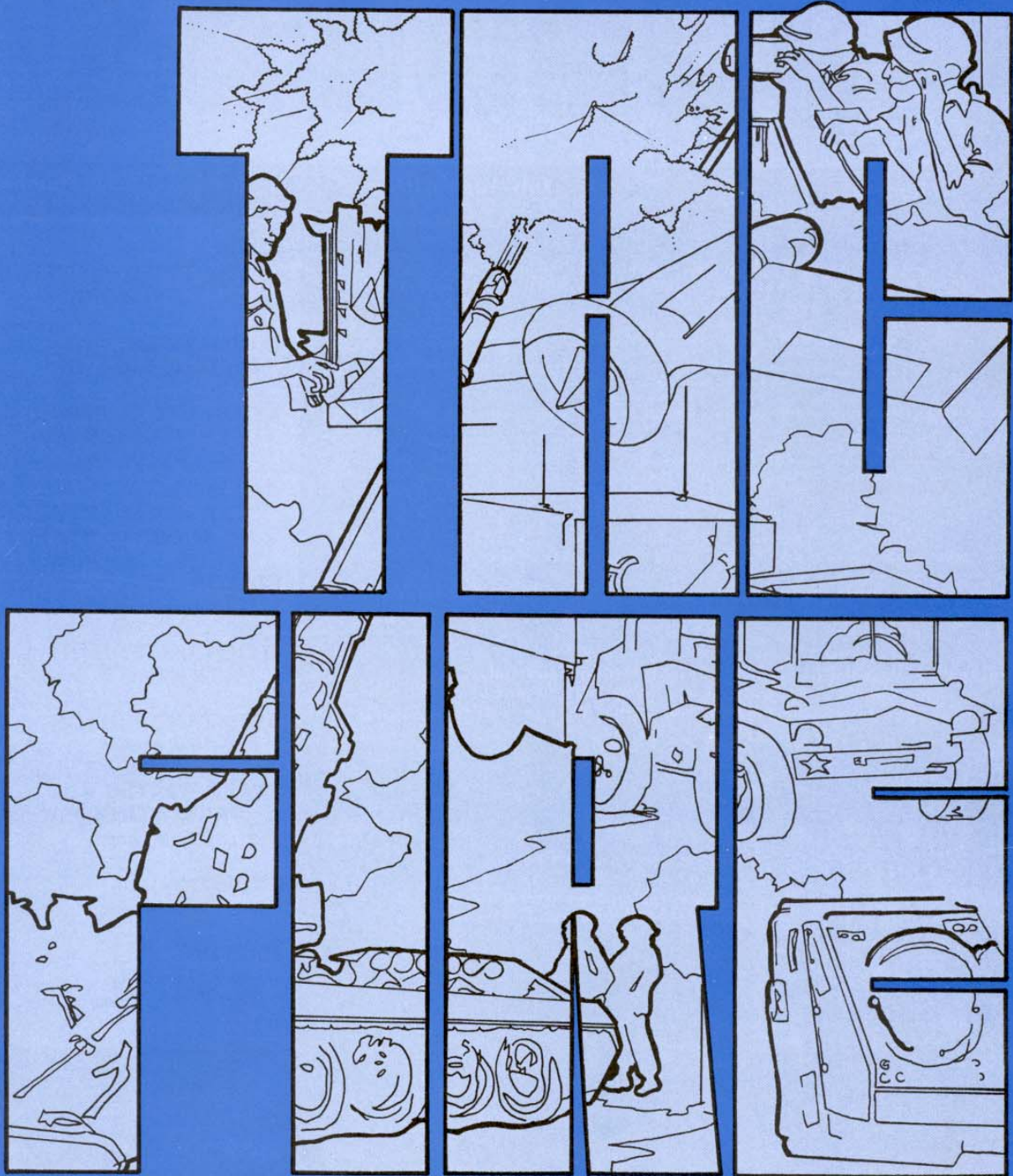


FIELD ARTILLERY JOURNAL

July-August 1975



TACFIRE. PG 28

INTERVIEW WITH PM ARTADS. PG 38

FORWARD OBSERVATIONS. PG 6

FIELD ARTILLERY JOURNAL

Volume 43

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Number 4

The **Field Artillery Journal** is published bimonthly at the US Army Field Artillery School for the same purpose stated in the first **Field Artillery Journal** in 1910:

"To publish a Journal for disseminating professional knowledge and furnishing information as to the field artillery's progress, development, and best use in campaign; to cultivate, with the other arms, a common understanding of the powers and limitations of each; to foster a feeling of interdependence among the different arms and of hearty cooperation by all; and to promote understanding between the regular and militia forces by a closer bond; all of which objects are worthy and contribute to the good of our country."

Unless otherwise stated, material does not represent official policy or endorsement by any agency of the US Army.

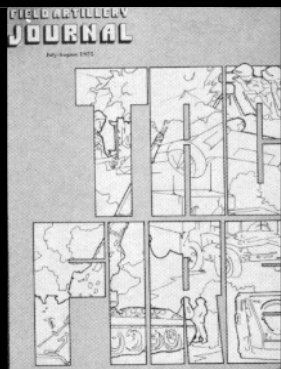
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For the second issue in a row, we feature SP4 Linda Hensley of the Army-Wide Training Support Department as our cover artist. We hope there will be many more.

THE FIELD ARTILLERY SCHOOL

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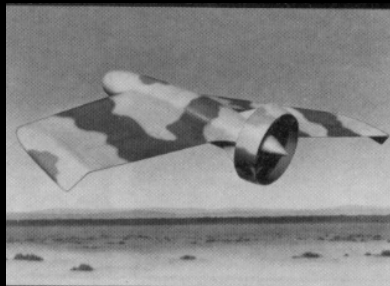
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a word from the editor

Journal readers, we need your help! Our last issue (May-June) contained our annual readership survey and if you have not completed one and returned it, please do so. We are required to furnish the results to Department of the Army along with our request to continue publication. A good return of the survey will, of course, assist us in this endeavor. The survey is also a simple, inexpensive way for you to let us know how we are doing. I might add that those of you who are subscribers (a good deal more than last year) have a monetary as well as a professional interest in each issue. Let us hear from you!

As indicated by our front cover, we are featuring the Tactical Fire Direction System or TACFIRE in this issue. Our thanks go to MG Albert B. Crawford Jr., the Project Manager of Army Tactical Data Systems (ARTADS), who took time from his busy schedule to provide us an interview on the developmental side of ARTADS and TACFIRE. CPT Gerard G. James of the Command and Control Systems Division of the Office of the Deputy Assistant Commandant for Combat Development wrote the article dealing with the system itself and the participation of the Field Artillery School in its development. MAJ Gene Wilson and his people in the TACFIRE Training Branch of CCSD have prepared a reference note (see photo) on TACFIRE that is now available. The extensive note covers the hardware, software and programming functions of the system and includes photographs of the major components. It can be ordered as a separate item in the new 1975-76 Field Artillery Training Support Catalog mentioned in this issue or by writing directly to USAFAS, ATTN: ATSF-AW-FS, Fort Sill, OK 73503. TACFIRE is also the subject of MG David E. Ott's "Forward Observations" column.

MAJ George Finger, formerly of the Field Artillery Board, provided us with the update of the remotely piloted vehicle (RPV) program.

CPT Bob Duedall of the Office of the Director of Instruction prepared the ROTC article. Branch selection will be coming up soon and we encourage

all Redlegs serving with ROTC Detachments to make the article available to their students.

The use of European villages as battery positions is the subject of MAJ Bob Scales' article. Whether artillerymen in Germany will agree with him remains to be seen. Bob, an artilleryman, teaches military history at the Infantry School.

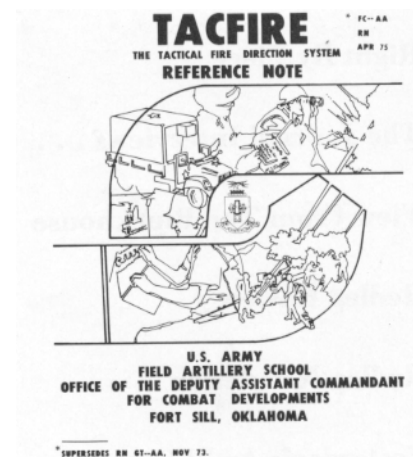
Our foreign article this issue is Russian and follows an artillery battalion commander through an attack of a prepared position as he supports a motorized rifle battalion.

The new procedures established by the Army Materiel Command for insuring the battlefield survivability of materiel are discussed by MAJ James Dearlove who recently served with the Materiel Systems Analysis Activity, Aberdeen Proving Ground. Credit also goes to LTC Warren of the Armor School Weapons Department for the Russian sight article. MAJ Howard Buchly, assigned to Project MASSTER, has provided a thorough review of that agency's missions, functions and current projects of interest to artillerymen.

We have also included the second and final portion of LTC Alexander Jennette's excellent article on the development and use of mass fire during WWI.

CPT James Chambless of the 1st Cav's Red Team conducted the testing and wrote the report on the use of the aiming circle with the AN/PPS-5. MAJ Frank Latzkus of the Missouri National Guard sent us the information on the Q4 radar trainer. We understand that the device is under study for incorporation as an official training device. CPT Steve Brown of the 9th Division Artillery wrote the information on the intelligence training being conducted in that unit.

*(Continued
on page 45)*





letters to the editor

M31 Trainer

Dear General Ott:

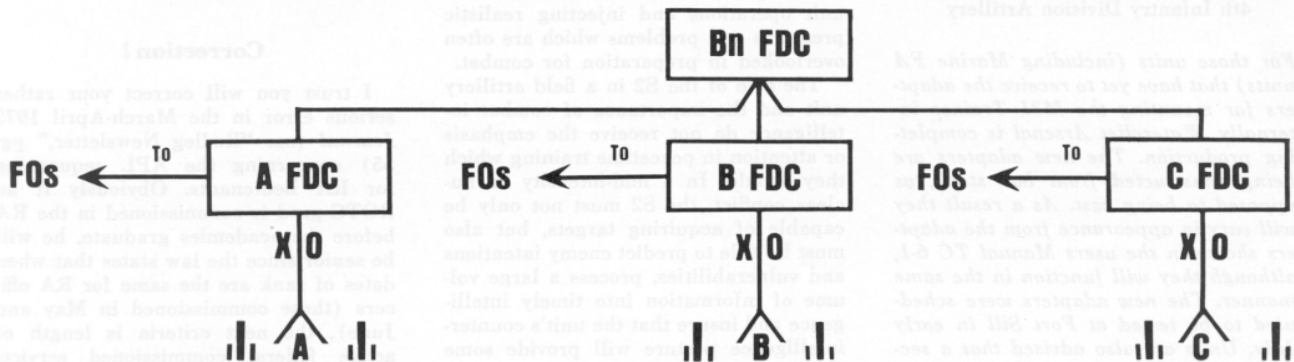
Thank you for your letter of 17 March concerning realistic training for the Field Artillery. The M31 (14.5-mm) Field Artillery Trainer is receiving strong command emphasis in the division artillery. Our experience factor indicates that a unit gets as much effective basic artillery training in one day utilizing the M31 system as it gets in approximately three days of live fire exercises. The trainer is particularly effective for cross-training and training of non-adjusting section crew members. In order to concentrate our training on

particular weaknesses within the firing battery, three different configurations, depicted in inclosure 1, have been successfully used in this division artillery.

A solid example of the value of the M31 Trainer to one of our units occurred last fall when the 2-20th FA took the first ARTEP. During their practice in October the battalion's mission times were unsatisfactory. The following week the M31 trainer was received and the 2-20th FA conducted three days of 14.5 training, expending 1,500 14.5 rounds. This training resulted in a 50 percent reduction in their mission times and, in our opinion, was one of the primary reasons that this battalion was able to meet the time

criteria for the test. Since this vivid example, our field artillery units have actively incorporated the trainer into their training programs.

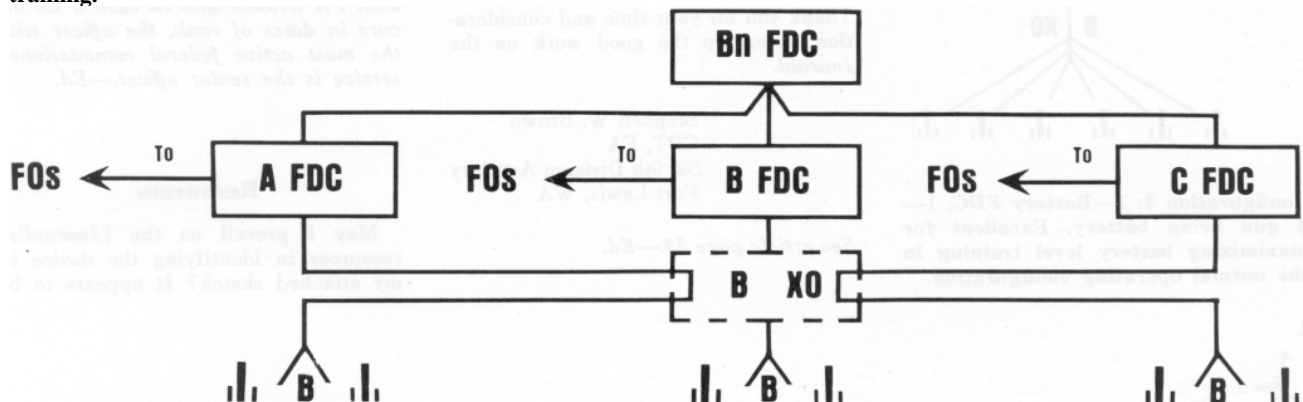
We have recently completed resurveying and remapping the 14.5 range. This is extremely critical because of the fact that a small map error results in a large error on the ground. Other improvements which we have made in the range include resurfacing the firing points, creating new OPs and FPs, upgrading the on-site buildings and constructing Warsaw Pact vehicle profiles as targets. In addition, we have found that the most effective training on this range is conducted with the PD fuze, M183. The



14.5-MM Training Configuration

Configuration 1: 1—Battalion FDC, 3—Battery FDCs, 3—2 gun firing batteries. Excellent for maximizing FDC and FO training. Two crews from each battery are continuously firing. On a three-day basis all gun crews in the battalion can be rotated through one day of intensified training. Concurrent firing battery activities such as special weapons training, maintenance, etc., can be conducted while 14.5-mm training is on going.

Configuration 2: 1—Battalion FDC, 3—Battery FDCs, 1—6 gun firing battery. Excellent for maximizing FDC and FO training. Excellent for maximizing gun crew training for six sections of one battery while the other two firing batteries are free to conduct other training. On a three-day cycle the howitzer crews of each firing battery in the battalion can receive one day of intensified training.



Incoming

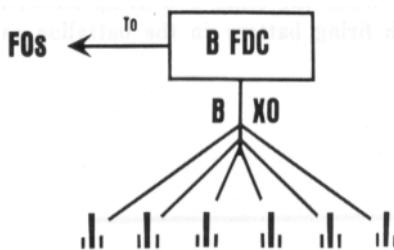
three-second and six-second delay rounds, although effective in training for high burst registrations, are of rather limited value because of the inability to vary time setting.

In conjunction with the on-going program for improvement of training methods and techniques we are currently testing the Safety Officers' Aid. The 1-19th FA has been issued a Safety Officers' Aid. Our plan is to validate its usefulness on the M109A1 during actual field training. We are enthusiastic about its potential.

I am very pleased by the efforts of the Field Artillery School to keep the field informed. I am passing on the Training Circulars to General Vessey as they become available. The 4th Division Artillery will continue to share with you those methods which work well for us.

Robert W. Sennewald
COL, FA
Commanding
HQ
4th Infantry Division Artillery

For those units (including Marine FA units) that have yet to receive the adapters for mounting the M31 Trainer internally, Watervliet Arsenal is completing production. The new adapters are being constructed from bar stock, as opposed to being cast. As a result they will vary in appearance from the adapters shown in the users Manual TC 6-1, although they will function in the same manner. The new adapters were scheduled to be tested at Fort Sill in early July. Units are also advised that a second addendum (first addendum, TC 6-1a) TC 6-40-3 to the Users Manual will soon be published and distributed containing additional "how to train" tips for the M31 Trainer.—Ed.



Configuration 3: 1—Battery FDC, 1—6 gun firing battery. Excellent for maximizing battery level training in the normal operating configuration.

9th Divarty

The attached article is submitted with two goals in mind. The first is to provide some information on the whole unit evaluation concept of the 9th Division Artillery. The other is to stimulate thinking among field artillery S2s on the many ways intelligence can be effectively integrated into what has always been an S3-dominated area, namely ORTTs/ATTs.

The whole unit evaluation concept covers the entire spectrum of command-staff functions. The importance of accurate and timely fire remains unchanged. However, the ability of a unit to accomplish this mission in combat cannot be measured solely by technical gunnery proficiency. Increased emphasis on personnel, intelligence and logistics related functions has not only provided divarty with additional information for evaluation, but has also benefited the tested unit by exercising staff coordination, involving commanders in all areas of unit operations and injecting realistic pressures and problems which are often overlooked in preparation for combat.

The role of the S2 in a field artillery unit and the importance of combat intelligence do not receive the emphasis or attention in peacetime training which they should. In a mid-intensity or nuclear conflict, the S2 must not only be capable of acquiring targets, but also must be able to predict enemy intentions and vulnerabilities, process a large volume of information into timely intelligence and insure that the unit's counterintelligence posture will provide some degree of survivability. To learn, practice and perfect these skills in peacetime requires command emphasis and the interest and cooperation of the S3, both of which, fortunately, are in great supply in 9th Divarty.

The attached article was written in hopes of encouraging S2s to get actively involved in increasing the already high standards of professionalism, readiness and excellence of the Field Artillery. Thank you for your time and consideration. Keep up the good work on the *Journal*.

Stephen W. Brown
CPT, FA
S2, 9th Division Artillery
Fort Lewis, WA

See article page 34.—Ed.

New Units

I am in an artillery unit at Fort Ord which will be activated this month [May]. I've been reading your *Field Artillery Journal* for November and December. I've found it very interesting. I was wondering if I could purchase a few copies of the latest *Journals*. I imagine you're very busy but I'd appreciate it if you would be kind enough to send me information on how to obtain a few of these *Journals*. Thank you for your time. I'm waiting on your response.

John L. Griffin
PV2, US Army
Svc Btry, 2d Bn
8th Field Artillery

Your Journals are on the way. We are keeping a close watch on the new field artillery unit activations so we can place them on our mailing list.—Ed.

Correction!

I trust you will correct your rather serious error in the March-April 1975 *Journal* (see "Redleg Newsletter," pg. 55) concerning the APL sequencing for RA lieutenants. Obviously if an ROTC grad is commissioned in the RA before the academies graduate, he will be senior since the law states that when dates of rank are the same for RA officers (those commissioned in May and June), the next criteria is length of active federal commissioned service. Thus, any ROTC grad appointed before 4 June 75 will be senior to all '75 USMA grads. Thank you.

2LT M. T. Ness
Pers Syst Div, PMD
AG School
Fort Harrison, IN

The lieutenant is correct. We checked with FA Branch and in case a tie occurs in dates of rank, the officer with the most active federal commissioned service is the senior officer.—Ed.

Resources

May I prevail on the [*Journal's*] resources in identifying the device in my attached sketch? It appears to be

Incoming

Thanking you, I am

Mrs. William J. Harmer
Boise, ID

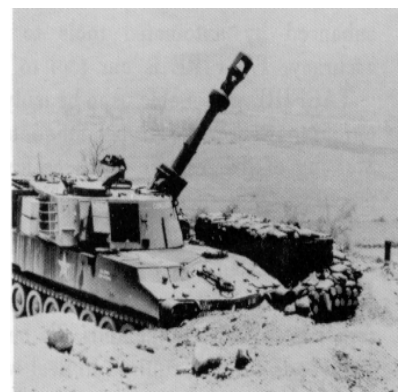
The inclosure Mrs. Harmer refers to was a letter from the Commandant, USAFAS, inserted into each issue of the March-April Journal soliciting support for the Field Artillery Branch by Redlegs in their conversations with ROTC cadets. Although we did not envision support of this nature, it is certainly welcome. We are sending Mrs. Harmer her magazines and returning her check.—Ed.

Fire Mission

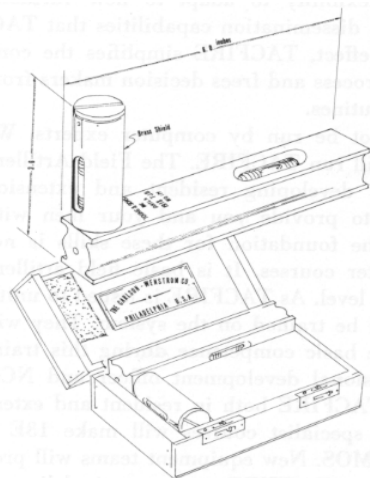
On 1 May 1975 CBS News conducted interviews with members of the Kentucky National Guard's 138th Field Artillery concerning their role in the Vietnamese conflict. I was aware that there were several National Guard and Reserve units activated to federal duty during this time, but they were of the logistic and medical types. I hadn't heard of any National Guard artillerymen being activated. Since your magazine has many National Guard and Reserve readers, this subject seems to me a very good basis for an article enlightening your readers on the units involved, what the criteria was for their selection, how they performed compared to their counterparts serving with the regular Army and what roles the National Guard and Reserves will play in the US defense posture in future conflicts.

Tony R. Fuller
1LT, FA
Btry A, 4th Bn, 113th FA
High Point, NC

An excellent idea. . . . your mission, Lieutenant Fuller.—Ed.



Ordered to active duty, C Battery, 2d Battalion, 138th Field Artillery of the Kentucky Army National Guard, await a fire mission on Hill 88 during March 1969 (see "In Order To Win," March-April 1975 Journal.)



a leveling instrument, I hasten to believe, for an artillery piece of some type. The body is painted OD with the flat surfaces of the level, bright.

As a collector of artillery artifacts I would appreciate any information you might uncover about this instrument.

John Hooper
Collector, US Artillery Munitions
Ortonville, MI

The Journal's "resources" are as vast as its distribution. Interested readers are invited to submit any information which may aid Mr. Hooper in the identification of the device in question.—Ed.

"Red Star"

The Army officers in the Defense Attache Office in Moscow join in congratulating you on the continuing high standards of the *Field Artillery Journal*. We look forward to its bimonthly arrival, as the *Journal* is of interest not only to us but to many of our allies as well.

Yet not only our allies are following US artillery developments. Recently (4/11/75) *Red Star*, the daily newspaper of the Soviet Ministry of Defense, included a short review of developments in US artillery systems. Entitled "Novelties in Artillery," the article described our new 105-mm howitzer and the modifications to the M109. Quoting *Army Times*, *Red Star* wrote that "in the near future the ground forces of the United States will receive two new artillery systems: 1) a new 105-mm howitzer with a new hydraulic recoil system and increased range capability, which will

replace the M101A1 and the M102; and 2) an improved M109, one with a lengthened barrel which will increase the effective range from 14-18 kilometers." Interest also was shown in the laser guidance systems under development with the targeting sequence given from the airborne or ground spotter to firing to target kill. Although the system is costly, it was added, the laser targeting system is now going into series production.

Robert A. Watters Jr.
MAJ, FA
Assistant Army Attache
Embassy of the United States
of America
Moscow, USSR

CLGP

I read your March-April issue of the *Field Artillery Journal* and, being in a 155-mm FDC, there are a couple of things that interest me. I would like to know if you have more information on the 155-mm "Smart Round" that you could send me. Also, I would like to get a copy of TC 6-40-1, TC 6-50-1 and TC 6-20-2.

William W. Watson
SP5, US Army
Howitzer Battery
1st Battalion, 11th ACR

Additional information regarding CLGP, "The Smart Round" (March-April Journal), will be available as the weapon development progresses. Watch future issues of the Journal for CLGP developments as they materialize. Your TCs are in the mail to you.—Ed.

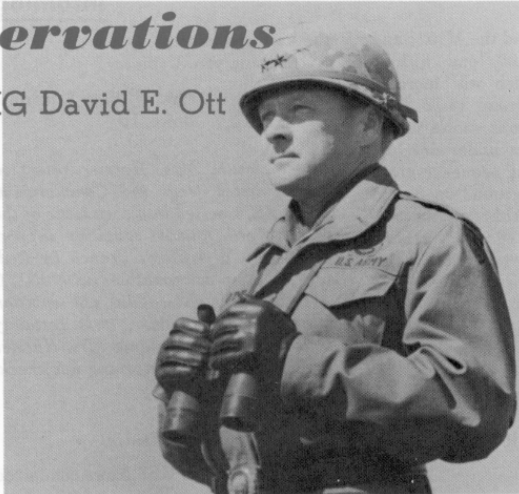
ROTC Cadets

I would like to secure three extra copies of the March-April 1975 *Journal*. I am enclosing a check which I hope will cover the magazines and their mailing costs.

My son, CPT George Harmer, has an article ("Recycling") in this edition and I would like to send a copy or two to the ROTC unit at Idaho State University, Pocatello, ID. Captain Harmer is a graduate of the ROTC program there. I feel that Major General Ott's inclosures in this issue might be of help to the unit and cadets.

forward observations

MG David E. Ott



The Field Artillery is getting TACFIRE. This command and control system will be our primary means for tactical fire control, target analysis, fire planning and target intelligence in the future. It will tie together the target acquisition, meteorological data, firing unit resources, fire planning and fire support coordination for timely effect on targets. What has been our dream for almost a decade is close to reality. Three division artillery sets and 11 battalion sets are being built for use in training and operational unit testing. These are the facts.

Although the use of automatic data processing equipment by combat forces has been with us for some time, there are several important aspects concerning computers in general and TACFIRE in particular that are worth keeping in mind. First, TACFIRE is not a be-all, end-all system that will abrogate the responsibilities of the field artilleryman. It is simply a tool for the rapid and efficient processing of fire support data. The heart of our Field Artillery System has always been our dedication to support of the maneuver arms and our responsiveness to them. This will never change. The technical competence and judgment of field artillerymen cannot and will not be replaced by a computer. These can, however, be enhanced by automated tools to increase speed and accuracy. TACFIRE is our tool to do this.

TACFIRE will enable us to be truly efficient in applying our firepower in the proper amounts at the proper time. Massing of fire will be much easier and more common than ever.

TACFIRE is not complicated. While the equipment is sophisticated, it is easily maintained, moved and prepared for action. Like any automated system, it responds to man's commands. To be sure, more complex commands will be required to deal with rapidly changing tactical situations encountered on the modern battlefield. To keep pace with these tactical situations we will require instantaneous target data input and retrieval, tactical situation update, flexibility to adapt to new variables and responsive data

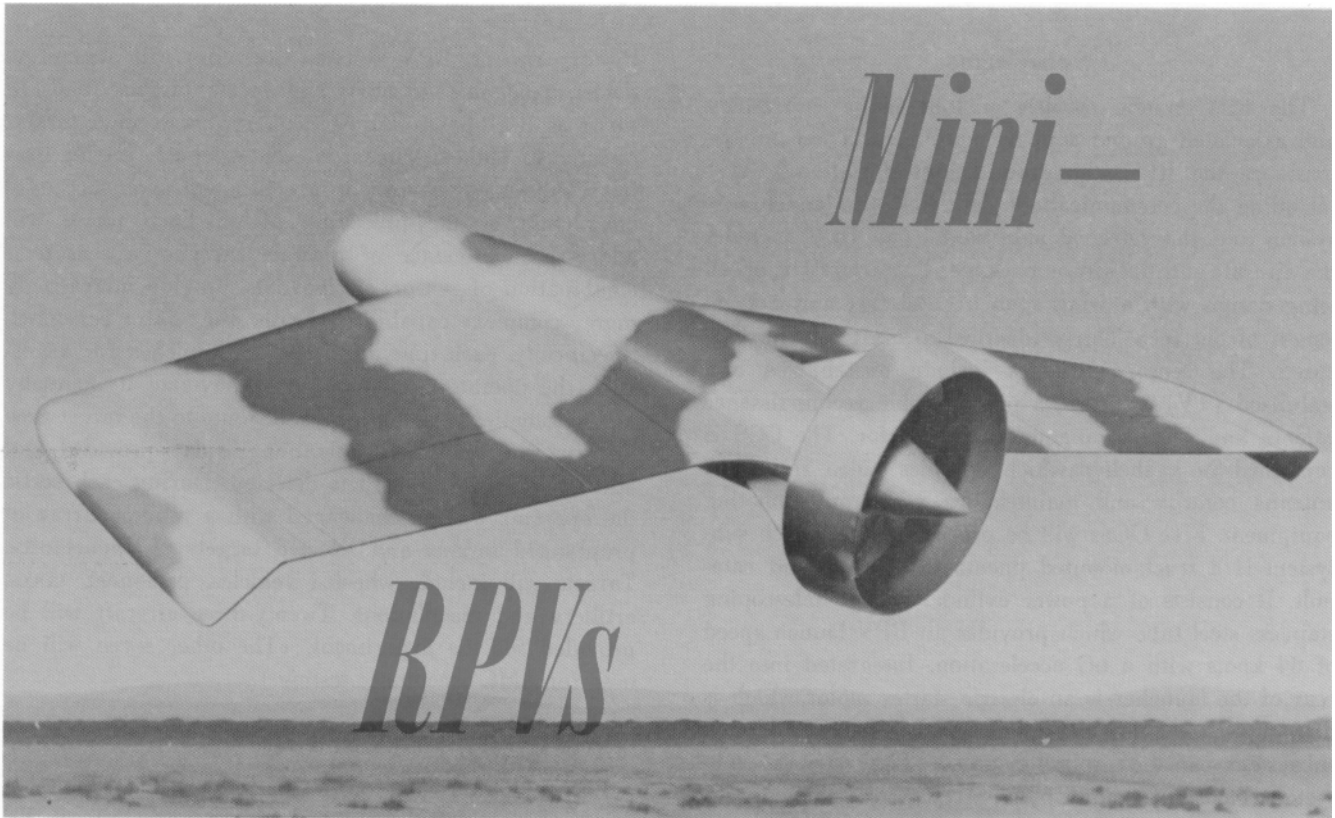
dissemination capabilities that TACFIRE provides. In effect, TACFIRE simplifies the command and control process and frees decision makers from time consuming routines.

TACFIRE will not be run by computer experts. We field artillerymen will run TACFIRE. The Field Artillery School is presently developing resident and extension training programs to provide you and your men with TACFIRE skills. The foundation for these skills is not independent computer courses. It is basic field artillery competence at every level. As TACFIRE is issued to units, key incumbents will be trained on the system. They will have to demonstrate basic competence during this training. Revised professional development officer and NCO courses will teach TACFIRE both in resident and extension training. New specialist courses will make 13E a TACFIRE oriented MOS. New equipment teams will provide on-site training as TACFIRE equipment is delivered to units.

TACFIRE will not make your present skills obsolete. It will require building on these skills to effectively use TACFIRE. As forward observers and recon sergeants, you will need to master the Digital Message Device and laser rangefinder. As fire direction computers, chart operators and fire direction officers, you will need to master battery and battalion TACFIRE equipment capabilities, operations and maintenance. Communications, electronic warfare and communications security training will be heavily stressed. As fire support coordinators, fire support officers and liaison and operations sergeants, TACFIRE equipment training will be oriented to the variable format message entry device. Additional training will stress fire support coordination and fire planning using TACFIRE capabilities. As battery, battalion and division artillery commanders and S3s you will master TACFIRE capabilities, interpretation of data output, tactical considerations during employment and the use of programs. All these skills will require the application of the basic field artillery fundamentals which you have already learned. You need to keep these fundamentals current and begin to learn about TACFIRE now. The key to success in the Field Artillery of the near future will be TACFIRE and how well you can apply your present skills to its employment and train your men in its use.

TACFIRE, as I initially stated, is not a dream. It is in production for final testing. I urge you to seriously consider TACFIRE and to encourage your men to do so.

The concept on which TACFIRE is based requires a thorough understanding of the nature of modern combat and the Field Artillery System. You can achieve this understanding through mastery of basic field artillery skills as individuals and application of modern battlefield techniques in section and unit training. We must revise our thinking. When you think field artillery . . . think TACFIRE.



RPV — this acronym has been in the news lately. You've undoubtedly seen pictures of them and perhaps are even aware that US Army TRADOC plans to test them at Fort Sill, OK, in 1976. But, what are they . . . can they work . . . what is the program to develop them . . . and what, if anything, can they do for a field artilleryman?

What are they? Remotely Piloted Vehicles (RPVs for short) are unmanned aerial vehicles controlled to some degree by operators from the ground via electronic data links. They are neither drones, which are pre-programmed for flight before takeoff, nor missiles. Missiles don't return to their users — RPVs do. Although not yet widely accepted, RPVs have been classified as mini (less than 200 pounds), midi (200 to 5,000 pounds) and maxi (greater than 5,000 pounds). A mini-RPV, the size which interests the Army, is inherently a short-range, limited endurance aircraft by virtue of its size and weight. The aircraft size implies simplicity and appears to offer advantages by keeping ground support equipment minimal and crew sizes small.

Can they work? A mini-RPV implies an aircraft scaled up from model airplane technology rather than something scaled down from manned aircraft technology. Technological changes in the model airplane field in the past decade have experienced a quantum jump in reliability.

by MAJ George H. Finger

It is this reliability, purchased with a modest investment of funds, that makes it possible to use a mini-RPV operationally. It can work because it is within the state-of-the-art to produce—and produce at relatively low cost. In fact, the guidance given by the Commanding General, TRADOC, (the user) to be followed in developing and fielding an RPV system for the Army was that "simplicity and low cost" will be the overriding objectives. A reasonable RPV capability to look "over-the-hill" can be developed rapidly and at low cost by utilizing off-the-shelf technology (as opposed to off-the-shelf hardware) — an important delineation. Sufficient information is not available at this time to establish required capabilities for mini-RPVs. Consequently, in August 1974, USAFAS was designated the user proponent for the TRADOC program to develop and experiment with an RPV system. A Task Force — Project Seeker — was chartered to conduct an experimental program using current technology and operated by user personnel: to develop user expertise, to demonstrate feasibility, to provide information necessary to refine organizational and operational concepts, to develop new concepts (if required) and to assist in defining future requirements for an RPV system.

US Army Aviation Systems Command (AVSCOM), the RPV system manager for AMC, through a competitive bidding process, chose Lockheed Missile and Spacecraft Company to fabricate the mini-RPV system for Project Seeker experimentation.

Subsystems

The RPV system consists of four major subsystems and associated ground support equipment. These subsystems are the RPV, the ground control station (GCS) including the communications data link, the launch subsystem and the retrieval subsystem. The RPV includes the aircraft and the sensor package. The aircraft is an all wing design with a wing span of 12.3 feet and a body length of six feet. Thirty identical aircraft will be procured. The sensor packages include unstabilized and stabilized (TV) cameras, a photographic reconnaissance camera and a laser rangefinder/designator. The GCS is contained in a shelter which includes video recorders, antenna controls and maintenance and troubleshooting equipment. Five GCSs will be procured. The launch subsystem is a truck-mounted pneumatically operated catapult. It consists of a power cylinder with a telescoping stainless steel tube which provides an RPV launch speed of 44 knots with a 6G acceleration. Integrated into the rear of the launcher is an electric starter motor which is disengaged after the RPV engine has started. The launch subsystem can be ground-mounted. The retrieval subsystem consists of a single nylon arrester strap that engages the RPV trailing hook to dissipate the forward kinetic energy of the vehicle through two hydraulic energy absorbers. A parallel-strap assembly cushions the RPV as it settles near the ground. Final approach guidance is accomplished by the use of a television camera located aft the parallel-strap assembly with its line of sight directed precisely along the desired RPV approach path. The communications subsystem consists of command and control uplink from the GCS to the RPV that provides aircraft and sensor commands, a telemetry downlink from the RPV to the GCS that carries RPV status data and a video display and target tracking data link from the RPV sensor and target tracking system.

USAFAS has requested the US Army Field Artillery Board to conduct the field experiment of the RPV system from January 1976 to November 1976 at Fort Sill under ambient, daylight environmental conditions. The concept of the experiment is to develop the RPV system's performance data under simulated, tactical, operational conditions. The system will be operated and maintained (operator level only) by military personnel organized into two provisional RPV player platoons which will be trained to operate and maintain the system.

Subexperiments

The experiment consists of seven subexperiments conducted in five phases with each phase incorporating different technology. Generally, during all five phases of

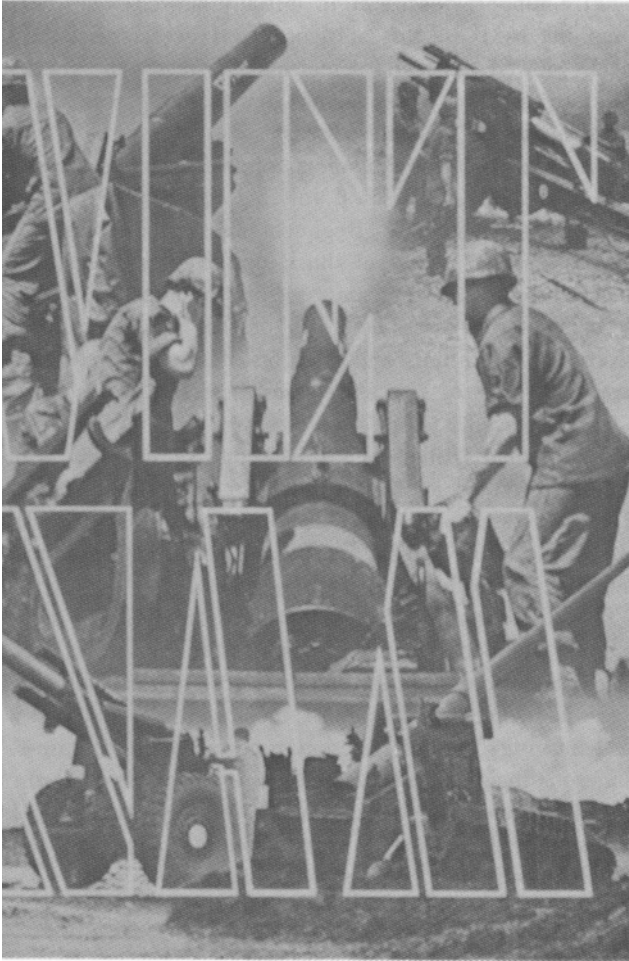
the experiment, RPV systems operators will attempt to detect, recognize, identify and locate targets; and, in three of the phases, adjust artillery bursts onto targets of interest. The experiment is event-oriented. Testing during a subsequent phase will be contingent upon successful completion of the preceding phase. Each phase will address the interface of aircraft carrying a sensor or combination of sensors designed to provide increasingly more complex capabilities with the user personnel. Specifically, each time an aircraft is launched for a mission, the operator will attempt to navigate it manually and automatically along a specific route to the target area utilizing the real-time navigation display provided and attempt to locate all targets detected. During each sortie the operator will be challenged with a random array of preplanned targets and selected targets of opportunity. Targets will include wheeled vehicles, personnel, tanks, artillery and installations. Twenty-three aircraft will be provided for the experiment. (The other seven will be used for AMC acceptance testing.)

Phases

Phase I will consist of the basic surveillance mission using seven aircraft equipped with a nonstabilized TV sensor, with a zoom capability which can be discretely adjustable in flight, designed to provide daytime, clear weather, real-time video images. Phase II will incorporate the nonstabilized TV sensor (from Phase I) with a standard aerial panoramic camera equipping the RPV system to perform photographic reconnaissance missions. Four aircraft will be employed in this and in each subsequent phase of the experiment. Phase III will provide a long-range target acquisition capability through a high performance, stabilized TV sensor designed with a zoom capability that is discretely adjustable in flight and automatic target tracking capability. Phase IV adds a laser rangefinder (boresighted with the line of the TV sensor required for Phase III) and a processor in the ground control station. This system will permit the determination of target location and provide UTM target coordinate readouts. The processor will also provide an artillery burst adjustment capability. In Phase V a laser target designator will be integrated with the Phase IV sensors. During a portion of each phase, a tactical scenario will be conducted with special emphasis placed on RSOP, crew sizes, communications, camouflage and aircraft turnaround time.

A total of 284 flights has been scheduled for the experiment. In the event that all delivered aircraft survive for all contracted flights (15 per aircraft), 345 flights will be conducted.

(Continued on page 16)



In Order To Win

by MG David E. Ott

Commandant, USAFAS

At 0530 on 5 May 1965, the first of 150 sorties of C-130 aircraft loaded with men and equipment of the 173d Airborne Brigade and its support elements landed at Bien Hoa Air Base in Saigon. Battalion-size elements of the US Fleet Marine Force, Pacific, had been operating around Da Nang in the northern portion of South Vietnam since March, but the arrival of the 173d (consisting of two airborne infantry battalions) marked the first commitment of a US Army ground combat unit in Vietnam. The brigade, under the command of BG Ellis W. Williamson, formed a defensive perimeter around the air base. In direct support of the brigade was the 3d Battalion, 319th Artillery (Airborne), a two firing-battery 105-mm battalion commanded by LTC Lee E. Surut.

Counterinsurgency operations dictated new tactics and techniques, and, as they affected maneuver units, so they affected their supporting artillery. Although the brigade had undergone rigorous training in Okinawa before its departure for Vietnam, the "first unit in" could not be totally prepared. Nevertheless, the airborne troopers of the 173d performed admirably. No sooner had the brigade unloaded its gear than it began to conduct operations around Bien Hoa, primarily search and destroy operations and patrol actions. The men of the 319th had a "jump" of two months on fellow artillerymen, which enabled them to compile an impressive list of firsts. The first field artillery round fired by a US Army unit in the Republic of Vietnam came from the base piece of Battery C, 3d Battalion, 319th Artillery, during a registration mission. With that round, the US field artillery role in the Vietnam war began.

On 31 May 1965 the 3d Battalion, 319th Artillery, as part of Task Force SURUT, participated in the largest air assault conducted in Vietnam to that date. The task force, consisting of the 319th reinforced by a cavalry troop, an engineer platoon and a composite platoon made up of volunteers from the support battalion, secured a landing zone (LZ) and guided in CH-37 Mohave helicopters carrying the howitzers. Up to this point in the war, the Mohaves had been doing yeoman duty as all-purpose aircraft. So smoothly and efficiently did this initial move go that three hours later these same howitzers mounted preparation fires on another LZ for Task Force DEXTER, a reinforced infantry element of the 173d Brigade. This was the first such operation ever conducted in actual combat by a US Army unit—one that had been in Vietnam less than 30 days.

The 173d soon had an opportunity to participate as the reserve force in an offensive operation. In June a Viet Cong regiment launched an attack on Dong Xoai, a district town 90 miles north of Saigon. With the press corps

closely following the events, the 173d moved to a forward airfield in case relief forces were needed. Although South Vietnamese troops ultimately relieved Dong Xoai, the Redlegs of the 3d Battalion, 319th Artillery, became the first US Army unit in Vietnam to engage in an offensive operation by providing fire support for the South Vietnamese troops relieving Dong Xoai.

After the Dong Xoai support operations, the 3d Battalion returned to Bien Hoa to ready for a history-making operation that commenced on Sunday, 27 June. Fifty kilometers north of Bien Hoa lies the southern edge of a huge tangle of double-canopy forest and thick undergrowth. Called War Zone D, it had long been a guerrilla haven, unpenetrated even by the French in their many years of fighting. In a massive, businesslike operation, five maneuver battalions penetrated deep into the area. The 3d Battalion (Airborne), 319th Artillery, provided coordinated fire support for the 1st and 2d Battalions (Airborne), 503d Infantry, of the 173d Airborne Brigade, and the 3d and 4th Battalions of the South Vietnamese Army 2d Airborne Brigade. The Royal Australian Regiment joined the operation after the second day. The size of the assaulting force determined the significance of the operation for the artillery. It necessitated the close coordination of large volumes of artillery fires augmented by close air support and armed helicopters.

Before the operation began, the brigade commander directed that artillerymen "exercise the complete system." Exercise it they did. One hundred and forty-four aircraft providing support for the operation assisted in the displacement of five infantry battalions, a field artillery battalion, a support battalion and a composite battalion of cavalry, armor and engineers. Throughout the entire operation, no serious incidents or major breakdowns in the system occurred. The artillery provided 10 forward observers [FOs] (including the battalion property book officer), three liaison officers (including the battalion communications officer) and two aerial observers in addition to those FOs and liaison officers normally provided. Three communication nets were used and all fires were cleared through the brigade fire support coordination center. The 319th fired nearly 5,000 rounds of 105-mm ammunition during the four-day period while maintaining contact and effecting coordination with the supporting Vietnamese and Australian artillery units.

Known only as OPOD 17-65, the designation of the original operation order, this venture into War Zone D yielded satisfying results. By conservative estimates, the enemy suffered 75 casualties and lost several trucks and nearly 250 tons of food and supplies. In an honest appraisal of the field artillery role shortly after the conclusion of the operation, Lieutenant Colonel Surut admitted having discovered some "bugs" in the fire

support system:

"Fire support coordination initially slowed some missions, but by D + 2 this bottleneck was overcome. Safety checks slowed the firing somewhat; however, the checks are necessary for close support, particularly with three major maneuver elements abreast."

The 173d Airborne Brigade again tested its fire support system in War Zone D on 6 July. Along with a battalion of the Royal Australian Regiment and units of the 43d Regiment of the Army of the Republic of Vietnam, the brigade conducted four multiple air assaults supported by helicopter sorties just north of the Song Dong Nai River. The operation resulted in 56 enemy killed, 28 captured, 100 tons of rice seized and several tons of documents destroyed.

For the field artillerymen, this second venture into War Zone D provided an opportunity to correct the mistakes of the previous operation. Clearance and safety checks now were routine and the liaison and coordination efforts functioned smoothly.

The 3d Battalion, 319th Artillery, maintained continuous "feedback" to the US Army Artillery and Missile School (later the Field Artillery School) at Fort Sill, OK. Correspondence included letters, memorandums and copies of debriefings and after-action reports which contained numerous insights on the employment of artillery. At the School the correspondence was thoroughly studied and discussed with a view toward including any new and valuable instruction in classroom instruction.

New Arrivals

The 3d Battalion (Airborne), 319th Artillery, relinquished its position as the only US Army artillery unit in Vietnam on 16 July 1965 with the arrival of the 2d Brigade, 1st Infantry Division (the "Big Red One") and its supporting field artillery, the 1st Battalion, 7th Artillery. Less than two weeks later the 1st Brigade, 101st Airborne Division, arrived by ship at Cam Ranh Bay with the 2d Battalion (Airborne), 320th Artillery. In September the 1st Cavalry Division (Airmobile) arrived and brought with it the first US Army division artillery to arrive in Vietnam.

The organization of the 1st Cavalry Division Artillery was typical of other division artilleries that followed. The division artillery consisted of three light 105-mm howitzer battalions with three batteries of six guns each and an aerial rocket artillery battalion with 39 aircraft. Most division artilleries contained three 105-mm battalions but also included a fourth battalion of three 155-mm howitzer batteries and one 8-inch howitzer battery. Whether aerial rocket artillery or heavy cannon artillery, the fourth battalion augmented and extended the range

of the three 105-mm battalions, each of which was in direct support of a brigade of the division.

Before the end of 1965, the remainder of the 1st Division Artillery arrived to provide support for the Big Red One in III Corps. Its organization was typical of most of the division artilleries that would arrive later, its firepower coming from three 105-mm battalions and a composite 155-mm and 8-inch battalion. The initial field artillery buildup also included the first few separate battalions that provided the general support and reinforcing fires needed to complement the divisional artillery.

As the number of US troops committed to Vietnam grew, organizational changes to facilitate command and control were required. US Army Support Command, Vietnam, was redesignated US Army, Vietnam (USARV). Task Force ALPHA was activated on 1 August 1965 and based at Nha Trang with control over all US units in the II and III Corps areas. III Marine Amphibious Force (III MAF) functioned as controlling headquarters for US units in the I Corps area. In early 1966, when it was redesignated I Field Force, Vietnam (IFFV), with responsibility for II Corps area, II Field Force, Vietnam (IIFV), was activated. I Field Force was then organized and assigned responsibility for III Corps area.

Coinciding with the activation of the II Field Force headquarters was the creation of controlling artillery headquarters. On 30 November 1965, XXX Corps Artillery arrived at Nha Trang and assumed control of US and allied artillery units under Task Force ALPHA. On 15 March 1966, XXX Corps Artillery was redesignated I Field Force Artillery. To the south, II Field Force Artillery,

C. Battery, 1st Battalion, 83d Artillery, fires from Fire Base Bastogne.



organized in January, arrived in Vietnam in March 1966. The force artilleries functioned as controlling headquarters for all nondivisional artillery. Commanded by a brigadier general, the field force artillery was similar to a corps artillery, long a part of the US Army organization. The force artillery was made up of all separate artillery battalions, batteries and detachments in addition to the artillery groups under its control. The artillery group made its debut in the war with the arrival of the 23d Artillery Group in November of 1965. The group functioned as the controlling headquarters for its assigned battalions and normally had a mission of general support of the field force and reinforcing the fires of specific artillery units within the field force area of responsibility. Although many smaller organizational changes occurred in the course of the war, these first few significant steps laid the basic framework for the artillery command structure that by 1969 would support the operations of over a half million US troops.

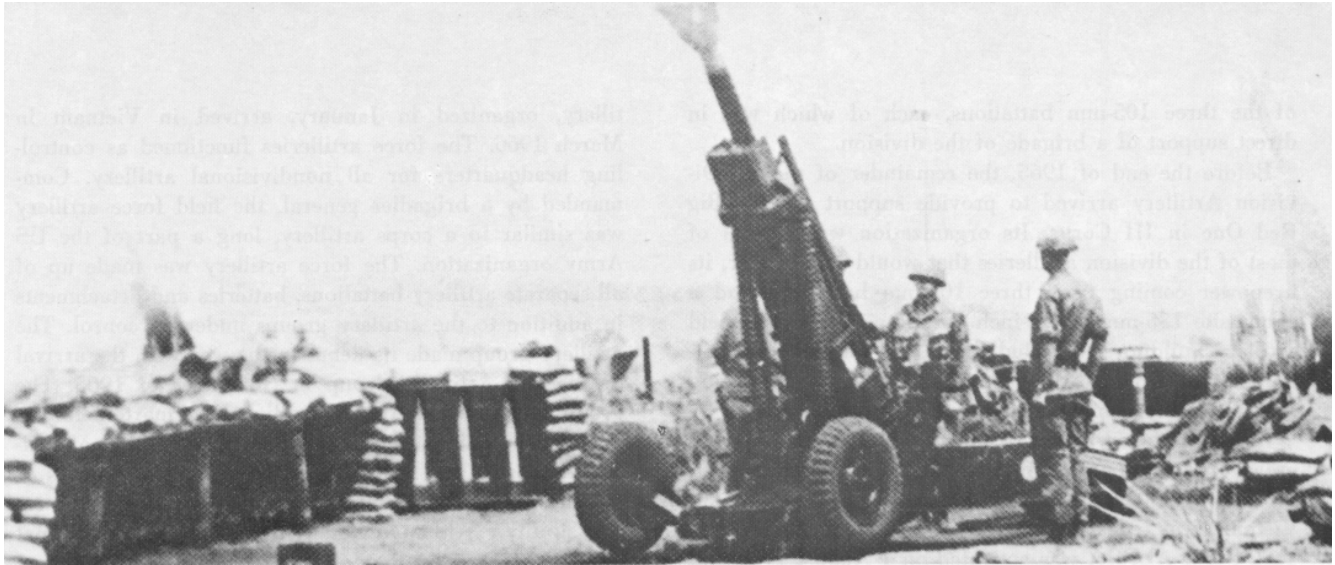
The Pleiku (Ia Drang) Campaign

In the early days of the buildup, units could not be permitted time for detailed planning and rehearsing. The North Vietnamese Army (NVA) had increased its forces significantly and had to be engaged at once. The situation was particularly critical in II Corps Tactical Zone, where at least three regiments of North Vietnamese regulars and one Viet Cong main force battalion were threatening to cut the country in half. Part of their mission was to meet and humiliate the newly arrived 1st Cavalry Division.

The 1st Cavalry Division did not arrive in Vietnam until September 1965, some of its units in early October. Yet on 22 October 1965 the commanding general of the division received the following order:

"Commencing first light 23 Oct 65, 1st Air Cav. Deploys one BN TF (Minimum 1 Inf Bn and 1 Arty Btry) to Pleiku with mission to be prepared to assist in defense of Key US/GVN installations vic Pleiku or reinforce II Corps Operations to relieve Plei Me CIDG Camp."

The Pleiku campaign, sometimes called the battle of the Ia Drang Valley, started with only a small force but eventually involved the entire division. Before the battle was over, the division accomplished several significant feats. Among these was the first air deployment and supply of tube artillery in an area of extremely rugged terrain and no roads. The operation proved that infantry units could always have tube artillery, as well as aerial rocket artillery, in support of their ground operations regardless of the terrain. The Pleiku campaign saw the first night employment of aerial rocket artillery in extremely close support of ground troops and in conjunction with the artillery and tactical air. Also, for the first time large American units met and defeated battalion- and regiment-size



High angle. 1st Battalion, 21st FA, received the first M102 howitzers in Vietnam.

NVA units under control of divisional headquarters. This was also the first real combat test of the airmobility concept.

The campaign opened on the morning of 23 October. Task Force INGRAM, composed mainly of the 2d Battalion, 12th Cavalry, and Battery B, 2d Battalion, 17th Artillery, moved by air from An Khe to Camp Holloway at Pleiku to reinforce the area. The commanding general of the 1st Air Cavalry Division received permission to move his entire 1st Brigade to Camp Holloway to assist in the security mission.

While the 1st Brigade was repositioning its forces, a South Vietnamese task force was moving from Pleiku to the relief of the Plei Me civilian irregular defense group camp, which had been attacked by a North Vietnamese regiment. Unfortunately, the relief column was engaged and halted by two or three enemy companies. The South Vietnamese commander absolutely refused to move unless he was provided US artillery support. In an effort to get the relief column moving, the artillery battalion commander placed an artillery liaison team with the task force and provided the support of two artillery batteries. Still, the attempt to get the column moving was initially unsuccessful because the Vietnamese commander then refused to move until he had been resupplied from Pleiku. It was several days before the relief column started to move, and then only after the US artillery FO mounted the lead vehicle of the convoy and literally walked artillery fires down the road in advance of the moving column. With this support, the column received only sporadic small-arms fire and this was silenced by attack helicopters and Air Force tactical air strikes. The South Vietnamese column finally arrived at the Plei Me camp at dusk on 25 October.

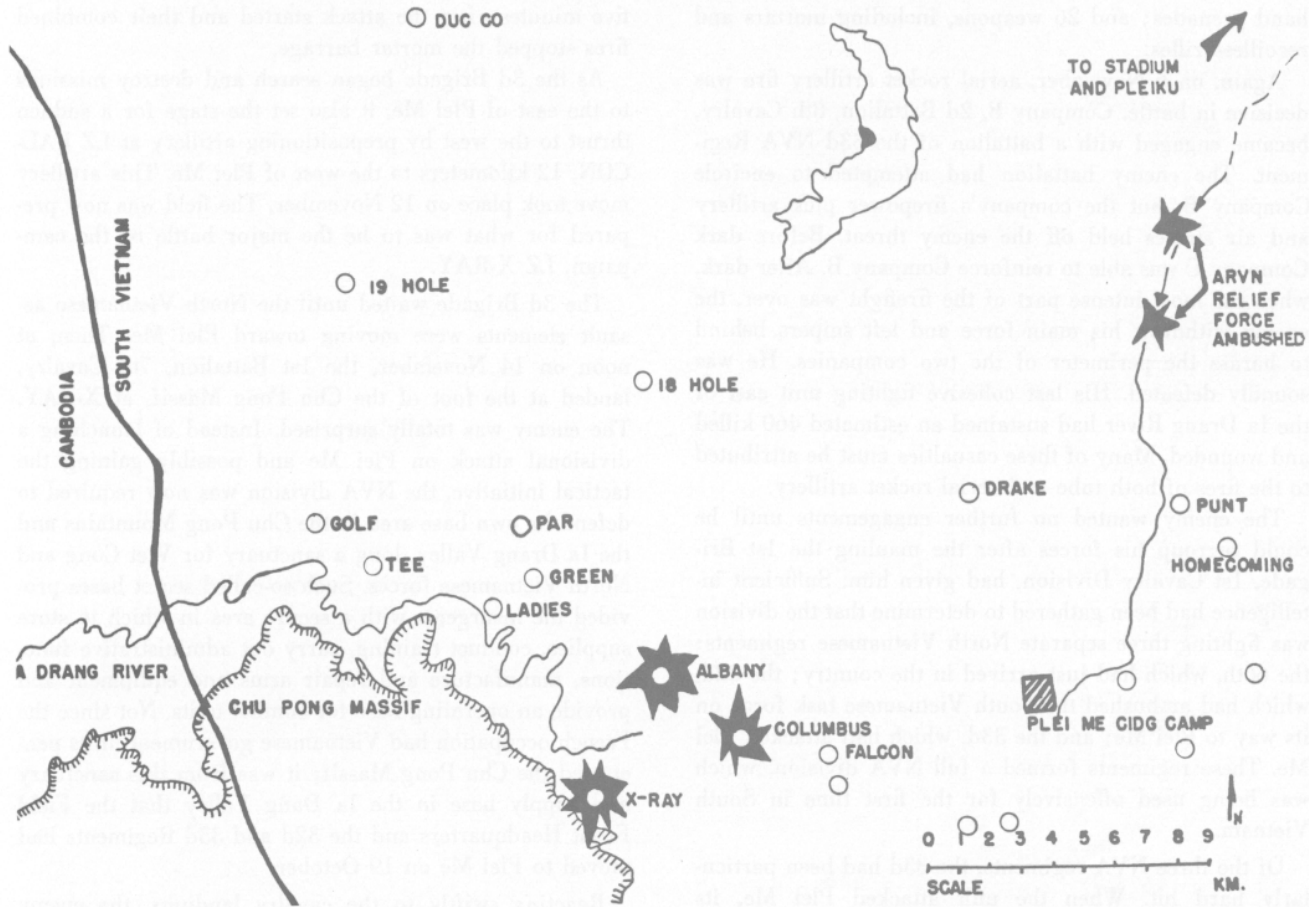
The reluctance of the Vietnamese commander to move on 23 October was probably a blessing in disguise, because it allowed the cavalry to reposition two batteries of the 2d Battalion, 19th Artillery, better to support the future battle. This proved a significant advantage later. The delay also gave the brigade time to learn more about the enemy disposition in the area.

On the morning of 26 October, the Vietnamese task force conducted a sweep around the Plei Me camp. Five minutes after noon the task force encountered mortar, small-arms and recoilless rifle fire. The force immediately took casualties and faltered. The two batteries of the 2d Battalion, 19th Artillery, responded at once with supporting fires which enabled the task force to regroup, withstand the attack and take the offensive. The North Vietnamese forces suffered 148 killed and five captured in this action. The two artillery units were credited with drawing first blood for the 1st Cavalry Division. Had they not been in position, what became the first friendly victory could well have been a defeat.

The division started hunting for the enemy force with all available means. It planned to support any engagement by rapid air movement of artillery batteries and by tactical air strikes. The airmobility concept had envisioned the movement and supply of maneuver and support forces by helicopter, and the 1st Cavalry Division had been organized accordingly with light equipment and aircraft. From 27 October until the morning of 1 November, the enemy proved to be elusive. He attempted to retreat toward sanctuary areas and avoided contact whenever possible. A few skirmishes occurred but they were mainly between small forces.

On the morning of 1 November, an air cavalry troop discovered a small enemy force guarding a regimental aid station. Before the action terminated, an enemy battalion was engaged by the air cavalry troop. The air cavalry habitually operated beyond artillery range; its mission

FIRE SUPPORT BASES AND LANDING ZONES USED DURING PLEIKU CAMPAIGN.



was to find the enemy and fix him in position, when possible, until the division ground forces and supporting artillery could be brought to the scene. In this case all friendly artillery was out of range, but even so the enemy lost the effectiveness of most of one battalion before the battle was over. The enemy withdrew pursued by division scout and aerial rocket artillery aircraft as well as Air Force tactical air strikes.

On 2 and 3 November, light action continued and ambush positions were established throughout the area. One of the ambushes caught an enemy platoon-size force by surprise and totally destroyed it. The ambush patrol then pulled back into the patrol base area and established a tight defensive perimeter. At midnight of the 3d, the patrol base was attacked by an enemy battalion-size force. It was evident that reinforcements were needed at once. The patrol base, which had been established by Troop B, 1st Squadron, 9th Cavalry, had a landing zone within the perimeter sufficient to accommodate five helicopters. Into this LZ came Company A, 1st Battalion, 8th Cavalry, in platoon-size lifts, making this

the first time that a perimeter under fire had been relieved by a heliborne force. Although cannon artillery was not within range of the patrol base initially, aerial rocket artillery was available and for the first time fired at night in very close support—as near as 50 meters to friendly positions. Aerial rocket artillery continued to support the defense of the patrol base until the morning of 4 November when tube artillery was moved to a supporting position. The enemy broke contact shortly after artillery rounds began to fall on their positions. Although a large number of the enemy dead was carried away by the retreating forces, the body count was 112, with an estimated 92 others killed in action. Intelligence discovered that this enemy force was an NVA unit that had just arrived in the country. The cavalry division had insured that they received a warm welcome.

The artillery also proved instrumental in defeating an enemy force engaged by elements of Company B, 2d Battalion, 12th Cavalry. While on a sweep operation, Company B came upon an enemy element guarding a cache of weapons and ammunition. The artillery fire caused the

enemy to disengage and abandon the cache. He lost 120,000 rounds of small-arms ammunition; 126 rounds of mortar ammunition, recoilless rifle ammunition and hand grenades; and 26 weapons, including mortars and recoilless rifles.

Again, on 6 November, aerial rocket artillery fire was decisive in battle. Company B, 2d Battalion, 8th Cavalry, became engaged with a battalion of the 33d NVA Regiment. The enemy battalion had attempted to encircle Company B, but the company's firepower plus artillery and air strikes held off the enemy threat. Before dark Company C was able to reinforce Company B. After dark, when the most intense part of the firefight was over, the enemy withdrew his main force and left snipers behind to harass the perimeter of the two companies. He was soundly defeated. His last cohesive fighting unit east of the Ia Drang River had sustained an estimated 460 killed and wounded. Many of these casualties must be attributed to the fires of both tube and aerial rocket artillery.

The enemy wanted no further engagements until he could regroup his forces after the mauling the 1st Brigade, 1st Cavalry Division, had given him. Sufficient intelligence had been gathered to determine that the division was fighting three separate North Vietnamese regiments: the 66th, which had just arrived in the country; the 32d, which had ambushed the South Vietnamese task force on its way to Plei Me; and the 33d, which had attacked Plei Me. These regiments formed a full NVA division, which was being used offensively for the first time in South Vietnam.

Of the three NVA regiments, the 33d had been particularly hard hit. When the unit attacked Plei Me, its strength was 2,190 men. In actions against the 1st Brigade, the regiment had lost 890 men killed, more than 100 missing and still more suffering incapacitating wounds. Materiel losses also had been heavy. The regiment lost 13 of its 18 antiaircraft guns as well as 11 mortar tubes and most of its recoilless rifles. In addition, there had been crippling losses of ammunition, food and medical supplies.

The North Vietnamese division headquarters next planned an attack for the morning of 16 November against the original target—the Plei Me civilian irregular defense group camp. With this objective in mind, the three enemy regiments regrouped and headed eastward toward Plei Me.

During the lull in battle, the 3d ("Gary Owen") Brigade relieved the now battle-tested 1st Brigade, 1st Cavalry Division, on the battlefield. The 1st Brigade returned to Camp Radcliff at An Khe for a well-deserved rest. No significant action occurred until 12 November, when the enemy (seemingly just to let the 3d Brigade know that he was still around) staged a violent battalion-size attack against the 3d Brigade base at LZ STADIUM. Aerial rocket artillery aircraft positioned at STADIUM responded

immediately. All seven aircraft were airborne within five minutes after the attack started and their combined fires stopped the mortar barrage.

As the 3d Brigade began search and destroy missions to the east of Plei Me, it also set the stage for a sudden thrust to the west by prepositioning artillery at LZ FALCON, 12 kilometers to the west of Plei Me. This artillery move took place on 12 November. The field was now prepared for what was to be the major battle of the campaign, LZ X-RAY.

The 3d Brigade waited until the North Vietnamese assault elements were moving toward Plei Me. Then, at noon on 14 November, the 1st Battalion, 7th Cavalry, landed at the foot of the Chu Pong Massif, at X-RAY. The enemy was totally surprised. Instead of launching a divisional attack on Plei Me and possibly gaining the tactical initiative, the NVA division was now required to defend its own base area in the Chu Pong Mountains and the Ia Drang Valley, long a sanctuary for Viet Cong and North Vietnamese forces. Such so-called secret bases provided the insurgents with a secure area in which to store supplies, conduct training, carry out administrative functions, manufacture and repair arms and equipment and provide an operating base for combat units. Not since the French occupation had Vietnamese government units penetrated the Chu Pong Massif; it was from this sanctuary and supply base in the Ia Dang Valley that the Field Front Headquarters and the 32d and 33d Regiments had moved to Plei Me on 19 October.

Reacting swiftly to the cavalry landings, the enemy Field Front ordered the 66th Regiment to attack the LZ. Strong elements of the regiment were established on the ridge line overlooking the LZ, to provide a base of fire for the attack. The 9th and 7th Battalions of the 66th and a composite battalion of the 33d (the combined forces of what remained of the 2d and 3d Battalions) provided the initial assault forces.

When the troops of the 1st Battalion, 7th Cavalry, landed at X-RAY, they expected to engage enemy forces, but they did not expect to face an entire NVA regiment before the day was over. The enemy attacked with great ferocity against all elements of the 7th Cavalry. At least two cavalry platoons were immediately cut off and completely surrounded. The only thing that saved the platoons was the combined fire of the aerial rocket artillery unit and the two batteries of artillery at LZ FALCON. The tube artillery support was frequently called to within less than 100 meters of the friendly positions. An additional company from a sister battalion of the 7th Cavalry was helilifted into X-RAY and filled a vacant and vulnerable position on the perimeter.

Throughout the night, the NVA forces attempted to crack the perimeter of one of the isolated platoons but intensive artillery protective fires that ringed the position broke up every attack. The main perimeter was also subjected to repeated probes and these too were repulsed. Batteries A and C, 1st Battalion, 21st Artillery, located at FALCON, fired over 4,000 rounds of high-explosive ammunition during the night in close support of X-RAY. The probing attacks continued into early morning. At first light, an NVA force of over two companies once again attempted to penetrate the perimeter. Despite intensive air strikes and cannon and aerial rocket artillery fires, the enemy closed to hand-to-hand combat range, attacking from all directions. Artillery fire was brought to within 50 meters of the hard-pressed perimeter. This devastating curtain of steel finally broke the back of the attack. By mid-morning the fight had been reduced to the point that reinforcements could again be helilifted into X-RAY and the wounded air evacuated.

To provide additional artillery support, LZ COLUMBUS was established four and a half kilometers to the northeast of X-RAY. This landing zone was midway between X-RAY and FALCON, where Batteries A and C of the 1st Battalion, 21st Artillery, were located. Battery B of the 1st Battalion, 21st Artillery, and Battery C of the 2d Battalion, 17th Artillery, were now moved into COLUMBUS.

The enemy broke contact and filtered back into the mountains after suffering tremendous losses. He was pursued with heavy fire power: cannon artillery continually pounded the area; and Air Force tactical air provided continuous support with a fighter bomber on a target run on an average of once every fifteen minutes. But the most devastating support was provided by B-52 bombers which struck without warning six kilometers west of X-RAY. Though the bombers had been employed initially in Vietnam some six months earlier, this was their first use in direct support of US troops on a tactical operation. For the next five days, the big bombers systematically bombed large areas of the Chu Pong Massif.

Early on the morning of the 16th, the enemy attempted again to overrun X-RAY and again there was a bloodbath. The defenses were just too tough to penetrate. The enemy lost 834 soldiers by actual body count and an estimated 1,200 more.

On 17 November, X-RAY was evacuated in preparation for a B-52 strike (referred to as an Arc Light) that was to be virtually on top of the LZ. The 2d Battalion, 7th Cavalry, was moving overland from X-RAY toward a clearing to the northeast, which was to be used as an LZ designated ALBANY. About 300 meters short of the objective, the battalion became involved in an intense battle with the 8th Battalion, 66th Regiment, of the NVA.

As all too often happens in a meeting engagement, the exact locations of friendly and enemy positions were uncertain. Although artillery aerial observers were overhead and two batteries of 105-mm and one battery of 155-mm howitzers were well within range, none could fire initially. It was solely an infantryman's battle for several hours. By mid-afternoon heavy supporting fires began falling among NVA elements. The first strikes were by aerial rocket artillery, followed by a tactical air napalm run on an enemy company that was forming for an attack. The attack never started.

Reinforcements were quickly brought into ALBANY and the perimeters were established—one by the 2d Battalion, 7th Cavalry, and one by two companies of the 1st Battalion, 5th Cavalry, which had moved toward ALBANY as reinforcements. The hard-hit 2d Battalion, 7th Cavalry, was able to expand the perimeter and recover friendly casualties from the battle area. This freedom of movement was afforded by the continuous artillery fire from COLUMBUS and FALCON and the illumination provided by Air Force flare ships.

The punishment taken by both friendly and enemy units was severe during the short battle at ALBANY. Over 270 troopers were casualties. The enemy lost 403 soldiers by body count and an estimated 100 others killed. No estimate of wounded was made.

The next morning, the battle area around ALBANY was relatively quiet. The enemy had moved on toward his new objective—the artillery units at COLUMBUS. At 1735 on 18 November, the last enemy offensive of the Pleiku campaign began. The remnants of two enemy regiments attacked COLUMBUS with heavy mortars and automatic weapons. Because the artillery based at FALCON was being moved to another location, tactical air strikes and aerial rocket artillery were used along with direct fire from the artillery weapons within COLUMBUS to repulse the enemy attack. After three hours the enemy attack lost momentum and subsided into sporadic small-arms fire and then quiet. The battle of the Ia Drang Valley was, for all practical purposes, over.

The 2d Brigade now entered the battle area and relieved the 3d Brigade. The new brigade continued to search for the enemy. Contacts were made with scattered NVA elements of squad or platoon size, and then only after they had been flushed out and chased by heliborne cavalry or foot patrols.

During the Pleiku campaign, the enemy lost over 1,500 confirmed killed and an estimated 2,000 more. His losses were so extensive that an entire NVA division was made ineffective. His casualties were produced by all types of weapons, ranging from the B-52 bomber to the individual rifle. But a very large proportion of those casualties must be attributed to the artillery of the cavalry division. The

enemy was driven back time and again, primarily by the intensity of artillery fire power. The division fired 40,464 artillery rounds and rockets during the campaign. Of the total casualties, 562 enemy killed and an additional 1,863 estimated killed and wounded were officially credited to the artillery.

Although the Pleiku campaign was the first time an entire US division was committed in battle in Vietnam, the division had been committed piecemeal, one brigade at a time. Piecemeal commitment in this case had certain benefits. As one brigade was committed, the relieved brigade along with its supporting forces (including the direct support artillery battalion) was withdrawn to a rest area and allowed to refit and to consider what had taken place in the battle.

The artillerymen had learned much from this campaign. First, the concept of displacing and supplying artillery by air was proved valid, particularly in support of an airmobile force. During the campaign, artillery units of the cavalry division artillery had made a total of 79 tactical moves—67 of them by air. Continuous air movement by maneuver and support forces unsettled the enemy. Properly executed airmobile operations could keep constant pressure on him, wearing him down and destroying his will to resist. Second, aerial rocket artillery was shown to be extremely responsive and effective in augmenting cannon fires. Ground forces learned that aerial rocket artillery was

reliable and extremely accurate, characteristics that were particularly important in close support mission. By controlling helicopter fires through artillery fire support channels, as was done with aerial rocket artillery, cannon and helicopter fires could be closely coordinated by a single individual, thus insuring that both were complementary. Third, artillerymen learned of the necessity of having artillery positions that were mutually supporting. Though LZ COLUMBUS had stood off an enemy attack without mutually supporting artillery, its defenders had required air support, which in poor weather might not have been available. Fourth, because of the rugged terrain and dense foliage, target acquisition was a definite problem. FOs were still the best means of target acquisition because they were always with maneuver companies. To augment the FOs, aerial observers aided whenever possible and were particularly effective in support of overland ground movements. Fifth, it was shown that the 105-mm howitzer was a particularly good weapon for reconnaissance by fire. As the unit moved, the artillery FO would adjust artillery rounds in advance of the unit. This provided two benefits: the artillery could disrupt any activity or ambush site the enemy might have and the location of the last round fired was a good indicator of the unit's location. This second advantage would allow for rapid delivery of artillery in the event the enemy ambushed the ground force. ☒

Mini-RPVs

(Continued from page 8)

Objectives

Experiment objectives identified are to: determine basic performance factors of the aircraft ground control and data link systems; determine the accuracy with which the RPV can be navigated to perform its mission; evaluate the organizational and operational requirements for employment; verify the safety; determine any human factors problems associated with the system; determine the reliability, availability and maintainability (RAM) of the

system; and evaluate the performance of reconnaissance, surveillance and target acquisition during daylight by an RPV system equipped with an unstabilized TV sensor and an aerial panoramic camera, a stabilized TV sensor with automatic tracking capability, a laser rangefinder and a stabilized TV sensor and a laser designator and a stabilized TV sensor.

At the completion of this experiment it is hoped that the information gained will define requirements, specifications and cost effectiveness resulting in a Required Operational Capability—a TRADOC/AMC document describing what the Army needs in an RPV. ☒

MAJ George H. Finger, FA, served as a test project officer, Project Seeker, US Army Field Artillery Board, Fort Sill, OK.

A multitude of materiel developments occurred in World War I with new tactics and doctrine evolving to make the Field Artillery the dominant force on the battlefield. The conclusion of this two-part series is presented here.—Ed.

Conclusion

Mass Fire In WWI

by LTC Alexander T. Jennette

If the artillerymen of World War I sometimes impressed the infantry they frequently overawed themselves. The other combatants had been jaded by four years of the most vicious and concentrated artillery fire in history; however, to the Americans it was a new world in 1918. A young officer at St. Mihiel describes the mass fire preparation in poetic terms, "It is a magnificent if terrible spectacle that arises in one's mind at the prospect of the grand attack—a tremendous phalanx of cannon, blasting a path down a valley of strongholds, levelling the hills, filling the valleys with havoc." Neither was a poet lacking at Chateau-Thierry as is evident from the following description of the start of the preparation. "And then the barrage opened. Like the recent thunderstorm it came—suddenly, overwhelmingly! This was the culmination of that hot, sultry, oppressive day of July 17: hundreds of guns of all calibers, French and American, from Soissons to Chateau-Thierry and beyond, all crashing at the same instant into a wild, tumultuous pounding." Even General Pershing was moved to the

point of eloquence; in praising the work of the artillery in the third phase of the Meuse-Argonne offensive he said, "The artillery acquitted itself magnificently, the barrages being so well coordinated and so dense that the enemy was overwhelmed and quickly submerged by the rapid onslaught of the infantry." Measured by any standards before or since, the American Expeditionary Force (AEF) artillery support evoked superlatives, particularly with respect to numbers of weapons participating and quantity of ammunition fired. The initial nine division assault in the Meuse-Argonne campaign was supported by 2,700 guns firing a three-hour preparation. At St. Mihiel 838,800 rounds were fired in support of the initial assault and a single 75-mm battery fired 11,806 rounds on the first day of the Meuse-Argonne offensive. Hell had no fury like the aroused cannoneers of the AEF!

Coordination of fire to prevent hazard to friendly troops while retaining flexibility to engage the enemy without delay is a delicate proposition. In 1918 it was exaggerated by the concentration of troops, the abundance of artillery and poor communication. Observation of fire received lip service as a safety and control measure; however, most map firing was not observed except in the gross sense that normally it was viewed by someone in a casual manner. In fact, discriminating observation of the simultaneous fire of



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several hundred weapons is possible. Discounting obviously, the direct observation of fire, a control principle usually adhered to was the sanctity of lateral boundaries. There appears to have been no measure such as a "no-fire-line" granting dispensation to fire across a boundary, without coordination, into the area beyond the no-fire-line. Strict adherence to areas of responsibility beginning with the close-in fires of the 75s and extending out was an effective guarantor of troop safety in preplanned fires. Targets of opportunity were a difficult matter, however, and zones of responsibility did not always provide a clear answer. To fire on a target of opportunity across a boundary required boldness and rapid balancing of gains versus risks. It was done, however, and rather spectacularly in the case of CPT, later President, Harry S. Truman (see March-April 1974 *Journal*) of the 129th Field Artillery. (Captain Truman apparently was highly regarded in the 129th. The book, *The Artillerymen, 129th Field Artillery, 1917, 1918*, written long before his later accomplishments could have shaped the evaluation, makes numerous references to his excellence as a field artillery officer.)

During the Meuse-Argonne offensive, Captain Truman observed a hostile battery in the zone of the neighboring 28th Division and demonstrated his typically aggressive character by taking it under fire without benefit of coordination. Adjusting his own battery, he effectively neutralized the Germans.

The intricacies of map firing and numerous barrages woven into a master plan of fire support served the AEF well in the defensive and during the initial stages of an assault. Indeed, up to a point, no serious indictment can be directed at the AEF artillery's support of the infantry other than a tendency to allow the fire plan to drive the scheme of maneuver rather than vice-versa. There was a juncture, however, at which artillery support began to weaken when the advance required displacement by the field artillery. This potential weakness was well recognized by the aggressive Americans who, after all, had embarked on their crusade with a view to defeating Germany with offensive action. The preferred solution was displacement by echelon. This sufficed well in concept but was much more difficult in execution. At some point before the infantry had moved out of range, a portion of the supporting artillery displaced forward by battery to be followed after arrival in new positions by the remaining batteries. Not a new expedient in 1918, it remains the best way to provide continuous support. What was new was the impact of rapid displacement on map firing. The artillery was uprooted from a comfortable set-piece situation to new territory where survey was wanting, wire was not laid, observation posts were not established and ammunition resupply was questionable. These

circumstances were not conducive to precise calculations and extensive map firing suffered in the bargain. Moreover, the field artillery fell victim to its own ferocity. Ground convulsed by thousands of shells frequently was impassable and movement was confined to a few crowded roads, themselves cratered by shellfire. The 7th Field Artillery Regiment, in advancing at St. Mihiel, found almost seven hours were required for a single displacement. Two divisions were trying to use a single road; guns and caissons sank in the mud and trucks stuck and blocked the road. By using tanks to extract the trucks it was possible to continue the advance. During a particularly slow displacement, the battery of Captain Truman attempted a mission before arriving at its destination but inadequate communications with the supported infantry aborted the mission. Displacements, although difficult, were, nevertheless, made and support was continuous, if diluted. By the end of the second day of the Meuse-Argonne offensive all but a few heavy batteries of the nine participating division artilleries had moved forward from their original positions. Mass fire was attenuated but not eliminated from the battlefield.

An interesting expedient developed to provide continuous support to a rapidly advancing unit was that of "accompanying guns." Accompanying guns were, in fact, the antithesis of mass fire. In an effort to make artillery more responsive during a rapid advance, 75-mm batteries were attached to the infantry on the basis of one battery per infantry brigade. Attachment of guns was thought to have the additional benefits of boosting infantry morale by their presence and of contributing to the solution of the problem of continuous support during the advance. As events developed, accompanying guns were beset by problems to the extent their efficacy was doubtful. The 129th reported extreme difficulty moving over cratered terrain, loss of horses to enemy fire and problems with ammunition resupply. Precision suffered since every mission fired was under emergency conditions from unprepared positions. An official 7th Field Artillery report on the St. Mihiel battle spoke of accompanying guns with disdain. Apparently on an experimental basis, one gun was assigned to an infantry battalion. It had trouble keeping up and fired only two rounds in operation. The infantry never once asked for its support. In spite of these tribulations, accompanying guns were found attached to the infantry to the very end of the war. After the dust of the war had settled, COL Robert R. McCormick, an artilleryman, offered this analysis regarding the fragmentation and attachment of artillery. "It is imperative that artillery be handled as artillery and not as though it were trench mortars or infantry cannon. Bringing artillery into the assaulting line adds nothing to the attack, while it deprives it of the



valuable support of guns properly handled." Few practicing artillerymen would disagree.

What observations of great import may be made from the field artillery experience of the US Army in World War I and what lessons are to be learned or, more likely, relearned? In current parlance, how do we know where we're "at," far less know where we're going without a good appreciation of the experiences of the past? Even casual study reveals a multitude of experience to be drawn from, and if we are sufficiently clever there is great profit to be had in recognizing and avoiding the failures and applying the successful innovations, suitably updated, to the modern battlefield.

It is apparent that relatively little progress has been made in field artillery materiel since 1918. Even considering the introduction of several new cannon prior to and during World War II and for the packaging of nuclear warheads in field artillery projectiles, improvements have been fractional. The progression from the French 75 to the M102 pales beside the revolution that has seen aviation leap from the Jenny to the F-15 or the Navy's dramatic march from coal burning battleships to nuclear supercarriers. We must redouble our efforts to produce weapons with the range and rate of fire to permit concentrations of fire across wide fronts without the requirement for high weapon density in any given area. Virtually full automation of future cannon—or rockets—would bear somewhat the same relationship to

current weapons as the French 75 did to muzzle loading and early breech loading cannon. Such advances are technically feasible and tactically mandatory. To do this we must find a way to short-circuit a well-intentioned but ponderous research, development, test and evaluation process that almost seems to guarantee obsolescence before introduction of the equipment.

There have been few recent significant improvements in target acquisition, although several developments seem on the verge of fruition. These represent few truly new concepts since World War I but the mechanics are more sophisticated and capabilities are geometrically increased. It is saddening to note that sound ranging has seen substantially no improvement since it was introduced. There are some interesting possibilities in sound ranging that would arrange the sensors in the vicinity of the hostile weapons and coupled with a computer to solve individual battery locations, permitting a massive but selective and precise counterbattery response.

In tactics, techniques and doctrine the lessons of World War I were well learned and subsequently refined. The marriage between specified maneuver elements and dedicated field artillery has been a permanent thing with even brighter prospects. The liaison and forward observer functions are the main contributors to dedicated fire support and more importance will be attached to them in the future. The Field Artillery School is investigating a degree

(Continued on page 45)

on behalf of the GENERAL MISSION

*The following article is reprinted from the USSR publication **Voennyi Vestnik (Military Herald)**, Number 6, 1974.*

by COL I. Panevin
and COL A. Gor'kov

The essence of coordination between a motorized rifle (MR) battalion and an artillery battalion which has been attached to the battalion or which is supporting it for purposes of attack lies in the coordination of the missions, of the assault positions and of the time of employing the support force, as well as in mutual aid for the purposes of carrying out the combat mission most successfully by the battalion.

The commander of the MR battalion is the organizer of the coordination, and his combat decision is the basis for putting into practice the planned measures. Let us consider the problems of organization and maintenance of continuous support within the framework of an MR battalion and an artillery battalion going into attack by advancing from an area where they were biding their time.

Coordination is a complex, creative and continuous process but in the work of its organization one can distinguish four characteristic stages: the arrival at a decision for the forthcoming attack (clarification of the mission and evaluation of the situation), the carrying out of reconnaissance work, the organization of the combat missions and the immediate organization of coordination after issuing the first battle command.

First Stage

When clarifying the mission and evaluating the situation, the battalion commander specifies which artillery battalion (or its elements) is being attached to him or supports him, and at what time; when will his commander arrive to receive the assignment, which missions for defeating the enemy during the battalion's attack at the front and flanks are carried out by the artillery which is at the disposal of the senior officer; which assignments should be given to the artillery battalion and which equipment should be allotted for reinforcing the MR companies.

The commander of the artillery battalion, after receiving an order from the senior artillery officer, specifies:



which MR battalion his division is supposed to support (or to whom it is attached); [and] when and where does one go to organize the coordination. He studies the tasks of his battalion and of other artillery units at the front and flanks of the enemy during the attack by the battalion. He designates additional missions that must be carried out for the benefit of the battalion, as well as missions for artillery reconnaissance. He plans the location of the batteries which are to support the MR companies and determines the sequence of shifting them in the course of the attack. He studies the sequence of coordination with the units of the general troops which was determined by the senior officer.

Second Stage

The commander of the artillery battalion comes to the commander of the MR battalion at the reconnaissance site and reports to him about the composition and location of the batteries, about the assignments received from the senior artillery officer, about the fire capacity of the battery, the availability of ammunition as well as the time set for opening fire.

In the course of the reconnaissance the MR battalion commander and the artillery commander adjust the provisional names for local objects and orientation points, define the nature of the enemy's defense in the locality (the main line of resistance, the location of the strong points, the fire equipment and barriers) and which objects (or targets) are hit by weapons of the senior officer (MRB) and which by fire of the artillery battalion. They study the locality in the direction of the attack, they determine the boundaries of safe distance for the tanks and motorized riflemen to prevent damage from the explosion of their own shells and additional fire missions for the artillery battalion. They specify the target designation methods.

Third Stage

When issuing the battle order, the MR battalion commander gives the artillery battalion commander additional assignments for hitting newly-detected targets, for covering and supporting tanks and motorized riflemen in their attempt to overcome barriers while carrying out the immediate mission and taking the attack deep into the enemy's defense zone. These assignments are made by the MR battalion commander on the basis of his decision and according to the unit's established order of battle.

After receiving the assignment from the MR battalion commander, the artillery battalion commander clarifies it and specifies it on location. Then he marks on the working map the combat missions of the battalion and companies, the structure of the battle formation and attack position

and determines the sequence of carrying out additional tasks.

Fourth Stage

After issuing the assignments for attack to the MR companies and reinforcements, the MR battalion commander organizes the cooperation between them and the neighbors. He must see to it that each commander under him understands well the sequence of coordination of his units with the others, that he be able to make his units flexible, reliable and efficient at any stage of the battle. In this connection it should be said that the instructions on coordination should complement and develop the battle order—be concrete and very clear.

Coordination is organized according to the following stages in carrying out the mission:

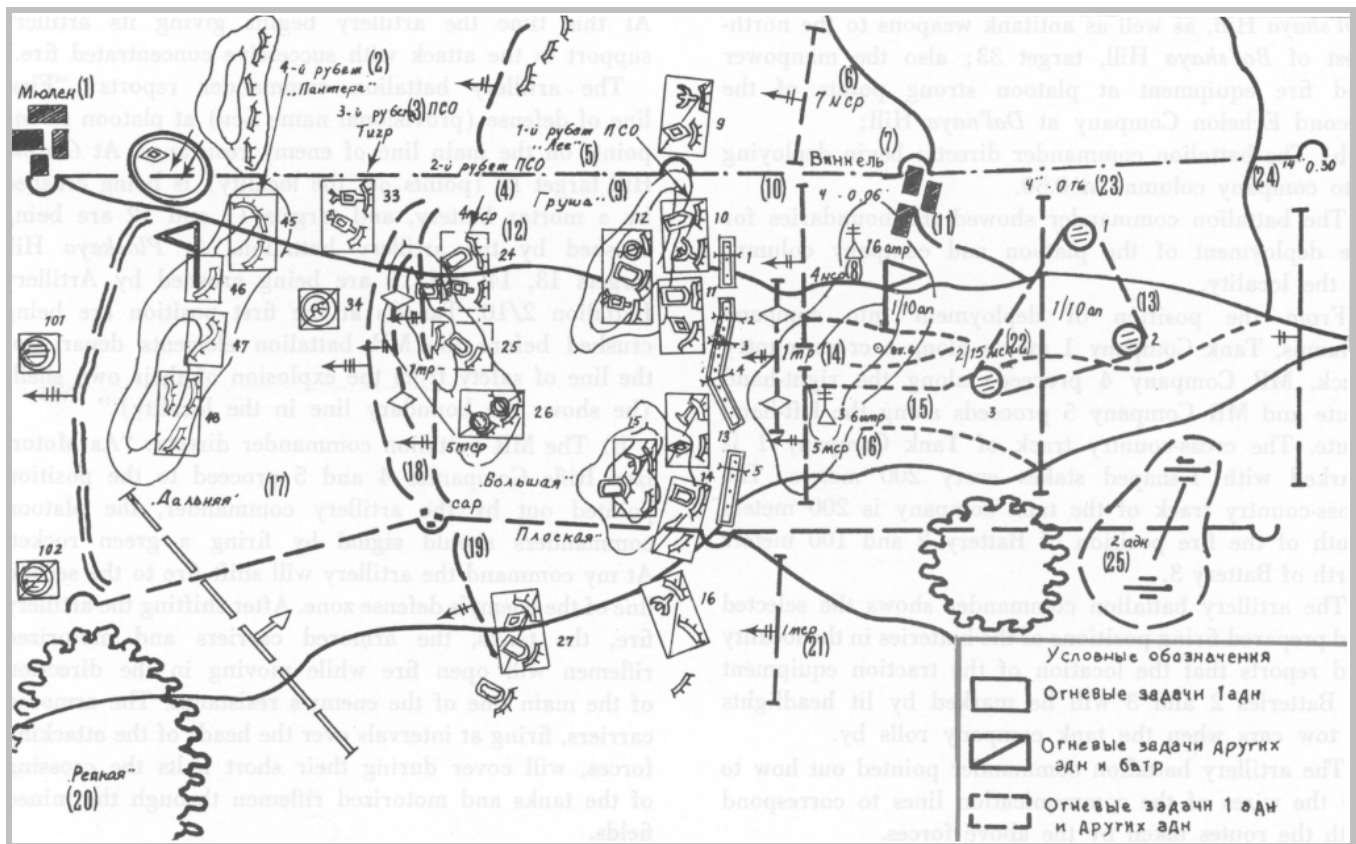
1. While moving from the waiting area to the position of attack;
2. While attacking the enemy's main line of resistance and carrying out the immediate assignment;
3. While solving the next problem; and
4. While developing the attack in a specified direction.

One of the possible variations in the organization of coordination when the battalion is moved to the attack position and when it carries out the immediate assignment will be studied in a concrete tactical example (see the scheme).

The 2/15 Motorized Rifle Battalion and Tank Company, a mortar battery and a sapper section advance for attack on the morning of April 20. The 1/10 Artillery Battalion is assigned to support the battalion. The MR battalion and artillery battalion are in the waiting area. The command observation post of the artillery battalion and the batteries are on Hill 85.6 at 7 o'clock on April 19. By 13:00 o'clock on April 19 the battalion commander carries out a reconnaissance mission and issues an oral battle command. At 13:00 o'clock the battalion commander begins organizing the coordination at the command observation post of the artillery battalion.

1. Advance of the battalion to the position of attack: a) The battalion commander directs the following structure of the battalion's columns: staff and communications section, tank company, MR Companies 4 and 5 with reinforcement equipment, MR Company 6 and the rear of the battalion. As the battalion proceeds toward the western edge of *Temnoye* forest (not in the scheme) the artillery preparation for the attack begins at 0.45.

The artillery battalion commander reports: the artillery will take 39 minutes to prepare, from 0.45 to 0.06. The first fire attack will last three minutes, from 0.45 to 0.42 and will be directed at artillery and mortar



Key to the Scheme of the Exercise

- 1) *Myulen*
- 2) 4th enemy line of defense *Pantera*
- 3) 3d enemy line of defense *Tigr*
- 4) 2d enemy line of defense *Volk*
- 5) 1st enemy line of defense *Lev*
- 6) Motorized Rifle Company 7
- 7) *Vinkel'*
- 8) Motorized Rifle Company 4
- 9) *Grusha*
- 10) Hour of 0.06
- 11) Battery 1
- 12) Motorized Rifle Company 4
- 13) 1/10 Artillery Section
- 14) Tank Company 1
- 15) Battery 3
- 16) Motorized Rifle Company 5
- 17) *Dal'naya*
- 18) *Bol'shaya*
- 19) *Ploskaya*
- 20) *Redkaya*
- 21) Motorized Rifle Company 1
- 22) Motorized Rifle Battalion 2/15
- 23) 0.16 hours
- 24) 0.30 hours
- 25) Artillery Battalion 2

Fire missions of Artillery Division 1.
 Fire missions of other artillery divisions and batteries.
 Fire missions of Artillery Division 1 and other artillery divisions.

batteries. The second fire attack will last 10 minutes, from 0.42 to 0.32 and will be directed at platoon strong points of the first echelon battalions. The third fire attack will last 14 minutes, from 0.32 to 0.18 and will be directed at targets situated deep within the "enemy's" defense zone. The fourth fire attack will last 12 minutes, from 0.18 to 0.06 and will be directed at platoon strong points of first echelon companies of the enemy. A covering fire attack directed at artillery and mortar batteries will take place from 0.08 to 0.02. Three artillery battalions and two mortar batteries of the senior commander will carry out fire missions while the artillery is getting ready at the front. The artillery crushes two artillery batteries and a mortar platoon, targets 101, 102 and 34, the manpower and fire equipment of the enemy at platoon strong points of the first echelon company at *Grusha Hill*, *Ploskaya Hill* and *Bol'shaya Hill* and the antitank equipment to the northwest of

Bol'shaya Hill, as well as antitank weapons to the northwest of *Bol'shaya* Hill, target 33; also the manpower and fire equipment at platoon strong points of the Second Echelon Company at *Dal'naya* Hill;

b) The battalion commander directs: begin deploying into company columns at 0.30.

The battalion commander showed the boundaries for the deployment of the platoon and company columns in the locality.

From the position of deployment into company columns, Tank Company 1 moves along a cross-country track, MR Company 4 proceeds along the right-hand route and MR Company 5 proceeds along the left-hand route. The cross-country track of Tank Company 1 is marked with T-shaped stakes every 200 meters. The cross-country track of the tank company is 200 meters south of the fire position of Battery 2 and 100 meters north of Battery 3.

The artillery battalion commander shows the selected and prepared firing positions of the batteries in the locality and reports that the location of the traction equipment of Batteries 2 and 3 will be marked by lit headlights of tow cars when the tank company rolls by.

The artillery battalion commander pointed out how to lay the wires of the communication lines to correspond with the routes taken by the above forces.

c) The MRB commander reports that he will come to the artillery battalion's reconnaissance post 15 to 17 minutes before the artillery completes its preparation. At the time 0.16 the first echelon companies should begin deploying into platoon columns from the designated position. The sequence of deployment is: MR Companies 4 and 5 should report to the command observation post of Battery 1 and Battery 3, respectively, not later than 10 minutes before the completion of the artillery preparation. As the last fire attack begins, the engineering and sapper elements should blast five passages in the enemy's minefields. (The battalion commander pointed out the places for the passages at the locality—see scheme. Commanders of the batteries and of the artillery battalion should organize observation of these places and if a passage is not made in any of these places I should be warned about it early when I arrive at the command observation post of the battalion.)

2. Attack on the main line of the enemy's resistance and carrying out the immediate mission by the battalion:

a) The MR battalion commander specifies the place of the attack position in the locality and directs: "First echelon companies advance to the attack position at 0.06 and proceed directly to the main resistance line of the enemy. The signal for the attack of the battalion is a series of astral rockets from my command observation post and the slogan *Uragan* (Hurricane) via radio. At this time the artillery

begins giving its artillery support to the attack with successive concentrated fire."

The artillery battalion commander reports: "First line of defense (provisional name *Lev*) at platoon strong points on the main line of enemy resistance. At *Grusha* Hill target 10 (points out the locality) is being crushed by a mortar battery, and targets 11 and 12 are being crushed by the artillery battalion. At *Ploskaya* Hill targets 13, 14 and 15 are being crushed by Artillery Battalion 2/10. Targets at the first position are being crushed before the MR battalion elements depart for the line of safety from the explosion of their own shells (he shows the boundary line in the locality)."

b) The MR battalion commander directs: "As Motorized Rifle Companies 4 and 5 proceed to the position pointed out by the artillery commander, the platoon commanders should signal by firing a green rocket. At my command the artillery will shift fire to the second line of the enemy's defense zone. After shifting the artillery fire, the tanks, the armored carriers and motorized riflemen will open fire while moving in the direction of the main line of the enemy's resistance. The armored carriers, firing at intervals over the heads of the attacking forces, will cover during their short halts the crossing of the tanks and motorized riflemen through the mined fields.

"The destruction of enemy manpower and fire equipment at the platoon strong points and on the main line of resistance will be effected by a precipitate attack by part of the forces from the front and by the main forces of the first echelon companies from the flank: Tank Company 1 (without tank platoon) and Motorized Rifle Company 4 (without motorized rifle platoons) will attack the strong points on *Grusha* Hill from the southwest: a tank platoon and Motorized Rifle Company 5 (without MR platoons) will attack the strong points on *Ploskaya* Hill from the northeast."

Next, the MR battalion commander listens to reports by commanders of the first echelon companies about the sequence of operations of the units and specifies the sequence in which the enemy is to be destroyed at the strong points.

The division commander reports and specifies the place: "The second line of the enemy defense zone (*Volk*) at platoon strong points is on *Bol'shaya* Hill. Battery 1 is firing on target 24, Battery 3 is firing on target 25 and Battery 2 is ready to crush newly-disclosed enemy fire equipment which interfere with the attack. Target 26 on the southern slopes of *Bol'shaya* Hill is being crushed by Artillery Battalion 2/10. The line of safe distance from the explosion of ones own shells is situated in front of the second line of the enemy's defense zone (he points out the place).

"The designated locations of the command observation posts, of batteries and of artillery battalion will be shifted forward: Battery 1 to the northwestern slopes of *Grusha* Hill and Battery 3 to the western slopes of *Ploskaya* Hill. The advance observation points of Batteries 1 and 3 will begin moving along with the commanders of MR Companies 4 and 5. The command observation post of the batteries will move after the acquisition of the platoon strong points at the main line of resistance by the attacking elements."

c) The MR battalion commander directs: "With the departure of the first echelon companies to the safety line,

which according to the artillery commander is situated in front of the second line of the enemy's defense zone, the company and platoon commanders will signal by means of two red rockets. At my command the artillery will shift its fire to the third line of the enemy's defense zone. When the enemy is destroyed at the strong points on *Bol'shaya* Hill, MR Company 4 will concentrate its basic efforts on delivering a blow to the enemy at its right flank, while Tank Company 1 and MR Company 5 will strike at its left flank. The frontal attack will be made by enlisting one MR platoon from MR Company 4 and one from MR Company 5.



D-30 howitzers in direct fire.

"In the battle for *Bol'shaya* Hill, enemy antitank weapons, situated on *Dal'naya* Hill, could direct their fire against the attacking tanks and armor carriers of the battalion. There also could be mine fields in front of *Bol'shaya* Hill and on its flanks."

The MR battalion commander listens to reports by commanders of Tank Company 1 and MR Company 5 (pointing out the place) about the sequence of coordinated operations during the crossing of the mine fields and during the destruction of the enemy on *Bol'shaya* Hill, and he specifies the sequence of operations for MR Company 4.

The artillery battalion commander reports: "The third line of the enemy defense zone *Tigr*, consisting of enemy antitank weapons, is at the northwestern and western parts of *Bol'shaya* Hill. The targets are not surveyable from the captured observation points. Battery 1 fires at target 33, a battery of antitank guided missiles. Artillery Battalion 2/10 crushes target 34, the installation of antitank guided missiles."

The line of safety in front of the third line of the enemy defense zone will be determined in the locality after the command observation post is moved to *Grusha* Hill. Batteries 2 and 3 will not be engaged in the battle against the third line of the enemy defense zone and will be ready to destroy the enemy fire weapons on *Dal'naya* Hill. The forward observation post of Battery 1 with the commander of MR Company 4 will be on the southwestern slopes of *Grusha* Hill. The forward observation post of the artillery will move behind MR Company 4. The commander of Battery 3 will move together with the commander of MR Company 5.

Conclusion

In conclusion, we shall briefly discuss the main problems in the maintenance of coordination in the course of the attack.

To ensure the coordination of the MR battalion and the artillery battalion it is necessary to attain the following:

- A correct understanding by the commanders and by the staff of the goals of the combat operations, the project of the commander of the general troops, the combat missions of the MR battalion and artillery battalion and the methods of carrying them out;
- Continuous reconnoitering of the enemy and a correct evaluation of his possible actions, joint knowledge of the obtained reconnaissance data, of the situation and the missions that are being carried out by the elements of the MR battalion and artillery battalion;
- Constant contact and personal meetings of the chiefs of the artillery battalion and (MR) battalion, of batteries

and companies;

- Constant knowledge of changes in the situation, timely assignment of missions by the MR battalion commander to the artillery battalion commander;
- Maintaining the batteries of the artillery battalion in constant readiness for carrying out missions on behalf of the combat carried out by the MR and tank companies; and
- Constant display of initiative by the commander of the artillery battalion and batteries in hitting disclosed enemy targets.

Continuous coordination is maintained at the very stages during which the assignments are carried out by the MR battalion and at which coordination was originally organized. When coordination is disturbed in the course of the battle, the MR battalion commander and artillery battalion commander take all necessary measures to restore it immediately.

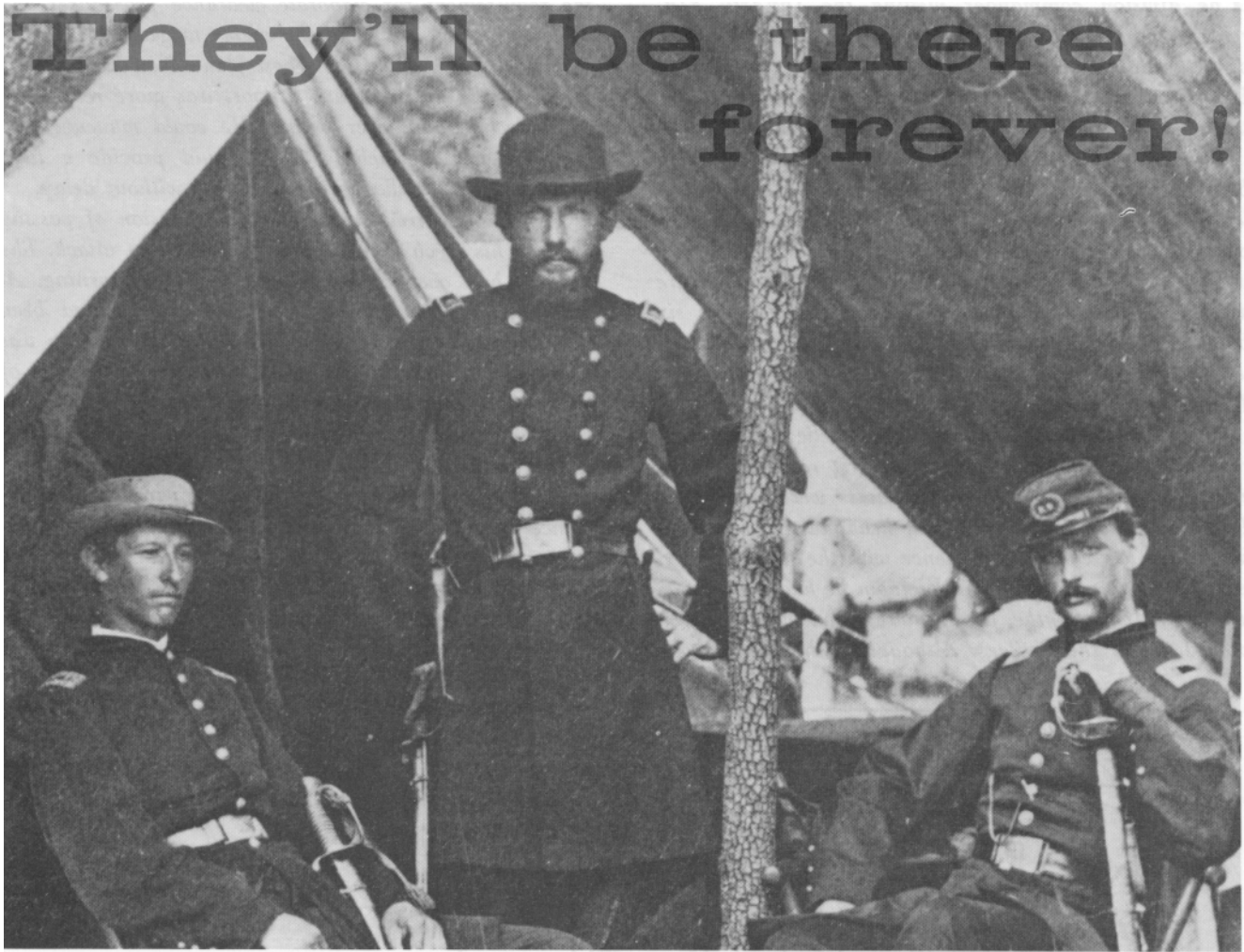
For coordination in the course of the battle there are two important stages: the repulsion of enemy counterattacks and the introduction of a second battalion echelon into battle.

To repel a counterattack the MR battalion commander, together with the artillery commander, ascertains in the locality the routes of enemy advance, the possible positions from which the enemy forces are being deployed and the direction of counterattack. The MR battalion commander announces his decision and issues assignments to the artillery battalion.

The artillery battalion commander determines the sequence in which they are to be carried out, specifies in the locality the planned fire missions and harmonizes them with the problems that are being solved by the forces of the MR battalion.

When a second echelon is introduced into battle the MR battalion commander informs the artillery commander about his decision and specifies it in the locality. Then he assigns the artillery battalion additional missions to protect the advance, the deployment and the attack of the second echelon. He points out which forces are to be assigned for support and arranges a meeting place for the commanders of the support forces with the company commander of the second echelon and specifies the place of his own command observation post. The artillery battalion commander determines which battery is to be assigned for the support of the second echelon company and the sequence of carrying out the fire missions assigned by the MR battalion commander. He harmonizes the sequence with that of the MR battalion and defines the sequence of coordination with the forces of the MR battalion when the second echelon is introduced into battle.





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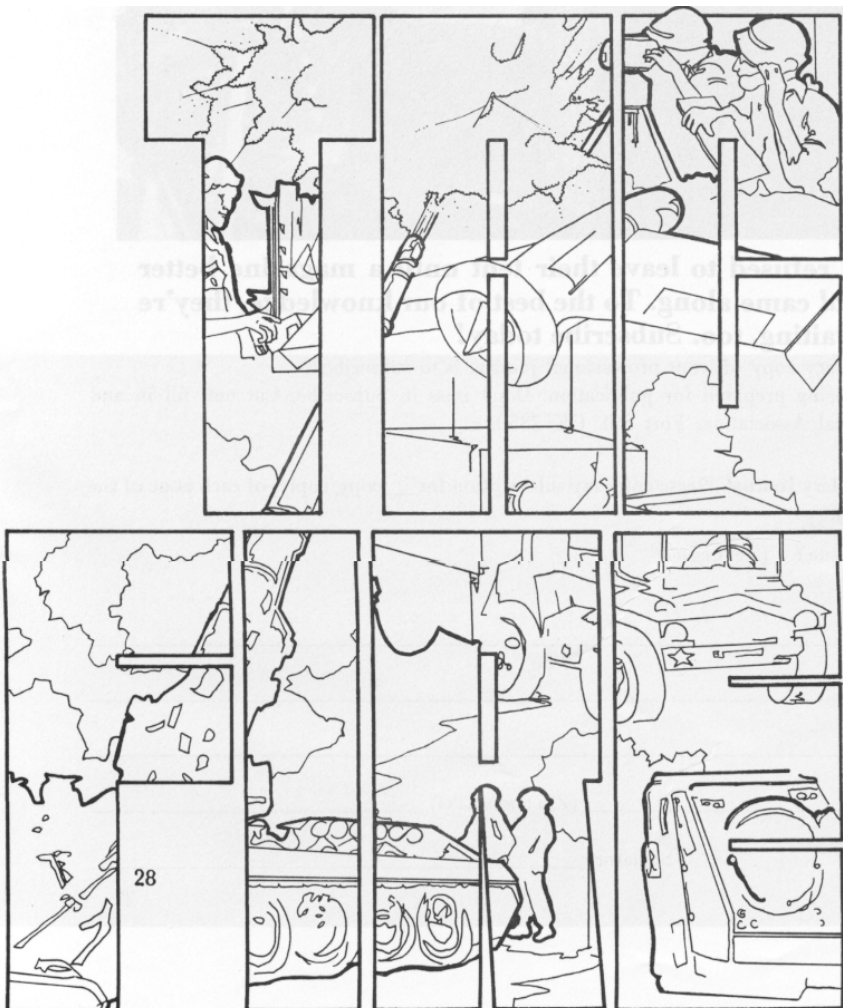
The division commander visiting the DivArty FDC relaxed momentarily from his concentration on the flow of battle data and the action around him. His mind was becoming saturated and he needed to organize his thoughts.

Impact — incoming! A pelt of shrapnel on the nylon blankets protecting the sides of the S-280 shelter. One volley incoming — sounds like D-30s . . . then silence. The control console displayed target data on the enemy batteries from counterbattery radars and drones. The fire direction officer (FDO) provided commands to his six battalions through his digital data links. Fire commands were at the guns in seconds. Time on target — Shot, out. The echo of the guns was reassuring.

The division commander couldn't believe the rapid reaction. Our rounds landing with first round effect on enemy batteries while the enemy units were still firing. This visit to his division artillery headquarters reminded him of his last combat experience with the field artillery. As a battalion commander in Vietnam he had been somewhat mystified by the fire planning and fire direction procedures of the Redlegs. Although he had understood the

requirement for elaborate clearance procedures and the often elusive nature of the enemy targets, time always seemed to work against his best plans. Now things were different, the field artillery support was more responsive and effective than ever before. He could maneuver his brigades and the field artillery could provide a fully coordinated umbrella of fires for him without delay.

An armored division had had the mission of passing through his mech division and exploiting an attack. The passage had occurred at 0300 hours this morning. At 1500 hours yesterday, 12 hours alert notice had been received. Since this was the main effort, the division was weighted with an FA group. Traditionally, a passage of lines is a complicated operation. However, both the armored division and his unit had TACFIRE which greatly simplified matters. The commander of the armored division wanted the field artillery preparation to commence at H-15 minutes and continue to H+5 minutes to cover the noise of the tanks and assault bridges moving prior to H-hour. In the pre-TACFIRE era, representatives from the armored division artillery would have met with the mech division artillery personnel and spent hours



by CPT Gerard G. James

going through target files and overlays. They had to copy all of the critical information, not just a transfer of the documents, because the mech division was still responsible for the sector until the armored division passed through. The armored division representatives then would go back to their own FDC and started passing targets to their organic battalions.

Under the manual procedures, it was optimistically estimated that the initial liaison could commence around 1900 hours and the organic FA battalions of the armored division artillery would begin receiving their portion of the targets piecemeal four hours later at 2300 hours (D-1). The transmission error rate of target intelligence under the manual system is high. Less than 95 of 100 targets would be correct. The most frequent errors were in coordinates that could ruin an S3's day. At the direct support artillery battalion level, the stubby pencils would madly scribble out a schedule of fires and FADAC operators got blisters on their fingers. The scheduling at the DS battalion level also included their reinforcing FA units. Since communication traffic must be kept at normal levels, the chances were that each battery involved would get its portion of the schedule by messenger. Visualize the middle of the night, unfamiliar terrain, throw in some bad weather and you have all the ingredients of a lost messenger. New targets come in — forget it! A new met comes in — too late to recompute ballistics.

But in this battle, the divisions had TACFIRE. After minimal coordination, the mech division transferred target intelligence data to the armored division artillery electronically; error transmission rate — zero percent. And they did not have to do this until about 2300 hours (D-1) so that the target intelligence data was four hours more current. This transfer took approximately 15 minutes electronically using secure digital networks over radio or wire. The DS battalions receive the target intelligence data pertaining to their areas of responsibility while the most current meteorological data is being received on another net from the met data sounding system. The DS battalion TACFIRE is set up to act as if the batteries from the battalions of the FA group who are reinforcing the DS battalion are really organic so when the schedule is computed, all firing batteries are included automatically. At this point, the schedules plus firing data could be sent by digital communication to all firing batteries, but there is no rush, there is still time to incorporate additional targets as they're received or update the firing data with a new met message.

The field artillery did more processing quicker and with greater accuracy with TACFIRE.

This fictionalized scenario provides a glimpse of TACFIRE on the modern battlefield of the next war. It casts us as winners because of the new equipment capability. But TACFIRE equipment alone is only part of the picture.

During the battle the FDO is not sitting in the corner with a martini in one hand and a cigar in the other. Computers haven't taken over the field artillery, only the time consuming "knuckle-drill." Additionally, the computer can store and analyze more data and provide the FDO and commander with many more options. TACFIRE always provides the correct solution to achieve the desired

TACFIRE Meets the AN/TPQ-37

In a recent test of the interoperability between the Artillery Locating Radars and TACFIRE conducted at Fort Sill, counterbattery fire commands were received at the battery before incoming rounds impacted. Congressman Robert Sikes (D-FL) came to Fort Sill to see the two radar systems and the FA School's TACFIRE work together as a fully automated counterbattery system. One of the TACFIRE battalion computer centers was set up as a direct support battalion fire direction center with its firing batteries located on Fort Sill's East and West ranges. Hughes Aircraft Company's and Sperry Gyroscope Division's competitive counterbattery radars (See MALOR, March-April 1975 *Journal*) were located at the battery positions. Members of 2d Battalion, 1st FA, and 1st Battalion, 17th FA, were in various locations on both ranges firing the "enemy" weapons. In order to achieve realistic distances between the friendly radars and the enemy weapons, the Hughes radar on the East range watched over the West range while the Sperry radar on the West range observed the East range.

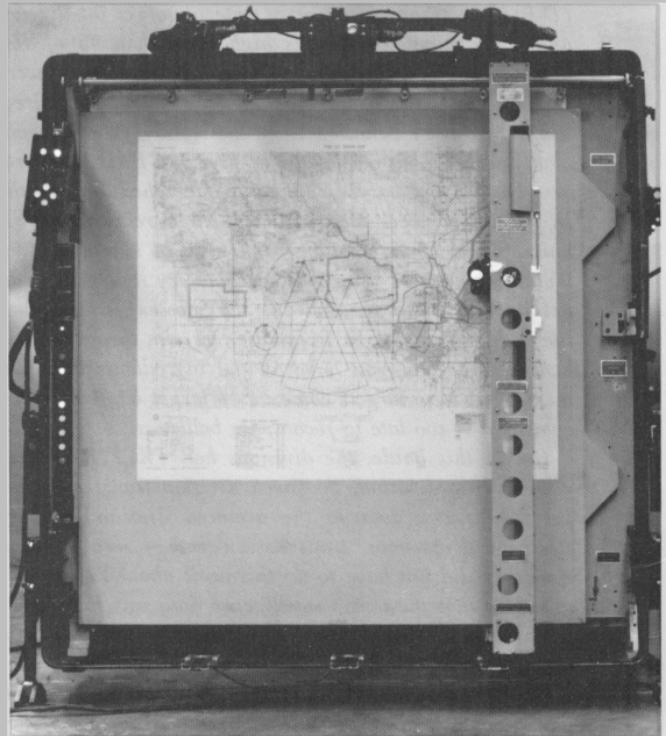
The enemy weapons fired on a random basis. One of the radars would detect the firing, track the rounds in the air and, from that piece of the trajectory, compute the location of the battery firing. With this information in the computer, the radar prepared an electronic fire request for transmission to the TACFIRE computer. On receipt of each fire request, TACFIRE automatically plotted the target, recommended type and quantity of munitions, selected fire units and computed the appropriate fire commands. If the fire direction officer approved the computer's recommendations, the fire commands were transmitted by digital data transmission to a Battery Display Unit at the firing battery. For ease of timing control the Battery Display Unit's were colocated with the radars. Times were measured from the firing of the enemy weapon to delivery of fire commands for counterfire.

TACFIRE CO

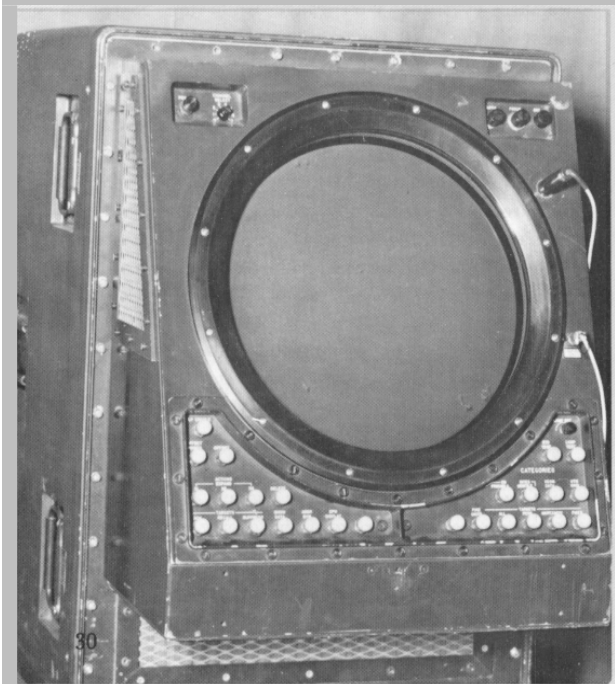


Artillery Control Console (ACC) [left]. Located at battalion and division artillery fire direction centers. The ACC is the primary device to manually control data into and out of the computer. This control device provides a visual presentation of data generated by the computer or received from external sources and provides the means to control and initiate action on those data by generating and transmitting messages.

Digital Plotter Map (DPM) [right]. Located at battalion and division artillery fire direction centers. The DPM is used to display existing or planned tactical situations on standard Army topographic maps or overlays. The DPM library consists of approximately 100 standard Army symbols and alphanumeric characters which can be drawn at 200 characters per minute over a 48- by 48-inch plotting surface. The accuracy is one thirty-second of an inch (80 meters on a 1:50,000 scale map).

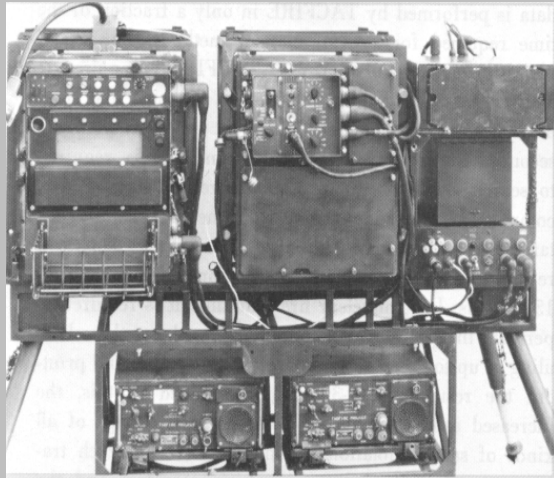
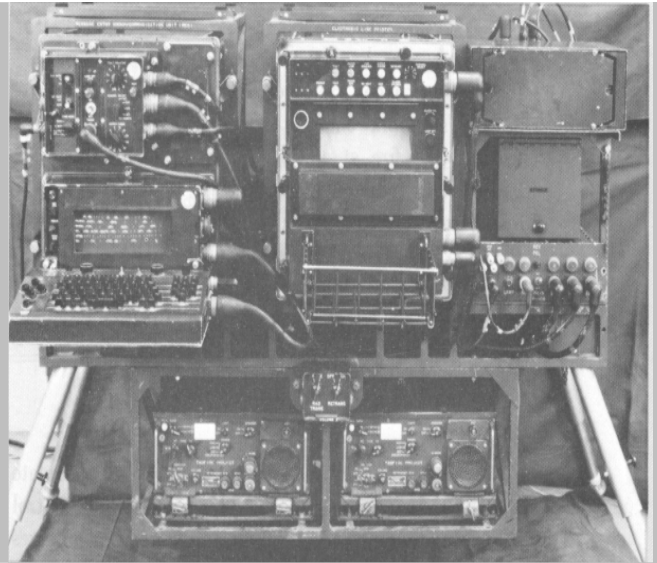


Electronic Tactical Display (ETD) [left]. Located at the division artillery fire direction center. The ETD is used in conjunction with the DPM. It provides a ground situation display of pertinent geometry such as fire control measures and fire unit and target locations. It also permits manual selection of classes of data for display such as enemy artillery locations. Controls are provided to expand and offset any portion of the DPM display desired.



MPONENTS

Variable Format Message Entry Device (VFMED) [right]. Located at the fire support element with the division tactical operations center and the fire support coordination centers at the maneuver battalions and brigades. The VFMED enables fire support coordination personnel to obtain formats and messages directly from the computer, make changes and transmit the messages back to the computer for processing and action.



Battery Display Unit (BDU) [left]. Located at the firing battery. The BDU is a remote unit consisting of a line printer and a digital data terminal. This enables the unit to receive and acknowledge digital communications transmitted over standard radio or wire nets and provides for the receipt of a printed copy of all fire commands and other information required to execute the unit mission. Digital communications are decrypted by a COMSEC device located with the BDU. This device will be replaced by the Battery Computer System (BCS).

Electronic Line Printer (ELP) [right]. Located at battalion and division artillery fire direction centers. The ELP is a component of the BDU and VFMED and provides a permanent record of data input and output. It is a medium-speed printer capable of printing 500 lines per minute with 72 alphanumeric characters per line.



effects on the target. However, the FDO can always override the solution, change the effects requirements or choose not to fire at all. TACFIRE also tells the FDO when there is not enough immediately available firepower for a target by automatically generating a request for additional fire (RFAF) message. The FDO at the FA battalion can send this message to his division artillery or ignore it. Man's judgment is still the main ingredient in the Field Artillery System.

What It Is

TACFIRE is much more than a device to calculate firing data. It is a computer-based command and control information system which provides numerous advantages for the commander.

Through the use of digital data communication, TACFIRE significantly improves control by speeding and securing communications. For example, to send a message to any particular unit it is necessary to simply address the message by entering the unit's name and depressing the transmit button. The computer transforms the message into digital form, encrypts it if required and transmits the data over conventional artillery communications media. The system provides the TACFIRE operator with an automatic acknowledgement that the message was received by the designated station in a matter of seconds.

At the destination, the message is acknowledged as received, decrypted, displayed visually to the operator and printed for record or local distribution. It is by this process of digital transmission that TACFIRE's files are established, updated and made available to all authorized users.

Once established, data can be rapidly updated. This insures that the most current data is available on request for printout, application or digital transmission to another station. For example, in a fire mission reports to update higher headquarter's data are automatically prepared, displayed for approval and transmitted during end-of-mission processing. These reports, such as Mission Fired Reports update ammunition files, provide the disposition of the target as a result of firing and the final target location to higher headquarters on an individual mission basis. TACFIRE will routinely notify the appropriate fire support officer when a fire mission is received from one of his observers, provide him with the location and enable him to halt the mission, if necessary.

TACFIRE's software can be set up with the commander's guidance and priorities to automatically provide recommendations for methods of attack, volume of fire and shell/fuze combinations for target attack. The attack method recommended by the computer can be

overridden by the FDO.

TACFIRE provides automatic data processing support in all phases of field artillery tactical command and control. The biggest benefits are realized in three key areas: *Artillery Target Intelligence*, which provides for storage, processing and retrieval of target information input from all sources. The program correlates target reports, combines reports in accordance with established criteria and furnishes the most probable location and description of each target. *Target Analysis and Fire Planning*, which provides nonnuclear, nuclear and chemical target analysis and fire plans. *Tactical Fire Control*, which performs a detailed analysis of incoming targets and the weapons and munitions required to defeat those targets.

In these programs, the time consuming and often unmanageable burden of analysis, correlation, computation, storage and dissemination of large quantities of data is performed by TACFIRE in only a fraction of the time required for present manual methods. For example — in tactical fire control — TACFIRE is required to analyze a target, display its location, compute and store an *optimum* fire order and print-out the solution in 20 seconds. In artillery target intelligence, it is required to search a file of up to 1,000 targets, determine and compare an incoming target with the most similar 10 targets, make a combination if appropriate, display a recommendation and print-out recommended actions in 15 seconds. In nonnuclear fire planning, it is required to perform the necessary computations, involving the scheduling of up to 80 targets and 16 fire units, store and printout the results in 10-30 minutes. Added to this, the increased safety provided by automatic warnings of all kinds of safety violations to include checking each trajectory against three-dimensional air corridors and the provision of hard copy firing data at battery level considerably reduces chances for accident or error. Further, the entire system is tied together with secure, on-line digital transmission of data by contemporary radio or wire which increases security, decreases net time and greatly speeds the dissemination of information from the source to the user.

TACFIRE is here. Before today's Officer Basic Course graduates are battery commanders, they are likely to be in a unit with TACFIRE. Prior to issue to all FA units, the Development/Operational Test III (DT/OT III) will be conducted with a TACFIRE division artillery located within the Continental United States in FY 1977. This test is designed to provide a conclusive basis for a final decision on full acceptance of TACFIRE. Training Army operators and supervisors will be a vital factor in the successful completion of this test and full integration of TACFIRE into the field artillery.

Table 1 The Field Artillery School OT III Preparatory Course Organization

<i>Course</i>	<i>Attendees</i>	<i>Content</i>
Fire Direction	Bn FDO, FDC Chiefs, FDC Computers, Chart Operators	Establishment and operation of the TACFIRE Computer under tactical conditions, maintenance of computer hardware, capabilities of remote devices, degraded mode, communication COMSEC, cabling, format completion.
Supervisor	S3, Bn Cmdr, DivArty Cmdr, Battery Cmdr	Capabilities of the TACFIRE system, interpretation of output, TACFIRE files, tactical considerations during employment, RSOP, communications, maintenance, application programs.
Fire Support Coordinator	FSOs, Liaison personnel	Operation of the VFMED, TACFIRE capabilities in Fire Support Coordination, fire missions, FSO files, geometry, observers, fire planning, COMSEC.
Battery Fire Direction	Btry FDOs, FD computers	Operation of the BDU/BCS, DMD, TACFIRE capabilities, reporting data, communications, COMSEC.

USAFAS Training

The 9th Division Artillery at Fort Lewis, Washington, has been selected by Department of the Army as the "player" unit for the Operational Testing (OT III) of TACFIRE. The Field Artillery School will support this effort by conducting functional training for the 9th Division Artillery in TACFIRE at Fort Sill. A breakdown of this training is shown in Table 1.

Planning has commenced for integrating both resident and non-resident instruction into existing courses, establishing resident and extension TACFIRE courses and forming new equipment training teams that will provide TACFIRE instruction at the units' station. These plans include incorporation of lessons learned from Development and Operational Tests into programs of instructions for presentation to all officer and enlisted personnel attending a Fort Sill course of instruction.


Intensive TACFIRE training for Advanced Course students will insure that graduates are qualified to fill battalion FDOs positions. The basic course student will receive concentrated instruction on skills required for operation of the Battery Computer System (BCS). This is a small firing data computer that will accept information from TACFIRE, apply individual piece corrections and provide visual display of firing data at each gun. The noncommissioned officers education system (NCOES) for MOS 13E will have appropriate TACFIRE instruction to insure previously trained specialists will be able to function effectively using this system. Senior staff officer and supervisor courses will provide refresher and orientation training in TACFIRE and field artillery

operations.

As each unit receives its TACFIRE the new equipment training team will assist, on the spot, in preparing unit training programs, equipment "uncrating" and checkout. They will also be available to provide initial instruction and other assistance as required. Current plans call for a 3 officer and 13 enlisted man team.

We must look to improved command and control capabilities like TACFIRE to keep pace with the increased tempo of modern combat, and the technological advances in target acquisition systems that increase our ability to obtain and report accurate and timely target information. These influences dictate the need for an improved means of processing and responding to the increased volume of information. Better munitions, longer range weapons and increased mobility influence the modern battlefield Troops will move more quickly, mass for shorter periods of time and disperse soon after an attack. Targets must be attacked rapidly and efficiently before they can disperse.

TACFIRE's responses are faster than traditional methods of achieving these objectives. More importantly, the results are far superior and more consistent than the present manual system. The information available with TACFIRE is infinitely greater than the most experienced field artilleryman could ever assimilate and use in a timely manner. It will greatly assist in eliminating the command and control "choke point" in the Field Artillery System.

TACFIRE has virtually assured its place on tomorrow's battlefield. Successful implementation of this system will also assure that the field artillery portion of the combined arms team mission will be accomplished. 

CPT Gerard G. James, FA, is assigned to the Command and Control Systems Division, Office of the Deputy Assistant Commandant for Combat Development, USAFAS, Fort Sill, OK.

Resources Pooled

FORT HOOD—The First Team's "Red Team," the 1st Cavalry Division Artillery and radar operators from the 1st Cav's 1st Brigade recently pooled their resources to increase the effectiveness of the AN/PPS-5 by adding directional control.

In the initial phase of a three-part exercise the senior radar operator was given a general direction on which to orient his set using the method most familiar to him. The operator chose the distant aiming point method and an aiming circle was quickly emplaced behind the position. The aiming circle was oriented on a known direction and used to check the azimuth to the target as reported by the radar operator. The operator proceeded to track two target vehicles moving from 10 to 20 mph at a range from 1800 to 2000 meters. At the maximum range of 2000 meters, the average variance of 498 mils caused a target location error of almost 1000 meters.

Radar and aiming circle operators orient AN/PPS-5 on terrain feature.



The operator was then given an M2 compass and directed to orient the radar on an azimuth of 3200 mils. The operator reported ready to observe and readings were again taken on the moving targets. An average variance of 83 mils existed between the radar azimuth to the target and the aiming circle to the same target, a distance of about 160 meters at a range of 2000.

During the final phase of the exercise the radar operator oriented his set on an easily identifiable terrain feature using a telescope mounted to the top of the radar. The aiming circle operator sighted on the same terrain feature and reported his azimuth to the radar operator who set it on the radar azimuth counter. Readings were taken on the same targets with an average variance of 5 mils, or a distance of about 10 meters at a range of 2000 meters . . . sufficient to initiate an accurate call for fire. By integrating directional control into AN/PPS-5 operating procedures the "Red Team" assisted in converting the radar into a valuable target acquisition device where none had previously existed.

Realistic Intelligence Training

FORT LEWIS—The incoming rounds exploded throughout the battery position. The crater analysis team quickly took their back azimuths. Checking the shell fragments against his template, the XO reported "152-mm" and prepared to evacuate the shell fragments to battalion. This scene did not take place in Vietnam or the Sinai Peninsula, but it will take place at Fort Lewis, WA, during all battalion and battery ORTTs. The incoming rounds will, of course, be artillery simulators, but the craters and shell fragments will be real—all a part of the intelligence awareness training being conducted within the 9th Division Artillery.

Intelligence play during ORTTs, ATTs and FTXs has always been difficult for field artillery units and has usually been accomplished by messages and umpires/controllers interjecting "what if" situations. This system gives the individual soldier absolutely no exposure to real combat intelligence situations and makes the S2 a glorified message clerk.



A sure cure for a dozing soldier, the 9th Division Artillery's own BMP-A . . . Body by Fort Lewis TASO.

To break this pattern, 9th Division Artillery has presented the soldier with visual (instead of verbal) situations. "Actual" 122-mm, 152-mm and 130-mm shell fragments and "dud" rounds, complete with foreign markings and produced by the Fort Lewis Training Aids Services Office (TASO), have replaced verbally interjected SHELLREPs. Captured aggressors are not armed with M16s, do not speak English and are carrying documents written in a variety of foreign languages. Ground attacks are supported by a full-size BMP-A, courtesy of TASO and the 9th MI Company. Propaganda leaflets have been produced and are scattered throughout the area during artillery and air attacks. Positive chemical agent readings using the SCAIT Kit and designation of selected individuals to exhibit biological agent symptoms create a credible CBR environment. These and other techniques involve the individual soldier in an extremely realistic combat intelligence setting.

The S2 involvement is still dependent on message play, but a greater number of messages are generated by the batteries from "actual" events. The remainder are carefully structured to support and trigger the operational aspects of the test or exercise scenario. Effectiveness is enhanced by realistic content, format, delivery means and time lag. Tailoring of the intelligence input to provide targeting data, early warning of possible aggressor CBR use, prediction of enemy courses of action and requirements for displacement create an environment in which S2/S3 coordination is essential for mission accomplishment.

The execution of realistic, fully-integrated intelligence play on ORTTs requires continuous detail coordination between the division artillery S2 and S3 during the planning and preparation phase. After approval of the basic mission and position scenario by the commander, events are carefully chosen so that each intelligence input supports and lends realism to the unit's operations. At the conclusion of the ORTT, the interaction of operations and intelligence is studied thoroughly to insure that the desired results were obtained.

COL Jack L. Zorn, Commander, 9th Division Artillery, is a strong advocate of whole-unit evaluation under realistic combat conditions. He believes that "rounds in the box" are not the complete measure of a field artillery battalion's ability to accomplish its assigned mission. As a result, being a battalion S2 at Fort Lewis is no longer a spectator sport!

"Super C" Lifts Six

SCHOFIELD BARRACKS — Lightning struck the home of the "Tropic Lightning" Division when combat-ready soldiers from B Battery, 3d Battalion, 13th Field Artillery, leaped from helicopters to secure an area of Sill's Field near the 25th Infantry Division Headquarters. Minutes later a CH-47 "Super C" lowered six M102 105-mm howitzers to the group of waiting men. The situation resembled Schofield Barracks' first military coup, but it was all part of an innovative idea to combine a tactical exercise with a scheduled division retreat ceremony.

A good degree of planning and coordination was needed to suspend the swaying 19,000-pound load of guns. A special steel plate, used in earlier lifts of three howitzers, was submitted to the 84th Engineers for safety tests. The rigging and the guns themselves underwent a cautious inspection by the men of B Battery. Though the CH-47 to be used in the lift was capable of a 20,000-pound load under ideal conditions, the 147th Aviation Company had to consider the effects of air density, temperature, wind velocity and altitude that might endanger the men and equipment involved in the operation.

The "Clansmen" of the 13th Field Artillery arrived quickly and safely for the retreat ceremony "without a hitch," setting a divisional record for moving an entire six-howitzer battery in a single airlift. The 13th Field Artillery is currently testing the feasibility of such lifts in simulated combat situations.

The CH-47 "Super C" Chinook moves out with its 19,000-pound load of six M102 105-mm howitzers. Note steel plate in center of load.



Right By Piece

A Trainer For Q4 Radar

MISSOURI NATIONAL GUARD—Due to the increase of the AN/MPQ4A radars being made available to Reserve Component Field Artillery units, a problem is surfacing on how to adequately train radar operators during inactive duty training. In the past, when the radar and supporting equipment were not available, training of radar personnel usually consisted of classroom presentation at the armory and possibly some field training.

One key problem in training radar operators is for them to be able to observe target echoes on the radar screen. Currently there are only three means available to display the target echo: one, using the AN/TPA-7 target simulator; two, using live artillery or mortar fire; and three, using the tear drop (mortar round) mortar method. Unfortunately, none of these methods provide a viable solution for reserve components during inactive duty training (IDT). The TPA-7 target simulator either is not available or uneconomical (\$21,500 per simulator); the live fire artillery requires an artillery/mortar range and a corresponding field artillery or mortar unit in close proximity to the radar unit's armory; and the tear drop approach requires an 81-mm mortar (which TA battalions are not authorized) and a corresponding range close to the armory. Therefore, the problem remains: how to conduct meaningful training for radar personnel during the unit's inactive duty training time?

Now, due to the efforts of SFC John Oetting, 635th Aviation Company, MOARNG, coordinating with CW2 William Harman, Battery C, 1st TAB, 128th Field Artillery, MOARNG, a simple radar trainer has been developed to be utilized for armory training of radar personnel (see Fig. 1).

The trainer developed by Sergeant First Class Oetting allows a radar operator to be trained adequately at his home station at a projected cost which would not preclude purchase by the reserve components, approximately 25-50 dollars per trainer. Currently the trainer is programmed to be utilized for either refresher training for the experienced operators or initial training for those who have not attended advanced individual training at Fort Sill, OK.

The manually operated trainer is used in conjunction with the Q4's computer. This does not suggest that the radar has to be fully operational to train radar personnel. All that is needed in the way of operational equipment is the 400-cycle radar generator, the radar's computer and strobe lines. By utilizing the trainer and the radar as a system, the unit has the following training capabilities:

- a) The location of hostile artillery and mortar positions.
- b) The conducting of HB and MPI registrations.

- c) The calling of friendly artillery fire on hostile gun locations.

- d) The ability to provide realistic play in the conduct of command post exercises for units which have these radars assigned.

Thus, for the first time reserve component units assigned the Q4 radar have an economical means available for training radar personnel during their IDT periods.

How does this simple system operate to adequately train a radar operator? Outlined here are the procedures whereby the J/O Trainer (named after the developer) in conjunction with the Q4 can be utilized to accomplish the task:

Step 1. Conduct all pre-operational/operational radar checks and adjustments.

Step 2. Prior to instruction the radar should be oriented to a pre-selected map grid on any size map—recommend maps with the scale of 1:50,000.

Step 3. The instructor selects the slides to be used during the instruction and plots all target echoes determined by the radar read-out prior to the class (see Fig. 2).

Step 4. The instructor discusses the proper procedures of observing and marking projected target echoes and then places the first of the series of slides in the rear of the J/O trainer (see Fig. 3).

Step 5. Student observes and marks target echoes, utilizing proper procedures on the trainer's plexiglass screen (see Fig. 4).

Step 6. Student then takes the marked plexiglass screen and places it over the glass screen of the Q4 radar (see Fig. 5).

NOTE: The plexiglass screen of the trainer is designed to fit the recess position of the Q4 screen, thus enabling the student free access with his hands to operate the radar.

Step 7. Student strobes the previously marked target in the normal manner.

Step 8. Student reads out the coordinates and altitude of the target location.

Step 9. Instructor compares the student's location of the target with the actual location of the target and computes the error, if any. At this time the instructor critiques the student on his problem.

In times when the defense budget is under heavy attack, it becomes our responsibility to devise different methods of training personnel which will reduce present training costs without greatly affecting the overall training programs. It is visualized that by the utilization of the J/O Trainer in conjunction with the Q4, such an achievement can be realized. However, it must be remembered that the J/O Trainer is designed to supplement, not replace, existing training methods.

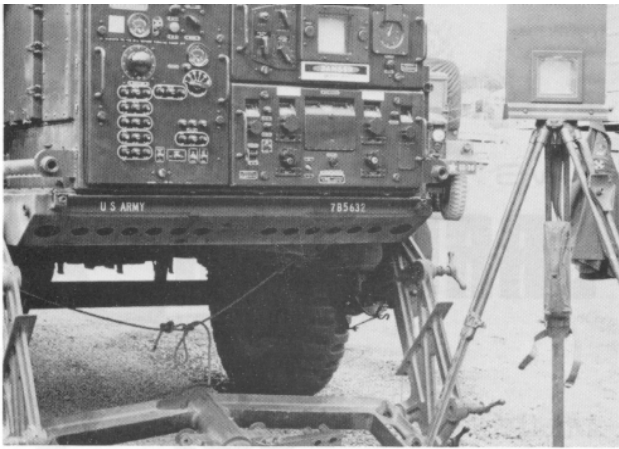


Figure 1—The size of the J/O Trainer compared to the AN/MPQ4A radar. The tripod on which the trainer stands is the same as used with the aiming circle.

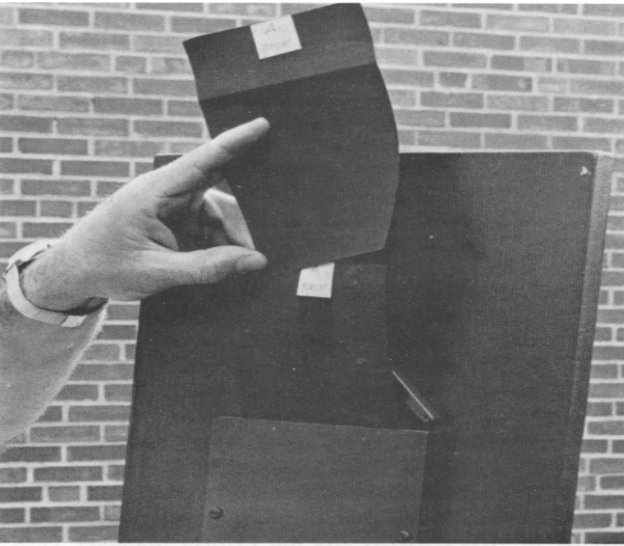


Figure 2— Depicted here is the method by which the target echoes are made to appear on the screen. In the instructor's left hand is a piece of black paper with two holes. These holes will show up as blips indicating the target echoes when the piece of paper with the white line is passed behind the paper with the holes.

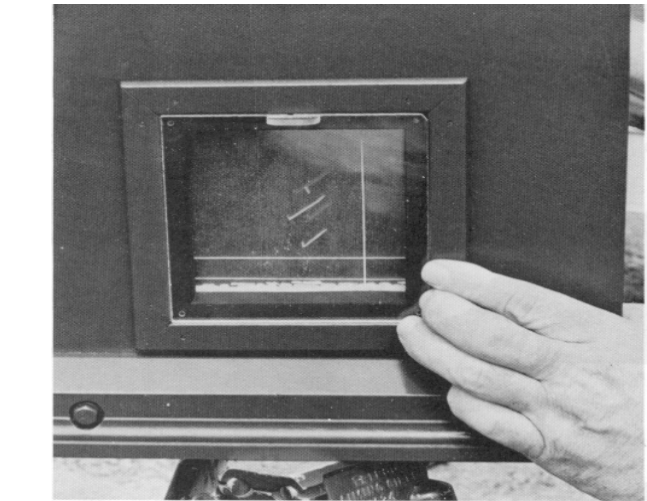
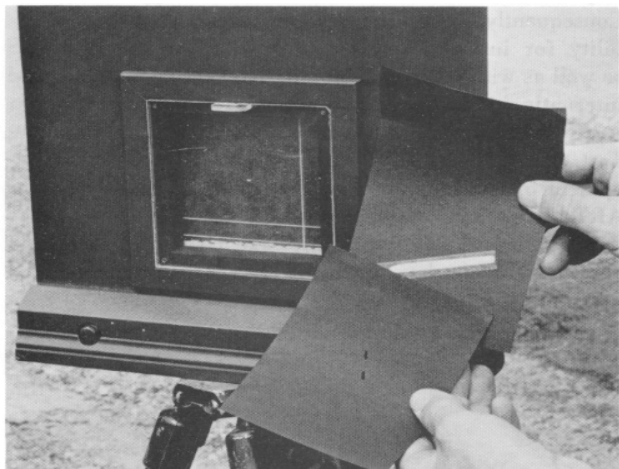


Figure 4—The target echoes appear on the screen of the trainer. The student then marks the target echoes on the plexiglass screen with a grease pencil.



Figure 5— The plexiglass screen is removed from the trainer with the target echoes marked in grease pencil and is placed over the window of the radar. (Note: The trainer screen is designed to fit in the window of the radar and has a handle attached which allows it to be easily removed from the trainer and placed in the radar and vice-versa.) When the screen is placed in the window of the radar, the student aligns the strobe lines on the target echoes and reads the weapon location from the radar's computer.

Figure 3— This is the rear of the trainer where the black pieces of paper are placed. The paper with the two holes is placed in front of the paper with the white line. The paper with the white line is then pulled by the instructor toward the top of the trainer.

The Journal Interviews . . .

MG ALBERT B. CRAWFORD

Project Manager, ARTADS

MG Albert B. Crawford Jr. is Project Manager for Army Tactical Data Systems (ARTADS). He entered the US Military Academy in 1946 and in 1950 was commissioned a second lieutenant in the Signal Corps. General Crawford has held assignments as a communicator, a commander and a pioneer in the Army utilization of automatic data processing (ADP). His assignments have included Operations Officer of the ADP Detachment at the US Army Electronics Proving Ground, Fort Huachuca; Chief of Systems Integration and TACFIRE Project Officer, CCIS-70 Project and the Automatic Data Field Systems Agency, Fort Belvoir; Chief of the Communications Systems Engineering and Management Agency, 1st Signal Brigade, RVN; Chief, Information Sciences Group and Deputy Management Information Systems Directorate, Office of the Assistant Vice Chief of Staff, Headquarters, Department of the Army. His educational achievements include a Bachelor's Degree in Military Science and a Master's Degree in Electrical Engineering and in Industrial Engineering.

Journal: General Crawford, why has it taken so long to develop TACFIRE?

Crawford: Frankly, the growth of TACFIRE from birth to adolescence has at times been painful. The problems encountered fall generally into two categories: non-compliance of the system to requirements and a change to the requirements themselves. When TACFIRE originally entered government testing, it became apparent that it simply was not developed to the point of acceptance. Therefore, the basic TACFIRE contract with restructured to permit a find-fix-test mode to identify,

correct and resolve the non-compliant areas. This phase was successful as demonstrated by the later formal test results and the favorable decision to proceed into limited procurement. In addition, this extensive testing revealed better ways of implementing certain functions. Also, evolving field artillery doctrine and techniques have caused some system changes. While a better system has resulted, the penalty has been a longer time in development.

Journal: Would you discuss the mission, functions and major projects of the Project Manager, ARTADS?

Crawford: The Army Tactical Command and Control Master Plan (ATACCOMAP) is the Army's blueprint for developing and fielding tactical data systems within the Army. The plan identifies and classifies candidate systems as ARTADS. Three of these have been assigned to me for project management: the Tactical Fire Direction System (TACFIRE), the Tactical Operations System (TOS) and the Air Defense Command and Control Systems (Missile Minder or AN/TSQ-73). As the Project Manager (PM) for these systems I am responsible for their life cycle management from the beginning of development through final disposition. Not all tactical data systems, as identified by the ATACCOMAP, have been assigned to me, though. For example, the Computer Systems Command is responsible for the Combat Service Support System. Consequently, I have been given the additional responsibility for insuring interoperability among all ARTADS as well as with other specified Army, service, national and international data systems. Finally, unlike most other Army PMs, I have an annual Research, Development, Test and Evaluation (RDTE) budget to expedite development of hardware/software items which lag the major ARTAD systems. Examples of this can be seen in our development of the Digital Message Device (DMD) and current efforts to develop a solid state large screen display.

One extremely interesting advanced development project involves the automation of discrete word recognition which could eliminate the need for any input devices relying on automatic digitizing of, for example, a verbal fire mission.

Journal: What are the major aspects of the Tactical Command and Control Master Plan?

Crawford: In addition to identifying tactical data systems, ATACCOMAP provides for the integrated management of the Army's overall efforts to improve tactical command and control capabilities. It contains a comprehensive program for the progressive development and fielding of improved command and control procedures and systems at all tactical echelons. The objective of this program is to provide the ground force commanders with an increased, more effective capability for planning, directing,

coordinating and controlling operations. Improving manual procedures and the developing of more effective organizations are part of the program in addition to the application of automatic data processing (ADP) to assist the commander and his staff. Experimentation and field tests are important hence the major role Project MASSTER at Fort Hood, TX, plays in the evolution of ARTADS and command, control and communication in general.

Journal: Would you assess the impact of plans and future tactical data systems on the combat arms in general?

Crawford: At last count there were some 55 systems in various stages of development which fell under the umbrella of the Executive Committee of the ATACCOMAP. These range from simple feeder systems such as sensors to the complex TACFIRE network. These affect all combat arms as well as the combat support and combat service support elements. I would say the nature of the emerging threat has precipitated the impending proliferation of ARTADS and other interoperating data systems. A highly mobile enemy equipped with modern weapons vastly increases the tempo on the battlefield. This, of course, demands a rapid reaction capability. A large part of such a capability resides in the use of swift and comprehensive intelligence and target acquisition gathering means already under development or in process of being deployed. Increasing intelligence and target acquisition will overwhelm our staffs and fire direction centers with information which cannot, with today's tools, be evaluated and processed in time for the commander to act in response to or, better yet, ahead of the enemy. There is no doubt the introduction of ADP in the tactical portion of the battlefield will have an impact on the Army much like the introduction of the tank back in World War I. The impact of the tank was felt throughout the Army, and I am not just talking tactics but also in the supply, maintenance, training and personnel areas. Some of the type criticisms and skepticisms which I understand were leveled at the tank back then are being leveled at tactical ADP today. For instance, "We'll never be able to maintain a complex vehicle like a tank." "What happens when the engine quits?" "What is our backup?" Well, our society became mechanically minded. We were able to maintain them and no one thought about dragging a horse along to offset an engine failure. Today, we see the same sort of what I term "cultural impact" stemming from electronics and computers. Children are learning how to use computers, and I don't mean the hand-held calculators, in the grade schools. High schools have programmable computers and most colleges have interactive terminals and computers readily available for student use. The younger generation feels comfortable with a computer.



The cultural shock, though, is with the older generation, and this is something else. Until one becomes familiar with computers and dispels the distrust, we will have this anti-computer feeling. Maintenance concepts must be developed so that a trained soldier will be able to repair these complex devices on the battlefield. Of course, we are not planning on repairing the integrated circuits and other such components in the field. These will be repaired at a depot. But the operator and maintenance personnel will be able to keep a system on the air with a minimum of special training or test equipment. Here again, automation of the fault detection and isolation process is the key—as implemented in TACFIRE. One last point regarding ARTADS impact . . . it is perfectly clear to me that each ARTAD system will in some way reduce the division slice. The major investment for this technology must be paid for by the elimination—trade-off—of personnel spaces. We saw this in the recent TACFIRE initial production decision process. Organization and doctrine WILL be impacted, of that I am sure.

Journal: Would you discuss the background and development of TACFIRE to include the major components of the system and the recent procurement decision?

Crawford: After a nine-year requirements gestation period, TACFIRE development was launched in December 1967 with the signing of a contract with the Data Systems Division of Litton Industries. In 1975, we might say TACFIRE reached its adolescence with the decision to proceed into Limited Procurement. The testing conducted prior to that initial production decision proved that TACFIRE is a highly successful data processing system designed to increase the effectiveness of field artillery firepower by automating the major functions of target intelligence, fire planning, "steel on the target," target analysis and fallout prediction. The success of TACFIRE to date can be attributed to a total, cooperative effort on the part of the developer (the US Army Materiel Command), the user/trainer (Training and Doctrine Command) and the testers (Test Command and Operational Test and Evaluation Agency) working with the contractor to produce a product which will revolutionize the field artillery of the future. I cannot stress enough the importance of all these agencies working together to reach that common goal.

TACFIRE consists of stored program digital computers, local and remote input-output devices, storage units, displays and communications equipment. At the heart of the system is the "third generation" AN/GYK-12(V) computer, one of which will be located at each corps artillery, division artillery, artillery group and at all cannon battalions.



The division Fire Support Element, the missile battalions and the fire support officers will have access to the system by means of the two-way Variable Format Message Entry Device (VFMED). One of the important results of the present testing was the determination that the current fixed format message entry device developed for the forward observer was inadequate. Therefore, a new development was initiated which will result in a new more capable, hand-held unit, the TACFIRE Digital Message Device. This device will provide the forward observer with improved two-way digital communications

with TACFIRE, and ultimately will accept the digitized input from a laser rangefinder.

Each cannon firing battery is equipped with a Battery Display Unit to provide the display of the fire commands generated by the computer at battalion. However, requirements are now crystalizing from which we plan to procure a battery level computer to replace both the TACFIRE Battery Display Unit, FADAC and possibly the VFMED. This computer would provide two-way digital traffic between TACFIRE and the battery and provide an independent calculation of the ballistic solution for batteries on detached missions as well as separate firing data for each individual cannon in the battery. Fort Sill is currently preparing a Required Operational Capability (ROC) for the battery level computer in parallel with the TACFIRE Limited Procurement and plans to integrate it into TACFIRE during or just subsequent to the next major test series.


The Defense Department decision in January of this year authorized the Army to proceed with the procurement of 14 TACFIRE Fire Direction Centers (three division artillery and 11 battalions) and the associated peripherals. These are scheduled to be available for Force Development Test and Experimentation by the Field Artillery School in February of 1977.

Journal: Would you elaborate on the battery computer, sir?

Crawford: As I mentioned, the requirements in the form of a ROC are now being developed. When TACFIRE was conceived many years ago, there was a battery computer associated with the system. For many reasons, though, the battery computer was eliminated. The battery computer was replaced with the simpler Battery Display Unit which displays the firing commands, computed at the battalion, at the battery. With the advent of new weapons and devices such as CLGP, the Cannon Launched Guided Projectile (see March-April 1975 *Journal*), the requirement for the battery computer has been revalidated. It is anticipated that the battery computer will be able to compute individual piece corrections and provide for independent operations. When the ROC is completed we'll have a better feel for the full range of requirements and concept of employment. I can assure you, though, the battery computer cannot end up being another battalion TACFIRE. The ROC, a Cost and Operational Effectiveness Analysis (COEA) and an Office of Secretary of Defense (OSD) directed survey of foreign weapons systems which could possibly be used in TACFIRE, coupled with the results of the HELBAT V series of tests scheduled for May and June at Fort Sill, will give the necessary documentation to validate the

requirement and permit engineering development to begin. Plans are presently being staffed at Department of the Army and OSD to provide for the Validation In Process Review in September of this year. This, in conjunction with the parallel development of a technical data package, would permit, around the first of January 1976, the issuance of a Request for Proposal to industry to develop a battery computer. Our best estimates are that the battery computer would be available for testing very near the end of the TACFIRE DT/OT III testing, hopefully in time to influence the TACFIRE Full Scale Production (FSP) decision.

Journal: What further TACFIRE testing will be required prior to the FSP decision?

Crawford: As with all major weapon systems, there is an extensive test cycle scheduled prior to the FSP decision. There are software Preliminary and Final Qualification Tests conducted to insure the software or computer programs meet their specifications. This testing is done on the hardware in a programming support center in parallel with the hardware production. The first major system test will be the First Article Test. This is conducted by the contractor to demonstrate that he has made the transition from development to production. This test, scheduled for three months, will insure that the system meets its specifications and is ready to be turned over to the user (the Field Artillery School) and testers (TECOM and OTEA) for their independent testing. First Article Test, by the way, will be the first time we will have tested a complete Division Artillery system with four battalions and its full complement of peripherals. The First Article Test will be followed by Force Development Test and Experimentation, as I mentioned earlier. The conduct of this test is a TRADOC responsibility. The purpose is to determine the field artillery doctrine and organization best suited to fight the wars of the future and to best exploit the capability of TACFIRE. In addition, the user will verify that the changes made to the system since the Developmental Operational Test II (DT/OT II), such as the new keyboard are acceptable, and the system is ready for further testing by TECOM and OTEA. Finally, DT/OT III will be conducted to insure that TACFIRE is ready for Full Scale Production and deployment throughout the Army. It is planned that TECOM will conduct DT III mostly at White Sands Missile Range, NM, while OTEA is planning on conducting OT III at Fort Lewis, WA, using the 9th Infantry Division Artillery as the test unit. Throughout this cycle the integrated test concept will be used to minimize duplication of the testing effort while insuring a complete and thorough test. 

artillery in villages

by MAJ Robert H. Scales Jr.

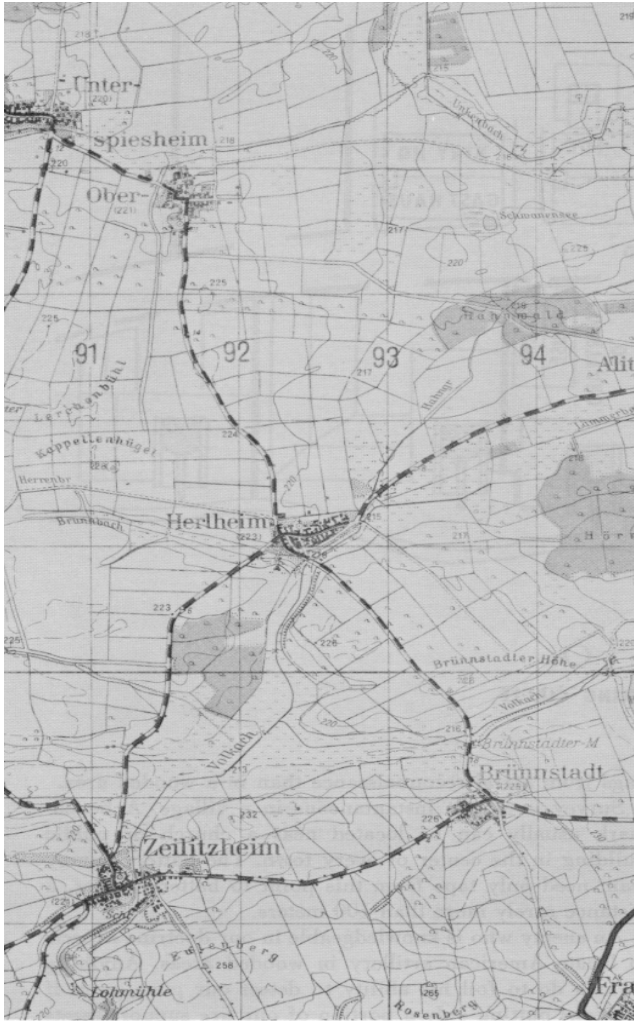
During late fall of 1944 the German high command in Western Europe faced a difficult problem as they prepared for the Third Reich's last major offensive of World War II. To win, they would have to mass an overwhelming superiority of combat power on a very narrow front stretching through the Ardennes Forest. Yet it was essential that the massing of German armored units be carried out in absolute secrecy. Ultimately the Battle of Bulge resulted in a disastrous defeat for the Wehrmacht, but the techniques used by the Germans to conceal their front line combat units from the watchful eyes of Allied intelligence proved amazingly successful. The Ardennes is thickly forested and ideal for hiding large combat forces. Yet many artillery commanders positioned their light and medium guns in the small villages and hamlets scattered throughout the area. Artillery pieces were dug into barnyards. Ammunition carts and vehicles were hidden in sheds and workshops. These positions remained undetected by American combat patrols and aerial reconnaissance until they opened their first deadly barrage on 15 December 1944.

Perhaps we can take a lesson from the past. Today we face a potential enemy possessing a substantial initial superiority in firepower and, like the Germans in 1944, to survive we must reduce the effects of our adversary's firepower by making the best possible use of cover and concealment. The manuals we are currently developing only address the positioning of artillery firing units in wooded areas. This is understandable since in Europe we tend to plan as we maneuver, and wood lines and forested position areas are all that are conveniently available at major training areas for battery and battalion exercises. On occasion, command and communications vehicles may locate in villages during command post



exercises, but major combat units have never had the opportunity to forsake classic wood-line firing positions and relocate into villages and towns.

Speaking practically, the use of wood lines as cannon and rocket artillery position areas has become more and more open to question as the topography of Central Europe has changed during the past 30 years. Many of the forested areas are gone, and many more have been thinned through forestation so they no longer offer cover from aerial observation. At the same time cities and towns have proliferated throughout the area that we consider a possible battlefield in the future. The reduction in the number and size of available tree lines facing perpendicular to the desired direction of fire has occurred simultaneously



with a subsequent increase in the number of units seeking concealment forward in the division zone. The resulting competition for a diminishing number of concealed position areas will only serve in the future to simplify the enemy's counterbattery mission. He will not necessarily have to *see us to kill us*. He has more than enough firepower to suppress many of the likely tree-line positions to his front, and the chances are becoming greater every day that he will hit something important. Wood-line position areas have other serious disadvantages. Only from early spring to early fall do forests in Europe offer excellent protection from visual detection. And only deciduous forests offer sufficient room between trees to accommodate large vehicles. Unfortunately, during the winter months most of the concealment offered by these trees falls away. "Hardening" or digging of a howitzer position in a forested area only aggravates the problem of concealment. Freshly turned earth and the tracks of earth-moving equipment are almost impossible to hide, particularly in

the winter.

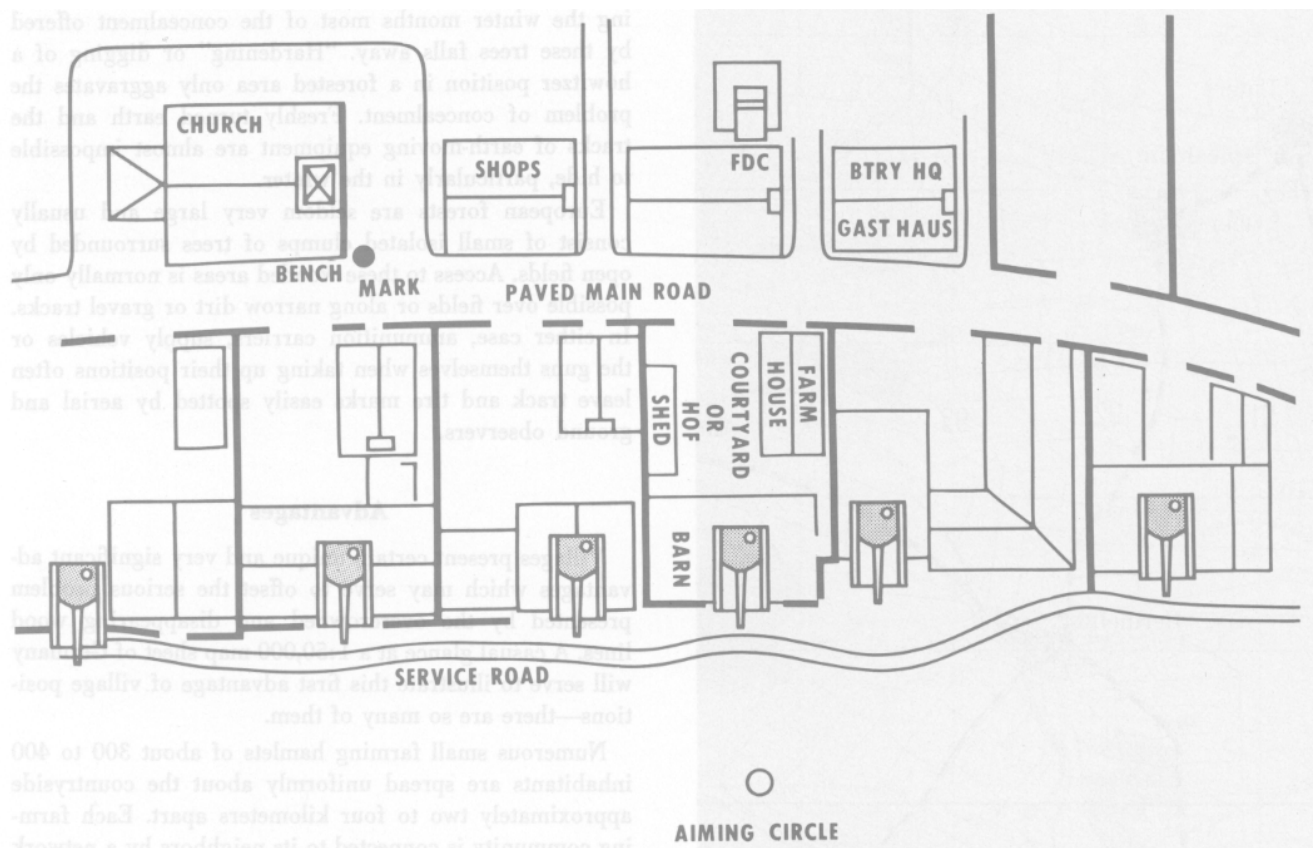
European forests are seldom very large and usually consist of small isolated clumps of trees surrounded by open fields. Access to these wooded areas is normally only possible over fields or along narrow dirt or gravel tracks. In either case, ammunition carriers, supply vehicles or the guns themselves when taking up their positions often leave track and tire marks easily spotted by aerial and ground observers.

Advantages

Villages present certain unique and very significant advantages which may serve to offset the serious problem presented by the overcrowded and disappearing wood lines. A casual glance at a 1:50,000 map sheet of Germany will serve to illustrate this first advantage of village positions—there are so many of them.

Numerous small farming hamlets of about 300 to 400 inhabitants are spread uniformly about the countryside approximately two to four kilometers apart. Each farming community is connected to its neighbors by a network of paved or improved two-lane roads. The villages are normally laid out evenly along both sides of a single street with a church and a churchyard near the middle of the village. Most of the shops and barnyards or *hofs* open on to this central thoroughway. The barnyards are very important and deserve closer investigation.

A *hof* normally consists of a cobblestone courtyard opening on to the main street and surrounded by a farm house, a small stable and a large barn at the end of the courtyard with two large doors giving the farmer access to his fields. These *hofs* would make excellent howitzer positions. A gun placed in each barn would be completely concealed. The rear doors of the barn need only be opened to fire. Protection from counterbattery fire for crew members outside the track is afforded by the thick stone walls surrounding the courtyard. The basements and cellars of the houses and shops are almost impervious to enemy shell fire and provide excellent shelter for sleeping billets, the battery fire direction center, the commo section, etc. As many of our infantry units discovered during the World War II, the excellent cover provided by these cellars actually improves if the buildings are destroyed by shell fire, because the collapsed superstructure acts as an efficient bursting level for the cellar and only a direct hit by a delay fuse will penetrate it. Because the battery is already well-protected by thick walls, little improvement




will be necessary and, in a fast moving situation, the gun crews can concentrate on shooting instead of digging and concealment. By restricting their movement to the central paved street, resupply and reconnaissance vehicles and roving guns can enter and leave the battery position without disclosing their positions.

Villages are much easier to defend. Normally they are surrounded by open fields and pastures offering good fields of fire and making surprise attack extremely difficult. Strong basements and thick walls also make excellent automatic weapons positions and the ease of maneuvering through the village street would allow self-propelled howitzers to shift positions rapidly when engaging an attacking enemy with direct fire.

Villages and hamlets would provide greater passive protection should the enemy employ sophisticated aerial detection devices. Infrared "hot spots" in villages could be interpreted as stoves, furnaces, lights or fireplaces. A series of hot spots in a deserted forest may indicate the presence of hidden vehicles. Also, aerial photography which detects square or rectangular objects arrayed uniformly within a forested area would almost certainly indicate a military target. In a village jeeps, trucks, generators and self-propelled guns may be easier to camouflages from aerial reconnaissance than in a wooded area.

Survey is almost instantaneous in a village. A benchmark usually can be located near a church or public building in the center of every town. The battery survey team need only tape from this point to battery center, a distance rarely more than 100 meters.

An enemy who is knowledgeable in our doctrine expects to locate American artillery in wooded areas. Anything we can do to foil his ability to detect our guns, even if it means putting only a portion of our fire support assets in towns, will increase our ability to survive. Perhaps prior to the Battle of the Bulge we were unable to locate German batteries because we *expected* to find them only in traditional places. If only we could create such deception ourselves, we would be well on our way to winning the next battle. 

MAJ Robert H. Scales Jr., FA, is a military history instructor at the US Army Infantry School, Fort Benning, GA.

Mass Fire

(Continued from page 19)

of dedication comparable to the accompanying guns of World War I but without the disadvantages attendant upon the supporting guns remaining physically with the maneuver force. A concept for "dedicated batteries" is being considered which recognizes the overriding need to respond to the demands of an advancing force. The dedicated batteries concept entails the placing of a battery in direct support of a lead maneuver company for the period of maximum threat to the advancing force. It is tailored to the situation in which a meeting engagement is anticipated and each succeeding move of the lead company may bring it into the last extremity.

The dedicated battery would still belong to the parent DS battalion but it would bear a special tag for a limited but probably unspecified time. The FO with the lead company and as many maneuver personnel as can be educated to assist will preplan fires to a greater extent than usual. In high threat areas, a rolling barrage of suppressive fire similar to those of WWI could be used to improve survivability of the lead company. The contact by a major element of the force, a coordinated attack, or assumption of the defense would all be conditions for termination of the dedicated battery status.

Since WWI the field artillery has held to the principle of maximum feasible centralized control that permitted mass fire—perhaps to a fault. Without abandoning the principle, the definition of "maximum feasible" is being scrutinized in light of fronts more than 10 times as wide per unit as those of WWI and the possibility of the maneuver force adopting a strong point defense or the emergence of a porous battlefield. Obviously, wider fronts and tactics embodying decentralization demand some introspection regarding how much centralization is feasible. All indicators are that the division artillery will assume most of the practical control of field artillery in the corps sector and outright ownership of the target acquisition means. The corps artillery function will be primarily one of apportioning resources in the fashion of the field army of old. It is emphasized again that this is a latter day application of a WWI principle, albeit at a lower level.

Part of the AEF's success was due to a highly developed and well integrated artillery intelligence organization oriented on counterbattery activities, tightly linked from the highest to the lowest levels. Currently, the Field Artillery School is studying the reorganization of target acquisition to bring it in conformance with the overall decentralization. The development of much more capable targeting sections, possibly including the Battle Information Control Center, is a major consideration. These targeting sections would be organic to DS battalion, division artillery and corps and would be tied together much as was the Artillery Intelligence Service of WWI.

WWI artillerymen placed a premium on map firing—fire-for-effect without adjustment—and its

constituents. The future battlefield characterized by limited ammunition stocks, the need for quick reaction and the vulnerability of fire units will make first round fire-for-effect the most essential technical ingredient for success. Our most prolific acquirer of targets, the forward observer, is also the most error prone and his contribution to first round fire-for-effect will be immeasurable if position and range finding equipment now in R&D fulfills its promise. Developmental meteorological equipment, velocimeters and computers all have potential to enhance map firing.

On balance, WWI, frequently thought of as an unimaginative if bloody conflict characterized by profitless frontal attacks, was actually a colorful and demanding war replete with innovations in terms of field artillery employment and materiel. There is much to be learned from WWI, especially that the purpose of field artillery is to support the maneuver force, that it does not stand alone. The field artillery must forever be searching for the creativity which will allow fire support to stay apace of maneuver doctrine and to take full advantage of materiel developments. ☒

*a word
from the
editor*

(Continued from page 2)

A word to our prospective authors. Needless to say, in July of 1973 we were extremely short of material. Almost as soon as we received articles and feature material, they went into print. I am happy to report that we are now in the process of building a backlog in almost all categories. What this means to you authors is that it may take a little longer for your contributions to appear in the *Journal*. Bear with us, and keep those cards, letters, articles and features coming!

We bid farewell last month to Mr. Allen Boules who has been our assistant editor for the last year. Al, an outstanding journalist and a dedicated civil servant, will be sorely missed. We wish him Godspeed.

Enjoy your *Journal*!

editor

ROTC GRADUATE ACTIVE DUTY AND BRANCH PREFERENCE STATEMENT

PART I—ADMINISTRATIVE DATA (TO BE COMPLETED BY PMS)

1. NAME	(1-18)	<input type="text"/>
2. SOCIAL SECURITY NUMBER	(19-27)	<input type="text"/>
3. SCHOOL CODE	(28-31)	<input type="text"/>
4. SCHOLARSHIP CODE	(32)	<input type="text"/>
5. DMG CODE	(33)	<input type="text"/>
6. SPECIAL TRAINING CODE	(34)	<input type="text"/>
7. RA APPLICANT CODE	(35)	<input type="text"/>
8. MEDICAL QUALIFICATION	(36)	<input type="text"/>
9. EDUCATIONAL FIELD	(37-39)	<input type="text"/>
9A. DEGREE LEVEL	(40)	<input type="text"/>
10. BRANCH IN WHICH TRAINED	(41-42)	<input type="text"/>

PART II—PREFERENCES (TO BE COMPLETED BY ROTC GRADUATE)

11. ACTIVE DUTY ACTIVE DUTY TRAINING DELAY PREFERENCE	(43-44)	<input type="checkbox"/>
12. BRANCH PREFERENCES		
A. FIRST	(45-46)	<input type="checkbox"/>
B. SECOND	(47-48)	<input type="checkbox"/>
C. THIRD	(49-50)	<input type="checkbox"/>
D. FOURTH	(51-52)	<input type="checkbox"/>
13. DATE OF GRADUATION (MONTH AND YEAR)	(53-54)	<input type="text"/>
14. PREFERRED ENTRY DATE (MONTH AND YEAR)		
A. FIRST	(55-56)	<input type="checkbox"/>
B. SECOND	(57-58)	<input type="checkbox"/>

DATE	SIGNATURE OF CADET
<input type="text"/>	<input type="text"/>

PART III—PMS RECOMMENDATIONS (TO BE COMPLETED BY PMS)

15. SPECIAL CATEGORY CODE	(60-61)	<input type="text"/>
16. RECOMMENDED BRANCH	(62-63)	<input type="text"/>
17. RECOMMENDATION FOR ACTIVE DUTY	(64)	<input type="text"/>

DATE	SIGNATURE OF PMS
<input type="text"/>	<input type="text"/>

PART IV—CONTROL HEADQUARTERS

18. HEADQUARTERS CODE	(65-66)	<input type="text"/>
19. PROCUREMENT PROGRAM NUMBER (PPN)	(74-75)	<input type="text"/>
20. LAST DIGIT OF FY APPLICATION SUBMITTED (E.G., 1 JUL 74—30 JUN 75 USE 5)	(76)	<input type="text"/>

by CPT Robert L. Duedall

DA Form 1809-R is a unique sheet of paper. With a few strokes of a pen a young man may simultaneously choose a career and commit himself to a heritage, a tradition following in the footsteps of men such as Ringold, Bragg, Pelham and Truman. In the past, several thousand such young men, Army ROTC cadets, have seen fit to designate Field Artillery as their first choice in future service among the other branches of the Army. Again this fall another group of cadets will make their branch selections. The Field Artillery proudly offers these future officers an opportunity to join the source of strength and firepower for the combined arms team—an opportunity unmatched in satisfaction and potential.

Today's Redleg is more than a commander of the lethal arsenal of cannons and missiles associated with field artillery. He is a trained supervisor and a professional in the management of men as well as weapons. He specializes in delivering firepower to a given target—quickly and effectively. He also dispels a popular misconception (perpetrated by well-meaning albeit uninformed officers of other branches) in that he is not a mathematical genius but does understand the arithmetic necessary to fire a howitzer or a missile accurately. He is a qualified leader of competent volunteers and a director of the most decisive weaponry in the Army. He exhibits pride in his heritage, confidence in himself and expertise in his job. He is an officer of the United States Army Field Artillery.

FA Training

As a newly-commissioned field artillery lieutenant you first attend the Field Artillery (FA) Officer Basic Course (OBC) at Fort Sill, OK, the traditional "home" of the Field Artillery. This course provides basic FA branch training and orientation. The curriculum is designed so that you learn to be a proficient forward observer (FO) and fire direction officer and become familiar with the duties of the battery executive officer. Your instruction includes principles of FA organization and tactics, characteristics and operation of artillery weapons, techniques and procedures of observed fire, fire direction and operation of the firing battery. Also, there is training with communication and target acquisition equipment and systems. Your instruction is structured and presented with emphasis toward employment of the combined arms team and the important part you will play in that team. Modern instructional techniques in a realistic environment are used to assist you in mastering the course and preparing you for rewarding FA careers.

For those interested in learning more about FA before making their branch selections, there are several opportunities of which you may take advantage. The Army Orientation Training Program is a follow-on to advanced

summer camp. Selected cadets are offered opportunities to join active field artillery units for a two-week period. The pay is the same as that drawn for summer camp and you will receive first hand experience in an FA unit assisting the battery officers in their duties. Your PMS will have the details.

In addition, Fort Sill runs an ROTC Orientation Program throughout the year for groups of cadets from many detachments. Training highlights are featured as well as an excellent overview of FA and Fort Sill (see box page 48). Some excellent material is available for study right on your own campus. The FA School's Army-Wide Training Support Department (long recognized as the finest in the Army) maintains an orientation study packet that may be obtained through your PMS. Additional correspondence courses are available, at no charge to you, through a correspondence catalog located in your detachment.

Approximately 300 colleges and universities are scheduled in December of this year to receive the Army's latest training and education equipment, the Beseler Cue/See audiovisual device. Termed Training Extension Courses, the equipment will assist ROTC detachments in their training mission. Fort Sill is currently developing an FA orientation and other courseware for use in the ROTC units.

The Forward Observer

An FA lieutenant's first traditional job is that of FO—the eyes and ears of the field artillery. While in the field he and his team, equipped with the latest acquisition, transportation and communication gear, "live" with the infantry or armor company they are supporting. The FO locates targets, assists the company commander in planning fires and calls for and adjusts artillery fire in support of the company's operations. He transmits the locations of targets back to the fire direction center (FDC) where it is converted into firing data for the gun crews. The FO is a critical member of the combined arms team . . . he's where the action is and his job is challenging and exciting. The FO does not command a group of men (that will come later) but the firepower he does control is truly awesome.

The lieutenant's next assignment is usually as the battery assistant executive officer (AXO). The AXO runs the "heart" of the battery, the FDC, monitoring and controlling its operations. He controls the elements necessary for the responsive delivery of effective fire. He receives and converts the FO's target data into the information needed to put the rounds on target. Everything comes together in the FDC, under the management of the AXO.

The Executive Officer

As the senior lieutenant in an FA battery, the executive officer (XO) is the leader of the firing battery. He controls

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and supervises the training and operations of all elements of the firing battery—the gun crews, the ammunition section and the FDC. The XO's job can be a satisfying experience, for this is the lieutenant's most important opportunity to develop and direct a large group of men, molding them into a cohesive, functional unit.

Missiles

The family of FA weapons includes guided missiles—the big, long-range punch. The Pershing and Lance missiles represent a significant portion of the total firepower available to the ground forces. Both are currently fielded at Fort Sill and in Germany. The leadership requirements and opportunities for junior officers in these units are as rewarding, demanding and challenging as any FA job. Advancement and career development are equal in both cannon and missiles and the FA officer moves with ease and confidence from one to the other throughout his career.

Under peacetime conditions, duty in cannon and missile units consists primarily of training personnel, developing top combat proficiency and maintaining the unit, its men and equipment in the highest state of readiness. This is an area demanding imagination, ingenuity and significant contributions. Knowledge of and responsibility for men and materiel, and their efficient management, are excellent preparations for any future endeavor—whether it be as a senior FA officer or a civilian in any career.

Nearly all FA assignments provide for keeping married officers with their families. Housing, either on or off post, is available whether your assignment is stateside or overseas. A wife's involvement in her husband's career and unit's activities can be as broad or as selective as she desires. An invitation is extended to both the cadet and his wife (or future wife) to join the field artillery community.

The Combined Arms Team

The FA serves as a vital link in the combined arms team concept. The Field Artillery System does more than just deliver the artillery rounds; it is responsible for coordinating the total fire support effort of the ground forces, the Air Force, the Navy and any other support weaponry found on a modern battlefield. The artillery works closely with infantry and armor to provide the total package required to get the job done. Many of the new techniques and changes in tactical doctrine that have been developed will soon be integrated into ROTC programs of instruction and summer camp activities. These include concepts of suppressive fires, simplified calls for fire, modified fire direction and firing battery procedures and improved fire support coordination techniques—all designed to better support the offensive and defensive operations of the ground-gaining forces.

Being an integral part of the combined arms team makes field artillery exciting and stimulating. The FA officer is at the best vantage point for gaining the "big picture" of the battle.

FA Career Officers

Field artillery has much to offer the career-minded cadet in command and specialty assignments. Command positions range from battery commander to command of division artillery. Under the Officer Personnel Management System, 47 specialty areas provide positions that take maximum advantage of previous college education, military experience and the individual's own interests. The Field Artillery Branch expects its officers to continue their military and civilian educations and has many programs to assist in this. During his career the officer will have opportunities to attend the FA Officer Advanced Course and specialty courses at the Field Artillery School and to attend higher level courses at the senior service schools. Monetary assistance also is available for many programs providing the officer an opportunity to pursue an advanced degree from a civilian school. Full and part-time programs are also available. Well-educated, experienced FA officers have many career opportunities available to them and they compete well against officers of the other branches when being considered for promotion.

This is the field artillery story. When you do sit down this fall and face that DA Form 1809-R to make your branch selection, keep field artillery, King of Battle, in mind. No branch has a finer heritage or a brighter future.

That is worth thinking about.



ROTC Cadets Visit "SHOT"

Selected ROTC cadets from the University of Oklahoma (OU) regularly visit Fort Sill to observe and participate with OBC students in the Student Highlights of Training (SHOT) exercise. Each OBC class is scheduled for SHOT the first day of training (after inprocessing) when they learn firing battery operations during a hands-on live-fire exercise. The activities include participation on an observation post adjusting live-fire, gun crew duties firing live ammunition, computing the fire commands in the FDC and conducting a reconnaissance, selection and occupation of position for an FA firing battery. The day's activities climax with a social hour at the Fort Sill Officers' Open Mess where students see video tapes of training and talk with instructors and department directors. Married students rejoin their wives who have been touring the post during the afternoon.

The exercise is an excellent opportunity for selected cadets of ROTC units to see the military schooling system at work under field conditions—to see and talk with newly-commissioned lieutenants on active duty. Several of the OU cadets during past visits were able to meet again and talk with former college classmates who were attending OBC. No equipment other than a fatigue uniform is needed. The FA School will furnish what may be needed for safety and comfort. Units wishing to take advantage of this program may call the Training Technology and Evaluation Branch, Office of the Director of Instruction (Autovon 639-3267/1125); or write for further details to Commandant, US Army Field Artillery School, ATTN: ATSF-DOI-T-TE, Fort Sill, OK 73503.

MASSTER and the Field Artilleryman

by MAJ Howard L. Buchly

The first question any self-respecting field artilleryman might ask is, "What the hell is MASSTER?"

By simple definition MASSTER (Modern Army Selected Systems Test, Evaluation and Review) is an organization which plans and conducts field tests and evaluation for the US Army. Located at Fort Hood in the central hill country of Texas, MASSTER was organized in October 1969 with a mission: evaluate equipment developed under the Surveillance, Target Acquisition and Night Observation Program. From this quick reaction (Vietnam-oriented) type of evaluation, MASSTER responsibilities have expanded to an all-encompassing mission: conducting field tests and evaluations to determine military potential or operational suitability of materiel/systems; making recommendations pertaining to organization, doctrine, materiel and training; and providing data for higher-level resolutions of force structure and organizational problems.

The "doers" of MASSTER are organized into five test directorates and one Engineering and Instrumentation Directorate. The test directorates are divided into functional areas with specific test responsibilities as noted in Figure 1.

A quick but perceptive glance at the figure will establish that MASSTER does have an interest in field

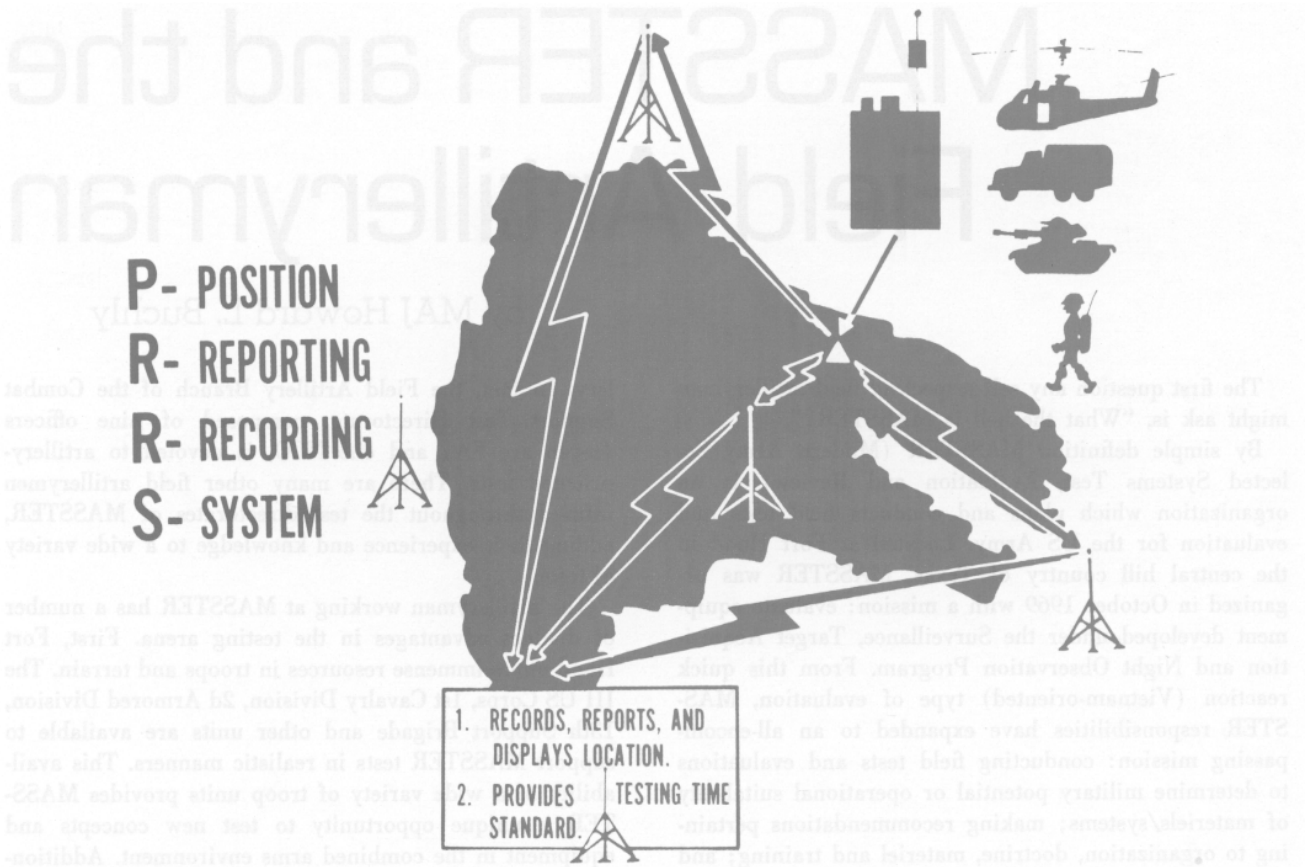
artillery. In fact, the Field Artillery Branch of the Combat Support Test Directorate, composed of nine officers (seven are FA) and one NCO, is devoted to artillery-oriented tests. There are many other field artillerymen infused throughout the test directorates of MASSTER, adding their experience and knowledge to a wide variety of tests.

The artilleryman working at MASSTER has a number of distinct advantages in the testing arena. First, Fort Hood offers immense resources in troops and terrain. The III US Corps, 1st Cavalry Division, 2d Armored Division, 13th Support Brigade and other units are available to support MASSTER tests in realistic manners. This availability of a wide variety of troop units provides MASSTER a unique opportunity to test new concepts and equipment in the combined arms environment. Additionally, Fort Hood offers varying types of terrain—more than 340 square miles.

The integrated instrumentation support available to MASSTER testers enables them to collect extremely accurate and complex test data. The Position Reporting and Recording System (PRRS) is able to provide the tester with accurate location of selected vehicles and personnel anywhere on the Fort Hood reservation. PRRS incorporates adaptable mobile units which may be placed on

Figure 1—Test Directorates

Ground Combat	Air Combat	Combat Support	Combat Service Support	Command Control Commo
Armor Units	Air Cavalry	Field Artillery	Personnel Admin	Tactical Command & Control
Armored Cavalry	Aerial Field Artillery	Air Defense Arty	Maintenance	Tactical Data
Infantry	Army Aviation	Military Intelligence	Supply	Processing Systems
Unconventional warfare	Systems/Materiel	Counterintelligence	Transportation	Signal Communications
Ground Combat Systems/Materiels			Health Services	
			Engineer	
			Construction	
			Utilities	
			Topographic & Geodetic functions	
			Field fortifications & camouflage	



vehicles, aircraft or personnel. These units transmit unique low frequency transmissions picked up by five 150-foot towers and relayed into a central processing facility where they are correlated and stored on magnetic tapes. This system operates on real time with display information continually available to the evaluator.

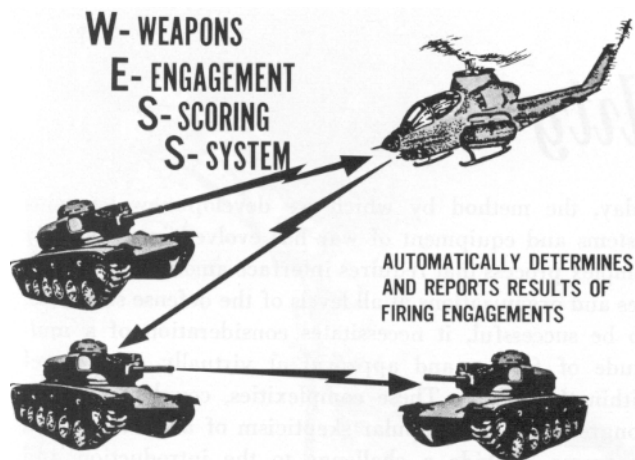
A second system, the Automatic Data Collection System (ADCS), correlates test data with time and position information received from the PRRS. ADCS automatically receives, processes and stores data for future analysis. This system is invaluable when large amounts of time-critical data must be collected to render a valid evaluation.

The Weapons Engagement Scoring System (WESS) is undergoing its final acceptance test and will provide the capability of realistically simulating weapons engagements. WESS uses laser transmitters and detectors combined with logic units which enable the system to simulate a wide variety of weapons systems. MASSTER will now be able to incorporate a meaningful type of attrition during its test.

The artilleryman at MASSTER thus has the advantage of a wide variety of troop support, ideal terrain and a sophisticated system of instrumentation support for testing purposes. A number of significant tests have been

conducted by MASSTER which directly affect the Redleg community. MASSTER has conducted extensive evaluations in target acquisition by radars, sensors, aerial platforms and a variety of night observation devices. A number of land navigation systems ("Right by Piece," September-October 1974 *Journal*) have been evaluated which may prove to have impact on artillery operation. An informal program of evaluation of the Aerial Field Artillery battery was conducted. The evaluation of the integration of the Ground Laser Locator Designator (GLLD) equipped observation parties into the direct support field artillery battalion fire support system employing conventional and Cannon Launched Guided Projectile (CLGP) munitions ("CLGP," March-April 1975 *Journal*) was recently completed by Field Artillery Branch. This test, Forward Observer Team Equipped with Ground Laser Locator Device (FOTEGLLD) saw the artillerymen of MASSTER and selected officers from USAFAS working together to find the creditable solutions.

The Combat Support Test Directorate of MASSTER is currently conducting a test which evaluates the relationship between artificial illumination and night vision devices. Phase II will investigate the effects of artificial



light coupled with various night seeing devices in a troop operational environment. This test, of course, directly impacts upon the artillery observer's ability to call accurate fire during periods of darkness.

In the immediate future, MASSTER artillerymen will be engaged in a number of artillery-oriented tests. Hopefully, an evaluation of a hand-held calculator integrated into the fire direction center of a direct support battalion will be conducted the first quarter of FY 76. This evaluation will examine potential of the hand-held calculator in performing as a replacement for the horizontal control chart, as a check device and as a principle aid in a "hip shoot." The training necessitated by using the calculator will be evaluated as well as the human reaction to use of the calculator.


At the request of USAFAS, the Field Artillery Branch of the Combat Support Test Directorate will conduct an evaluation of a vehicle adopted for use as a dedicated forward observer (FO) vehicle to assist the FO in providing continuous field artillery support for armored, armored cavalry and mechanized infantry units. The testbed FO vehicle to be tested will be an M113A1 armored personnel carrier modified with an AN/GVS-5 Laser Rangefinder internally mounted in an M-36 periscope. The test will be conducted in three phases to evaluate the interface of the three-man FO party and the

vehicles, to include the accomplishment of such FO duties as fire planning and fire support of mounted and dismounted operations. Phase I will be a limited field exercise conducted under simulated tactical conditions during which the M113A1, with and without the LNS-516 Land Navigation System, will be compared to vehicles commonly used by the FO party. The LNS-516 should provide the FO with positioning information which, coupled with the rangefinder, will allow for more accurate data.

Phase II will be a field exercise incorporating most tactical situations normally encountered by an FO in which the mission performance of the FO party operating in the testbed vehicle will be compared to the mission performance of FO parties operating in selected current TOE vehicles. This phase will include night operations and periods of limited visibility and adverse weather, if available. Phase II will be integrated with on-going exercises to the maximum extent possible.

Phase III will be a live fire adjustment exercise for the testbed vehicle only wherein the FO party will operate from a closed vehicle. The results of this test will be used to evaluate the relative impact of the vehicles on an FO party's ability to perform its tactical mission, on logistics support requirements and on human factors and to identify any shortcomings in the testbed FO vehicle.

The Combat Support Test Directorate will test a sensor package programmed for remotely piloted vehicle surveillance operations. This test will provide USAFAS with basic parameter information as to the limitations of the sensor package. Selected operational and organizational concepts will be tested to produce the recommended unit of assignment and to develop command, control and communications procedures.

The artilleryman in MASSTER is provided an unparalleled opportunity to participate in the development of Army materiel, doctrine and operational concepts. The wide variety of tests conducted at MASSTER ensure an acute awareness of the latest developments in the combined arms team which, in turn, assist the artilleryman to apply his experience and knowledge to practical field artillery solutions. 

MAJ Howard L. Buchly, FA, is a test officer, FA Branch, Combat Support Directorate, Headquarters, MASSTER, Fort Hood, TX.

Battlefield *Survivability*

by MAJ James W. Dearlove

The search for better means to project our policies of state, through warfare if necessary, continues in ever widening, more complex research and development programs. These programs, which investigate all manner of things, employ the newest of equipment coupled with the latest technological breakthroughs in pursuit of the elusive objectives. In this effort to obtain weapons and equipment that are better than those of our potential enemies, a basic requirement seems to have lost the emphasis it deserves. The concept of battlefield survivability (the characteristic of personnel or materiel to withstand adverse action, deterioration or the effects of natural phenomena which singly or collectively result in the loss of capability to effectively perform the prescribed mission) has, for some time, been shunted aside in the attempt to gain technological superiority that would give our fighting force greater effectiveness than any other in the world.

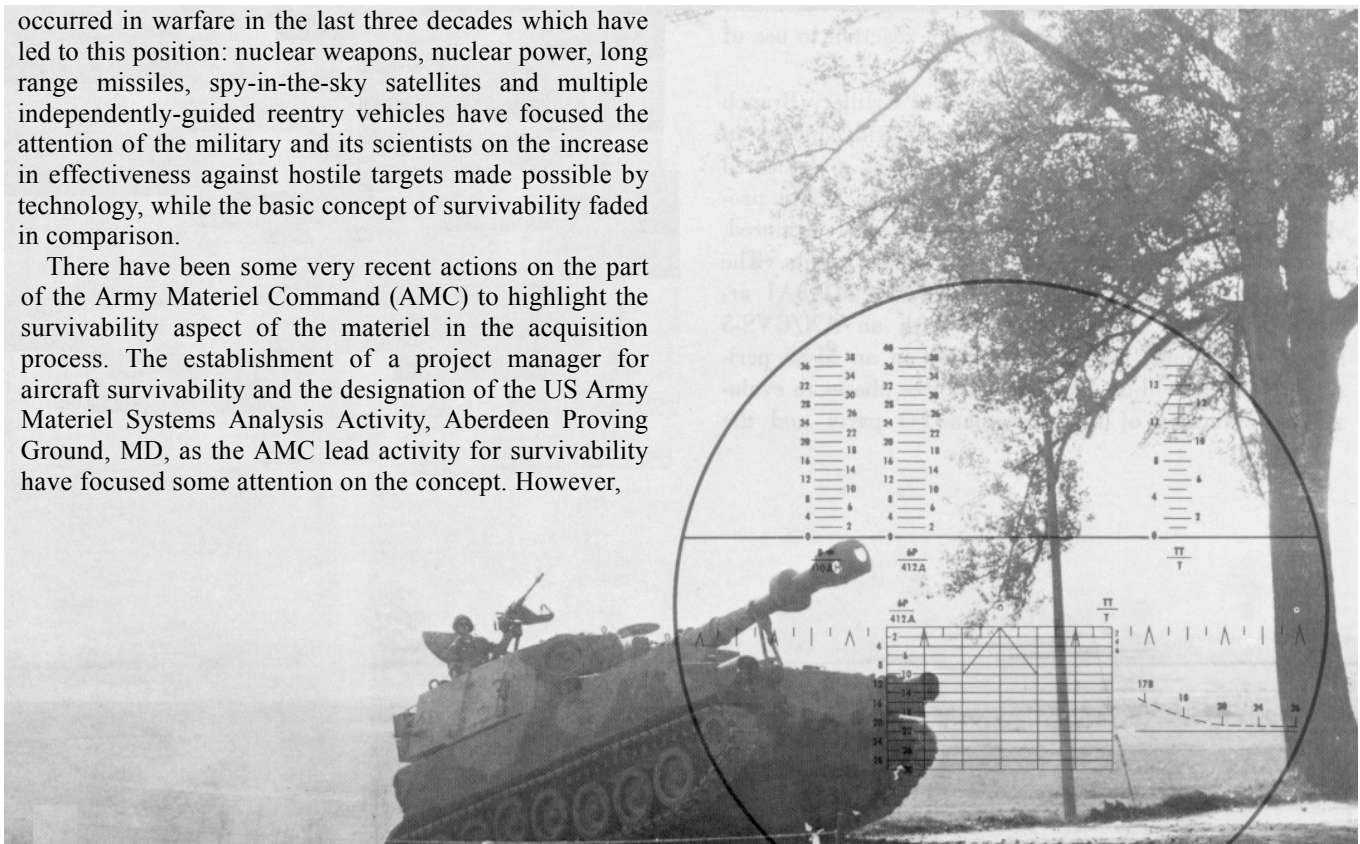
Consider some of the technical advances that have occurred in warfare in the last three decades which have led to this position: nuclear weapons, nuclear power, long range missiles, spy-in-the-sky satellites and multiple independently-guided reentry vehicles have focused the attention of the military and its scientists on the increase in effectiveness against hostile targets made possible by technology, while the basic concept of survivability faded in comparison.

There have been some very recent actions on the part of the Army Materiel Command (AMC) to highlight the survivability aspect of the materiel in the acquisition process. The establishment of a project manager for aircraft survivability and the designation of the US Army Materiel Systems Analysis Activity, Aberdeen Proving Ground, MD, as the AMC lead activity for survivability have focused some attention on the concept. However,

today, the method by which we develop new weapons systems and equipment of war has evolved into a highly complex process that requires interface among many agencies and organizations at all levels of the defense structure. To be successful, it necessitates consideration of a multitude of factors and approval at virtually every level within the system. These complexities, coupled with the Congressional and popular skepticism of all development programs, provide a challenge to the introduction and highlighting of survivability considerations that must be met.

An approach that seems logical in today's materiel acquisition process is to use the Required Operational Capability (ROC) to formally specify battlefield survivability as an end product of our efforts just as we require a weapon with maximum effectiveness, a truck with maximum miles between failures or a radio with minimum repair time. All must be goals of our materiel acquisition process.

Within the review and analysis that occurs during the acquisition of new equipment is the analysis of that



equipment as to cost and effectiveness under operational conditions. These Cost Operational Effectiveness Analyses (COEAs) would be the natural point in the acquisition cycle to evaluate the survivability of an item or system. To add the survivability factor to these evaluations, these questions should be addressed in each analysis:

- How can it be made difficult to detect? Can it be camouflaged, not only visually but from all means of detection, including sound and electromagnetic, or are we generating equipment with signatures that are virtually impossible to hide or disguise on the battlefield? An example of one item of equipment that is receiving more and more interest is the Laser, but this equipment, when used, generates a very detectable signal. What can be done to reduce this detectability and provide the operator and the Laser a greater chance of survivability? Perhaps using decoys would be better than camouflage. Whatever form it may take, the counterdetection method must be effective and usable in providing an increase of survivability while not degrading the effectiveness of the equipment or its operator.

- How to make it difficult to be hit if detected? The size, shape and speed of a piece of equipment play a great role in this consideration. High speed vehicles of reduced size or aircraft possessing the ability to maneuver quickly can reduce or eliminate hits from guns which, in turn, may force an enemy to spend his money and development time on target acquisition systems and missiles that are more costly and easily fooled by countermeasures—thus achieving an advantage. Reorientation and retraining in new concepts (such as nap-of-the-earth flying) are beneficial in increasing survivability of helicopters as the time available to the enemy to react, acquire, aim and fire on a target is reduced.

- How can it be made difficult to damage if hit? First, a provision for an increased knowledge on what causes damage, the effectiveness of enemy weapons versus the vulnerabilities of our equipment, is a basic need. We spend much time doing just the opposite. The US Army Ballistic Research Laboratories' Vulnerability Laboratory and the Joint Technical Coordinating Group's Munitions Effectiveness Element devote their full efforts to determining information on our weapons versus enemy equipment and providing it to both the research and development community and the user in the field. It would seem natural to learn about our equipment and the enemy's weapons . . . but do we? Then, do we provide the information to the troops? I think, in both cases, not nearly enough. Look at how long it has taken to convert the basic fuel in combat from gasoline to diesel. We still aren't there fully. What about protection of trucks? None of ours has a capability to withstand even

a light fragment hit in the tires or radiator. Yet, they are our basic workhorse and we expect them to operate in a hostile environment. Radio vans and communications equipment can gain survivability through some easily applied fixes: use of ballistic nylon blankets to stop or reduce fragment damage, burying cables and protecting connectors also are simple ways to shield from fragments. Fixes such as these can reduce significantly the equipment's susceptibility to damage. Quick and dirty solutions perhaps, but effective. Large gains in survivability also can be obtained in the design of equipment using mutual shielding with positioning of critical components in the least vulnerable positions. These are but a few examples of how damage may be reduced. Imagine the results of an all-out awareness and application.

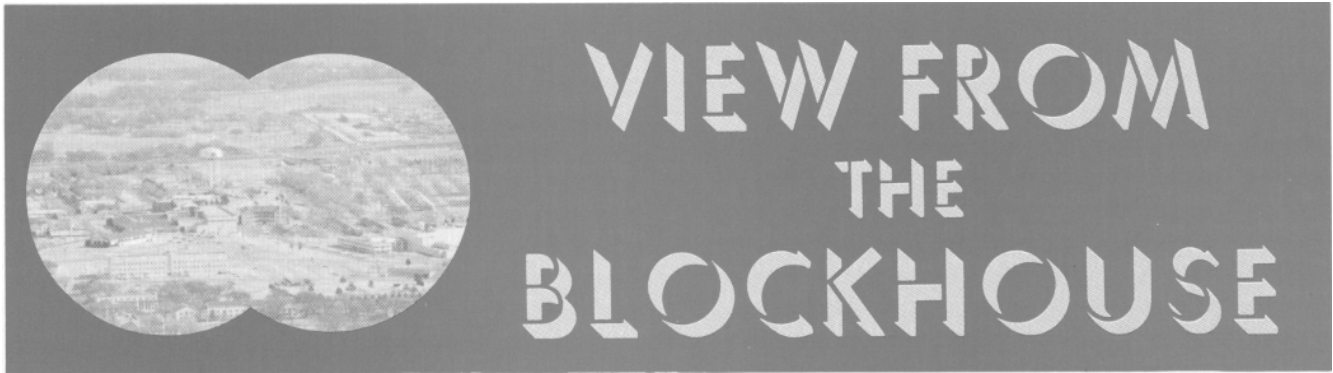
- How can it be made easy to repair if damaged? Simple, easy to repair equipment that is available for use for longer periods with less "down" time, rather than the complex equipment that in many cases replaces it, must be the objective. Quick change modules are speeding up equipment repair; however, the expense of these modules can mean that there are fewer available, thus increasing the possibility that the right black box to fix the widget won't be in the right place at the right time. With the current constraints on manpower, it is natural to attempt replacing the man with a machine which, in most cases, increases the complexity required and, of course, the possibility for failures as well as increasing the length of time and level of competence required to repair the equipment should it fail or be a casualty of warfare. Continual and constant thought must be directed to simplicity, for therein lies maximum usage of equipment in its designed mission.

Attention to the concept of battlefield survivability during the writing of the ROC as well as during the COEA phase of the acquisition process will naturally highlight survivability and cause all agencies and activities in the acquisition process to properly address it. This will involve the equipment maker, AMC, as well as the final users, Forces Command and the Overseas Commands. Achieving a reawareness of survivability will require time and innovative thought on the part of developers and users alike, but once achieved it can be a base to build upon.

The demand of the user for survivability in his equipment and for training on the techniques of survivability, coupled with his inherent ingenuity on the battlefield and the technological advances available, will generate the impetus to assure that survivability is considered and built into systems of warfare of the future. It is in this manner that the challenge of battlefield survivability can be met, thus providing an element, perhaps the critical one, for success.

MAJ James W. Dearlove, FA, formerly with the US Army Materiel Systems Analysis Activity, Aberdeen Proving Ground, MD, is now with the 1st Infantry Division, Fort Riley, KS.

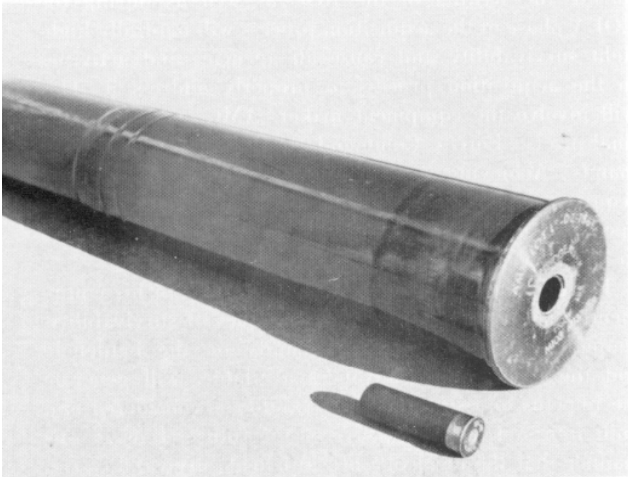
Notes from the School



Sound Off, Dummy

The silence of crew drill may be shattered forever by the USAFAS Weapons Department's new training round. Devised by the Review and Analysis Division and Fort Sill's TASO, the round utilizes a standard 105-mm cartridge case, an inert plastic "projectile" and a deactivated fuze. The three pieces are center-bored to accommodate a "barrel" of 13/16-inch pipe which chambers a 10-gauge blank shotgun shell in the base of the shell casing. The result is a simulated firing of the actual M1 HE round but at a fraction of the cost and danger.

Students will jump to the report of this roaring dummy this summer as the device undergoes testing in III Corps and USAFAS School Brigade units. If the test proves successful the round will be sent to the Training Management Agency at Fort Sam Houston, TX, for evaluation while a similar round will be designed for 155-mm applications.



New 105-mm training round center-bored for a 10 gauge blank shotgun shell.

The "Gunner's Digest"

The Weapons Department has recently gathered the fire control alignment test (formerly "basic periodic test") for all current field artillery weapons into a single, highly-illustrated Reference Note. Compiled by Mrs. Martha M. Porter, while an Education Specialist in the Weapons Department's Research and Analysis Division, the publication contains alignment procedures and final test tolerances for the M109, M109A1, M107, M110E2, M102 and M114A1. The Reference Note also provides instructions for the correct use of recently introduced instruments such as the M140 Alignment Device (see January-February 1975 *Journal*) and the Tube Leveling Device (see March-April 1975 issue). A welcome addition to the gunner's library, distribution of the booklet is slated for July 1975.

GFT Fan Cursors Available

Information from the Gunnery Department, USAFAS, indicates that replacement cursors for the new graphical firing table (GFT) fan (see May-June 1975 *Journal*) are available. Cursors may be ordered through normal supply channels by: NSN 5355-00-620-3758, Manufacturer's Number 7688829.

Battlefield Illumination

The Field Artillery School has been conducting extensive reviews of existing doctrine to insure it is in keeping with the requirements for increased responsiveness and survivability on the modern battlefield.

During the review of battlefield illumination, it was found that the principles of employment and the capabilities and vulnerabilities of various illumination means presented in FM 20-60, *Battlefield Illumination*, and the technical procedures presented in FM 6-40, *Field Artillery Cannon Gunnery*, remain valid.

However, on the modern battlefield the delivery means have become more susceptible to detection and neutralization. Since illumination must be available immediately when requested, consideration must be given to reducing the vulnerability of the delivery system by using more than one illumination means or selecting a system less vulnerable to enemy countermeasures. Following the procedures in FM 20-60 will contribute to providing adequate illumination and to increasing the survivability of the delivery system.

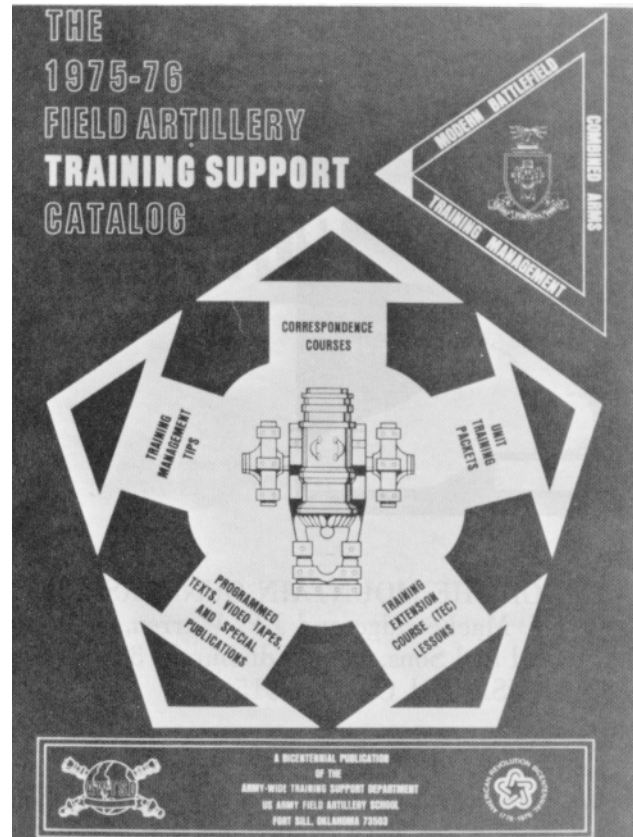
Battery XO Handbook Revised

The battery executive's dog-eared companion, "Notes for the Battery Executive" (1971), has been revised by the Weapons Department, USAFAS, to a tightly-edited booklet entitled the "Battery Executive Officer's Handbook."

The handbook integrates new information along with topics found in the 1971 issue into a concentrated, quick-reference format. Emphasis is directed toward several new concepts outlined in TC 6-50-1, such as the elimination of the XO's post in response to those fast-moving situations which demand the XO's attention elsewhere in the interest of battery responsiveness. "The Battery Executive Officers Handbook" will also include the XO's Minimum Quadrant Elevation Rapid Fire Tables which are precomputed listings of minimum quadrant elevations for all weapons, ammunition and powder currently in the field artillery inventory. The tables conveniently compensate for Tabular Firing Tables, elevation, verticle angle for appropriate verticle clearance, complementary angle of site for 300 mils angle of site and two forks for piece-crest range as listed.

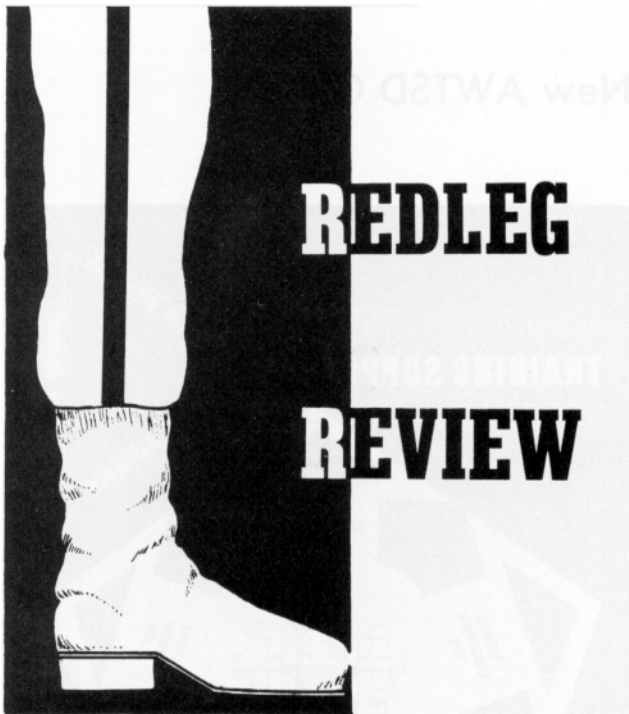
The handbook has been distributed to field artillery units world-wide and may now be obtained by writing: US Army Field Artillery School, ATTN: ATSF-AW-FS, Fort Sill, OK 73503.

New AWTSD Catalog



The Army-Wide Training Support Department (AWTSD), USAFAS, has condensed the annual *Correspondence Courses Catalog* and *Catalog of Instructional Material* into a single publication: *The 1975-76 Field Artillery Training Support Catalog*.

The new catalog integrates the contents of its predecessors into a complete listing of available correspondence courses, unit training packets, TEC lessons, training management publications and USAFAS video tapes, programed texts and special publications. The catalog will be updated through a monthly List of Instructional Material (replacing the older bi-monthly list) which should be filed with the catalog for reference. The new catalog has been distributed to active and reserve units, USAR schools and other agencies.



TALES OF THE MOUNTAIN GUNNERS, edited by C.H.T. MacFetridge and J.P. Warren, William Blackwood and Sons, LTD, Edinburgh, 327 pages, £5.50 (USA and Canada, \$15).

Every now and again a skill has to die because for one reason or another there is no longer a need for it. Then the historians who weren't there get out their pens to tell where and why, and those whose expertise made it all possible put away their manuals which tell how.

"Tales of The Mountain Gunners" which covers a time span from the mid-1800s to the end of WWII is neither history nor technical manual—nor is it written with recent memory as an aid. As its name suggests, it consists of a collection of stories, beautifully illustrated and all written in the first person by a miscellany of retired British and Indian artillerymen. Naturally some of the authors are more gifted than others but all look back with nostalgia upon a period of both active and garrison soldiering in India, Burma, East Africa and Gallipoli (but mostly India) where terrain was wild—sometimes demanding guns to be deployed at over 17,000 feet—the enemy was respected and the mule-borne mountain gun was their weapon.

Politics and the enemy are both taken for granted as facts of life, and neither are spoken of with any venom—and campaigns, or "scraps," are eagerly anticipated. All you need to know to appreciate the majority of this book is that while Americans were still

settling the Great Plains of the West, the Queen was also having trouble with the indigenes in the outposts of Her Empire in its mountainous East.

Although some tales will seem a little "dated," there are some gems of soldier humour, like the story of the "auditor" who journeyed long and high into the mountains of Chitral to investigate how so many stores had apparently been lost on one mule when it fell over a cliff. However, the account by Major Shivharsh Dube of his battery's first move by air in 1940 must take the accolade—"It was so impressive that I believe I will never be expecting it in my life again."

There are some more sombre accounts of fighting in WWII, the most thought-provoking of which I found to be "A Newly Joined Subaltern's (lieutenant's) First Experience of Battle" at Kohima against the Japanese in 1944.

To one who has seen even a little of the North East Frontier, in what is now Pakistan, Afghanistan and Nepal, and who has worked with mules on one occasion, these tales made compelling reading. This is not a book to be taken with dedication from cover to cover but one to keep on the bedside table, to be dipped into when brows become knotted with the seriousness, rigour and complexity of present day peacetime soldiering and one knows that one has forgotten what it is really all about—(1913 Assignment Order—"I have to send a section to join the outpost at ***** (50 miles away in Baluchistan) — You are the last joined and have most to learn, so I am sending your section. You will march tomorrow morning with an escort of 27 Punjabis. You will be away for a year.")

Has it any applicability to the present day gunner? Well, if toughness, techniques and tenaciousness still have their place in the serving of field artillery pieces around the world, the modern soldier will surely find much to inspire as well as to instruct him—at the very least in the time proven tactic currently termed "overwatch" so well illustrated at the bottom of the first page.

Certainly Messrs MacFetridge and Warren have succeeded in setting down something that could never have been captured either by historian or drill book author. This is no literary masterpiece, but I bet that any reader will agree with me in humbly stating how worthwhile their efforts were. Had these tales been lost to posterity, St. Barbara's disciples would have been that much the poorer.

LTC S. Love is the British Army Liaison Officer to USAFAS, Fort Sill, OK.

A BRIDGE TOO FAR, by Cornelius Ryan, Simon and Schuster, New York, 1974, 670 pages, \$12.50.

On the first of September 1944, there was general agreement among the Western Allies that the German armed forces were on their last legs. If the British and Americans could only cross the Rhine River, Germany's historical barrier, without losing the momentum of their great summer offensive, they believed they could win the war before the end of the year.

In his last book, Cornelius Ryan describes Operation Market-Garden, the bold attack intended to provide that Rhine crossing. After seven years of exhaustive research that included 1,200 personal interviews with combatants and civilians, the author used his now-familiar technique of creating a historical mosaic from official records and eyewitness accounts. These are skillfully interwoven to explain the origins, execution and failure of Market-Garden.

Ironically, the daring operation was conceived and pushed to fruition by Field Marshall Sir Bernard Montgomery, usually regarded as one of the most conservative Allied commanders. The plan called for a three and one-half division airborne assault to capture five major bridges over a series of rivers along a 64 mile corridor and hold them until relieved by armored forces. The primary objective was the fifth bridge, across the Lower Rhine at Arnhem, the Netherlands.

As Ryan clearly illustrates, the operation never really had a chance. For one thing, it was based on intelligence that concluded the Germans would not be able to offer any effective resistance. This *was* the case on the first of September and, if the operation had begun then, the outcome would probably have been quite different, but by the time it began—on the 17th—the defenders were reorganized and greatly reinforced.

Another significant shortcoming was the Allied command's inflexibility in reacting to last-minute reports of German armor in the airborne drop zones. Junior intelligence officers saw their doubts brushed aside by superiors who believed the massive operation was too far along to be changed or cancelled. Anyway, the airborne units were composed of elite soldiers and commanders who could be counted on to react properly to whatever situation existed in the objective areas. Somehow everything would work out.

It didn't, of course. The deficiencies in the plans and preparations were compounded by unforeseen problems

of the type that occur in all combat. New radios that no one had time to check beforehand failed to operate, a British airborne division commander was separated from his headquarters for 39 crucial hours at the beginning of the battle, an operational ferry across the Rhine that could have played an important role was initially overlooked, bad weather grounded supporting air forces and dozens of lesser problems bedeviled the attackers.

Despite the enormous weight of men and materiel used by the Allies, their attack failed because they couldn't mass enough of their combat power at critical points and because lightly equipped airborne soldiers, however courageous, couldn't cope indefinitely with enemy armored units. Most of Market-Garden's secondary objectives were achieved, including capture of four major bridges and an armored penetration that extended 50 miles into German-occupied territory. Montgomery asserted that the operation was "90 percent successful" but this can hardly be considered an objective judgement. Since the primary objective, the Rhine bridge at Arnhem, was not secured, the other achievements counted for nothing. Reacting to Montgomery's assessment, Prince Bernhard of the Netherlands said, "My country can never again afford the luxury of another Montgomery success."

The nine-day operation, involving history's largest airborne assault, was probably the most significant undertaking by the Allies in Europe after D-Day. Even so, Market-Garden's story has until now been almost unknown in the United States, except in official and semi-official reports and unit histories. There are several likely reasons for this. The principal US organizations in the operation were the 82d and 101st Airborne Divisions and parachutists behind enemy lines are plainly more difficult for reporters and historians to observe than troops in conventional battles. Also, the failure of the operation has undoubtedly made it a less popular subject than victorious actions—even though both American divisions accomplished their Market-Garden objectives.

Ryan's book will unquestionably become the authoritative work on Operation Market-Garden. It is written for the general public but professional soldiers will find it technically accurate and extremely engaging. This book is the story of a battle in a type of war we are unlikely to see again but it is filled with lessons for contemporary military men.

MAJ Robert R. Edwards, Gunnery Department, USAFAS, Fort Sill, OK.

REDLEG Newsletter

Alternate specialties have been designated for all field artillery officers with more than seven years active Federal commissioned service (AFCS) who are not scheduled for retirement/release from active duty prior to end 1976. At this point, it might be useful to review the designation process and results. Eleven hundred and ninety (1,190) lieutenant colonels received their alternate specialties in September 1974. Over 92 percent received their first or second choice specialty. Designations were made by the Field Artillery Branch based on Army requirements as identified by Project Expanded Additional Skill Identifier (EASI), the Branch's participation objectives, individual experience, education or training and individual preference. The bulk of the lieutenant colonels were designated Operations and Force Development (35 percent), Personnel Management (19 percent), Research and Development (11 percent) or one of the Logistics specialties (seven percent). Lieutenant colonels are now being assigned in accordance with their primary and alternate specialties. Sixteen hundred and forty (1,640) majors received their alternate specialties in April 1975. Ninety-three percent received their first or second choice specialty. Designations were made based on Army requirements as identified by Project EASI, the Field Artillery Branch's participation objectives, any funded graduate schooling involved and individual preference, training and experience. The largest designations were Operations and Force Development (22 percent), Personnel Management (18 percent), Research and Development (12 percent) and Education (10 percent). Majors are now being assigned in accordance with their designated specialties. Approximately 1,800 captains received their alternate specialties in July 1975. At writing, the exact number and breakout of specialties were not known; next issue of this newsletter should include this information. Designations were made by the Field Artillery Branch of the Combat Arms Company Grade Division and were based on essentially the same considerations as for majors. It is anticipated that the designations will follow the same pattern. Captains with alternate specialties are now being assigned by Field Artillery Branch in accordance with their designated specialties. The Primary Specialty, Field Artillery, has been designated for officers with less than seven years AFCS. These officers will be requested to state their preferences for an alternate specialty during their eighth year of service for designation prior to completing eight years AFCS.

The Field Artillery Branch needs a copy of each unit/organization officer personnel roster. Many times we have an immediate need to know your current job and a current personnel roster is the best way to determine it. Personnel officers should send us a roster now and a new one each time you republish to: CDR, MILPERCEN, ATTN: DAPC-OPD-F, 200 Stovall St., Alexandria, VA 22332.

MILPERCEN OPD FA Specialty Managers Colonels Division

Name	Location	AUTOVON*
LTC(P) Robert L. Ray	Room 6 N 57	221-7862
Lieutenant Colonels Division		
LTC Don P. Tillar	Room 6 S 55 LTC-O/S	221-0421
LTC Herbert M. Wassom	Room 6 S 55 LTC-CONUS	221-0421

Majors Division

MAJ Marshall McRee	Room 6 S 17 MAJ-CONUS	221-8858
MAJ Stacy E. Reeves	Room 6 S 17 MAJ-O/S	221-8858

FA Branch, Combat Arms Division

LTC Richard L. Reynard	Room 4 N 65 Chief	221-0116
MAJ John A. Mullett	Room 4 N 65 CPT-CONUS	221-0187
MAJ Phillip Kitchings	Room 4 N 65 CPT-O/S	221-0118
CPT David A. Schulte	Room 4 N 65 LT-O/S	221-7817
CPT George W. Lauffer	Room 4 N 65 LT-CONUS	221-7817

*Commercial 325.

Commanders Update

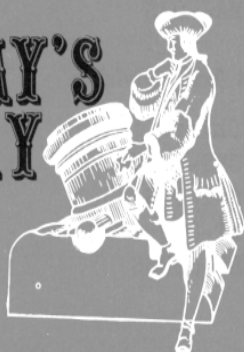
Brigadier General Charles F. J. Gorden III Corps Artillery	LTC Roscoe Swann 3d Battalion, 6th Artillery	LTC William Muhlenfeld 1st Battalion, 38th Artillery
Colonel Isaac D. Smith 1st Infantry Division Artillery	LTC John A. Seitz 1st Battalion, 8th Artillery	LTC John J. Welker 1st Battalion, 40th Artillery
Colonel Robert C. Forman 1st Armored Division Artillery	LTC Robert W. Salley 3d Battalion, 9th Artillery	LTC J. T. H. Denney 4th Battalion, 77th Artillery
Colonel Harold M. Davis 2d Infantry Division Artillery	LTC Paul Makowski 2d Battalion, 10th Artillery	LTC Michael McAdams 2d Battalion, 78th Artillery
Colonel Jim Holley 4th Missile Command	LTC John E. Hayes 1st Battalion, 12th Artillery	LTC Wilson A. Shoffner 3d Battalion, 79th Artillery
Colonel Robert Hammond 7th Infantry Division Artillery	LTC Richard Beltson 1st Battalion, 17th Artillery	LTC Michael Gilmartin 3d Battalion, 81st Artillery
Colonel Ben Walton 24th Infantry Division Artillery	LTC Harold Briggs 2d Battalion, 17th Artillery	LTC Courtney Prisk 1st Battalion, 80th Artillery
Colonel William Schneider 25th Infantry Division Artillery	LTC Arthur Johnson 2d Battalion, 18th Artillery	LTC James B. Lincoln 1st Battalion, 82d Artillery
Colonel Niles Fulwyler Field Artillery Missile Group Number 9	LTC Federik McConville 2nd Battalion, 19th Artillery	LTC William T. Zaldo 2d Battalion, 83d Artillery
Colonel Charles Hoenstine 41st Field Artillery Group	LTC Colonel B. Jones 2d Battalion, 27th Artillery	LTC Phillip Spears 1st Battalion, 92d Artillery
Colonel Fredrick Schleusing 72d Field Artillery Group	LTC Charles S. Williams 1st Battalion, 30th Artillery	LTC Lee C. Smith 2d Battalion, 92d Artillery
Colonel Dwight Wilson 42d Field Artillery Group	LTC Henry L. Harrison 1st Battalion, 32d Artillery	LTC Hugh Socks 1st Battalion, 321st Artillery
Colonel David Blackledge 212th Field Artillery Group	LTC John C. Tompson 2d Battalion, 34th Artillery	LTC Leon Cloud 512th Group
LTC Richard Sundt 1st Battalion, 2d Artillery	LTC John Kraus 1st Battalion, 37th Artillery	LTC John Farley 557th Group
LTC Frank Partlow 2d Battalion, 4th Artillery	LTC Joseph Nagel 3d Battalion, 37th Artillery	LTC Raymond Cole 5th Battalion, 4th Brigade Fort Leonard Wood, MO
LTC Donald Hammel 1st Battalion, 6th Artillery	LTC Stanley S. King 1st Battalion, 41st Artillery	LTC Ted Gray 11th Aviation Battalion



YESTERDAY'S ARTILLERY

200 Years Ago . . .

July-August 1775



When George Washington took command of the American Army at Boston 3 July 1775 there was no Continental Artillery. Colonel Gridley's artillery units then present were not taken into Continental service until later that month. Gridley's artillery had been organized using the 3d Rhode Island Regiment's artillery as a nucleus. One officer in that unit was John Crane who would later rise to the rank of colonel in the Continental Artillery.

In May 1775 John Lamb, a New York wine merchant (see "Yesterday's Artillery," May-June 1975 *Journal*), had begun to raise an artillery unit under a New York commission. Lamb's unit was taken into the Continental service on 17 July and became the first and only unit until what was left of Gridley's men were reorganized in November by Henry Knox into the Continental service. In an attempt to put some *esprit de corps* in his unit. Lamb received permission to enlist his own men rather than taking cast-offs from the infantry as had been the practice. He also sought and received permission to dress his men in distinctive uniforms of blue with buff cuffs and facings. He paid for these out of his own pocket and certainly made his men a match in appearance for the Green Mountain Boys of Eathan Allen. British artillerymen at this time wore blue coats trimmed with scarlet and white waistcoats and stockings.

The position of artilleryman was considered to be a skilled job that commanded a higher pay than the infantry. This European distinction was continued by Congress when, on 29 July, they voted for higher pay for the artillery officers. For instance, an artillery captain received over \$26 a month whereas his infantry equal received \$20. This pay scale adjustment also carried through the enlisted ranks.

Despite the better pay, the enlistment of artillerymen was difficult. This was due in part to the danger of being in close proximity to the guns not only for incoming rounds but also for the possible premature firing or

explosion of their own gun. The group of men Lamb finally assembled was characterized by one observer as the "sweepings of the York streets." Chaplain Benjamin Trumbull, a Connecticut divine, referred to them as, "Perhaps there never was a more ill-governed Profane and Wicked army among a People of Such Advantages."

In July an expedition to Quebec was being planned. General Schuyler, the commander of the thrust up the Hudson River Valley, recognized the need for artillery when he petitioned Congress: "Could not a gentleman be got to accept a commission as commander of artillery? Perhaps, if rank was given, it would induce some good men to undertake it. Such an officer is so evidently necessary that I hope this recommendation will claim your attention." Schuyler, like most American commanders, had little firsthand knowledge about artillery as evidenced by his letter to the New York Congress requesting ". . . an assortment of articles in the artillery way."

On 23 August, the same day King George III declared the colonists in rebellion, Lamb's men participated in a raid on a British battery in New York City and were successful in removing 21 nine-pound cannons. By 29 August, Lamb was ordered north to join the army at Fort Ticonderoga which was on its way to Canada.

Back in Boston the soldiers with Washington had settled into a camp routine which included a detailed inspection of the artillery position by engineers and artillery officers. There was also a study conducted as to the utilization of each artilleryman during periods of inactivity. Time must have hung heavy for the troops there as Washington's General Order of 22 August indicated. "The General does not mean to discourage the practice of bathing whilst the weather is warm enough to continue it, but he expressly forbids, any persons doing it, at or near the Bridge in Cambridge, where it has been observed and complained of, that many Men, lost to all sense of decency and common modesty, are running about naked upon the Bridge, whilst Passengers, and even Ladies of the first fashion in the neighbourhood, are passing over it, as if they meant to glory in their shame:—The Guards and Sentries at the Bridge, are to put a stop to this practice for the future."

Powder and lead were too scarce to fire artillery at the British and powder that was available had to be saved for small arms. Throughout the summer of 1775 Washington's artillery was virtually useless due to these shortages.

On Saturday, 29 August, the Americans worked all night to advance their lines to a forward position. At 9 am Sunday the British began a heavy cannonade

that lasted the whole day and killed four Americans. The Americans' lack of supplies would not let them return the fire in kind, so they had to be satisfied to fire a nine-pounder at a British floating battery which they sank.

To help alleviate the logistical problems, Congress authorized Washington to appoint a Commissary of Artillery Stores. On 17 August Mr. Ezekiel Cheever was appointed and began a systematic collection of ordnance.

All efforts throughout July and August preceeded the entry of Henry Knox into the service and the creation of the artillery in November 1775.

The Movement of the Artillery

Artillery had never successfully traveled with an army in America. Braddock had been defeated on the Monongahela, partly because his guns delayed movements and fatigued the men. The Revolution proved that artillery could travel with marching men. By Christmas, 1776, Knox was convinced that artillery should accompany the column to Trenton. A soldier there recorded, "We moved slow on account of the artillery, frequently coming to a halt or stand still. . . ." As a result of this innovation the artillery became a significant factor in the success of the operation. However, artillery with marching troops did not become standard practice until Napoleon used the tactic 30 years later.

In 1781 when Washington passed through Philadelphia, artillery was mixed with the infantry. The general usually put on a "show" through cities for the morale of the troops and citizens alike. He would include artillery in the line of march to give a balanced appearance and deprive spies an accurate count of the pieces.

The usual placement for the artillery was in the center or closer to the front so they could be protected and brought into action quickly. It does seem that whether the artillery was dispersed or marched as a unit, the artillerymen kept apart and aloof.

Terrain often dictated the order of march. Excluding cities, roads were dirt or mud, depending on the weather. They were rutted easily and often it was better to travel cross-country. The heaviest loads traveled first to take advantage of the best conditions before the men and cavalry "chopped up" the road. Tactically this was unsound and numerous passages in diaries curse the artillery for cutting the road to pieces. A nine-pounder and its ammunition wagon weighed about 3,000 pounds each. A horse pulled about 700 pounds, so two pairs would pull the nine-pounder.

It was discovered that four horses in pairs could pull more than five in line and this was important because of the scarcity of horses. The American artillery did not hitch oxen to cannons.

When the French moved to the Hudson River in 1781 they mention resting to mend carriages and refresh "artillery horses and oxen." On the same march they enlisted farmers' "oxen to help the baggage trains in a pinch." Knox had used oxen to bring artillery from Ticonderoga but these cannons were in pieces, not field artillery. Captain Mott of Lamb's artillery unit recalled: "The damage sustained in our carriages and wagons and field pieces was to (sic) great on my arrival at Danbury (CN) that I was obliged to remain there . . . if the artificers had been worth a dam (sic) I might have marched yesterday am but such a set of infernals I have not met with before. Expect to reach North Castle if our carriages don't fail. Differences of roads induces me to avoid that to Ridgebury."

Men were usually sent to reconnoiter artillery routes. Detours of 20 miles were common to locate a ford, as many bridges could not support artillery. This matter became critical in retreat and before an engagement. Sometimes boats tied together as single crafts were not able to transport a piece. Horses generally swam.

In 1781 when Washington moved to Yorktown he used coastal vessels with excellent results but most of the guns were dismantled.

Artillery moving on a slope, where there was danger of overturning, had to have a rope fastened to the lowest side of the carriage, passed over the top and held on the upper side of the hill. From Harlem Heights to White Plains in 1776, artillery was "carried or drawn off by hand" and the few horses were used to shuttle pieces over difficult terrain. Lieutenant Feltman's *Journal* mentions they marched through a thicket and had "great difficulty" with the artillery. Thacher records that it was necessary to hoist "cannon from tree to tree to get to the top of a hill" that commanded the area.

Will Heath, a matross, wrote he was exhausted before the battle of Germantown because of the guns. One of General Stirling's men recorded after a battle, "As long as we had no horses, the prisoners were harnessed in front of the cannon." In the 1775 Quebec attack, General Arnold had a piece lashed to a sled and artillerymen pulled through chest-high snow until they could not continue.

The great difficulty, yet ever present work, of moving artillery showed better than anything the importance placed on the guns.

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