and masonry structures designed and positioned to resemble a typical German village.

The present MOUT area at Fort Benning consists of antiquated and rapidly deteriorating wooden World War II vintage troop billets and is considered inadequate for innovations in doctrine, training, and projected usage here.

The new facility will add maneuver area and allow the integration of mechanized, armor, and helicopter operations as part of combined arms training in a MOUT environment. The use of smoke, pyrotechnics, and chemical agents normally associated with combat in cities will round out the training capabilities.

### Army blast is an awesome sight

AWESOME—that's the only way to describe the detonation of 600 tons of ammonium nitrate-fuel oil (ANFO) at White Sands Missile Range.

The project, called Mill Race, was first planned in September 1980 by the Defense Nuclear Agency.

The purpose of this large-scale, high explosive field test was to expose and determine the durability of military equipment. Included was above surface and partially buried shelters and industrial buildings, various types of radomes and antennas,





**Engineers inspect nearly 600 tons of ammonium nitrate fuel oil (ANFO) before placing it into firing position. The resulting explosion resembled a giant mushroom cloud reminiscent of a nuclear fireball.**

communication vans, anthropomorphic dummies, pillow tanks, cloud measurement devices, ship deckhouse, debris, armored vehicles, and flying aircrafts (T-38 drones).

Additionally, other experiments by NATO countries (Norway, Sweden, France, Israel, United Kingdom, Canada, and Germany) were also strategically placed within a 100-acre perimeter around the blast area.

"Overall, the detonation, equivalent to 500-tons of TNT or a 0.5 kiloton nuclear blast, was very successful," remarked Tom Kennedy, Defense Nuclear Agency test director.

The Mill Race Test Site is approximately three and a half miles from Trinity Site, the site of the first atomic bomb explosion on 16 July 1945.

The historic McDonald's Ranch, 2.2 miles farther away, was used by scientists for final assembly of the first nuclear device.

In support of the test, 136 cameras of various types were strategically placed to document the event; 862 sensors were used to record data, 490 miles of cables and wires were needed for power and signals, and 100 airblast gauges recorded incident overpressures.

An after-blast survey revealed the blast created a crater approximately 140 feet wide and 30 feet deep. (Ric Ortega)

## Counter-obstacle vehicle tested

Mine neutralization equipment, being developed and tested by the US Army Mobility Equipment Research and Development Command, was recently used in the Army's first field test of a robotic counter-obstacle vehicle. The test, conducted at Fort Knox, KY, demonstrated the Army's ability to breach an antitank minefield with an unmanned, remotely controlled system.

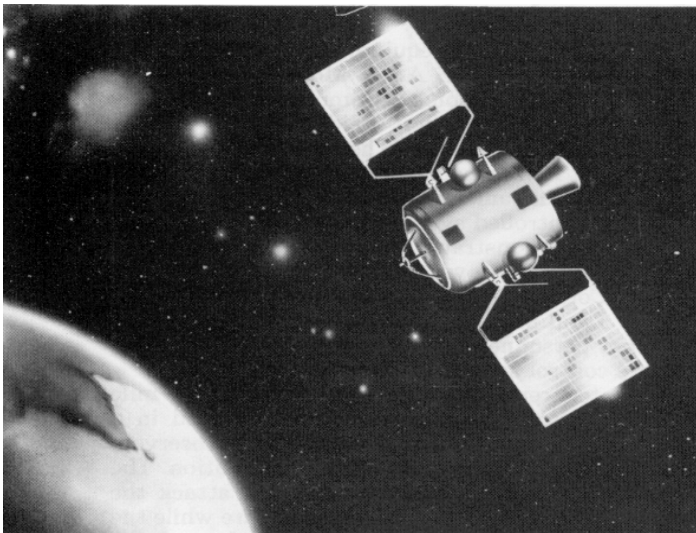
For the demonstration, a modified M60A2 tank chassis was fitted with a mine clearing roller, a Marine Corps M58A1 mine clearing line charge, and a Clear Land Marking System (CLAMS). An M114 armored personnel carrier was also outfitted with remote control systems for the test.

Operated remotely by personnel located a mile from the site, the robot vehicles were used in a simulated combat scenario during which observers detected an enemy minefield laying operation. The armored personnel carrier was used to attack the enemy position and draw suppressive fire while the counter-obstacle vehicle cleared a path through the minefield. The counter-obstacle vehicle located the boundary of the enemy minefield by using the mine clearing roller to detonate one of the mines. It then backed up and breached the minefield by projecting the rocket-propelled mine-clearing line charge. After clearing a path, the vehicle marked the safe lane as it moved through the minefield. When the cleared path was marked, the armored personnel carrier safely followed the counter-obstacle vehicle across the minefield.

Other robotic systems will be tested in the future.

**A modified M60A2 tank counter-obstacle vehicle equipped with mine clearing equipment demonstrated the feasibility of breaching an antitank minefield with an unmanned, remote controlled system.**





Artist's concept showing the sensors attached to the Apple.

### The eyes of India's Apple

Powerful Lockheed sensors are helping mission controllers gather flight data that could expedite development of satellite communications in India. These sensors were attached to the outer surface of India's Airiane Passenger Payload Experiment (Apple) which was placed in orbit last summer. Apple is being used for experiments in radio broadcasting, data relay, remote area communications, and other applications.

The Lockheed sensors use infrared detectors to sense the location of the earth's horizon. This information is then transmitted to Apple's attitude control system, enabling it to accurately point and vehicle to selected locations on earth for specific experiments. Data gathered from the experiments will be used to set up ground stations for an operational communications satellite called INSAT-1, scheduled to be placed in orbit late this year. INSAT-1 will allow India to develop domestic capabilities in telecommunications, television broadcasting, and meteorology and will enhance educational efforts in that country.

### New ammunition devices to ease training costs

A new family of training ammunition devices may soon help make the huge costs associated with training soldiers a thing of the past.

The new ammunitions are primarily made of plastic or are subcaliber devices for larger weapons. All are aimed at providing realistic training in less space than is required for firing "real" ammunition.

Plastic and subcaliber ammunition now being tested at Aberdeen Proving Ground's Materiel Testing

Directorate (MTD) generally is supplied by foreign manufacturers as part of the International Materiel Evaluation Program (IMEP).

The Europeans, who have real space problems and not much acreage to devote to training areas, have put a lot of effort into these training devices. The US Army is now looking at them for training purposes.

The advantage of plastic and subcaliber munitions is that they can be fired in relatively small areas. The new 5.56-mm round for the M16A1 rifle, for example, has a maximum range of less than 200 yards at any elevation, and the .50 caliber round will travel only about 600 yards.

While many US installations have adequate acreage for conventional real-bullet firing ranges, National Guard, Reserve, and overseas-based units do not. This is costly because these units have to transport their troops and equipment to one of the few ranges available. But with these short-range bullets, simulated or scaled-distance ranges can be built and soldiers can train in their own areas.

With plastic bullets, troops actually fire their weapons and handle them just the way they would with ball ammunition. Soldiers will probably fire more often with these because transportation costs are reduced.

However, close ranges, possibly up to 25 feet for the 5.56 or out to about 100 feet with .50 caliber, plastic bullets can be dangerous. They have enough energy behind them to wound a soldier or cause injury. That means that soldiers must learn weapons safety with them just as they would with ball ammunition.

Another aspect of realism with the new plastic ammunition is the ability to make "pop-up" targets work. They have enough energy to knock a pop-up down. That lets the soldier know he has hit something when he fires. At close ranges, the plastic bullets are accurate enough to zero a weapon or fire at simulated, long-range targets. At short ranges they simulate ball ammunition trajectories very well.

One of the critical design criteria factors for these rounds is safety. The M16 will not fire the plastic bullet except as a single-shot, hand-load-and-ejected round. In order to use the plastic bullet on semi or full automatic, a different bolt must be put into the rifle. It takes about 10 seconds to make the change. And, with the other bolt in place, ball ammunition cannot be fired in the rifle.

The .50 caliber plastic bullet cannot be fired in the machinegun at all without making some modifications. The barrel must be changed and the bullet guide altered. Both are quick-change items. (*Army RD&A Magazine*)

## Navy Maverick seeker successful

In infrared seeker for the Navy's new air-to-surface Maverick missile that can see beyond visual range successfully began captive flight tests recently off the southern California coast.

The tests, conducted by Hughes Aircraft Company, demonstrated that the day/night seeker could meet two crucial program goals:

First, the guidance unit was able to recognize ship targets at a longer than visual range of the flight crew.

Second, the ability of the aircrew to lock the missile's guidance tracker on selected targets at stand-off range was achieved at very low altitudes.

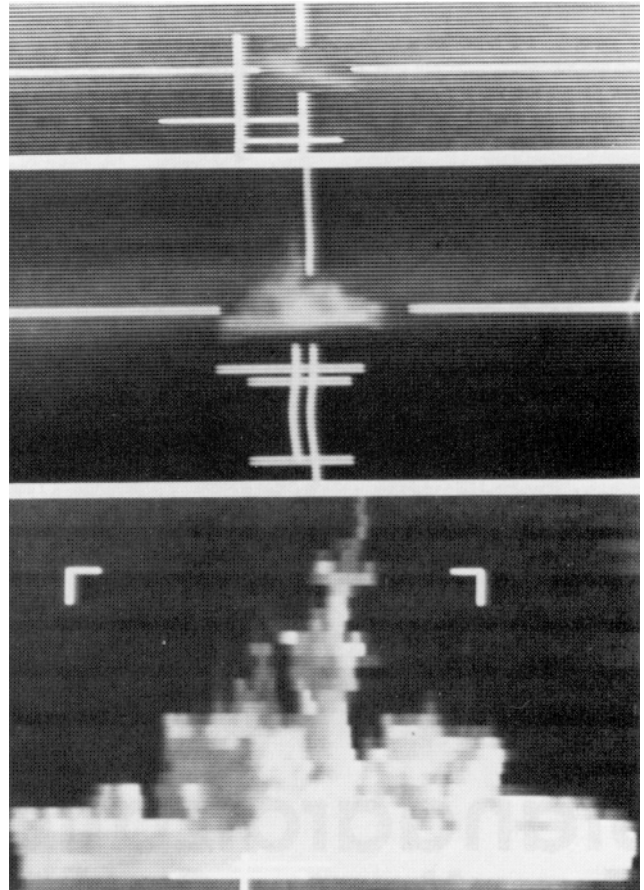
The seeker's lock-on range will permit flight crews to launch the missile beyond enemy air defense perimeters. After launch, the flight crew will be free to take evasive action or to fire successive missiles at other targets. Additionally, the ability of the aircrew to approach the target and launch the Maverick at very low altitudes minimizes detection by enemy radar.

The new Maverick, designated the AGM-65F, or Navy IR Maverick, will enhance both sea and ground target strike capabilities of the US Navy.

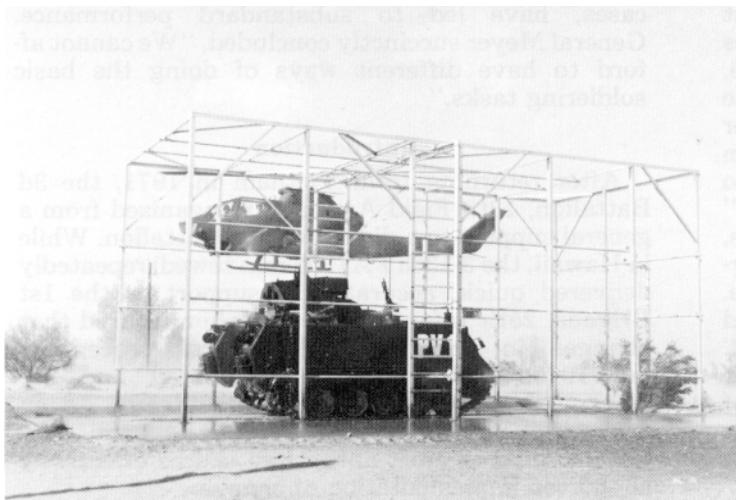
Hughes is developing the missile for the Navy by making minor modifications to the imaging infrared guidance unit of the US Air Force's IR Maverick (AGM-65D) to optimize the missile's antiship tracking capabilities.

The Navy Maverick also incorporates the heavy alternate warhead with selectable fuzing of the Laser Maverick (AGM-65E), planned for the US Marine Corps.

For the current series of captive flight tests, the seeker is mounted in the nose of a Hughes-owned and operated B-26 aircraft. The seeker will then be captive-test flown on a Navy A-7 aircraft before the live missile test launches.



**MAVERICK IMAGERY**—This series of photographs shows the images produced on a cockpit-type display by an infrared seeker for the AGM-65F Maverick missile during captive flight tests. In the top segment, the seeker "locks on" to the guided missile destroyer *USS Bagley* at a longer range than the flight crew's visual range. In the middle, the image is shown at the time the ship was sighted visually by the flight crew. At the bottom, the *Bagley* is shown in what would have been the terminal stage of the missile's flight.



Less than three inches of annual rainfall at the US Army Yuma Proving Ground in the Sonora Desert did not stop test engineers from giving the XM981 fire support team vehicle (FISTV) a thorough drenching. It simply required a stop at the artificial rainmaking facility and the use of an AH-1S Cobra helicopter as a wind machine to check for possible leaks in the hull during a "thunderstorm." The FISTV is undergoing developmental testing for possible use by forward observers assigned to infantry and armor units. The M113A1 chassis mounts a laser target designator and houses a communications system to make the job of directing artillery fire more accurate and faster on the battlefield of the future.



# Standardization of M102 Howitzer Section Equipment and Crew Drill

by MAJ George P. Coan Jr.

In his "White Paper on Standardization," General E. C. Meyer, US Army Chief of Staff, stated that "The US Army . . . must standardize the way it does many things if it is to train and fight as an effective, cohesive team." The purpose of standardizing battle drills and tactical procedures is ". . . to build soldier confidence by eliminating some of the frustration and waste of time associated with having to learn to do the same thing a new way with each transfer." We in the Field Artillery have had, for many years, established procedures for preparation for firing, firing, march order, fire direction, and observed fire. These procedures have endured many reviews and critiques, the latest being the "modern battlefield" update of the mid-1970s. What has happened over the past decade which has hindered the discipline of basic soldier skills is that ". . . many standard drills have been modified locally and, in some instances, forgotten altogether." It is the "local modification" syndrome that has taken basic procedures

and shaped them to adapt to a given situation. This tampering has caused "short cuts" which, in some cases, have led to substandard performance. General Meyer succinctly concluded, "We cannot afford to have different ways of doing the basic soldiering tasks."

## Introduction

After returning from Vietnam in 1971, the 3d Battalion, 13th Field Artillery, reorganized from a general support to a direct support battalion. While in Hawaii, the 3-13th FA (105-mm towed) repeatedly delivered quick, accurate fire support to the 1st Brigade, 25th Infantry. The battalion insured that changes in doctrine and tactical procedures (mid-1970s) were quickly assimilated and implemented throughout the gunnery team. As an authorized level of organization (ALO) 1 unit, the full manning of most authorized spaces effectively supported implementation of change.

In December 1980, the 25th Infantry Division became an ALO 2 unit, with a reduction in authorized



**Figure 1. Case b (howitzer and prime mover together).**

spaces and, consequently, a reduction in personnel fills. "Resident knowledge" quickly evaporated as soldiers, noncommissioned officers, and officers were reassigned and not always replaced. (Many other units also faced similar situations of personnel turbulence.) As such, the need for standardized procedures became acutely evident as personnel turbulence increased. A logical question at this point is: "Why not use procedures as published in field manuals (FMs), technical manuals (TMs), and US Army Field Artillery School literature to 'standardize' crew training?" A valid argument is, any deviation from these established procedures negates the purpose of standardization and defeats General Meyer's main thrust by injecting another modification. However, most literature presupposes ALO 1 strength level since it is the basis for the development of the established procedures. What are the standard procedures for units who are only authorized ALO 2 strength levels and operate sections, as a maximum, at that reduced manning level? The purpose of this article is to address that question and present a standardized M102 howitzer section equipment layout and crew drill for ALO 2 strength sections.

### Concept

ALO 1 strength level authorizes an M102 howitzer section a total of nine personnel (section chief, gunner, assistant gunner, prime mover driver, and five cannoneers). ALO 2 reduces the number of cannoneers from five to three each, for a total of seven personnel. The reduction appears initially to have a minimal effect upon the ability of a section to accomplish its mission; however, it does substantially affect the established procedures within the section as set forth in doctrinal literature, such as where to position its prime mover. FM 6-50, section III, paragraph 14-13C states, "In towed units, the prime mover, loaded with ammunition, should be positioned near the howitzer." What does the term "near" mean? Is the prime mover adjacent to the howitzer? The coordinating draft, *Survivability*,



**Figure 2. Case d (howitzer and prime mover separated).**

published by the United States Army Field Artillery School, suggests that "... more thought ... be given to positioning the ammunition carriers away from the rear of the howitzer as is the normal practice ... Towed and 8-inch units could use small stockpiles on the ground ... ." These questions caused the battalion to analyze four cases in order to standardize equipment layout and crew drill for a reduced strength (ALO 2) section:

- Howitzer and prime mover adjacent using ALO 1 strength crew.
- Howitzer and prime mover adjacent using ALO 2 strength crew.
- Howitzer with prime mover separated using ALO 1 strength crew.
- Howitzer with prime mover separated using ALO 2 strength crew; or in matrix format:

Howitzer and prime mover:	ALO 1	ALO 2
Together	case a	case b*
Separated	case c	case d**

\*See figure 1. \*\*See figure 2.

Cases a and c were the baseline cases in which procedures and displays could be analyzed to facilitate ALO 2 manning. Cases b and d became the test models for the standardization effort. What follows is applicable to both cases b and d.

### Execution

The battalion's standardization program consisted of three phases: development, demonstration/approval, and implementation. Doctrinal literature provided the basis for cases a and c. Executive officers (XOs), chiefs of firing battery (CFBs), and gunnery sergeants (GSs) formed the nucleus for the development of cases b and d. Using established procedures (ALO 1) and prioritizing

duties within the section, the firing battery supervisors developed a concept for cases b and d. Demonstration of this concept consisted of a "side-by-side" comparison of all four cases, each showing emplacement, firing, and march order procedures. All commanders within the battalion observed and made comments. Upon the battalion commander's approval, the battalion used cases b and d during the field training exercises held in November and December 1980. Commanders provided comments from the exercises which "fine tuned" the cases and became a portion of the tactical standard operating procedures (TAC SOP). The final test bed for the cases was the Army Training and Evaluation Program (ARTEP) taken in March 1981 in Korea in conjunction with "Exercise Team Spirit, 1981." The division artillery evaluation team found that the procedures and displays were fundamentally sound and practicable.

### Results

The battalion used the US Army Field Artillery School (USAFAS) booklet, "Duties of Personnel of the 105-mm Howitzer (M102) Section," to develop a standardization program as depicted in tables 1 through 7 and figures 3 through 7.

**Table 1. Duties of the chief of section (CS).**

#### Prepare for action

1. Dismounts at the release point (RP) and walks with number 3 cannoneer to the position.
2. Stands by the pantel marker stakes and signals to number 3 cannoneer when to stop vehicle.
3. Locks both hand brakes. Commands, "DISMOUNT."
4. Gives command, "UNCOUPLE."
5. Gives signal to number 3 cannoneer to move vehicle forward.
6. Moves to phone and supervises lay of howitzer. Repeats commands from aiming circle (AC).
7. After howitzer is laid, gives phone to number 2 cannoneer.
8. Verifies lay of howitzer.
9. Obtains site to crest.
10. Checks the boresight.
11. Insures howitzer is returned to lay position.
12. Conducts prefire checks.
13. Selects distant aiming point (DAP).
14. Supervises unloading of vehicle.
15. Supervises erection of the camouflage net.
16. Unpacks gunner's quadrant.

#### Indirect fire

1. Monitors phone and records data.
2. Checks powder, shell, and fuze prior to loading.
3. Repeats commands from the fire direction center (FDC).
4. Checks gunner's sight picture, bubble, and deflection.
5. Checks elevation using gunner's quadrant.
6. Reports to FDC when ready.

#### Direct fire

1. Upon receipt of the command to fire direct fire, identifies the target to the crew.
2. Determines the range to the target (range card/estimation) and announces the range.
3. Determines and announces the lead in mils.
4. Announces subsequent commands for changes in lead and range, as required.

#### March order

1. Insures howitzer is not loaded, and supervises the work of all cannoneers.
2. Directs, if applicable, any movement of the prime mover.
3. Commands, "COUPLE."
4. Checks area and vehicle to insure that all equipment is loaded in accordance with load plan.
5. Commands, "MOUNT."
6. Announces to executive officer (XO), "Number \_\_\_\_\_ in order."

**Table 2. Duties of the gunner.**

#### Prepare for action

1. Dismounts on right side of vehicle.
2. Uncouples howitzer from right side with the assistance of the number 1 cannoneer.
3. Removes canvas cover from M134 panoramic telescope mount and loosens four wing nuts to remove protective cover.
4. Places cover in stowage chest.
5. Removes M113 panoramic telescope from stowage box and opens parallax shield.
6. Mounts pantel site, insures that wing nuts are tight, and sets gunner's aid counter to zero.
7. Opens azimuth counter cover, uncovers level vials, opens parallax shield, and places deflection given to him by number 3 cannoneer on azimuth counter.
8. Traverses howitzer onto aiming point and levels bubbles.
9. After assistant gunner (AG) announces "SET," lays howitzer on command from chief of section.
10. Records all data on gunner's reference card.
11. Emplaces M1 collimator and aiming points (APs) with the assistance of the number 3 cannoneer.
12. Records the value appearing on the azimuth counter and closes the door.
13. Sets 3200 on counter reset.
14. Assists chief of section in obtaining site to crest.
15. Records data on gunner's reference card.
16. Boresights howitzer.
17. Returns to collimator and rechecks lay.
18. Determines two distant aiming points (DAPs).
19. Assists in unloading vehicle and erecting camouflage net.

#### Indirect fire

1. Sets announced deflection and lays for direction.
2. Announces "READY."
3. Refers the piece.
4. Measures the deflection.
5. Applies individual piece corrections for deflection.

#### Direct fire

1. Uncovers the window on the azimuth counter, sets the azimuth counter to 3200, verifies that the gunner's aid is set on zero, turns the direct fire lead knob so that the word "DIRECT" is visible, and centers the pitch and cross-levels bubbles.
2. Sets the initial lead (announced by chief of section) on the azimuth counter, traverses the howitzer until the vertical reticle is centered on the target, and maintains this sight picture by continuous tracking of the target.
3. Commands "FIRE" after the assistant gunner announces "SET."

#### March order

1. Sets azimuth counter to read 3200.
2. Sets correction counter to zero.
3. Closes parallax shield on pantel optics.
4. Rotates elbow to travel position.
5. Inspects vials and reticles for illumination.
6. Covers level vials on pantel mount and quadrant.
7. Loosens four retaining wing nuts and removes pantel.
8. Stores pantel in carrying case.
9. Covers M134 mount.
10. Insures that gunner's quadrant is cased.
11. Rotates howitzer to allow access to stakes.
12. Disconnects telephone set TA-312/PT and reels in wire.
13. Assists in packing and loading ammunition and equipment.
14. Retrieves collimator.
15. Assists in coupling howitzer.
16. Mounts prime mover when commanded.

**Table 3. Duties of the assistant gunner (AG).**

#### Prepare for action

1. Dismounts prime mover on left side.
2. Uncouples howitzer from left side with assistance of number 2 cannoneer.
3. Removes cover from M14 fire control quadrant.
4. Removes M114 elbow telescope from stowage box.
5. Mounts M114 elbow telescope, fastens latch, and uncovers level vials. Sets counter to zero.
6. On command from number 2 cannoneer, elevates tube to 800 mils. Sets elevation counter to 300.
7. On command from number 2 cannoneer, depresses tube to elevation 300 mils. Announces "SET."
8. Opens breechblock.
9. On command from chief of section, depresses or elevates tube to measure site to crest. On the command, "MEASURE ELEVATION," sets off zero on the correction counter and levels bubbles. Announces reading to chief of section.
10. Closes breechblock.
11. Depresses tube to zero mls
12. Mounts M140 boresight alignment device.
13. After boresighting, removes alignment device and cases device.
14. Elevates tube to 300 mils.
15. Assists in unloading vehicle.
16. Assists in erecting camouflage net.

**Indirect fire**

1. Sets quadrant.
2. Closes breechblock.
3. Levels bubbles.
4. Announces "SET."
5. Fires the howitzer on command from chief of section.
6. Opens breechblock.

**Direct fire**

1. Centers the bubble in the elevation vial with the elevation counter knob, centers the cross-level bubble, and checks the functioning of range gages.
2. Moves the range gage line on the telescope reticle along the proper ammunition scale to range announced by the chief of section, elevates or depresses the tube until the target is on the range gage line, maintains the correct sight picture by continuous tracking, and announces "SET, SET, SET . . . TRAILING THE TARGET."

**March order**

1. Closes breechblock.
2. Covers breechblock assisted by number 1 cannoneer.
3. Elevates tube to 800 mils for removal of stakes.
4. Removes elbow scope and cases it.
5. Covers vials and mount.
6. Assists number 1 cannoneer to extract stakes from firing platform. Places muzzle plug into tube.
7. Places stakes in trail box.
8. Depresses tube while number 1 cannoneer removes travel lock from stowed position and places it in travel position.
9. Assists in loading of vehicle.
10. Assists in disassembling and loading camouflage net.
11. Assists in coupling howitzer.
12. Mounts prime mover upon command.

**Table 4. Duties of number 1 cannoneer.**

**Prepare for action**

1. Dismounts on right side of vehicle.
2. Uncouples howitzer from right side with assistance of gunner.
3. Once vehicle has moved forward, removes quick release pin. Rotates drawbar to upright position and replaces locking pin.
4. Removes actuator crank and one stake from trail box.
5. Moves to the left front of the howitzer.
6. Removes locking pin from travel lock, places the travel lock in the stowed position, and commands "ELEVATE."
7. Removes the left wheel suspension quick release pin and places it in holder.
8. Releases left-hand brake.
9. Cranks wheels into firing position.
10. Locks left-hand brake.
11. Drives in stake (sledge hammer from number 2 cannoneer) on left side of buffer at the 11 o'clock position (end of tube is 12 o'clock).
12. Removes muzzle plug from tube.
13. Assists in unloading the vehicle and drives in remaining stakes.
14. Assists in erecting the camouflage net.

**Indirect fire**

1. Loads round on announcement of "QUADRANT."
2. Inspects the bore and chamber after each round is fired to insure that they are free from residue left by charge and announces "BORE CLEAR."

**Direct fire**

Same duties as in indirect fire except fires the howitzer when the gunner commands "FIRE."

**March order**

1. Helps assistant gunner coyer breech.
2. Secures sledge hammer, stake extractor, and actuator crank.
3. Commands "ELEVATE" to assistant gunner.
4. Removes stakes from firing platform assisted by assistant gunner.
5. Releases both brakes.
6. Cranks wheels into travel position.
7. Replaces suspension quick release pins and locks both brakes.
8. Commands "DEPRESS" removes travel lock from stowed position, and places it in travel position.
9. Retrieves aiming posts.
10. Assists in loading equipment on vehicle.
11. Assists in disassembling camouflage net.

**Table 5. Duties of number 2 cannoneer.**

**Prepare for action**

1. Dismounts on left side of vehicle with the assistant gunner.
2. Pulls cotter pin from tow pintle.
3. Opens tow pintle. Disconnects blackout/tail light system.
4. Gives signal to chief of section.
5. Uncouples howitzer from left side with aid of assistant gunner.
6. Removes one stake and sledge hammer from trail box.
7. Moves to right front of howitzer.
8. Removes right wheel suspension quick release pin and places it in holder.
9. Releases right brake.
10. If needed, assists number 1 cannoneer in cranking actuator.
11. Drives in stake on right side of buffer at 1 o'clock position (end of tube is 12 o'clock).
12. Locks right brake.
13. On command from chief of section, emplaces aiming posts.
14. Assists in unloading ammunition and equipment from vehicle.
15. Assists in erecting the camouflage net.

**Firing**

1. Cuts announced charge.
2. Insures that chief of section sees charge cut and announces "VERIFY CHARGE."
3. After verification, moves to the rear of the piece with the remaining charge increments. Holds up remaining increments with both hands until howitzer is fired. Places powder in powder pit.
4. Returns to howitzer and helps driver prepare ammunition.
5. Stacks expended cartridges on right side of howitzer.

**March order**

1. Assists driver in disassembling vehicle net.
2. Assists in packing and loading of ammunition and equipment into the vehicle.

**Table 6. Duties of number 3 cannoneer.**

**Prepare for action**

1. Meets chief of section at the release point.
2. Briefs chief of section while walking howitzer/vehicle into position.
3. Guides vehicle into position.
4. Stops vehicle on command from chief of section.
5. Motions to driver to move forward on command from chief of section when vehicle is uncoupled.
6. Points out aiming point to the gunner.
7. Gives card to gunner with aiming point data.
8. Assists driver in dropping tailgate.
9. Secures collimator.
10. Emplaces collimator at direction of gunner.
11. Assumes duties of radiotelephone operator (RTO) while chief of section verifies lay of howitzer, obtains site to crest, checks boresight, and supervises duties of his section.

*Note: At this point, the number 3 cannoneer is required for the advance party or perimeter. Therefore, his duties on the howitzer are terminated.*

**Table 7. Duties of the driver.**

**Prepare for action**

1. Takes commands from number 3 cannoneer to bring vehicle into position.
2. Takes commands from number 3 cannoneer to reposition vehicle.
3. Drops tailgate (assisted by number 3 cannoneer).
4. Unloads vehicle, assisted by section personnel.
5. Assists in erection of camouflage net.

**Duties in firing**

1. Mates announced fuze with proper projectile.
2. Sets time on fuze.
3. Hands round to number 1 cannoneer.
4. Prepares next round.

**March order**

1. Disassembles net.
2. Loads vehicle.
3. Insures that vehicle is loaded in accordance with load plan.

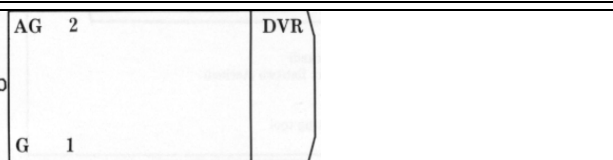
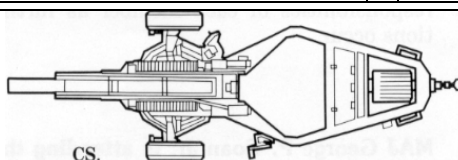
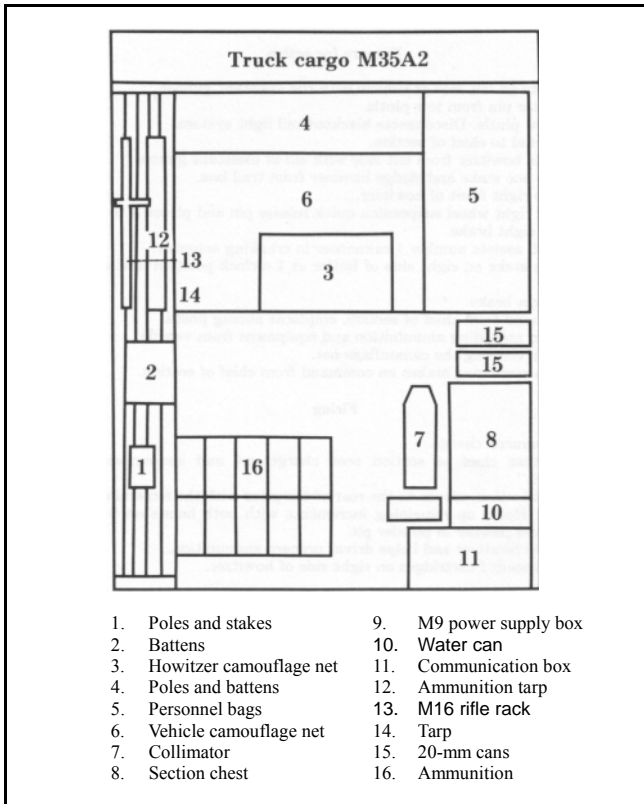
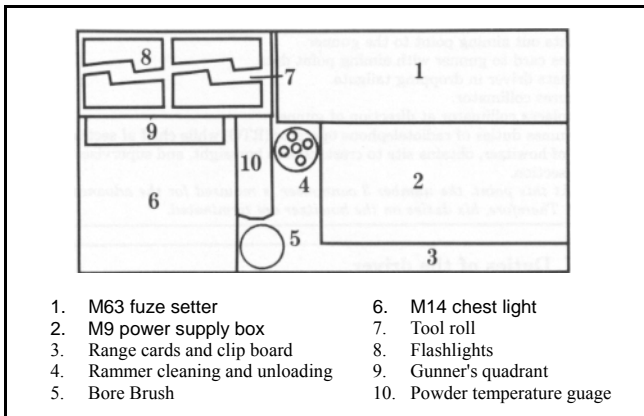


Figure 3. Mounted howitzer section personnel.



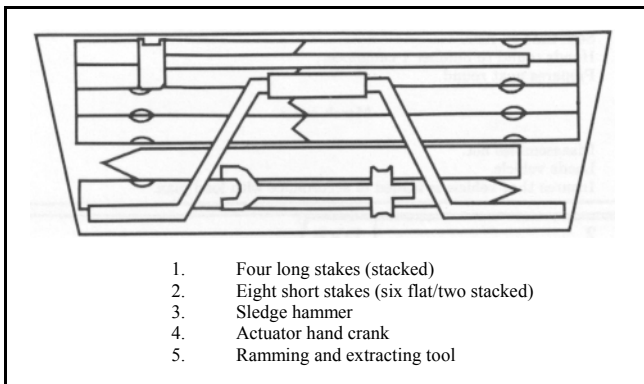
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| 1. Poles and stakes        | 9. M9 power supply box |
| 2. Battens                 | 10. Water can          |
| 3. Howitzer camouflage net | 11. Communication box  |
| 4. Poles and battens       | 12. Ammunition tarp    |
| 5. Personnel bags          | 13. M16 rifle rack     |
| 6. Vehicle camouflage net  | 14. Tarp               |
| 7. Collimator              | 15. 20-mm cans         |
| 8. Section chest           | 16. Ammunition         |

Figure 4. Section equipment loaded on prime mover.



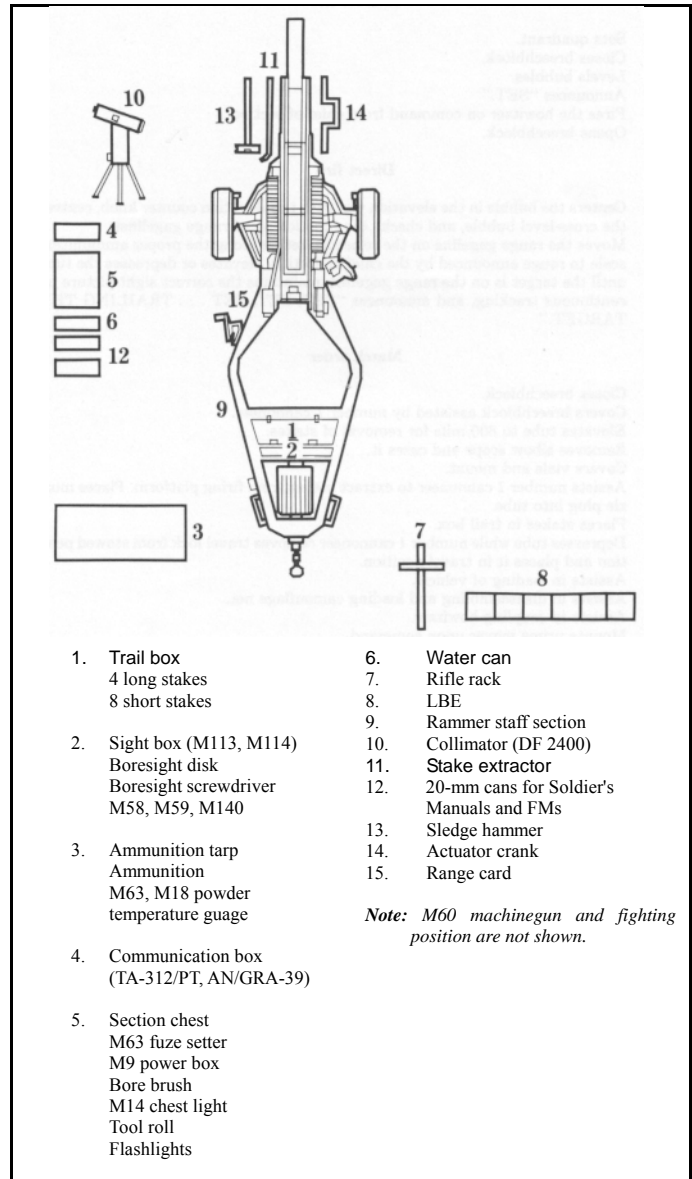
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| 1. M63 fuze setter               | 6. M14 chest light           |
| 2. M9 power supply box           | 7. Tool roll                 |
| 3. Range cards and clip board    | 8. Flashlights               |
| 4. Rammer cleaning and unloading | 9. Gunner's quadrant         |
| 5. Bore Brush                    | 10. Powder temperature gauge |

Figure 5. Equipment display.



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|--|
| 1. Four long stakes (stacked)                |
| 2. Eight short stakes (six flat/two stacked) |
| 3. Sledge hammer                             |
| 4. Actuator hand crank                       |
| 5. Ramming and extracting tool               |

Figure 6. Equipment display.



- |  |   |
|--|---|
| 1. Trail box<br>4 long stakes<br>8 short stakes  | 6. Water can                                    |
| 2. Sight box (M113, M114)<br>Boresight disk<br>Boresight screwdriver<br>M58, M59, M140                           | 7. Rifle rack                                   |
| 3. Ammunition tarp<br>Ammunition<br>M63, M18 powder<br>temperature gauge   | 8. LBE  |
| 4. Communication box<br>(TA-312/PT, AN/GRA-39)   | 9. Rammer staff section                         |
| 5. Section chest<br>M63 fuze setter<br>M9 power box<br>Bore brush<br>M14 chest light<br>Tool roll<br>Flashlights | 10. Collimator (DF 2400)                        |
|  | 11. Stake extractor                             |
|  | 12. 20-mm cans for Soldier's<br>Manuals and FMs |
|  | 13. Sledge hammer                               |
|  | 14. Actuator crank                              |
|  | 15. Range card                                  |

Note: M60 machinegun and fighting position are not shown.

Figure 7. Howitzer section equipment layout.

### Conclusion

The pamphlet "Duties of Personnel of the 105-mm Howitzer (M102) Section," states, under the chief of section duties during firing, that the section chief assigns duties in firing with reduced personnel. With ALO 2 units, this reduction in personnel already exists; therefore, the purpose of this discussion is to produce a workable section drill and equipment layout which facilitates delivery of timely accurate fire support with personnel shortages. Perhaps the next step is a proposal which outlines responsibilities of each member as further reductions occur. ☒

MAJ George P. Coan Jr. is attending the Armed Forces Staff College.



# Redleg Newsletter

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## ITEMS OF GENERAL INTEREST

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### **ROTC active duty scholarships**

Soldiers thinking about college, but who may not be able to meet the inherent financial burden, can seek an ROTC scholarship as a possible solution.

Army ROTC has reserved 100 scholarships for active duty enlisted soldiers, which cover tuition, textbooks, laboratory fees, and certain other education expenses. For example, if a college major requires use of a calculator or slide rule, the Army will pay for it.

The Army will also pay scholarship winners \$100 a month, up to \$1,000 for each academic year, in tax-free subsistence allowance. Additionally, cadets will be paid for the six-week advanced camp, which they must attend in the summer between their junior and senior years.

Scholarship winners can also use any GI Bill or Veterans Educational Assistance Program (VEAP) benefits they may have earned while on active duty.

In 1980, the Army expanded the active duty scholarship program to give more soldiers the chance to apply; i.e., there is a new three-year scholarship in addition to the two-year award.

Also, some rule changes have extended the age limit by giving soldiers credit for active service. For example, the "old rules" stated that applicants had to be younger than 25 on June 30th of the year in which they would be commissioned; now, the maximum age is younger than 29 on June 30th of the commissioning year. This means that soldiers can count up to four years of active duty. Three years active duty extends the age limit to under 28; two years extends it to under 27, etc., which gives soldiers more time to earn credits.

To apply for ROTC active duty scholarships, soldiers must:

- Be US citizens.
- Be at least 17 years old before the scholarship becomes effective.
- Have served at least one year on active duty.
- Have been accepted for enrollment by a college or university that offers ROTC (or the applicant must be able to make arrangements to attend ROTC classes at a nearby school which does).
- Have scored at least 115 on the General Technical (GT) Aptitude Test.
- Have a satisfactory National Agency Check.
- Have maintained a "C" average in college work.
- Have two years of college credit for a two-year scholarship or one year of college credit for a three-year scholarship.
- Be recommended for the scholarship by their commanders.

Selected soldiers will be discharged from active duty to enter college and will become Army ROTC cadets.

Individuals can major in any area except theology that leads to a bachelor's degree and can take part in any extracurricular activity which doesn't interfere with military science requirements. Scholarship cadets will receive commissions as Regular Army or Army Reserve second lieutenants after graduation and then must serve four years active duty.

For applications, or for more information, interested soldiers should write: ARMY ROTC, HQ TRADOC, ATTN: ATRO-CS, Fort Monroe, VA 23651.

Applications for scholarships for the 1982-83 school year must be submitted between 15 January and 15 April 1982. Completed applications must reach HQ TRADOC postmarked no later than 1 May 1982.

### **Parachutist Badge Award**

There are three degrees of the Parachutist Badge authorized for award: The Master Parachutist Badge, the Senior Parachutist Badge, and Parachutist Badge. The criteria for each badge are set forth in AR 672-5-1, Military Awards. The term "novice" when referring to the Parachutist Badge gives the impression of an inexperienced jumper. Many individuals with a Parachutist Badge are very experienced jumpers but have not had an opportunity to complete certain requirements for the higher degree badge. The term "novice" is not used in any official Department of the Army publication.

### **Drill sergeants needed**

The Army continues to look for men and women to become drill sergeants. Volunteers must be in grades E5 through E7, if male; E4 through E7, if female. Personnel may volunteer regardless of MOS.

Those noncommissioned officers selected for drill sergeants are considered among the most highly qualified for promotion, schooling, and assignments.

Volunteer applications are submitted through command channels on DA Form 4187, following procedure 3-34, DA Pamphlet 600-8.

Soldiers selected for drill sergeant duty will receive two years' stabilization at an Army training center with the option to request up to 12 additional months. In addition, they will receive special duty assignment pay, supplemental issue of uniforms which will be laundered free, and authorization to wear the distinctive drill sergeant hat and badge.

## USAR dependents may shop at PXs

Dependents of most US Army Reserve unit members are no longer required to have their Reserve sponsors present each time they shop at post exchanges.

The House Armed Services Committee has ruled that dependents of Reservists, who are assigned to Troop Program Units, are entitled to one day of unaccompanied exchange shopping for each day of Inactive Duty for Training (IDT) performed by the Reservist. The new privilege, however, does not apply to dependents of those Reservists who are attached but not assigned to Troop Program Units.

To shop unaccompanied, a dependent must present the Reservist's Leave and Earnings Statement or a unit letter of authorization. The dependent also must have a driver's license or some other form of identification to verify relationship to the Reservist.

According to Army and Air Force Exchange Service (AAFES) officials, dependents who special-order merchandise, purchase on a layaway basis, or leave items for repair will be allowed to complete the transaction on another day. That day will not count against the total number of days which they are permitted to shop.

The officials pointed out, however, that shopping days used by unaccompanied dependents will count against the total number of days which their sponsor can use exchange facilities.

Reserve unit members are allowed one exchange shopping day for each Unit Training Assembly performed. This means that on the average they're entitled to four shopping days per month or 12 days per quarter. Those days cannot be carried from one quarter to the next.

## Foreign Area Officers

All Foreign Area Officers (FAO), specialty code 48, will have their records reviewed during the next few months by a new management section.

The FAO Management Section, Officer Personnel Management Directorate (OPMD), will manage FAOs from second lieutenant to lieutenant colonel while FAO colonels will continue to be managed by OPMDs colonels division.

The staff of the new section, within the Combat Arms Division, will provide assistance and information as well as make assignments and provide training.

The records of all FAOs will be reviewed to verify their regional and functional skills. FAOs are encouraged to review their Officer Record Brief and inform the section of any qualifications that should be added to their records.

The FAO Management Section may be contacted by writing to Commander, US Army Military Personnel Center, ATTN: DAPC-OPE-C, 200 Stovall St., Alexandria, VA, or by calling (202) 325-9622/3 or AUTOVON 221-9622/3.

## Army staff organizational change

A realignment of the HQDA staff recently established the Office of the Assistant Deputy Chief of Staff for Operations and Plans for Command and Control, Communications, and Computers (OADCSOPS-C4).

Concurrently, the Office of the Assistant Chief of Staff for Automation and Communications (OACSAC) and the Command and Control Division, Requirements Directorate, Office of the Deputy Chief of Staff for Operations and Plans (ODCSOPS), were disestablished and the functions integrated into OADCSOPS-C4 as part of the realignment.

The interrelated advances in electronics technology, communications, and military command and control spawned the need for a major organizational change in the Army staff.

The change places all of the major elements of command and control and associated automation and communications in one general staff agency. The realignment also improves the Chief of Staff's span of control and provides a closer association of automation and communication requirements, concepts, and doctrine.

## Army Achievement Medals

The new Army Achievement Medal (AAM) allows 15 promotion points for soldiers advancing to grades E5 and E6. The medal is one of four new awards that took effect in August last year to recognize soldiers' contributions during peacetime and is the *only* one of the new awards that is worth promotion points. The other three peacetime awards—the Army Service Ribbon, the NCO Professional Development Ribbon, and the Overseas Service Ribbon—will be awarded to soldiers meeting prescribed requirements. All Active Army, National Guard, and Army Reserve soldiers may be recommended for the AAM. Approval is required by a commander in the grade of colonel or above.

The medal is awarded to servicemembers for significant achievements deserving special recognition but is not considered as qualifying as an Army Commendation Medal (ARCOM) which is worth 20 promotion points.

The new medal should appear in post exchanges soon but probably will not be available through the normal supply system until late this year. In the interim, soldiers will receive orders and a certificate.

## Extensions of drill sergeant duty

Enlisted soldiers serving as drill sergeants may now extend for periods of 6 to 12 months, provided the request for extension is submitted five months before the end of tour as drill sergeant.

The new program is designed to allow soldiers more flexibility in avoiding moves during school months and other undesirable times.

## Writing requirement expanded for CGSC

If you're an officer beginning Command and General Staff College (CGSC) this year through correspondence or the US Army Reserve Schools program, this is a reminder of the expanded writing requirement.

No longer will the old standard of a 750- to 1,000-word paper on a military subject meet school requirements. As a result of the Army's renewed emphasis on writing skills, beginning with the 1981-82 school year, the requirement will be a 500-to 750-word argumentative paper plus a 1,000- to 1,500-word staff paper. This change parallels a similar one in the college's in-resident curriculum.

Students already enrolled in Phases III and V of the Command and General Staff Officer Course with USAR schools and those students having already passed the writing requirement through correspondence courses are exempt from the change.

According to the college's director of extension training management, Phase I students must submit the argumentative paper by 31 May 1982. Students failing the requirement on the first submission have until 1 October 1982 to pass.

For students enrolling now, the second paper (staff paper) is to be turned in for a passing grade by 1 October 1983 in order to progress to Phase V.

## Improvements in Reservists' pay system

A two-part test to improve the pay system for Reservists is scheduled to begin in January this year.

The Drill Attendance Reporting Test (DART) and the Consolidated Army System for Processing Entitlements to Reservists (CASPER) are two separate enhancements to the Joint Uniform Military Pay System-Reserve Components (JUMPS-RC).

DART provides for "positive reporting for pay." A Reservist, now paid automatically unless reported absent, will present a plastic card when reporting for drill attendance. A pay form will be prepared on an impression machine and signed by the Reservist and the commander. The pay form will be forwarded to a central input station for optical character reading to tape for transmission to the US Army Field Artillery Center.

CASPER, a new concept in maintaining personal finance records (PER), will then reduce the administrative workload at the Reserve unit by relieving unit responsibility for maintenance of PFRs, which will be maintained at the JUMPS-RC input station. The responsibility for coding of JUMPS-RC input transactions will be transferred from units to input stations.

The plastic card concept was tested at Fort McCoy, WI,

and again at Fort McPherson, GA, along with the new concept in maintaining PFRs.

Reserve units will begin using the DART and CASPER systems after all units have transferred their finance records.

## Warrant officer associate degree program

The Department of the Army's educational goal for warrant officers is attainment of a specialty-related associate degree (DA PAM 600-11) to include MOS 201A and MOS 211A.

Quotas are now available to permit warrant officers to attend academic institutions as full-time students for a period up to 18 months (PCS status) in order to attain an associate degree. This is a fully funded program for which the Army bears all expenses for tuition and fees to include reimbursement of up to \$100 per fiscal year for textbooks, school supplies, and related expenses. Further, the individual receives full pay and allowances while enrolled.

The program is open to applicants who are within 18 months of completing degree requirements. Application procedures are outlined in paragraph 4-3, AR 621-1. Individuals who participate in the program will incur an additional service obligation as outlined in paragraph 4-4, AR 621-1.

## Change in rating chain

The Officer Efficiency Report (OER) rating chain for Active and Reserve Component officers was changed as of 20 October 1981.

As stated in an immediate-action interim change to AR 623-305, the policy change now integrates OER rating chains without regard to the component affiliation of the rated officer and other members of the chain (including the senior rater).

According to the US Army Military Personnel Center (MILPERCEN), the procedural change allows commanders more flexibility in setting up rating chains to correspond as closely as possible to the actual chain of command.

For example, an Active Component officer serving as platoon leader with a US Army Reserve company could be rated by his/her Reserve company commander, with the Reserve battalion commander serving as the senior rater.

Another example would be a Reserve officer serving in an Active Guard Reserve status on the Department of Army staff; normally this officer would be rated by an Active Component branch chief, while an Active Component division chief would be the senior rater.

For more information on the change, contact your local Military Personnel Office.



# BATTERY + INTEGER PROGRAMING = TRANSPORTATION

by CPT John M. House

Deploying men and materiel is a difficult task made easy with adequate planning; however, under many conditions, time often severely restricts the planning function. Since deployments or movements may cross a post, country, or ocean, current personnel shortages and the lack of a staff at battery level usually force the

necessary coordination on a few individuals. Anything then which reduces this workload should obviously provide for smoother operations, and it is there that integer programing can be of great assistance in transportation planning.

A mathematical function describing the transportation problem must be developed for integer programing to be used. For example:

$$\text{minimize } c_1x_1 + c_2x_2.$$

Here  $c_1$  and  $c_2$  may be the cost associated with employing the transportation assets  $x_1$  and  $x_2$  respectively. Such assets could be trucks, railcars, aircraft, ships, etc. or load plans associated with the carriers.

Minimization is constrained by several inequalities of the type:

$$ax_1 + bx_2 \geq Y.$$

$Y$  could be the number of 2½-ton trucks in a unit with  $a$  and  $b$  the number carried by  $x_1$  and  $x_2$  respectively. Inequalities express the constraints which must be considered; e.g., equipment time allowed and personnel to be deployed. Obviously, complex problems require many constraint inequalities. An additional restriction for integer programming is that only integer answers are allowed; therefore, the solution cannot indicate one-half of a truck should be used.

At first glance, integer programming appears to many as magic—just as artillery is sometimes viewed. However, many techniques, which are readily adaptable to computer programming, have been developed to simplify solving such a problem. Numerous pre-programed packages exist which insure that integer programming models are solved with a minimum of effort and time. Such algorithms are used throughout the military and civilian industry

Description	Number
Personnel with combat equipment	87
Container express	6
M561 1¼-ton truck	1
M561 1¼-ton truck, M101A1 ¾-ton trailer	1
M35A2 2½-ton truck (without winch), M332 ammunition trailer	2
M35A2 2½-ton truck (without winch), M149 water tank trailer	1
M35A2 2½-ton truck (without winch), M105A2 1½-ton trailer	1
M35A2 2½-ton truck (with winch), M101A1 105-mm howitzer	6
M35A2 2½-ton truck (with winch)	1
M151A2 ¼-ton truck	1

**Table 1. Equipment types.**

to reduce planning time. My experience has been that, even though this resource may be available at the Department of the Army or Major Army Command level, it is not found at battery or battalion sized organizations. In other words, the "doers" do not benefit from these mathematical techniques which have existed for years.

A fictional deployment situation follows which illustrates the use of integer programming in deploying a field artillery battery. Suppose a battery must be transported from Fort Benning, GA, to Charleston, SC, and San Francisco, CA. Unit equipment types are listed in table 1. The "X" values used are load plans associated with each carrier. Organic motor transport supplemented by 5-ton tractors pulling 12-ton semitrailers for the container express (CONEX); C-130, C-141, and C-5 aircraft; and Department of Defense 50- and 54-foot flatcars and guardcars are available. Table 2 summarizes the

Carrier	Number Available
C-130	30
C-141	25
C-5	15
M561 1¼-ton truck	1
M561 1¼-ton truck with M101A1 ¾-ton trailer	1
M35A2 <sup>2</sup> /—TON TRUCK WITH M332 ammunition trailer	2
M35A2 2½-ton truck with M149 water trailer	1
M35A1 2½-ton truck with M105A2 1½-ton trailer	1
M35A2 2½-ton truck with M101A1 105-mm howitzer	6
M35A2 2½-ton truck	1
M151A2 ¼-ton truck	1
M52A1 5-ton tractor truck with M127A1 12-ton stake semitrailor	3
54-foot by 10-foot, 6-inch flatcar	25
50-foot by 10-foot, 6-inch flatcar	10
Guardcar	10

**Table 2. Carrier types.**

Route scenario	Modes considered	Modes chosen	Total cost
Charleston	Air, motor, rail	Motor, rail	\$ 2,365.28
Charleston	Air	Air	\$ 33,210.28
Charleston	Motor	Motor	\$ 2,414.07
Charleston	Rail	Rail	\$ 12,283.25
San Francisco	Air, motor, rail	Motor	\$ 26,587.75
San Francisco	Air, rail	Air, rail	\$ 64,852.54
San Francisco	Air	Air	\$154,092.54
San Francisco	Motor	Motor	\$ 26,587.75
San Francisco	Rail	Rail	\$100,295.23

**Table 3. Objective function values.**

transportation carrier types considered. Costs associated with each carrier (or load plan) are used in the minimization function. Constraints include transportation assets available, personnel and equipment to be moved, deployment time allowed and required, and rail motive power. Deployment times are 3, 7, and 30 days. Required time includes time lost due to line interchanges (as with railroads), maintenance time, refueling time, movement distance divided by average speed, loading time, and unloading time. The objective is to minimize the cost of the movement.

This deployment requirement was modeled and solved utilizing a computer and a pre-programed software package. When time allowed consideration of all carriers available, motor assets were selected as the primary means except for the unit M151A2s and CONEXs moving by rail. The three-day deployment scenario to San Francisco only allowed air assets to be considered. The interesting result was that motor transportation was indicated as the least expensive carrier for the majority of the equipment with rail next. However, when rail and air carriers were considered for the San Francisco movement, the model indicated air least costly for personnel and rail for the equipment. This does not "prove", however, that motor transportation is always the least expensive or preferred means of deployment. The question is raised but can only be answered by an agency with cost data that can universally be accepted as correct. The total exclusion of C-5 aircraft is another interesting result. Its cost effectiveness has apparently been degraded by the structural problems resulting in the peacetime cargo load of 100,000 pounds as opposed to its wartime capacity of 265,000 pounds. Table 3 lists the routes, transportation modes, and total movement costs.

Obviously, integer programming can be used to solve transportation problems that match the format discussed. Military problems of this sort are often so complex a

computer is needed to rapidly determine the answer. For such techniques to assist battery and battalion planners, a computer system with easily accessible terminals is required. A central computer with remote terminals at strategic locations (unit area, loading points, etc.) would provide the access required. Unit tables of organization would be stored for direct access and a linear programming software package always programmed in the computer. Unit planners would only need to add or delete vehicles based on the situation and key the previously stored package to derive a solution automatically. Load plans could be determined manually, or a program could be developed to derive them utilizing computer assets. A hard copy printer would easily provide multiple copies of the load plans or carriers required. Placing terminals at numerous locations would assist the planners when unforeseen mechanical problems force deletion of a carrier or item of equipment at critical locations such as loading ramps.

Integer programming is a viable technique to plan transportation requirements in support of deployments. Additional research is necessary to determine the feasibility of the system outlined here which would facilitate using this mathematical technique. The results would be more efficient resource use and additional time for battery and battalion movement control personnel to accomplish the myriad tasks required when deploying. Cost savings would result once the initial outlay for the system is recovered. These benefits mandate further research concerning a means of assisting battery and battalion movement planners.

**CPT John M. House is assigned to the 6th Battalion, 14th Field Artillery, 1st Armored Division.**

# 1981 Redleg Reference

The following is a list of *Journal* articles and "View From The Blockhouse" items for calendar year 1981 and the issue in which the material was published. The letters (VB) indicate "View From The Blockhouse" items.

## Air Operations/Support

Airlifting the AN/MPQ-4A radar, Jul-Aug (VB).  
Tactical Airpower: What is it? How does the ground commander use it? May-Jun.

## Ammunition/Fuzes

Artillery Ammunition Interoperability in NATO, May-Jun.  
New 155-mm training round, Nov-Dec (VB).  
Precision Guided Artillery: First and Second Generation Projectiles, May-Jun.

## Communication/Electronics

PLRS/JTIDS Hybrid, Jan-Feb.  
SINGGARS—the hopping radio, Mar-Apr (VB)

## Counterfire

Alternate power for the DM-60, Nov-Dec (VB).  
American Sound Ranging in Four Wars, Nov-Dec.  
AN/MPQ-4A being replaced, Mar-Apr (VB).  
AN/TPQ-36 templates, Sep-Oct (VB).  
Correction—Hand-held calculator applications in radar operations, May-Jun (VB).  
Dissemination of met messages, Jul-Aug (VB).  
FALOP change, Mar-Apr (VB).  
Field Artillery Crewmember Course external evaluation, Nov-Dec (VB).  
Field Artillery Target Acquisition Conference, Jan-Feb (VB).  
Firefinder registration data, Jul-Aug (VB).  
Generator set D423A, Nov-Dec (VB).  
Hand-held calculator applications in radar operations, Mar-Apr (VB).  
Input to CFD Systems Review, May-Jun (VB).  
New Field Artillery Surveyor Course Begins, May-Jun (VB).  
PADS is here! Sep-Oct (VB).  
Programmed Operator Proficiency Trainer, Nov-Dec (VB).  
Radar Technicians Course, Jan-Feb (VB).  
Radar Technicians Course, Nov-Dec (VB).  
Sound/flash ranging update, Sep-Oct (VB).  
Sound Ranging Set AN/TNS-10, May-Jun (VB).  
TAB Commander's Conference, Sep-Oct (VB).  
Target simulator for radar set AN/MPQ-4A, Jul-Aug (VB).  
Targeting Cell, Sep-Oct (VB).  
Television films available, Sep-Oct (VB).  
The Targeting Cell, Sep-Oct.  
TI-59 forms revised, Jan-Feb (VB).  
TI-59 survey forms, Mar-Apr (VB).

## Doctrine

Artillery Ammunition Interoperability in NATO, May-Jun.  
Fire Support Mission Area Analysis, May-Jun.  
Extending the Battlefield, Sep-Oct.  
Implementing the AirLand Battle, Sep-Oct.  
Interdiction, Mar-Apr.  
Mission Area Analysis: Shaping the Future Field Artillery Force, Mar-Apr.  
Putting It All Together, Nov-Dec  
Rationalization, standardization, and interoperability (RSI) notes, Sep-Oct (VB).  
The Field Artillery System of the future, Nov-Dec (VB).  
The Question of Deploying US Theater Nuclear Weapons in Europe, May-Jun.  
The Targeting Cell, Sep-Oct.

## Equipment

Alternate Power for the DM-60, Nov-Dec (VB).  
Crew ballistic shelter, Jul-Aug (VB).  
Fire Observation Training Set, Nov-Dec (VB).  
Generator set D423A, Nov-Dec (VB).  
PLRS/JTIDS Hybrid, Jan-Feb.  
Prefire checks for the M110A2 8-inch howitzer, Sep-Oct (VB).  
SINGGARS—the hopping radio, Mar-Apr. (VB).  
Sustainment training for TACFIRE units, Nov-Dec (VB).  
TACFIRE and Reserve Components, Jan-Feb (VB).  
TACFIRE and the Maneuver Commander, Jan-Feb.  
TACFIRE Deployment and Training, Jan-Feb.  
TACFIRE training program, Nov-Dec (VB).

## Foreign

Field Artillery Survivability: The Soviet Perspective, Sep-Oct.

## Gunnery

Don't Forget Your FIST, Mar-Apr.  
Error in M109A1/A3 and M109A2 direct fire tables, Jul-Aug (VB).  
Fire Support Control at the Fighting Level, Mar-Apr.  
Terrain Gun Position Corrections: An Alternate Method, Nov-Dec.  
The Firing Battery Commander, Nov-Dec.

## History

American Sound Ranging in Four Wars, Nov-Dec.  
Captain Harry, Jul-Aug.  
Dan T. Moore: Founder of the Field Artillery School, Nov-Dec.  
Father of the Rock Island Arsenal, Jan-Feb.  
Greek Fire—The Best Kept Secret of the Ancient World, May-Jun.  
The King of Battle: Ruler of Yorktown, Sep-Oct.

## Maintenance

Mobile Maintenance Shop Vehicle, Mar-Apr.

## Miscellaneous

Departments renamed, Jan-Feb (VB).  
Field Artillery Senior Commanders Conference, Jan-Feb (VB).  
Firepower Maximization, Nov-Dec.  
Fire Support Conference, Jan-Feb (VB).  
Fire Support Conference 1981, Nov-Dec (VB).  
*Journal* on microfilm, Jan-Feb (VB).  
NATO Artillery Working Party, May-Jun (VB).  
Old APAC now ACE, Jul-Aug (VB).  
Quadripartite, Jan-Feb (VB).  
Revision of FM 6-10, Jul-Aug (VB).  
Revision of FM 6-20-2, Sep-Oct (VB).  
TM 9-2350-303-10 fielded, Mar-Apr (VB).

## Organization

Continuous Operations: Who Melts, When, and Why? May-Jun.  
The Targeting Cell, Sep-Oct.

Training Management in Small Units, Nov-Dec.

## Personnel

Mannin' the Cannon: MOS Structure Problems in the Field Artillery, Sep-Oct.  
The Firing Battery Commander, Nov-Dec.

## Research and Development

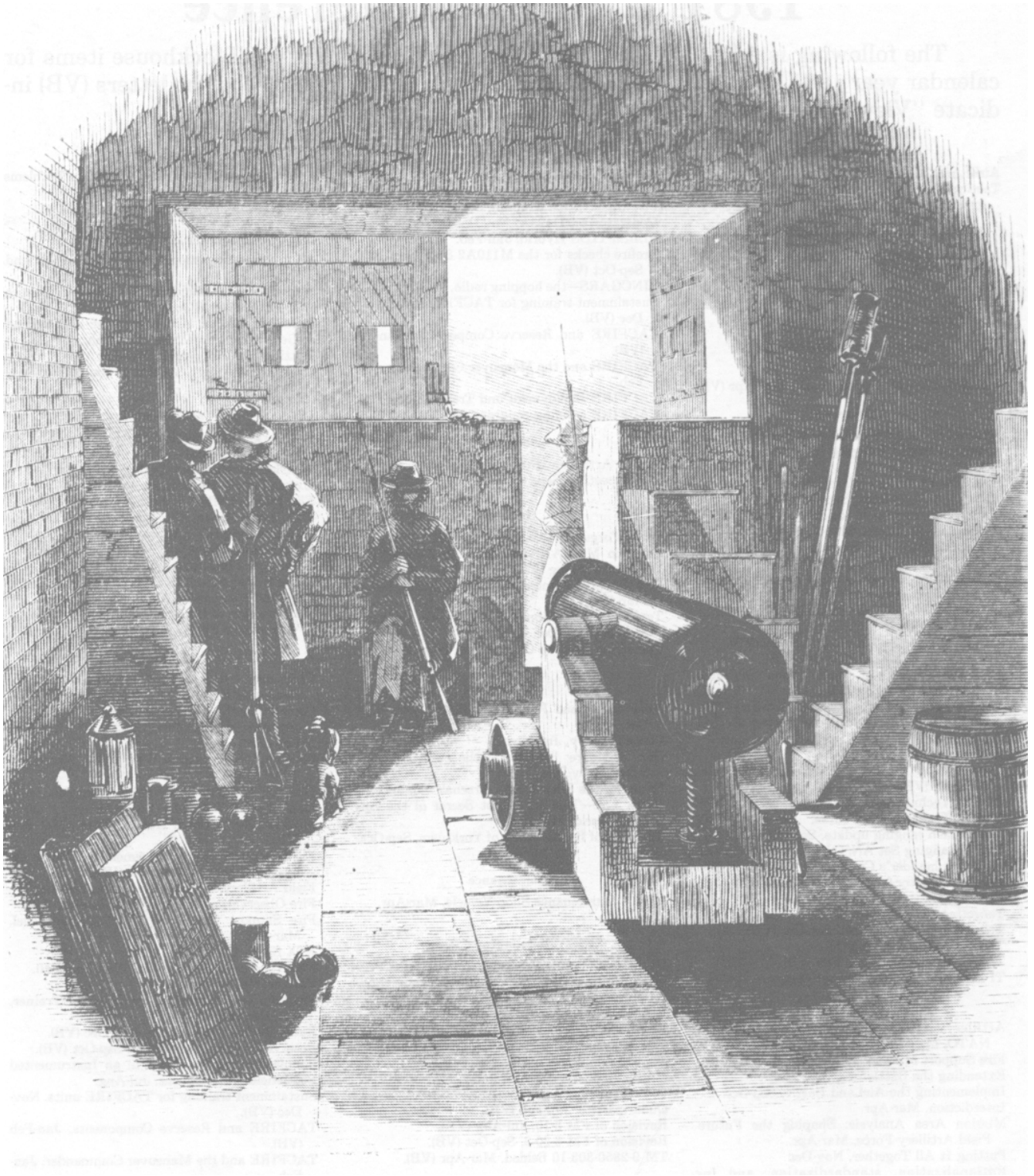
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Precision Guided Artillery: First and Second Generation Projectiles, Mar-Apr.  
Putting It All Together, Nov-Dec.  
The Field Artillery System of the future, Nov-Dec (VB).

## Tactics/Strategy

Artillery Ammunition Interoperability in NATO, May-Jun.  
Division Artillery Survivability, Jan-Feb.  
Extending the Battlefield, Sep-Oct.  
Fire Support Mission Area Analysis, May-Jun.  
FTX Sankt Georg, Mar-Apr.  
Implementing the AirLand Battle, Sep-Oct.  
Interdiction, Mar-Apr.  
Survive to Fight, Jan-Feb.  
Tactical Airpower: What is it? How does the ground commander use it? May-Jun.  
The Question of Deploying US Theater Nuclear Weapons in Europe, May-Jun.

## Training

Combined Field Army (ROK/US) Artillery Readiness Exercise, Jul-Aug (VB).  
Completing the Readiness Picture, Jul-Aug.  
Computerized Skill Qualification Testing Jan-Feb (VB).  
Continuous Operations: Who Melts, When, and Why? May-Jun.  
Division Artillery Survivability, Jan-Feb.  
Don't Forget Your FIST! Mar-Apr.  
Field Artillery Branch Training Team, May-Jun (VB).  
Field Artillery Radar Crewmember Course external evaluation, Nov-Dec (VB).  
Field Artillery Training in Europe, Jul-Aug.  
Fire Observation Training Set, Nov-Dec (VB).  
Fire Support Control at the Fighting Level, Mar-Apr.  
FTX Sankt Georg, Mar-Apr.  
New 155-mm training round, Nov-Dec (VB).  
Partnership, Jul-Aug.  
Programmed Operator Proficiency Trainer, Nov-Dec (VB).  
Radar Technicians Course, Nov-Dec (VB).  
Reserve Component training, Sep-Oct (VB).  
Simulating Indirect Fires in an Instrumented Battlefield Environment, Jul-Aug.  
Sustainment training for TACFIRE units, Nov-Dec (VB).  
TACFIRE and Reserve Components, Jan-Feb (VB).  
TACFIRE and the Maneuver Commander, Jan-Feb.  
TACFIRE Deployment and Training, Jan-Feb.  
TACFIRE training program, Nov-Dec (VB).  
The Job Training Program (JTP), Sep-Oct. (VB).  
Training Management in Small Units, Nov-Dec.  
Training Realism: Lifeblood or Lip Service, Jul-Aug.



**Fort Sumter.**