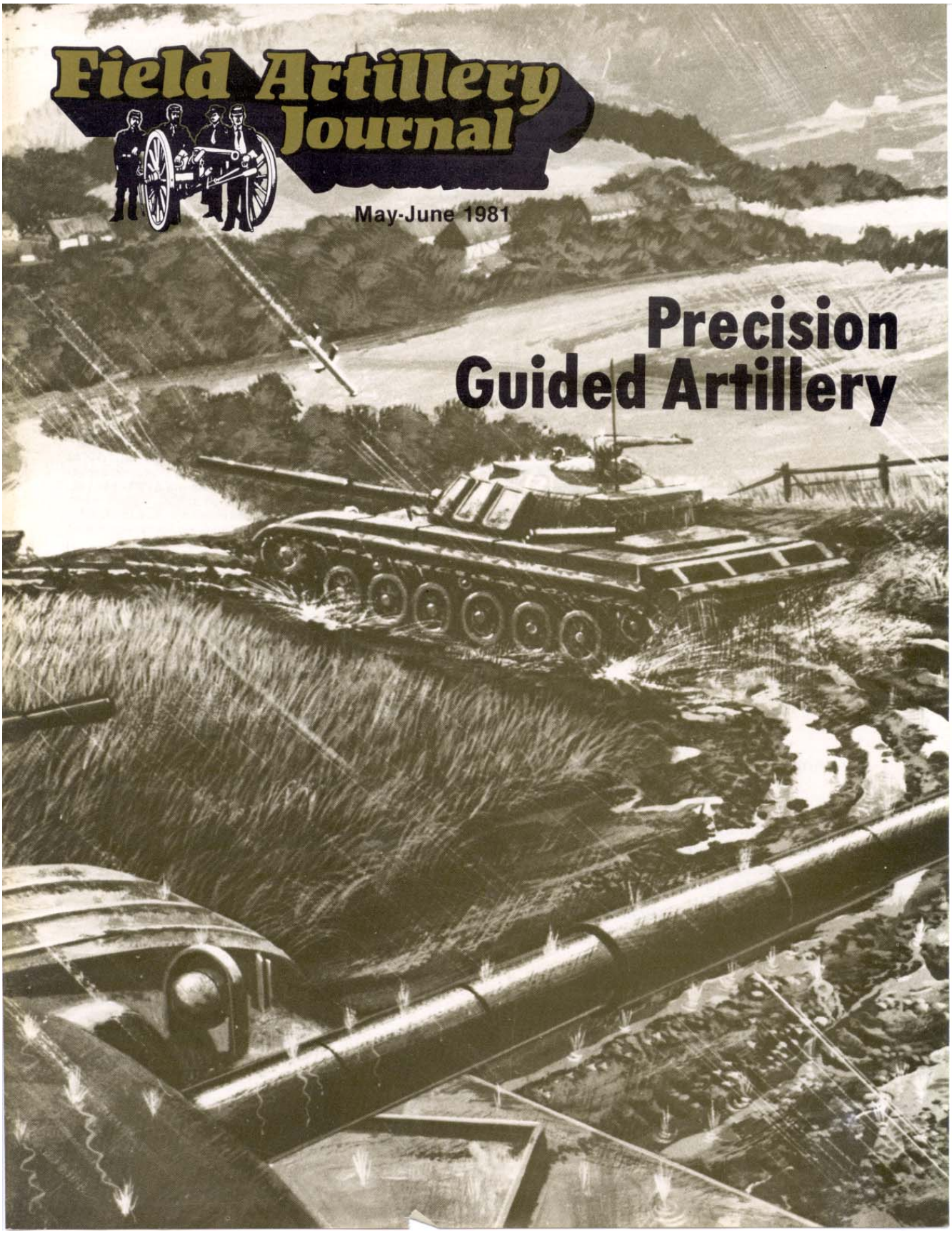
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Precision Guided Artillery

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ARTICLES

FEATURES

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PURPOSE (as stated in the first *Field Artillery Journal in 1911): "To publish a journal for disseminating professional knowledge and furnishing information as to the field artillery's progress, development, and best use in campaign; to cultivate, with the other arms, a common understanding of the power and limitations of each; to foster a feeling of interdependence among the different arms and of hearty cooperation by all; and to promote understanding between the regular and militia forces by a closer bond; all of which objects are worthy and contribute to the good of our country."*

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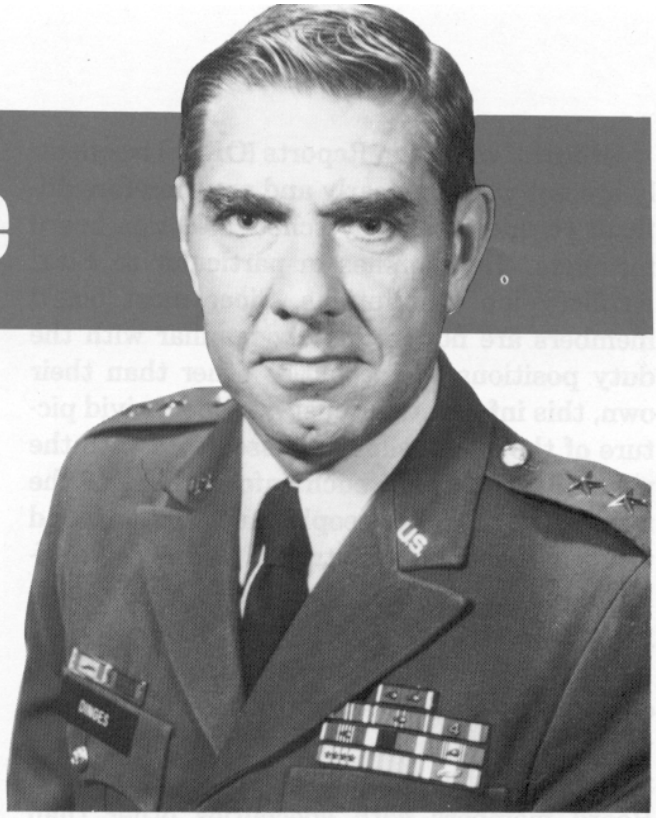
On the Move



by MG Edward A. Dinges

One of Fort Sill's most important responsibilities is to participate in the career management and professional development of Field Artillery officers throughout the world. In reviewing our progress over the past year, I have become increasingly concerned about an apparent inconsistency between the Field Artillery's field grade promotion rates and our staff college/war college selection rates compared to those of the other branches.

Accordingly, last January I asked officer personnel managers at Fort Sill to evaluate how the Field Artillery compared with the other Combat Arms and Army-wide field grade promotion and school selection rates during the period 1977-1980. In the course of this examination, we not only developed statistical comparisons, but also acquired observations and perceptions from senior service college (SSC)/command and staff college (CSC) selection board members concerning the *quality* of the information filed in the records of school-eligible officers. These comments focus primarily on Officer Evaluation Reports (OERs), Officer Record Briefs (ORBs), and official photographs.

Promotions

Generally, our analysis indicates no major problem with Field Artillery field grade promotions. Although selection rates have varied from year to year for all grades and specialties, the Field Artillery aggregate selection rate has consistently exceeded the Army rate over the four-year period examined, and has remained favorably competitive with rates achieved by the other Combat Arms.

School Selections

Although the Field Artillery aggregate senior service college selection rate for the four-year period was above the Army rate, the 1977 and 1980 Field Artillery rate fell below the corresponding Army figures. Additionally, with only one exception, the aggregate rate for Field Artillery was below all the other Combat Arms. Field Artillery command and staff college selections were consistently above the Army rate during the past four years, but as with rates for senior service school selection, were below all but one of the other combat arms.

In an effort to determine why Field Artillery officer school selections have been so inconsistent with promotion rates, we contacted members of the 1980 SSC and CSC selection boards. The following summarizes their common observations and perceptions.

The OER

Officer Evaluation Reports (OERs) frequently are not written clearly and are therefore difficult to understand by school selection board members. That applies in particular to Field Artillery job descriptions. Since most board members are not intimately familiar with the duty positions of specialties other than their own, this information must provide a vivid picture of the responsibilities associated with the position, to include such information as the number of dollars, people, and amount and types of equipment controlled by the rated officer. Job descriptions should also address major additional duties.

On Field Artillery OERs specifically, three commonly misunderstood terms are "missile warhead detachment," "assistant executive officer," and "fire support team (FIST) chief." Board members with specialties other than Field Artillery perceive a detachment as a very small element, and may not understand the magnitude of responsibilities associated with a warhead detachment. To remedy this, I have recommended to TRADOC that Field Artillery detachments be redesignated so that their title includes the term "battery" to insure that all detachment commanders are fairly evaluated when being considered for promotion and school selection. Similarly, "assistant executive officer" may connote for some an unnecessary or "extra" position; "fire direction officer" would be much more descriptive. As for "FIST chief," since FIST is still a relatively new term, it should be explained with something other than an acronym.

Turning now to the narrative section of the OER, board members tell us they see too many overworked phrases, such as "firm but fair" and "can do," as well as qualifiers like "although" and "however" which can make the rater's intent ambiguous instead of clearly positive or negative. Finally, board members scored a consistent failure to highlight significant items — for example, the fact that an officer was working two grades above his rank, or that he was progressing toward a graduate degree during off-duty time.

The ORB

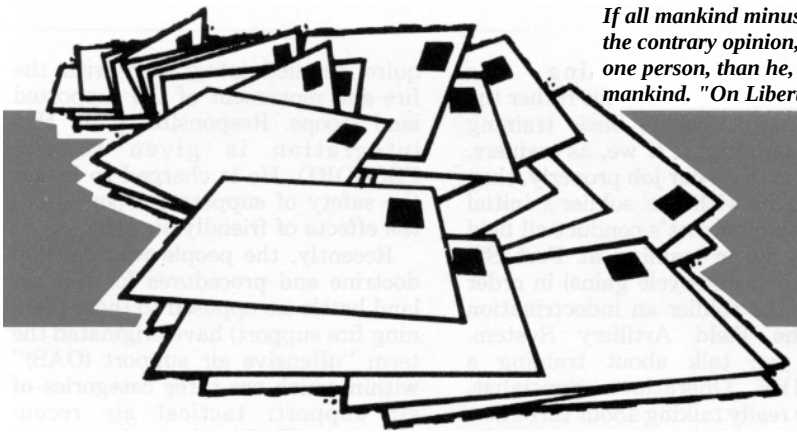
Board members complained that Officer Record Briefs (ORBs) were frequently marred by inaccurate or missing data (awards, date of last physical, special qualifications, education, etc.) Keeping his or her ORB up-to-date is the individual officer's responsibility. Since the ORB is typically the first record to be reviewed, its accuracy and completeness are essential.

Photograph

Photographs were frequently poor and/or outdated. Some officers were improperly posed, wore poorly fitted uniforms, or appeared to exceed Army weight standards. Here again, since the photograph is frequently examined early in the file reveiw, insuring that it is correctly prepared is very much in an officer's own interest.

These comments and observations confirm that improvement of our officers' potential for school selection requires shared effort by the officer in question, his or her rater, and the servicing military personnel center. The individual officer must personally insure that all information reflected in the record is current, accurate, and complete. Rating officers should carefully follow established guidelines when preparing evaluation reports. And military personnel centers must insure that additions and changes to the individual file are posted rapidly and accurately.

None of these actions, of course, nor all of them in combination, are sufficient to assure favorable selection rates. Only effective duty performance can do that. But they *can* help insure that outstanding performance is recognized and rewarded. The Field Artillery is blessed with an abundance of officer talent. It is up to all of us to insure that this talent has an opportunity to grow and to contribute.



If all mankind minus one, were of one opinion, and only one person were of the contrary opinion, mankind would be no more justified in silencing that one person, than he, if he had the power, would be justified in silencing mankind. "On Liberty"—John Stuart Mill

Incoming

letters to the editor

Where's the met?

In September 1979, meteorological (met) sections received a product improvement (PIP) package for rawin set AN/GMD-1. This product improvement was the OL-192/GMD-1 Meteorological Data Processing Group, consisting of an HP-9825A calculator and a REMEX reader/perforator.

As a meterological technician in Europe, I was overjoyed to receive equipment that could assist my section in providing faster and better support to Field Artillery units. (This equipment replaced the tables, charts, forms, and plotting boards that all met sections use to produce meteorological data and provide an expeditious means for disseminating the met data—a perforated tape for use by the radio teletypewriter team (RATT).

It was disheartening, however, to see this equipment not utilized to its full potential. For example, the perforated tape version of the met message was frequently thrown away because the met section didn't have a RATT capability. Instead, the met message was transmitted by VOICE FM.

By doctrine, RATT is the primary means of transmitting met data where the recipient is provided a typed copy as well as a punched copy of the transmitted message. As such, a fire direction center (FDC) equipped with FADAC can load the computer with the punched tape or load it manually through the keyboard. The RATT will accept and transmit the met data tapes punched by the OL-192 Met Data Processing Group; this represents a significant improvement over the VOICE FM method, which violates every communication security rule in FM 11-50. The VOICE FM procedure requires:

1) A lengthy broadcast time (approximately 20 to 30 minutes) consisting of numerous retransmissions by units which:

•Did not monitor the met net at the prescribed time and subsequently failed to receive the met.

•Had radio problems during the initial broadcast.

•Failed to receive a clear copy due to interference.

2) Accurate copying of the message and checking as the transmission is repeated.

3) Manual entry of the met data into FADAC.

4) Disclosure of a met station's location (and units being supported) to radio direction finders.

Many commanders and signal officers may not realize the great disservice they are doing themselves and their FDC sections by not insuring that their met sections have operational RATTs and fully trained RATT teams. The FDC would save a significant amount of time and effort if a perforated tape version of the met was made available and utilized. If so, the following schedule of events would occur:

•The met team completes all data entries into the OL-192/GMD-1 Meteorological Data Processing Group.

•The HP-9825A (part of the OL-192) is placed into the compute mode.

•Approximately 30 to 45 seconds later the calculator completes computations and furnishes a hard copy and a perforated tape version of the met message.

•The perforated tape is delivered to the RATT team (who have already cut a heading for the message) and 15 seconds later the met data is transmitted.

•The FDC RATT receives the data in hard copy and perforated tape versions. The FADAC operator then loads the met data into his computer utilizing the perforated tape.

The whole process, from transmission to delivery and input into the FADAC takes less than two minutes.

If the Field Artillery is going to win on any battlefield of the future, it must train the way it will have to fight. Our equipment must be utilized to the maximum, and old, non-doctrinal procedures must be eliminated.

Stewart L. Ellis Jr.
CW3, USA
Chief, Met Division, Counterfire Department
US Army Field Artillery School
Fort Sill, Oklahoma 73503

An open forum

Congratulations to you and your staff! The January-February 1981 *Journal* is really something to be proud of because it serves a dual purpose.

•Firstly—the information sheet as usual.

•Secondly—"Incoming" is now an open forum.

Your willingness to publish critical views followed by a thorough response is most important. Reader participation is bound to increase, and the influence of the *Journal* will grow accordingly.

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

Many thanks, sir, for your kind words. As I recently suggested to a fellow editor, our business is not to create controversy but, on the other hand, not to avoid it. Going one step further, we also do not avoid criticism. "Incoming," therefore, will continue to serve as the one place in the ***Journal*** *where our readership can express thoughts and opinions which otherwise might not be appropriate as an article or feature item.—Ed.*

Reflections of a Graf past

Another Graf is past, finished, done.
Nothing is left, but memories of fun.
Nothing is left of the mosquitoes and dust,
The woods filled with water, the beer and the lust,
"C-Rats" for lunch, the dust of the "hole,"
The beer hall at night, just one for the soul.
Get up in the morning, before the sun;
It'll already be gone, long 'fore you're done.
Into the field, protesting you go.
What will happen there, nobody knows!
Midnight moves and madness, "GAS!" and guard—
And listening at night, to the radio's bard.
No women, no liquor; just Graf dust and beer—
Counting the days, that we have left here.
But this one's gone, and all that's left Are some Polaroid pictures, in the back of the desk.
I think of it and smile, and know I've not died —
Still one more to go through, will I survive?

Jack D. Cornelison
SP4, FA
Svc Btry, 2d Bn, 33d FA
APO New York

TACFIRE OPERATIONS Specialist (13C) Basic Training

Having been a battery commander of a 13B One Station Unit Training (OSUT) battery for 19 months, I would like to comment on something that is very important to me, i.e., giving the young soldier the best possible training. This training begins in basic.

While reading the Commander's Manual for the TACFIRE Operations Specialist (13C), I noticed a statement that said "All TACFIRE Operations Specialists receive eight weeks basic combat training (BCT) at Fort Sill, Oklahoma." This is misleading in the sense that *not* all TACFIRE Operations Specialists receive basic training at Fort Sill. As of 19 March 1981, the School graduated 45 TACFIRE Operations Specialists and out of these 45 students, 18 graduated from basic training at a post other than Fort Sill.

I'm not criticizing the Commander's Manual, but rather the philosophy of where basic training should be taught. If we, as trainers, are going to do our job properly, then let's begin with the soldier's initial entry training. Let's conduct all field artillery basic training at Fort Sill (other than mid-cycle gains) in order to give the soldier an indoctrination into the Field Artillery System. When you talk about training a TACFIRE Operations Specialist, you are really talking about three new ideas the soldier must master — the Army, the Field Artillery, and TACFIRE.

We must train properly and, presently, perhaps we are not always succeeding. A soldier who lacks a working knowledge of the Field Artillery System will encounter a myriad of problems when he begins his TACFIRE training. It is our job to see that this doesn't happen. We can decrease the soldier's problems by giving TACFIRE Operations Specialists basic training at Fort Sill.

Jeffrey C. Carter
CPT, FA
Course Director, TACFIRE
TCADD, USAFAS
Fort Sill, OK

As you point out, the Commander's Manual for the TACFIRE Operations Specialist (13C) is in error and is currently being changed to reflect that all 13Cs will receive Advanced Individual Training (AIT) at Fort Sill. Further information can be obtained by writing or calling the School's Directorate of Training Developments: AUTOVON 639-1203/6376.—Ed.

Troop safety

This letter is in reference to a recent action involving the fire support coordinator's (FSCOORD) responsibility for the safety of supported troops and the offensive air support (OAS) for those troops.

Prior to 1979, one of the fire support coordinating measures used by a corps commander was a "bomb line." It restricted air actions against ground targets short of it without prior coordination with the establishing headquarters. Subsequent to 1979 the bomb line was replaced by the current fire support coordination line (FSCL) to serve the same purpose. All close air support (CAS) missions short of the line require detailed integration with the fire and movement of the supported land troops. Responsibility for this integration is given to the FSCOORD. He is charged to insure the safety of supported troops from the effects of friendly air attacks.

Recently, the people who develop doctrine and procedures for the airland battle (as opposed to those planning fire support) have originated the term "offensive air support (OAS)" within which are three categories of air support: tactical air reconnaissance (TAR), close air support (CAS), and battlefield air interdiction (BAI). The last two fall into the category of fire support.

Both CAS and BAI may be targeted on targets *short* of the FSCL. While CAS targets will be completely integrated with the actions of the supported ground troops, some BAI targets so located may not be. This negates the very purpose of the FSCL. So long as fire support planners call all targets short of the FSCL for air attack CAS they will get complete integration; as BAI targets, they may not.

Currently the Army has no literature that I know of which tells a FSCOORD the difference between a CAS and BAI target; yet the FSCOORD (for the supported commander) must recommend how many daily air sorties will be needed for each type. As I see it, this introduces nothing but confusion and lessens the degree of safety which ground troops can expect from OAS.

Charles W. Montgomery
LTC (Ret), FA
Lawton, OK 73505

Correction

Reference your "Clark was a Redleg" blurb on page 52 of the January-February 1981 issue of your fine magazine—Please note that Clark's redlegness is not addressed; rather, Lewis' is. Was Clark a redleg also?

Sincerely,
Harry L. Lewis Jr.
1LT, FA
HHB, 2-4th FA

A two-sentence filler and we blew it! The "blurb" as you call it should have said, "William Clark of Lewis and Clark fame became a Second Lieutenant of Artillery prior to his trip," (rather than William Lewis). Lewis' first name was Meriwether.—Ed.

Howitzer-fired antiarmor weapons

Despite periodic correspondence with the *Journal* from individuals interested in howitzer-fired antiarmor weapons for battery defense, the Field Artillery remains equipped with organic antiarmor rounds only for the light howitzer. As such, battery defense is still based on displacement and use of light antitank weapons (LAWs) to avoid and/or defeat enemy armored fighting vehicles (AFVs). this I believe is a real tragedy! Are there then any quick fixes or adapt-table items that can solve this dilema?

Perhaps Copperhead could be used in battery defense; however, the minimum arming time is more than three seconds, the round must travel approximately 1,500 meters before activating. As such, other fire support assets will have ample time to defeat attacking units before they reach the battery position. On the other hand, if Copperhead could be activated at a shorter range (under 500 meters), then the battery would require some sort of laser designator like the GLLD or a more powerful version of the MILES training laser mounted on the barrel of a perimeter guard who has communication with the FDC/BOC.

How about our standard antiarmor weapons? LAWs are limited because of range estimation problems and warhead size while Dragons and TOWs require much more training, dedicated gunners, and vehicles to carry them. The 90-mm recoilless rifle suffers from back blast and ranging problems and requires trained personnel. Further, a 106-mm recoilless rifle requires a vehicle for carrying the weapons, ammunition, and crew, and uses a .50 caliber spotting rifle which is accurate to about 1,100 meters (the burn-out range of the spotting round.)

The Vought Hyper Sonic Kinetic Energy Rocket might work if placed co-axially with the main gun or the .50 caliber machinegun on self-propelled howitzers/M548 ammunition carriers (with appropriate back blast protection for the firer and vehicle).

I doubt that shaped charge or high explosive plastic rounds will be developed for medium/heavy howitzers due to problems of range estimation, developmental costs, and the fact that they require direct hits to cause damage. Also, I do not think a modified Shillelagh wire guided missile fired through the howitzer tube is the answer either, because of the size of the missile and the complexity of the needed fire control equipment.

It might be better and cheaper to upgrade the battery .50 caliber machineguns to 25-mm Bushmaster cannons or single-barrelled 30-mm cannons. Subcaliber armor-piercing penetrators are in development for the 25-mm gun while the 30-mm gun has the depleted uranium (DU) projectiles operational. With a Dual feed on the weapons, both antiarmor and antipersonnel rounds could be used.

It also might be interesting to examine the idea of using modified Armor Piercing Fin Stabilized Discarding Sabot (APFSDS) penetrator as a direct fire weapon. Instead of one penetrator in the sabot carrier, put in five in a cross configuration with the outside penetrators angled about two mils off center to help spread out the pattern (figure 1); use the same type penetrators as those used in the 105-mm tank round and make the carrier out of Teflon cut in four quarters with grooves for the penetrators. A Teflon cap would sit over the bottom of the carrier sections and rotate freely to prevent spin in the barrel while the nose of the round could be contoured to the wind screens of the penetrators. The carrier and penetrators would weigh about 50 pounds, and a charge 7 would probably give the entire assembly a muzzle and the penetrators would have a 2-meter spread at 1,000 meters. Probability of a hit would increase by 400 percent over a single unguided projectile or penetrator. (Present reticle pattern stadia sights in the elbow telescope and direct fire tables would have to be modified to meet the new muzzle velocity requirements of the flatter trajectory.)

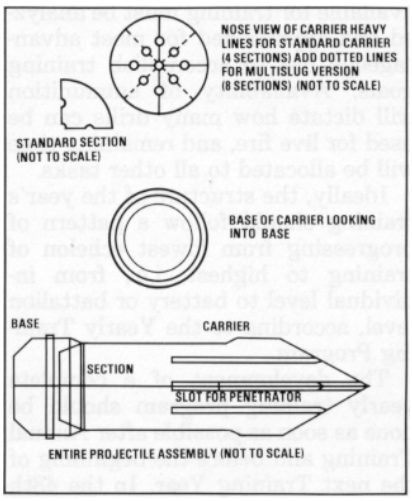


Figure 1.

Another idea along the same lines is the use of 30-mm DU projectiles, similar to those used in the GAU-8 cannon but longer and fin stabilized, in a carrier. This would act as a giant shotgun shell or antiarmor beehive round. Several dozen such projectiles in the carrier would be effective against APCs for battery defense.

These proposed rounds would be muzzle action functioning projectiles. Maximum effective range would be about 1,000 meters. Coupled with smoke grenade launchers on tracked vehicles in the battery, they might allow a battery to withdraw to safety or even destroy a platoon-size element of light armored vehicles. Further fire missions would be less prone to interruption from ground attack and the rear areas would be less vulnerable to isolated units that slipped through the covering force and main battle areas.

The overall readiness and responsiveness, not to mention survivability, of the Field Artillery would be enhanced.

Larry A. Altersitz
CPT, FA (PAARNG)
1-107th FA
28th Infantry Division
Pittsburgh, PA

The M712 (Copperhead) projectile, even with modification, could not be used in this direct fire role. The M712's steering capability is based on the "footprint" created by the Laser Designator, and because of "footprint" characteristics the M712 would not be able to home in on the target in a flat trajectory launch mode.

The use of an Armor Piercing Fin Stabilized, Discarding Sabot (APFSDS) penetrator is impractical because of the characteristics of kinetic energy projectiles. The 105-mm tank gun develops a muzzle velocity of 1,478 meters per second and its M392 APFSDS projectile is only marginally effective against the NATO standard armor target. The M109A1/A2/A3 series of howitzers can only achieve a maximum muzzle velocity of 684.3 meters per second firing charge 8, with shell HE M107. This low muzzle velocity renders the

concept of a kinetic energy projectile unworkable.

There have been recommendations that the DRAGON antitank weapon be included in the FA as a weapon. Also, the VIPER, the replacement for the LAW, will undoubtedly increase the FA's antiarmor capability, but the main point of all of this must not be overlooked: The FA is not in the direct fire antitank business. We exist to provide further indirect fire to support the maneuver forces.—Ed.

Members of 7th Field Artillery

Material, such as photographs and true personal anecdotes of the 7th Field Artillery for the period from 1940 to date, is needed for a book now underway. Also wanted is information on all Regular Army, Air Force, Reserve, and National Guard units stationed at Fort Ethan Allen, Vermont, from 1940 to 1961.

Anyone willing to furnish any meterial or information, please contact me at the address below.

Robert B. Denis
CPT (Ret), AUS
7th Field Artillery Association
34 Butternut Lane
Methuen, MA 01844

National Guard yearly training

One of the major areas of emphasis in today's Army is construction and preparation of viable training programs that accomplish necessary unit goals. While there are many successful methods, the one detailed here has produced the best results for my battalion.

FM 21-5-7 gives the following steps for the organizational cycle of unit training: analyze, provide, conduct, and evaluate. These steps are actually key points in a closed loop, with each step leading to the next.

FORSCOM Regulation 350-2 indicates that the yearly Training Plan should be based on an evaluation of the previous year's training results. This falls under the heading of "analysis of training" which is the key to proper construction of a good training program. In Reserve Component units, however, one initial step must be taken prior to analysis of the previous year's training results. With time in such short supply National Guard and Reserve Units must plan training around required events directed by regulations and higher headquarters. Such events include Annual Training (AT), command post exercises (CPXs), and annual qualification firing of individual and crew served weapons. In the Field Artillery, this also includes the conduct of the annual Gunner's Test. As such, the only way to properly schedule and plan training is to use these events as guideposts within the parameters of inactive duty training (IDT).

The first step in planning yearly training is to establish *start* and *goal* points which, for RC units, are the beginning of the Training Year on 1 October and the dates of Annual Training. (The period after AT is best used for such things as inventories and individual training to correct weaknesses noticed during Annual Training.)

Having established the outer perimeters of usable training time before Annual Training, the next task is to insert those prescheduled training events that are controlled by higher headquarters. These include the staff CPX (frequently held with a higher headquarters) or civil disturbance training. This training should come after AT, if possible, since the period between the start of the Training Year and Annual Training should be dedicated primarily to preparation for AT.

Once the parameters of the training time are established, including those events dictated by higher headquarters, the next step is to structure a training program that will fulfill required training goals. Thses goals are those identified through analysis of the previous year's training evaluations, supplemented by the Three-Year Training Plan. Resources available for training must be analyzed and apportioned for most advantageous use to accomplish training goals. Availability of ammunition will dictate how many drills can be used for live fire, and remaining time will be allocated to all other tasks.

Ideally, the structure of the year's training should follow a pattern of progressing from lowest echelon of training to highest; i.e., from individual level to battery or battalion level, according to the Yearly Training Program.

The development of a complete yearly training program should be done as soon as possible after Annual Training and before the beginning of the next Training Year. In the 48th Infantry Brigade, GAARNG, this is accomplished by scheduling a training conference for commanders of battalions and separate units and key training personnel within attendant units. Here attendees schedule drill events in the manner previously stated; i.e., home station drills, dry firing field practice, required training, and service practice.

Detailed planning at battery level is not neglected, nor is battery input discounted. When the training program reaches the point just mentioned, detailed training is still to be defined at battery level. We solve this problem through a simplified version of the brigade planning conference which allows all battery commanders and staff members to be thoroughly briefed on the overall layout of the battalion's training for the year. The batteries can then define their own training program within this framework, based on their own strengths and weaknesses. The battery commander then briefs the battalion commander and S3 on his training plan and obtains command approval.

After using these two conferences to finalize the Yearly Training Program at all levels, the next major task is dissemination of information to all personnel concerned. Here the primary means of disseminating information are training circulars (published at battalion and higher levels) and training forecasts (published at battalion and battery levels). At battalion level, the training circular closely parallels the brigade circular, with an annex which gives of the yearly training forecast. The battery training forecast is much more informal, but is still intended as a serious working document.

The system of planning training outlined here allows for thorough planning with the detail and feedback necessary for all performance-oriented training. Generally, the training program will not exhibit much change throughout the year; however, as with any system of dynamic training, some adaptation to changing circumstances will be required.

Ideally, all training should be based on the demonstrated needs and weaknesses present in the unit, but real world requirements obviously must be included. For the Reserve Component unit, the most overriding consideration is time.

George W. Olney
CPT, FA (GAARNG)
Waycross, GA

Hot off the Hotline

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

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

1. **Question:** My question is in reference to the 13C SQT for sergeants first class. The Soldier's Manual just received shows 28 tasks and 25 of them refer to TACFIRE. My unit is not equipped with TACFIRE and I would like to know what has been done to get the 13E personnel trained. How can we get some assistance?

Answer: *Department of the Army will soon announce criteria for those to be tested. In essence, the individual must have received formal school training and carry an MOS designator "T" before he will be required to take the 13C SQT for 1981. Training in the MOS will be given to individuals assigned to a TACFIRE-equipped unit either while TDY en route to the unit or by a New Equipment Training Team at the unit.*

2. **Question:** Would the AN/MPQ-4 radar ever, doctrinally, be attached to a general support battalion in a US defensive posture?

Answer: *This question was geared to the ARTEP of a general support battalion. Doctrinally, the radar section could be attached or placed under the operational control of the general support battalion. This could certainly be accomplished for the purpose of an ARTEP (FMs 6-20 and 6-121), and it would also be feasible to use the AN/MPQ-4 radar as part of the opposing force and have it attempt to locate the ARTEP unit.*

3. **Question:** Is there any device that can be used in conjunction with the laser target designator (LTD) to train personnel? That is, can a person using an LTD designate a target and is there a device that will determine whether the laser is actually on the target and whether it is there long enough to effect a kill?

Answer: *There is no training device for the laser target designator. The LTD is not designated as a precise target designator, but it can provide general target area designation so that an aircraft can acquire and subsequently attack the target.*

4. **Question:** My question refers to the article on PLRS/JTIDS Hybrid in the January-February 1981 *FA Journal.* In this article, MAJ Ondo describes the use of PLRS for the positioning of weapons but does not give an order of magnitude of the accuracy of this positioning. What is the order of magnitude that we can expect if we put the PLRS system on an MLRS or a howitzer?

Answer: *The operational requirement on PLRS, which will carry over into the PLRS/JTIDS Hybrid, is to achieve 20 to 30 meters circular error probable (CEP) accuracy for self location. This falls short of established field artillery accuracy required for positioning of cannon artillery weapons; e.g., QSTAG 269, Annex A, "Artillery Survey Accuracy Criteria," which is 10 meters CEP.*

The requirement for enhanced PLRS user units in self-propelled howitzers and MLRS SPLL's is generated by the requirement for digital communications, not solely on position/location requirements; and, in the case of the howitzers, actually stems from anticipated communications requirements of an Enhanced Self-Propelled Artillery Weapon having an on-board processing computer. Having such a device on board, however, it is expected that its position/location capability will be used for positioning of weapons whenever more accurate means are unavailable.

5. **Question:** When you're in the field and one of your batteries fires a registration and the other batteries transfers GFT settings, what do the other batteries use in a concurrent met? Do they use the range to the registration point and the deflection to the registration point or do they use data from the transferred GFT setting?

Answer: *Computation of the GFT setting for the nonregistering batteries is outlined in FM 6-40, page 7-8, paragraph 7-10. You will note that the difference in the GFT settings are based on the shooting strength of the basepiece for each battery. The data used to compute the concurrent met worked by the nonregistering batteries is the same as that worked by the registering battery except for: the GFT setting and the time-on-target deflection, range, and fuze corrections which are based on the comparative velocity errors of the basepiece.*

6. **Question:** Is there a cutoff point for velocity error (VE) in a 109A2 when it reaches a point greater than or equal to two range probable errors when a nuclear round cannot be fired?

Answer: *As far as gunnery procedures are concerned, there is no "velocity error cutoff point" for any nuclear capable cannon system that would preclude a nuclear round from being fired from a gun.*

In 155 nuclear gunnery computations, muzzle velocity (MV) loss due to tube erosion is considered when computing data using the met correction technique. This is done because the M107 HE projectile and the 155-mm nuclear projectile are not ballistically matched. Since the position VE is affected by projectile type, we cannot use the HE position VE obtained from a concurrent met to compute firing data for the nuclear projectile. Therefore, the VE that we use is one derived from the loss in muzzle velocity due to tube erosion, which is obtained from a recent pullover gage reading or from EFC rounds for erosion. This procedure is adequately explained in FM 6-40, chapter 13.

It is suspected that you have calibration procedures and 155 nuclear gunnery procedures somewhat confused. A weapon should be recalibrated when the muzzle velocity loss, since the last calibration

is equivalent to two range probable errors (a reduction of approximately 1.5 meter per second in MV).

As far as gunnery procedures are concerned, a nuclear round can be fired from any gun possessing a nuclear delivery capability as long as its tube is still serviceable.

7. **Question:** During adjustments in a precision registration, why do you shoot, on your brackets, two rounds at an "add 25" which brings you back to the original "did hit" grid and then you give required data? The question is, why do you shoot two rounds at that point and then drop back to one round?

Answer: *In a precision registration, we obtain the "did hit" data by adjusting onto the registration point such that the mean-point-of-impact (MPI) of a group of rounds occurs at the registration point.*

This is accomplished by obtaining spottings of two overs and two shorts along the observer-target line from rounds fired at the same data or data 25 meters apart. From these four spottings, the observer determines the necessary corrections that would move the MPI of the four spottings onto the registration point. We cannot use just one spotting from a single round.

Due to the effects of dispersion, there is only a 50 percent assurance that a single round will impact within one probable error of the true MPI achieved by the data from the round that was fired.

Further, in a precision registration, it is critical that the MPI from which the observer will make his final refinements be very representative of the true MPI. To obtain a higher percentage of assurance, we fire a sampling of rounds (normally four) to obtain the desired four usable spottings.

8. **Question:** Our question concerns the recall of the self-alignment boresighting device on the M109A2 series howitzer: Can the scribe marks and a parallax shield be used to set up a standard angle for the howitzer for boresighting instead of the test target board? Are there any problems using this method or any advice concerning it?

Answer: *The standard angle method of checking boresight is feasible for all cannon weapons; however, the normal fire control alignment tests must be conducted prior to establishing scribe lines. Precautions must be taken to insure that the cannon tube is in the full battery position when referring to the witness mark. Any removal of the muzzle brake will require that the witness mark be reverified as to the accuracy of its locating or be reestablished.*

9. **Question:** I would like to determine if we could be more accurate in our direct fire if we boresighted at the range of the targets; i.e., if our expected management range was 600 meters, could we boresight on the specific target at 600, thereby converging our sight and tube to that point.

Answer: *Boresighting for 600 meters would increase your direct fire accuracy at 600 meters* ***only****. However, by destroying the parallelism achieved by boresighting at infinity, as required by the TM, any fire at a range of less or greater than 600 meters would be grossly inaccurate.*

Any finite boresighting procedure would only apply in a last-ditch, Bastogne-type scenario.

10. **Question:** What is the proper procedure to be used by the battalion FDC/Net Control Station when opening fire nets in the battalion. I also need guidelines on when to authenticate on FM radio for fire missions.

Answer: *To open a net, the Net Control Station (NCS) sets its transmitter frequency to the assigned net frequency. Using the net call, the NCS calls the stations assigned to the net and identifies itself as the NCS. After the called stations reply in alphabetical order, the NCS states that their transmissions have been heard. The NCS then declares the condition of the net (Free Net, Directed Net, Listening Silence, etc.).*

Challenge and authentication is considered a normal element of initial request for field artillery fire. The FDC inserts the challenge in the last repeat sequence of the fire request transmission. The FO transmits the correct authentication reply to the FDC immediately following the challenge (normally 5 to 7 seconds; never more than 15 to 20 seconds), during the time the FDC is processing the fire request for execution. Authentication replies exceeding 15 to 20 seconds are automatically suspect and a basis for rechallenge.

11. **Question:** I need some information on standardization of radio configuration or radio installation for the M113 to support the FIST concept. Any standardization that the Field Artillery School has (i.e., diagrams, pictures, points of contact, letters) would be greatly appreciated. We have four M113s in our FIST which support the armor battalion here and we're trying to find out if there is any standardization for the radio installation kits.

Answer: *The M113 vehicles are produced with a radio wiring harness for either an AN/VRC-46 or AN/VRC-49 radio set. An "Interim FIST Difference Kit" is required to install the mechanized infantry, armor, or armored cavalry FIST headquarters radio configuration: one AN/VRC-47 and two AN/GRC-160 radios. The difference kit was issued to USAREUR in 1979 and to other major commands in 1980 when it was indicated that the M113 would be made available for FIST use. Spare parts for the modified intercom will be available in June 1981. (Units should retain the installation instructions for the purpose of identifying part numbers, etc., pending availability of the technical manual (TM) in 1982.) Questions pertaining to the kit should be directed to: Commander, CERCOM, ATTN: MMG-C, Fort Monmouth, NJ 07703. Points of comtact at CERCOM are CPT Williams and MSG Morant, AUTOVON 992-1819.*

12. **Question:** This question concerns the recall of the self-alignment boresighting device on the M109A2 series howitzer. Is it possible, using the scribe marks and a parallax shield, to set up a standard angle for the howitzer for boresighting instead of the test target boards? Are there any problems using this method or any advice concerning it?

Answer: *The standard angle method of checking boresight is feasible for all cannon; however, the normal fire control alignment tests must be conducted prior to establishing scribe lines. Also, precautions must be taken to insure that the cannon tube is in the full battery position when referring to the witness mark. Any removal of the muzzle brake will require that the witness mark be reverified as to the accuracy of its locating or be reestablished.*

Precision Guided Artillery

First and Second Generation Projectiles

by Mr. James F. Hall

Three target tanks are proceeding down a roadway when the second in line is suddenly enveloped in flames and grinds to a halt. Thirty seconds later the lead tank is hit and, within a short time, the third explodes. Three hits, three kills — what has happened? There was no rocket motor signature nor audible firing signal — nothing in view!

In this scenario, three laser-guided projectiles "homed in" on laser designator spots on the tanks, allowing each shaped charge warhead to penetrate and destroy them. The only possible warning was the invisible (to the eye) coded laser pulsed spot appearing for about 15 seconds on each tank. This happened during Operational Test II (OT II) of Copperhead at Fort Carson, CO, in 1979, demonstrating the accuracy, reliability, and lethality of the first generation Cannon Launched Guided Projectile (CLGP). Place this scene now on a line of Warsaw Pact tanks approaching Hunfeld on Route 84 and imagine the confusion and consternation.

Much has been written about the increasing numerical superiority of Warsaw Pact combat vehicles and the difficulty of the current US force structure to counteract a surge attack. Not only are the numbers and capabilities of tanks increasing, but increasingly more personnel are being put under armor in armored personnel carriers (BMP and BTR), air defense vehicles (ZSU-23-4 and SAMs), and self-propelled artillery (120-mm and 152-mm). As such, the US field artillery must have the capability to destroy a large number of these before they reach the contact zone to better balance the force ratio, reduce the presentation rate, and also neutralize the arillery that is supplying suppressive fire on the frontline antitank guided weapons (ATGW). Further, mission requirements dictate that firing batteries have the flexibility to distribute fires across a wide front in close support and at a depth within enemy territory where targets of various types, sizes, and hardness will be numerous.

Target kill limitations

Current field artillery weapon systems and munitions with the exception of Copperhead are not accurate enough to provide hard, point, stationary, and moving target kill capabilities without excessive ammunition expenditure, resupply, and tube wear.

History has shown that only about one percent of tank kills in World Wars I and II, Korea, and Vietnam were attributed to artillery. For example, Army studies show that in some situations munition expenditures against hard moving targets (tanks) require as many as 1,500 conventional high explosive 155-mm rounds or 300 improved conventional munition (ICM) rounds to achieve a target kill. This mode of fire is obviously not only very time-consuming, allowing deeper enemy penetration, but also requires extensive logistical support. Additionally, artillery battery locations with high rates of fire are readily detectable and vulnerable while communication requirements are extensive and vulnerable to jamming and location disclosure. Finally, there is no capability to attack moving targets in Zone II beyond the line of sight of the forward observers.

Copperhead

These limitations have led to the development and initial production of Copperhead (figure 1), a 155-mm semi-active laser (SAL) guided projectile with demonstrated gun-to-target ranges of 3 to 16 kilometers and laser designator-to-target ranges of several kilometers against armor targets. Copperhead can hit and destroy laser designated stationary and moving point targets with less than three rounds. Laser designators that have been successfully demonstrated with Copperhead include the Ground Laser Locator Designator (GLLD), Remotely Piloted Vehicles (RPVs), helicopter-borne

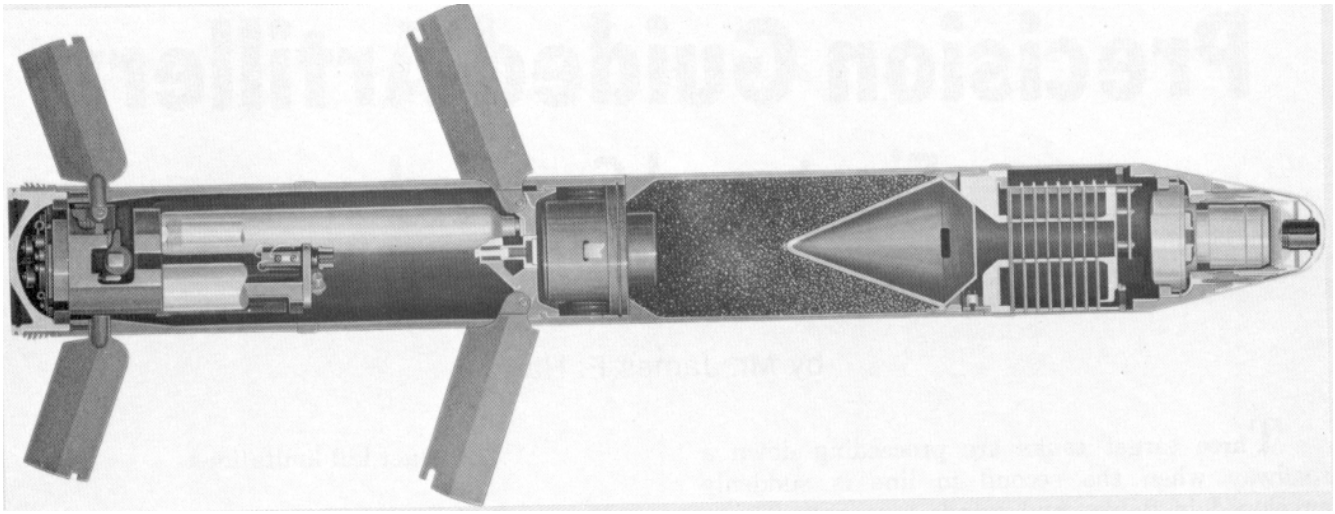


Figure 1. Copperhead cutaway.

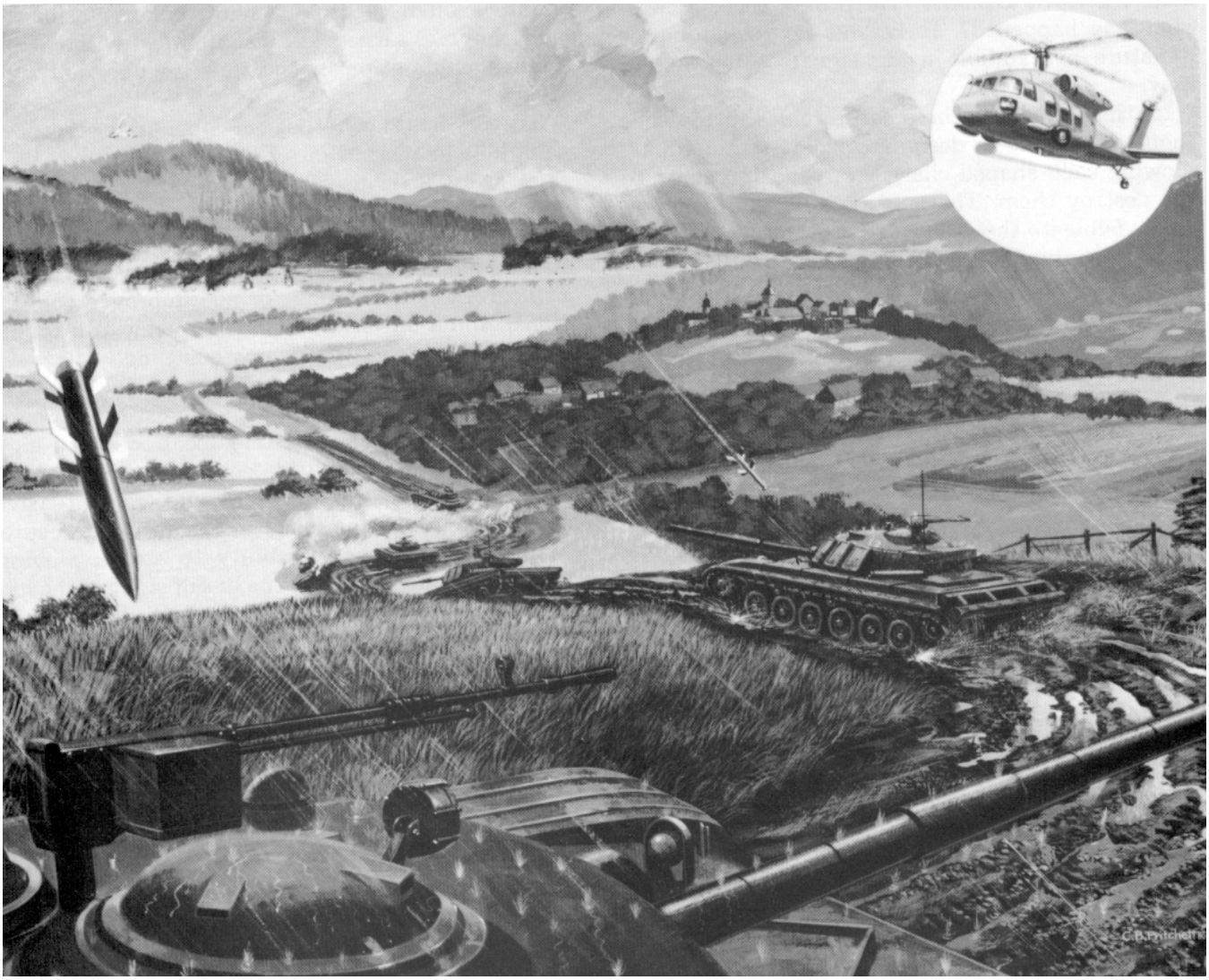


Figure 2. An artist's concept of the Advanced Indirect Fire System and Stand-Off Target Acquisition System (insert at upper right), showing the infrared round (lower right) and the millimeter wave round (lower left) about to strike target tanks.

designators (such as TADS/PNVS on the AH-64), and hand-held designators. The Copperhead round consists of three major sections:

•Nose—contains the guidance seeker and electronics.

•Mid-section—contains the shaped charge/fragmentation warhead and fuze module.

•Aft section—contains the wings, control fins, control actuator, and power.

With the addition of the AN/TAS-4 night sight to the Ground Laser Locator Designator and the improved seeker electronics, the system can operate at night or in fairly significant quantities of obscurants such as smoke and dust. Additionally, the modified glide trajectory permits Copperhead to operate under cloud ceilings.

The laser semi-active technology proved feasible under combat conditions in the Vietnam conflict in the form of laser guided bombs used against high value targets such as dams, bridges, and power plants. Today, however, improvements in Copperhead have increased the accuracy and efficiency of laser-guided weapons sufficiently to hit moving tanks; e.g., the seeker has been hardened for cannon launch with improved overall system performance to make it a practical antiarmor weapon for the artillery. Copperhead can be fired from the M109A1-A3, and M198, and allied guns including the FH70, SP-70, and AU F1 (GST). However, the Army would very much like to field a similar weapon with a fire-and-forget capability that will fly out, find an armored target on its own, and then destroy it. Some of the reasons why fire-and-forget, lock-on-after-launch projectiles are needed are as follows:

•Targets can be attacked with precision guidance at a greater depth than forward observers can detect them with optical sensors.

•Infrared seekers will operate through smoke, dust, and other obscurants except dense clouds and fog. Millimeter wave seekers are essentially all-weather.

•Artillery will be able to conduct long range counterfire at guns and missile launchers with few rounds.

•Target designators such as lasers are not needed.

•Command and control is simplified by eliminating the need to coordinate battery firing with laser operation.

•Destruction of targets in Zone II before reaching Zone I improves the exchange ratio and reduces the presentation rate to shorter range antitank guided weapons such as TOW and Dragon.

•Countermeasures are difficult.

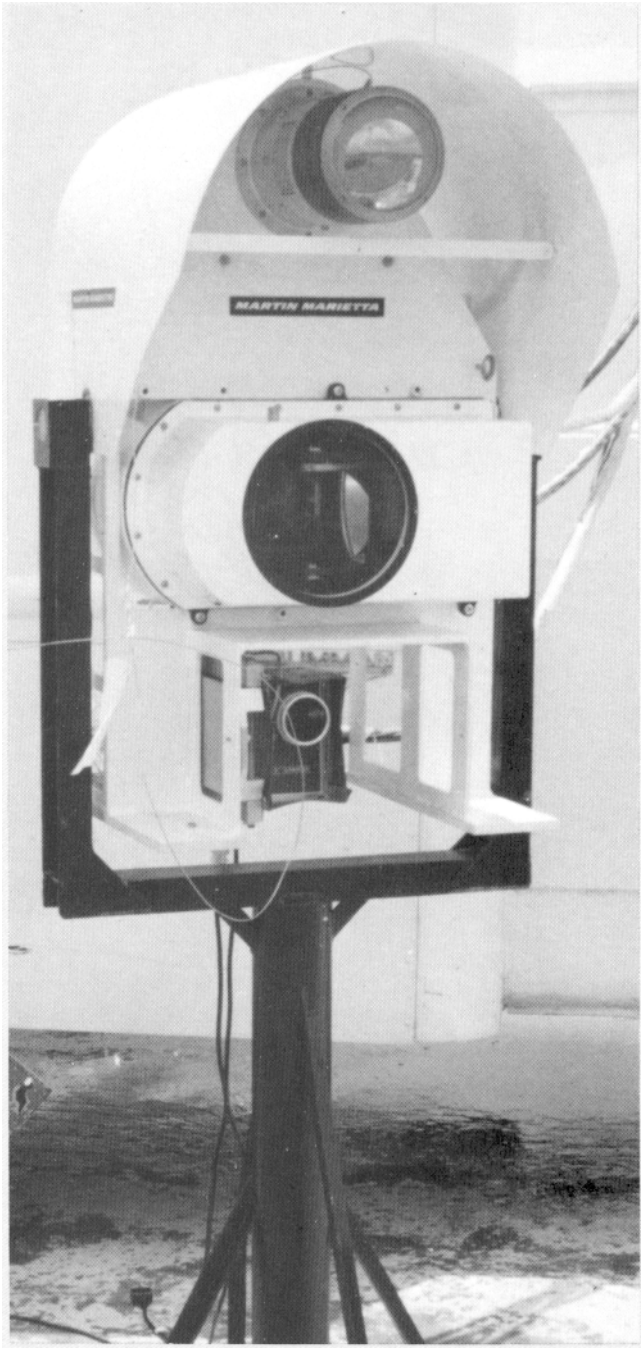


Figure 3. Infrared seeker.

•They will be very cost-effective.

•They can operate with longer range target acquisition systems such as the Stand-off Target Acquisition System (SOTAS) and counterbattery radars AN/TPQ-36 and -37.

New systems

The Army desires a fire-and-forget projectile that will satisfy most or all of the aforementioned criteria and, as part of the Advanced Indirect Fire System

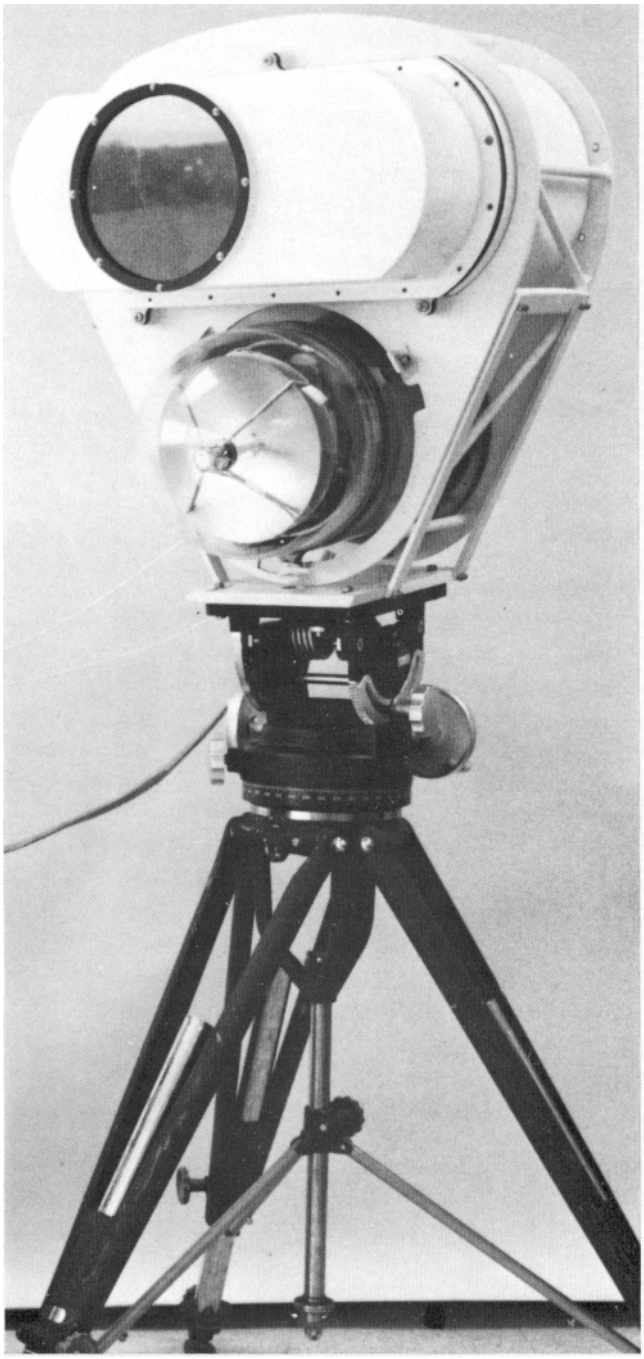


Figure 4. Millimeter wave seeker.

(AIFS) program, two such systems are being developed and tested (figure 2). One is a passive infrared (IR) seeker that uses signal processing to search out, identify, and guide on an armored target. The second is an active millimeter wave (MMW) seeker that uses a new and unique signal processing technique for target detection and projectile guidance. Both of these systems are being developed in the 155-mm configuration.

The infrared prototype device is shown in figure 3. The dome covered seeker is located at the top, and below it is a television tracker to verify what the seeker is looking at and a wide angle television for scene coverage. This prototype was recently tested under an Air Force contract on a 300-foot tower at Elgin AFB where it was able to successfully detect and track US and other armored vehicles at desired ranges. Later this year it will be captive flight tested on tactical targets at several locations.

The millimeter wave seeker fabrication is nearing completion using a tactical size antenna. An earlier prototype with a larger antenna is shown in figure 4. The upper dome is the television verification tracker, and below it is the millimeter wave tracker. This device has been used to verify the theory and to collect data on targets and backgrounds for use in computer simulations. The new system, simulating a tactical configuration, will be tested this year in comparison with the infrared seeker.

Meanwhile, system design efforts continue that will enhance the projectile's range well beyond that of the present Copperhead by reducing drag and increasing maneuverability. Detail design and test of critical cannon hardened infrared and milimeter wave components and subassemblies will also occur in late 1981.

Following successful completion of these feasibility demonstrations, it is planned to proceed into the validation phase. Subsequently, full scale engineering development of the "best" seeker will provide the need for a fire-and-forget projectile that is cost-effective, requires minimal training, and can destroy armored targets at long ranges with very few rounds. Meanwhile, Copperhead will be an effective "force multiplier" to counterbalance the Warsaw Pact numerical advantage and will be an adjunct to combined force operations with M1 tanks, antitank guided weapons, and attack helicopters. Copperhead will also complement fire-and-forget projectiles with the ability to hit any type of target that can be laser designated, plus be able to work in mixed forces of friendly and enemy armor with the man-in-the-loop to identify friend from foe.

Copperhead is in production today and will soon be operational in 155-mm artillery batteries. It will be an effective weapon to help blunt any surge attack of Warsaw Pact armor as well as providing precision delivery of an effective warhead on any tactical laser designated target. Meanwhile, following right behind is a precision guided fire-and-forget projectile development that will reach out and destroy targets in Zone II, thus providing the US field artillery with a devastating capability.

James F. Hall is employed by Martin Marietta Aerospace, Orlando, FL.

Who Melts, When, and Why?

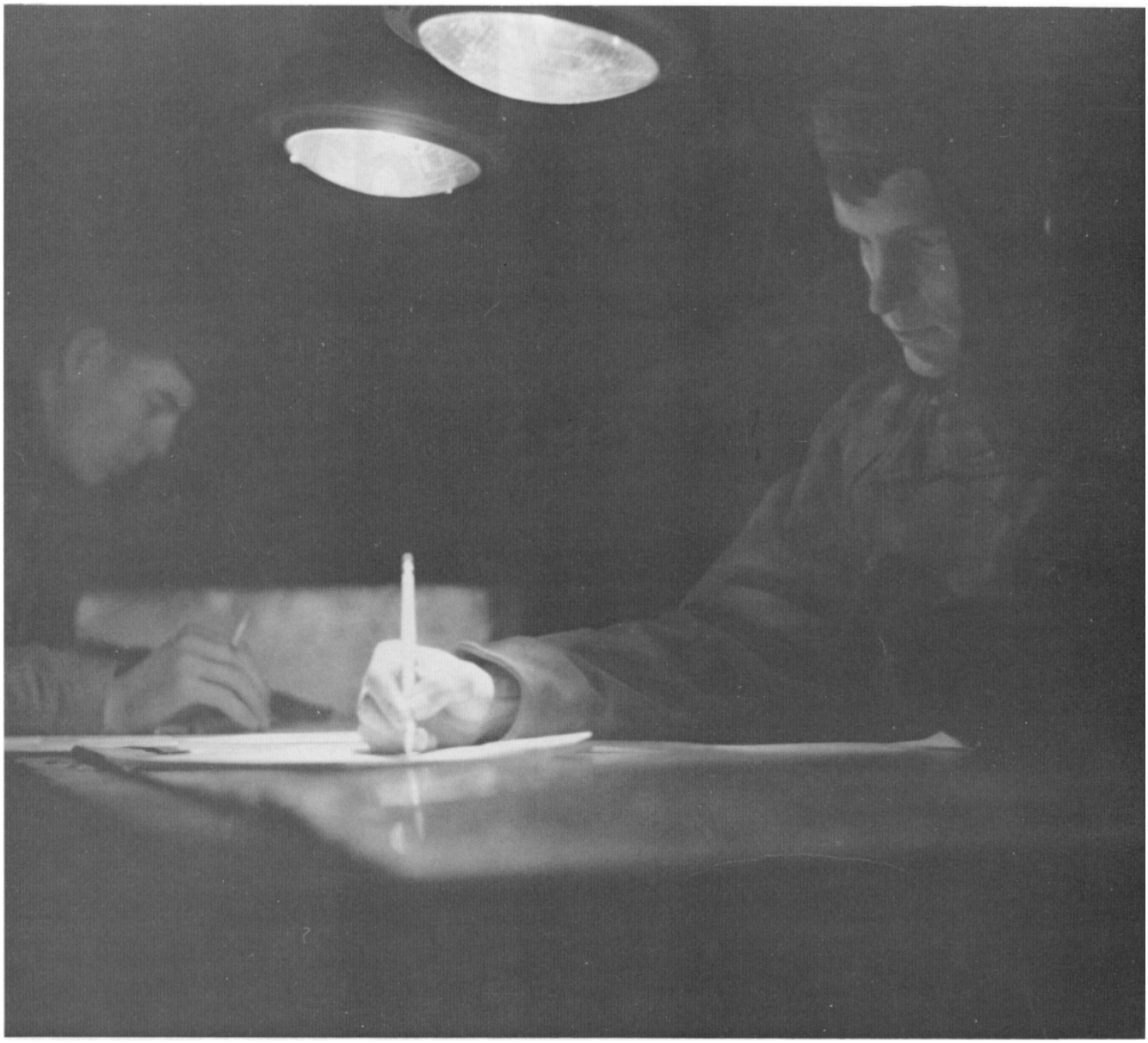
by Doctors Frederick J. Manning and Larry H. Ingraham

In late 1977, the authors of this article arrived in Heidelberg, West Germany, to set up what was indeed to *be* a Special Foreign Activity of the Walter Reed Army Institute of Research. Hardly had the lettering on our office door dried when a distressed looking major wearing crossed cannons brought us a field artilleryman's version of that old tongue twister, "How much wood could a woodchuck chuck if a woodchuck could chuck wood?" He wanted to know, "How much ammo can an ammo humper hump if an ammo humper hadda hump ammo?" That is to say, he explained that the corps headquarters where he worked had recently begun a major evaluation of what would be required of whom should their present war plans have to be executed.

His field artillery section was naturally concerned with the enormous number of rounds likely to be required of the corps artillery. They had a good idea, from maintenance data and test firings, of how many hours the self-propelled howitzers could propel themselves before a serious deficiency showed up and of how many rounds could be fired at varying rates of fire. He had come to us, he explained, to find out how long they could expect to operate on a round-the-clock basis before the men

"melted." As guidance, he went on, we would probably be most interested in one member of the gun crews in particular: the soldier charged with wrestling the 200-pound projectiles from their storage place in the ammunition vehicle to the howitzer's hydraulic loader and lifting it into place. The major calculated that this individual would be lifting on the order of 16 tons a day if the Warsaw Pact behaved as they were supposed to. The major stated that, if we could simply tell him how many days an individual could continue this, the study could move on to other areas.

It was not easy to tell a man who had figured vehicle and barrel lives out to two decimal places that we thought *continuous* operations were viable from a human standpoint for approximately 36 hours, plus or minus 26 hours. It was even more difficult to tell him that the laboratory studies of sleep deprivation (on which we based this estimate), though totally unrelated to field artillery operations, also led us to believe it was the leaders, not the ammo humpers, who were most likely to be the weak link in the conduct of continuous high intensity combat operations as described in the Army's new now-to-fight manual, FM 100-5. However, we did voice our opinion, and, as a result, the



The quality of work performed by mental laborers is affected by sleep deprivation.

authors and three enlisted members of our unit spent the next six months watching the day-to-day operations and training of a field artillery battalion in Europe. Here it was clearly not within our resources to stage a 30-day, round-the-clock field exercise. Instead, we observed the applicability of well-controlled laboratory findings to this specific real-world situation to discover possible "fault lines" along which such a unit might crack under the stress of continuous operations.

Direct observation and informal interviews of soldiers and their families, in garrison and during field training, both during and after duty hours, were the primary means of data collection. As such, 1,000 pages of field notes were gathered. Additional sources of data were formal interviews, questionnaires, personnel and medical record screens, and third party evaluations such as the Annual General Inspection (AGI) and the unit Nuclear Surety Evalution. In this article, we shall emphasize some of the more general issues of leadership and performance. Additionally, now being blessed with the gift of hindsight, we shall confine

ourselves to observations whose generality we have subsequently noted as we visited other units on other projects.

Our original focus was on sleep deprivation, and it quickly became apparent that, in the field as in the laboratory, it was psychological rather than physiological exhaustion that is the critical problem with sleep deprivation. In a sentence, it is not a question of muscle, but of *judgment* and *will*. Further, though the fit is not perfect, we found it useful to think about the effects of sleep deprivation on judgment when considering *leadership* in continuous operations, as well as the will to continue when we turn to the *junior enlisted*.

Leaders and judgment

There have been a number of well-conducted experiments in the field, as well as in the lab, which indicated that cognitive tasks such as map reading, encoding and decoding, logical reasoning, and short-term memory are affected much sooner and more severely by sleep loss and other stressors than purely physical tasks such as marching or even marksmanship. Perhaps even more disturbing from the viewpoint of unit survival (unlike physical laborers whose work quantity is decreased by fatigue), decision makers and other mental laborers have the quality of their work reduced. The latter, particularly when unrecognized or unacknowledged, is clearly the greater of two evils. That it is unrecognized and unacknowledged, at least by its primary victims, became obvious to us on our first trip to the live-fire training area with the battalion. This three-week event, which takes place twice a year, features a 36-hour continuous operations scenario for each of the batteries and constitutues a kind of final exam. Although we, as observers, personally found the pace of events painfully slow (in large measure because of elaborate safety measures imposed by range officials), we were immediately struck by the reluctance (nay, refusal) of the officers and senior NCOs to get any sleep. Tasks were delegated to junior officers and NCOs, but then senior officers and NCOs would remain awake, often with little actual work to do, until all delegated tasks were completed. Staying awake was more than a point of pride for these men who appeared to subscribe fully to the view that sleep is only for the weak, for they expended a fair amount of energy on anyone in the unit whom they chanced upon napping between moving and shooting. This was nowhere more firmly entrenched than among the men for whom sleep was most important, commanders themselves, who acted as if they were the least vulnerable, if not completely immune. Confronted with the disparity between their behavior and their previous enthusiastic agreement about the necessity for sleep, some appeared mildly disturbed, but only one would admit, after 30 hours, that he "wasn't worth a damn," but felt he simply couldn't go to sleep while his men were still up.

In practice, this means that the performance of decision makers, such as commanders and battery executive officers, and those whose jobs involve primarily cognitive skills, such as battalion staff, FDC (fire direction center) members, survey sections, chiefs of firing battery, and communications equipment operators, will very likely be more susceptible to the stress of continuous high intensity combat than those with more labor-intensive jobs. Further, these same battery "exams," enhanced by a two-week stint with the battalion in REFORGER 78, gave us some idea of the kinds of problems likely to beset us if the Soviets ever carry out their published strategy of constant attack, 24 hours a day. Exactly as we saw in the sterile conditions of a US lab, a striking division of effort developed as time wore on. Forced-paced activities, e.g. requests for fire from forward observers and higher headquarters, continued to produce well-trained, timely responses; however, it soon became apparent that the "cost" of this performance was "increasing neglect" of self-paced activities such as updating meteorological corrections, plotting potential targets, preplanned fire and no-fire zones, setting up camouflage nets, running telephone wire to perimeter guards, etc. Though none of us knew enough about field artillery to document it, it seems unlikely that battalion and brigade headquarters were unaffected, since good planning ought to be self-paced rather than mere reaction to outside forces.

Junior enlisted and will

Now, let us turn to the other half of the answer to the question of who melts and why: the followers and the will to continue. We focus on will rather than ability here because it became obvious very quickly during field exercises that the majority of the troops in our artillery battalion could and did manage short periods of sleep in spite of the noisy and uncomfortable conditions. Though the addition of incoming artillery rounds may change our views, at present we

think it safe to assume that most of the junior enlisted ranks will snatch the three hours of sleep necessary to support the largely physical and forced-paced work demanded of them. The "will and drive to continue," however, may be worth some consideration. We don't mean for a moment to conjure up images of cowardice, desertion, mutiny, or giving up without a fight by this phrase "will to continue." More experienced and perceptive observers than we have asked this question of why men fight; however, the answer seems to be at least in this half of the world in this century, best described by the words of S.L.A. Marshall: "The same things that induce him to face life bravely—friendship, loyalty to responsibility, and knowledge that he is a repository of the faith and confidence of others." Certainly we in the Army Medical Department have come to regard what has been variously called bonding, cohesiveness, or esprit-de-corps as the most important variables in the prevention and recovery of neuropsychiatric casualties in combat. Talks with Israeli medical authorities and others have led us to conclude that such casualties will be generated far more quickly and in even larger quantities in any future conventional war than in World War II. As a result, we were more than a little dismayed at how easy it was for a stranger to the unit, a major at that, to elicit disparaging remarks about the unit and its members from the very people whose lives depended on it.

The reason for this may be partly due to the high turnover rate (one-third of the battalion in the six months we studied it), which made shared experiences and lasting friendships difficult. Another factor was surely the very pronounced vertical segregation we were in good position to observe, since our team included officers, a senior NCO, and two junior enlisted soldiers. The division of junior enlisted, NCOs, and officers was absolute and all-encompassing, characterized at each level by lack of respect for, and confidence in, members of the other two levels. Laziness or ignorance, or both, were the characteristics offered most in describing the other two groups. Though some might argue that this was an inevitable result of grafting a Prussian military system to a society which has as its founding principle, "All men are created equal," we feel the results of our most recent research give cause for hope.

For the past year, the VII Corps Inspector General and his team have included a standardized series of interviews as they conducted week-long unannounced inspections of corps combat battalions. Designed by us in an attempt to assess cohesiveness and esprit in these units, results have shown considerable variation among units, and these variations in turn are closely correlated with differences among these units on traditional measures of battalion functioning. More important to the present discussion are the five questions which most reliably differentiate the high-esprit, high-preformance units from the low-esprit, low-performance units:

•How often, aside from meetings, does your platoon leader talk to you personally?

•How often, aside from meetings, does your CO talk to you personally?

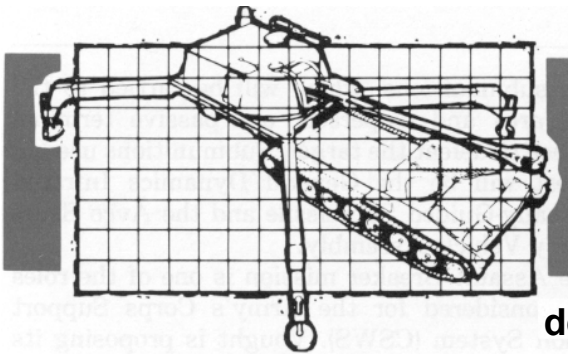
•Is your squad (section) leader ever included in after-duty activities?

•Who would you go to first if you had a personal problem?

•If we went to war tomorrow, would you feel confident about going away with this unit, or would you rather go with another?

These questions were directed toward the junior enlisted personnel, and four of the five questions dealt directly with the frequency of non-duty interaction with leadership. Today's troops, it seems, want to know their leaders and, in turn, be known by them as individuals rather than mere cogs in the "green machine" and are willing to pay for that interaction with better performance, even in garrison. One might even speculate that just the sort of interaction these troops seem to crave would go a long way toward releasing their leaders from the apparent dilemma described above, wherein the leader knows that fatigue and stress will soon degrade his judgment but believes that a good leader should never sleep while his men are asked to work. As long as leaders and followers alike are only allowed to role-play, troops will seldom have the courage (or desire) to tell the old man to "Get some sleep, sir! You need it more than we do, and we can handle this by ourselves." Nor will the "old man" have the knowledge of and confidence in the troops to do it on his own.

Frederick J. Manning Ph.D., and Larry H. Ingraham, Ph.D., are assigned to the United States Army Medical Research Unit—Europe, which is a special foreign activity of the Waler Reed Army Institute of Research, Washington, DC.



FA Test and Development

design ● development ● testing ● evaluation

Proof acceptance testing

Most American and allied soldiers have considerable confidence in their weapons because of a stringent quality control program currently in force. The main line of that quality control program leads to Aberdeen Proving Ground's Materiel Testing Directorate (MTD) where proof acceptance (PA) testing is accomplished. Proof acceptance is the last quality check a weapon receives before it is issued to a unit or depot.

"Proofing" a weapon or a weapons system component involves subjecting the item to unusually high stresses and pressures that go beyond those normally encountered in daily operations. Excess pressure testing, one of the main means of determining a weapon's structural reliability, pushes chamber pressures to as much as 15 percent above normal pressures. Weapons tested range from mortars and 105-mm tank gun tubes to field artillery pieces and recoiless rifles.

Components of major caliber weapons (such as mounts, recoil mechanisms, etc.) which are subjected to the enormous stresses of big gun firing are also tested.

Proof testing of weapons takes considerable man-hours because it also includes doing dimensional inspections, magnafluxing, or magnetic particle studies of the metals used.

Many of the items tested have relatively short life spans — some only about 1,000 rounds; therefore, firing several "normal" rounds would not be cost-effective. The usual proofing sequence is for the component to be assembled for firing and then transported to a range where about a half-dozen rounds are fired — some of them with excess pressure.

A test director at the site takes pressure measurements after each test firing to insure that test pressures are not so high that a weapon becomes unserviceable. The weapon is then sent to a shop for further inspection and, if a potential problem exists, the weapon is withheld from issue.

During initial production of a weapon, or when a new manufacturer is added, 100 percent of the first few months' production is tested; however, once the Army is assured that all the problems have been worked out of the production process, only one out of five or seven is pulled for testing. On the other hand, if the testing shows a problem, 100 percent testing will be resumed until the fault has been corrected. More than 95 percent of Army proof testing, which averages between 100 and 200 major caliber weapons per month, is done at Aberdeen Proving Ground.

The weapons are tested in batches because it is more efficient to test a group of similar weapons at the same time.

Over the years, the reliability of US-made weapons has been proven and failure rates are very low. Occasionally weapons will have some kind of waiver for a small flaw attached, such as a blemish in the machining, but nothing that presents any sort of operational or structural deficiency.

Aberdeen Proving Ground also proofs weapons for overseas sales, and foreign buyers are generally strict in their demands of the weapons and often will not accept weapons with minor blemishes. The weapons purchased by foreign buyers are sometimes used in roles slightly different from those of US forces, so testing must occasionally be modified to produce results which satisfy the uses intended by the buyers.

XM445 contract awarded

A contract for more than $5 million for low rate initial production of the XM445 fuze was recently awarded to KDI Precision Products, Inc., Cincinnati, OH. Harry Diamond Laboratories (HDL), an element of the Army Electronics Research and Development Command, awarded the contract which calls for 3,740 fuzes to be produced over a 30-month period.

The XM445, designed and built by HDL, is a low-cost, digital electronic, remotely set time fuze with an air-driven fluidic generator power supply and gearless safety and arming mechanism. The HDL fuze, which is the seventh fuze to enter production in the past six years, is used with the Multiple Launch Rocket System.

Contract awarded for AN/TPQ-36

Recently, a contract for almost $54 million was awarded to Hughes Aircraft Company, Fullerton, CA, for production of 48 AN/TPQ-36 mortar locating radars. In awarding the contract, the Army Electronics Research and Development Command (ERADCOM) exercised an option to the original 1978 contract of $106 million awarded Hughes for production of the highly mobile radars.

The fully automatic battlefield radar relies on the speed and precision of a min-computer to search out hostile weapons. Scanning the horizon with a pencil-shaped beam so quickly that an electronic curtain is dropped over the sector covered, the device greatly increases the early warning capability for frontline troops and is the first such radar designed for use by ground troops. The AN/TPQ-36, along with the AN/TPQ-37 artillery locating radar and an operations shelter, comprise the entire Firefinder system.

The mortar locating radar, which was live-fire tested at Yuma Proving Grounds, will probably be added to the Army inventory later this year.

Assault Breaker missile contract awarded

The LTV Corporation recently announced that its aerospace subsidiary (Vought Corporation) has been awarded a US Army contract for $10 million in support of the Department of Defense Assault Breaker flight test demonstration program. (Vought was awarded 18.7 million for work on the program in October 1979.)

Under the new contract, Vought will launch six T-22 missiles, which are the same size as the Lance. Four of the six test missiles will receive target updates from the Pave Mover radar target acquisition system. The radar will acquire and track targets and simultaneously provide target data to Assault Breaker missiles.

Additionally, four of the six tests will involve live submunitions as opposed to the inert submunitions provided for in the earlier contract.

The program also calls for two T-22 test flights to demonstrate an automatic alignment system that rapidly provides high accuracy azimuth data to the on-board flight computer, allowing rapid initialization for the laser inertial measuring unit.

Assault Breaker, which is designed to defeat second echelon enemy surface forces at long ranges, is a part of a Defense Advanced Research Projects Agency technology demonstration program, which will test surface-to-surface and air-to-surface missiles carrying antiarmor submunitions.

The submunitions, which will be carried to the target area and dispersed, use passive terminal guidance to defeat the target. Submunitions used in the test will be the General Dynamics Infrared Terminally-Guided Submissile and the Avco Skeet Delivery Vehicle Assembly.

The Assault Breaker mission is one of the roles being considered for the Army's Corps Support Weapon System (CSWS). Vought is proposing its Lance II or T-22 missile as a candidate for CSWS.

The T-22 missiles to be used in the tests are a variation of the missiles that successfully completed the Army's Simplified Inertial Guidance Demonstration (SIG-D).

The Assault Breaker T-22 uses a solid rocket motor employing the same low-cost propellant as the Vought Multiple Launch Rocket System. The SIG-D missiles used a different propellant.

The T-22 is the same size as the existing 22-inch diameter Lance and the external appearance is very similar except for four fixed cruciform wings. (It uses rear surface elevons for steering instead of thrust control as in the liquid fuel Lance). The T-22 features a Honeywell H-700 digital strapdown inertial guidance system which employs ring laser gyros, a Q-flex accelerometer triad, and a digital computer which processes the intertial measurements and performs computations for navigation, autopilot, and guidance functions.

The T-22 is similar in appearance to the Lance missile except for four cruciform wings.

Fire Support Mission Area Analysis:

Impact of Precision Guided Munitions

by MAJ Michael W. Hustead

One of the most significant revelations of the recently completed Fire Support Mission Area Analysis (FSMAA) in the area of Munitions was the potential for total force enhancement with the availability of precision guided munitions (PGMs). Here, technology has finally progressed to the point where the artillery's indirect fires have the potential to effectively counter that long-standing countermeasure to artillery — armor!

From the beginning of armed conflict, adversaries have progressively developed more lethal combat measures and, for every measure introduced, a countermeasure was developed. For example, shield and body armor was introduced to counter the sword, battle ax, spear, sling, and bow. To counter the shield and body armor, the long bow, crossbow, and eventually firearms were developed. To counter these new higher velocity weapons, wagons of armor were conceived (figure 1) in 1916, the first tank was introduced into armed conflict by the British (figure 2). Although many antiarmor measures have been developed over the years since World War I, tank developers have been able to stay ahead of the measure-countermeasure race with enhanced armor and increased mobility, but the race continues.

To increase the effectiveness of our armor countermeasure, we must utilize the combined arms concept to the maximum potential. However, before our direct fire weapon systems can impart their maximum lethality upon the enemy, the rate at which armored targets are presented for engagement must be limited to a manageable quantity. To accomplish this

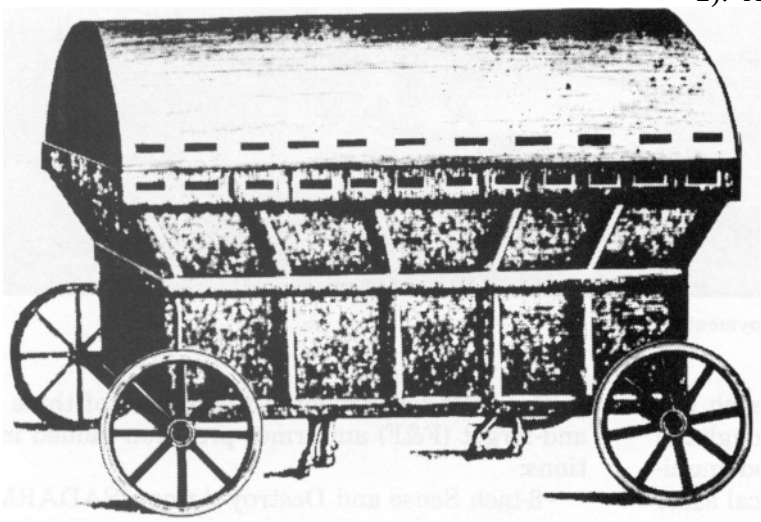


Figure 1. Horse-drawn Scotch war cart (circa 1456).

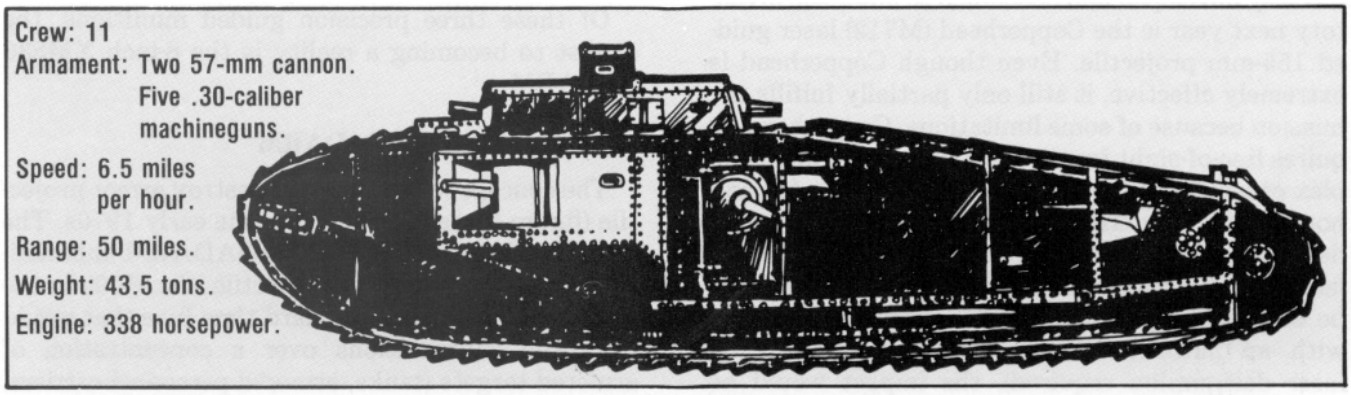


Figure 2. World War I Mark VIII tank.

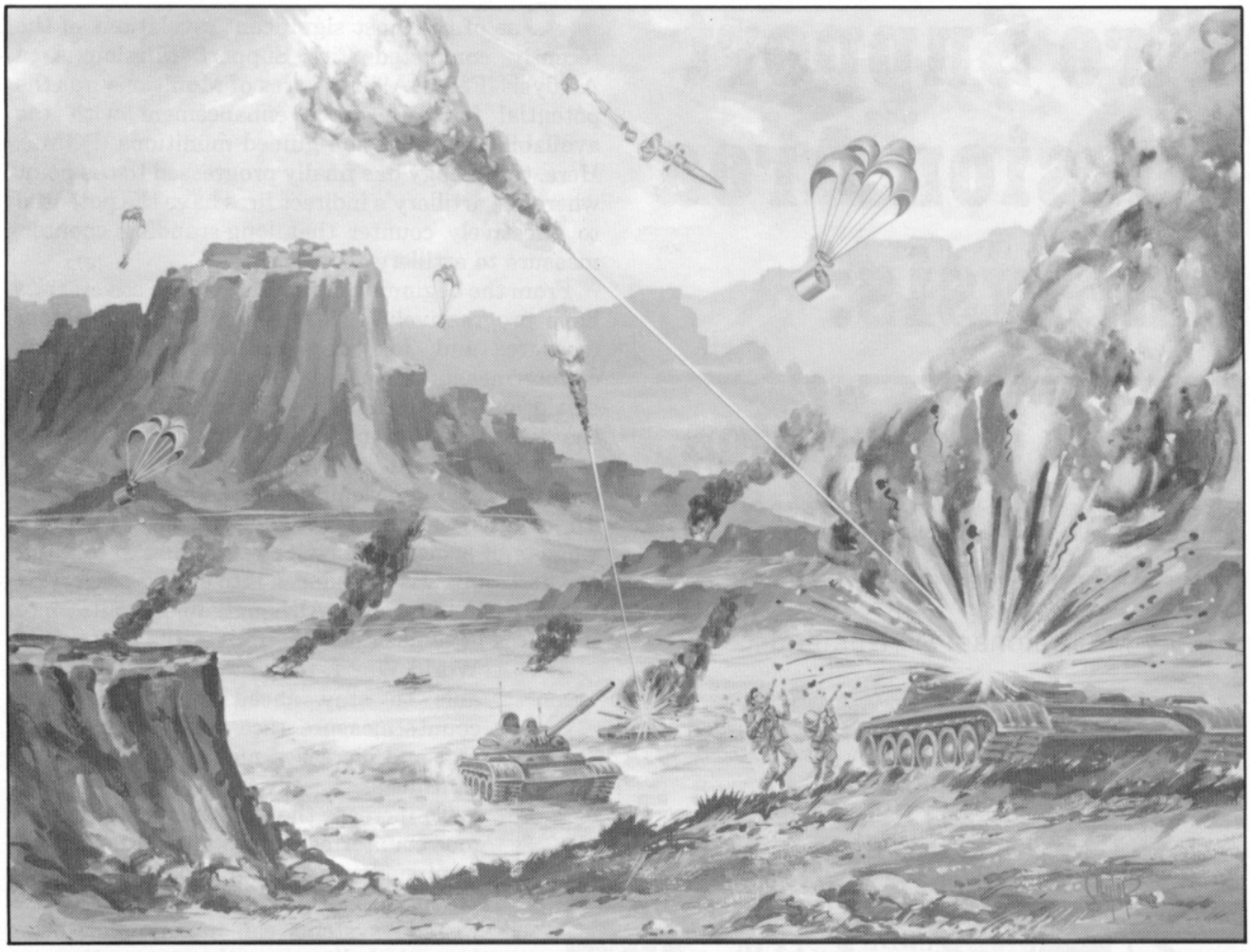


Figure 3. Artist's concept of XM836 SADARM employment.

task our counter-countermeasures must reach out beyond the range of direct fire systems. Through the development of antiarmor precision guided munitions, the Field Artillery has become a critical asset to the accomplishment of this mission.

One highly effective antiarmor artillery projectile recently developed and scheduled to enter the inventory next year is the Copperhead (M712) laser guided 155-mm projectile. Even though Copperhead is extremely effective, it still only partially fulfills the mission because of some limitations. Copperhead requires line-of-sight for the laser designator and complex coordination between the laser designator and howitzer battery. The number of targets that can be defeated at any one time is limited by the number of laser designators available. If such a projectile could be developed with all the same characteristics but with an autonomous "fire-and-forget" seeker (no laser designation required), the impact would be dramatic.

The FSMAA evaluated the impact of three fire-and-forget (F&F) antiarmor precision guided munitions:

•8-inch Sense and Destroy Armor (SADARM).

•Multiple Launch Rocket System (MLRS) Terminally Guided Warhead (TGW).

•155-mm fire-and-forget Copperhead.

Of these three precision guided munitions, the closest to becoming a reality is the 8-inch XM836 SADARM.

SADARM

The concept for a sense and destroy armor projectile (figure 3) was conceived in the early 1970s. The design called for placing three SADARM submunitions in a cargo-carrying projectile (the M509 in the 8-inch caliber) with a standard time fuze that would eject the submunitions over a concentration of armored targets (tanks, armored personnel carriers, self-propelled howitzers, etc.). A specially designed

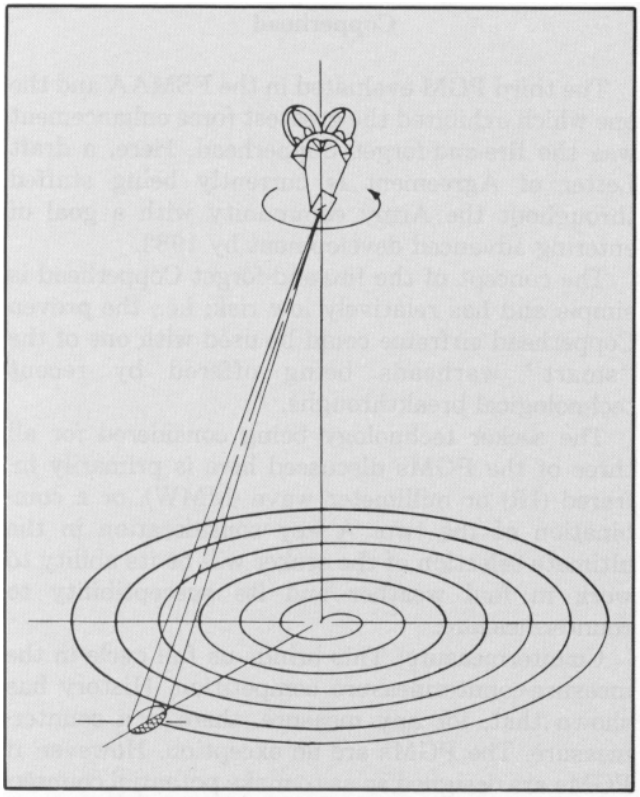
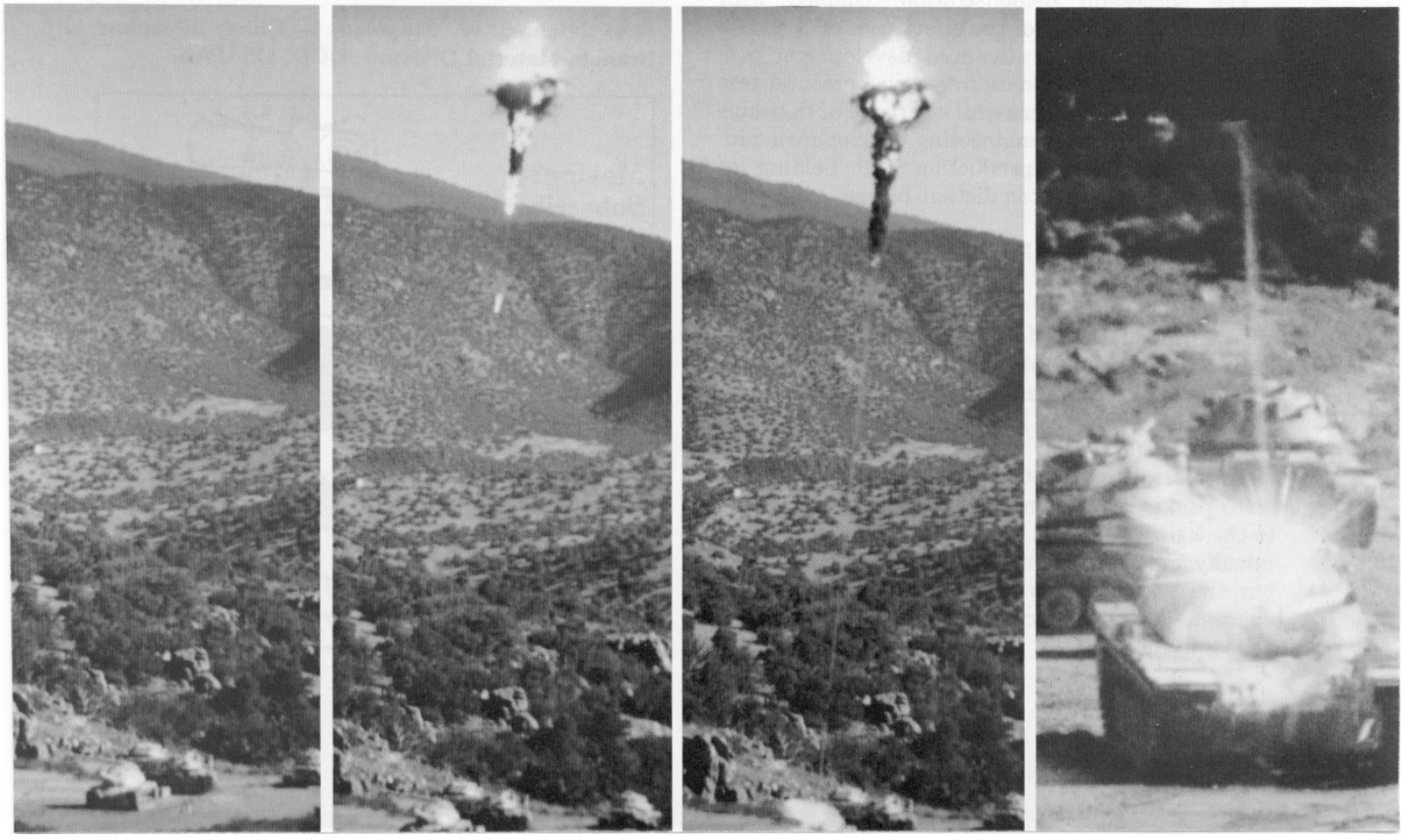


Figure 4. SADARM scan geometry.

parachute (figure 4) would then deploy to stabilize each submunition, control its descent rate, and cause it to rotate. The cylindrical submunition would be suspended from the parachute at a specified angle to the vertical with the warhead and autonomous sensor directed downward. This, in combination with the simultaneous descent and rotation, would cause the sensor to scan the earth's surface in a collapsing spiral pattern. If a target were caught within that deadly spiral, its chances of escape would be minimal. Should a target be detected, the sensor would transmit an electronic impulse which would detonate the high explosive, propelling a slug of metal at hypervelocity toward the center of the target. This "self-forging fragment" warhead would be extremely effective against armored vehicles.

This conceptual description was impressive, but received very little attention in the combat developments community. SADARM appeared to be a technologist's dream with little chance of becoming a cost and operationally effective weapon — until it was successfully demonstrated in August 1979 (figure 5). Live prototype SADARM submunitions were individually dropped over a target array of four tanks. Of the four submunitions that were released, two had electronic malfunctions and the sensor was not activated, but the remaining two accurately sensed, fired, and scored direct hits near

Figure 5. Concept demonstration of SADARM submunition (1979).



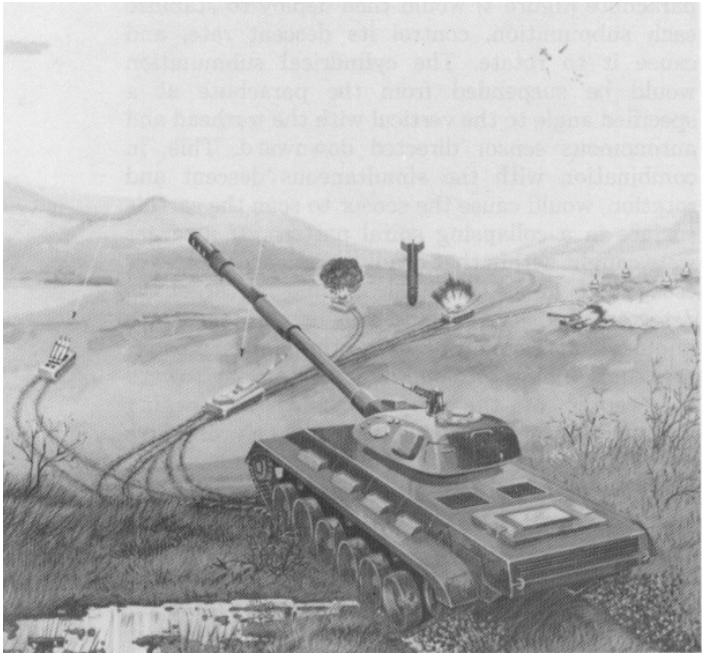


Figure 6. Artist's concept of the MLRS terminally guided submunitions employment.

the centroid of the target. At the concept demonstration phase of the development, these results were encouraging and the fire-and-forget projectile was considered to be within reach.

The successful demonstration, coupled with analytical projections of the effectiveness of such a weapon, launched an advanced development program which will culminate in a developmental test (DT/OT I) in 1983. Successful clearance of that hurdle should lead to an engineering development program and eventual production and fielding of SADARM in the not too distant future.

MLRS

The development of the MLRS Terminally Guided Warhead (TGW) is following close on the heels of the XM836 SADARM. The Letter of Agreement (LOA) which recommended advanced development was approved by the Department of the Army in October 1980.

The current concept for the MLRS TGW envisions packaging terminally guided submunitions into the warhead carrier. The quantity and type of terminally guided submunition has not been defined, but the technology is available to implement the concept. An artist's conception of the system is shown in figure 6.

Copperhead

The third PGM evaluated in the FSMAA and the one which exhibited the greatest force enhancement was the fire-and-forget Copperhead. Here, a draft Letter of Agreement is currently being staffed throughout the Army community with a goal of entering advanced development by 1983.

The concept of the fire-and-forget Copperhead is simple and has relatively low risk; i.e., the proven Copperhead airframe could be used with one of the "smart" warheads being offered by recent technological breakthroughs.

The seeker technology being considered for all three of the PGMs discussed here is primarily infrared (IR) or millimeter wave (MMW), or a combination of the two. A key consideration in the ultimate selection of the seeker will be its ability to work in foul weather and its susceptibility to countermeasure.

Countermeasure! This brings us full cycle in the measure-countermeasure competition. History has shown that, for any measure, there is a countermeasure. The PGMs are no exception. However, if PGMs are designed so as to make potential countermeasure prohibitive in cost and operational effectiveness, they will have served their purpose. Certainly, the potential force enhancement projected by the Fire Support Mission Area Analysis makes the continued pursuit of precision guided munitions a worthy goal.

MAJ Michael W. Hustead is Chief, Weapons Branch, Materiel Division, DCD, USAFAS.

With Our Comrades In Arms

notes from other branches and services

Stinger on the way

In February this year, the Army announced that it had begun supplying soldiers with the new Stinger air defense guided missile system.

The first combat-ready units to receive the manportable, shoulder-fire weapon were maneuver elements of the US Army in Europe. (The US Marine Corps will also use the weapon).

Stinger protects ground forces against attack by low-flying, high-speed jet aircraft and helicopters. Replacing the outwardly similar Redeye missile system in use for several years, Stinger offers several distinct advances in fighting capability. It can engage faster targets at greater ranges including those flying directly toward the gunner. Stinger has built-in electronics compatible with all NATO aircraft that aid the gunner with aircraft identification.

The missile uses a passive infrared seeker and a solid fuel rocket motor. It comes from the factory sealed in a fiberglass tube which converts to a launcher by quick attachment of a reusable gripstock containing the firing circuits and IFF electronics. Once the missile is fired, the launch tube can be discarded. Missile, launch tube, and gripstock weigh about 35 pounds.

New command created

Two commands at Fort Monmouth, NJ, have been merged to create the new US Army Communications-Electronics Command (CECOM).

The new command was formed by consolidating the Communications-Electronics Materiel Readiness Command (CERCOM) and the Communications Research and Development Command (CORADCOM).

The change was effective 1 May but implementation will be phased over a period of time to reduce turbulence.

CERCOM assumes total management responsibility for communications-electronics logistics support and materiel readiness (now assigned to CERCOM) and research, development, and acquisition (now assigned to CORADCOM).

New kit detects chemical agents in water

Advanced development of an improved chemical agent testing kit — which is designed to quickly detect chemical warfare agents in water supplies — has been announced by the US Army Armament Research and Development Command's Chemical Systems Laboratory.

The compact, lightweight kit will reportedly detect hazardous levels of nerve, mustard, lewisite, and blood agents quickly and easily. Troops will also be able to analyze water at temperatures ranging from 32 to 125 degrees Fahrenheit, using a newly designed enzyme-ticket in the XM272 kit.

Housed in a drop-and-shock-resistant case, the kit requires no power source and contains simulants for each of the chemical agent classes so that senior personnel can train soldiers how to use the kit. It is expected to be used primarily by engineer and medical personnel. *(Army RD&A)*

Abrams tank type-classified standard

The Abrams tank was recently designated as "standard" by the Army. This decision was made based on the tank's superior capabilities, the relative completeness of engineering, the commitment made to this weapon system, and the Army's confidence in it.

Test results were considered from troop testing at Fort Hood, TX and Fort Knox, KY and engineering testing at Aberdeen Proving Ground, MD, Fort Greeley, AL, White Sands Missile Range, NM, and Yuma Proving Ground, AZ. The tests to date show that engineering problems discovered in experimental model testing have been corrected in the production model. Additionally, quality control problems found on early production vehicles are being resolved.

The M1 Abrams tank joins with the new M2 Infantry Fighting Vehicle and M3 Cavalry Fighting Vehicle as the leading edge of the Army's program for modernizing its combat vehicle fleet.

Army negotiates LoAD contract

The Army recently opened negotiations with McDonnell Douglas Astronautics Company in Huntington Beach, CA, to elevate the company from associate to prime contractor status for the Ballistic Missile Defense Low Altitude Defense (LoAD) project.

The LoAD project, managed by the Ballistic Missile Defense Systems Technology Project Office in Research Park, is designed to demonstrate technology for a cost-effective, rapidly deployable low altitude system to defend US land-based intercontinental ballistic missiles from attack. The system is composed of an inertially guided interceptor, a small phased array radar, and a distributed data processor.

Since the project's inception in 1979, the LoAD Project Office has operated under an associate contractor system with separate contracts with McDonnell Douglas for systems engineering and integration and Martin Marietta Aerospace, Orlando, FL, for interceptor development.

With the prospect of awarding another contract in the near future for the LoAD Sensor and Engagement Controller (an integrated radar and computer), it became impractical for the Army to continue to administer the contracts separately due to current constraints in government staffing levels.

The LoAD Project Office will retain overall responsibility to oversee and direct project development. (Redstone Rocket)

Russian tanks in US?

Rumbling through the dense early morning fog, the Soviet T-62 tank mock-up surprised casual observers. At first glance many thought it was the real thing. On closer inspection they realized that Training Aids Service Center, Fort Lewis, WA, had done another outstanding job in adapting an M551 Sheridan tank to look like a genuine T-62 tank.

The $2,500 Soviet-bloc T-62 tank mock-up is manufactured with fiberglass and metal. The turret is of prefabricated fiberglass with a steel tube frame and mounts over the existing turret, held in position by simple turn-bolts. To maintain realism, a plastic 115-mm smoothbore gun tube is included, complete with bore evacuator.

Auxiliary fuel tanks and mounting racks are mounted directly on the chassis to insure accuracy. With the five road wheels of the Sheridan, the visual image is complete.

To add realism in training, a Hoffmann-Weiss main gun simulator is used to give sound effects for the 155-mm gun tube.

SGT Bruce Meier and SP4 Roscoe Shepherd, 9th Infantry Division Opposing Forces Detachment, drive this Russian-looking tank into the division headquarters parking lot for display. It's an M551 Sheridan inside the shell of a Soviet T-62 mock-up. (Photo by Scott Davis)

This mock-up, as well as others under construction or completed, is maintained and operated under the supervision of the 9th Infantry Division Opposing Forces (OPFOR) Detachment.

Currently on hand are four BMP mock-ups to be mounted on gama goats, four T-62 mock-ups to be mounted on APCs, and one BRDM mock-up to be mounted on an M151 jeep.

Other mock-ups to be constructed or under construction include three T-64 tanks, two ZSU 23-4s, both to be mounted on Sheridan tanks, and four BRDM-2s, with kits for SA-9 antiaircraft missile launchers and turret.

The OPFOR inventory includes actual Soviet equipment ranging from two T-54/55 tanks and one BTR-60BP armored personnel carrier to one UAZ-69 AT-1 Snapper, (antiarmor missile launcher) vehicle. Various small arms, mortars, and shoulder fired antiarmor missile launchers complete the inventory.

The 9th Inf Div OPFOR Detachment provides the basis for the establishment of realistic and competitive opposing forces which are used against 9th Inf Div units during ARTEPS and field training exercises.

Detachment cadre instruct and supervise units assigned to play opposing forces on Soviet tactics and utilize the various mock-ups and foreign equipment to vigorously display the real opposing forces threat.

The OPFOR Detachment is under the operational control of the G2, 9th Inf Div, and any questions relating to the use and availability of the OPFOR Detachment may be addressed to G2, 9th Infantry Division, Fort Lewis, WA 98433. (Scott Davis)

New armored vehicle for Marine Corps

The LTV Corporation recently announced that its aerospace subsidiary, Vought Corporation, plans to offer a new lightweight armored vehicle (called the Wolverine) in the upcoming US Marine Corps Mobile Protected Weapon System competition.

Vought will be the prime contractor for the program. Groupement Industriel des Armaments Terrestres (GIAT), the French Ministry of Defense's armored vehicle manufacturer, will provide the basic vehicle. Other Wolverine team members will be Rheinmetall of West Germany, which will supply the gun and turret for the vehicle, and Texas Instruments Incorporated of Dallas, TX, which will provide the fire control system.

Vought will be responsible for systems integration and final assembly of the Wolverine.

Company officials said that by melding top European and American technology into one system Vought will be able to offer the Marines a way to meet their MPWS needs with an earlier production date and less cost than an entirely new design. The Wolverine, which could begin entering service in 1985, can be quickly deployed as a formidable antiarmor force to address any trouble spot in the world.

The Wolverine has a GIAT AMX 10 RC hull and chassis and a US engine and transmission. It carries a Rheinmetall 105-mm gun and turret and contains a Texas Instruments' day/night fire control system. It has the firepower of an M60 tank but weighs two-thirds less.

The system can be deployed to the battle area by a wide variety of transports including airlift by the CH-53E helicopter. It carries a crew of three and is agile on land and mobile in water.

Groupement Industriel des Armaments Terrestres specializes in the engineering development and fabrication of land-based systems including battle tanks and armored fighting vehicles. The six-wheeled, aluminum-hulled AMX10, which GIAT has produced since 1973, features a hydropneumatic suspension system capable of handling the impulse levels from the 105-mm gun. The AMX10 steers like a tank, which permits pivot turns in tight quarters and provides high mobility in soft soil, mud, or snow. Its variable height suspension system allows it to maintain a low battlefield silhouette and yet travel over rough terrain.

The Wolverine will use a US-designed and manufactured high performance engine and transmission which reduces total vehicle weight and simplifies logistical support.

The new vehicle will feature the low-recoil-force 105-mm high-muzzle-velocity gun and lightweight turret designed by Rheinmetall. The gun, a derivative of the 105-mm version currently used on the XM1, M60 and M48A5 main battle tanks, reduces recoil forces while maintaining high energy levels. Its unique mounting on a pedestal external to the turret allows a long recoil stroke, reduces blast effects on the crew, and prevents gun gases from entering the crew compartment. The gun fires all NATO and US standard 105-mm tank ammunition while the turret features an automatic ammunition loader.

The Texas Instruments' fire control system is a modular day/night system which utilizes a US Army common module, forward looking infrared (FLIR) thermal imaging system. It also features proven state-of-the-art electronic and microprocessor technology. The Wolverine fire control system is as accurate as that used in present-day main battle tanks but costs less.

NIGHT PROWLER—This US Army AH-1S Cobra attack helicopter is equipped with a telescopic sight, part of the airborne TOW missile system, that has been augmented with a forward-looking infrared (FLIR) receiver. The Cobra's night vision, called the FLIR Augmented Cobra TOW Sight (FACTS), was used in simulated combat for the first time during recent field exercises at Fort Polk, LA. The FACTS, mounted on the aircraft's chin, enables gunners to "see" through darkness, smoke, or haze to accurately fire TOW antitank missiles, rockets, and cannon. Flying missions for the 101st Airborne Division during the exercises, the Cobra effectively monitored the position of opposing armored forces as they maneuvered under cover of darkness. The FACTS system represents significant improvement in capability of the Army's Cobra helicopter, enabling it to provide around-the-clock combat support. (Hughes Aircraft Company photo)

Program of instruction for 2E-14B course

The Development Branch, Roland/DIVAD/Stinger (RDS) Division, of the Directorate of Training Developments, US Army Air Defense School, is currently revising the short-range air defense (SHORAD) 2E-14B Chaparral/Vulcan Officer Qualification Course program of instruction (POI). The division is using the instructional system development process as a basis to prepare an analysis to determine the specific tasks performed by the Vulcan/Chaparral and forward area alerting radar (FAAR) platoon leader. Once the analysis is completed, lesson plans and POIs will be structured to provide more performance-oriented instruction on SHORAD tactics, crew drills, training devices, and maintenance of SHORAD systems.

Any comments concerning MOS 14B tasks are appreciated and encouraged and should be addressed to: Commandant, US Army Air Defense School, ATTN: ATSA-TDI-RD, Fort Bliss, TX 79916.

Air defense hotline

Air Defense Artillerymen worldwide now have a source of information available 24 hours a day for training-related problems. With the addition of an automatic answering and message recording device, known as the Hotline, the US Army Air Defense School has taken another step toward obtaining training feedback from units around the world.

Located in the US Army Air Defense School (USAADS), Directorate of Evaluation and Standardization, the Hotline will be answered by Branch Training Team personnel during duty hours. After normal duty hours, incoming calls will be recorded automatically and then transcribed the next duty day. The caller's questions or problems are referred to the appropriate agency within the School for action. Callers are requested to state their name, AUTOVON number, and unit address so that the School can contact them by telephone or letter within seven days.

The Branch Training Team acts as the USAADS's point of contact with Air Defense units in the area of training feedback, to include obtaining the unit's assessment of school products, both personnel and material.

Constructive comments and suggestions, as well as questions, are solicited in the following areas:

- •Acceptability, use, or errors in ADA publications.
- •Air defense concepts of employment needs.
- •Training techniques needs.
- •Air Defense School course content assessment.
- •Audio-visual aids needs.
- •Correspondence course needs.
- •Training devices needs.
- •SQT needs.
- •ARTEP needs.
- •Training related subjects not listed above.

The USAADS also encourages other schools that interface with air defense to make use of its Hotline to exchange data of feedback to enhance training.

The Air Defense Hotline AUTOVON number is 978-3159 or commercial 1-915-568-3159. Collect calls cannot be accepted. Units or individuals unable to call the School can write to the following address:

Commandant
US Army Air Defense School
ATTN: ATSA-EV
Fort Bliss, TX 79916

Mooring system

The Army will soon have a tactical mooring and off-loading pipeline system that is air-transportable and capable of handling tankers as large as 25,000 deadweight tons.

The US Army Mobility Equipment Research and Development Command (MERADCOM), Fort Belvoir, VA, recently awarded a $3.39 million contract to Oceans Search, Inc. of Lanham, MD, for the fabrication of two such systems.

The multileg type tanker mooring system, developed by MERADCOM, is designed to unload bulk liquid fuel from tankers over undeveloped beaches or where port facilities are unusable due to battle damage or natural disaster. All mooring and support equipment can be delivered by C-130 transport planes and the system can be installed in 72 hours.

Each leg of the multileg mooring system is a packaged unit incorporating a high holding power explosive embedment anchor. The new system also includes buoys, boat launching and recovering equipment, a motor surf boat, underwater survey equipment, and tanker unloading equipment. It can be quickly and easily installed and offers a rapid off-loading capability and maximum mooring reliability.

Mooring sites can be located up to 5,000 feet from shore, where ships will discharge their bulk fuel through submarine pipelines to onshore storage facilities.

The tactical mooring system gives the Army the capability to quickly establish a marine terminal in an unimproved area to assure adequate fuel supplies for troop deployment and sustained operations.

A-7K introduced to Air Guard

The new, two-seat A-7K tactical fighter aircraft was recently introduced to the Air National Guard during ceremonies conducted at the Vought Corporation, Dallas, TX. The manufacturer of the aircraft will make the first deliveries to Air Guard units nationwide this year.

Therefore, a total of 31 aircraft have been procured for the Air National Guard. The purpose of the two-seater tactical fighter is to increase training efficiency by using on-board instruction, thereby reducing the number of fuel-consuming chase aircraft and further enhancing combat capability.

Current plans call for the assignment of A-7Ks at each of the Air Guard's 15 A-7D units located in Arizona, Colorado, Iowa, Michigan, New Mexico, Ohio, Oklahoma, Pennsylvania, Puerto Rico, South Carolina, South Dakota, and Virginia.

The aircraft is 34 inches longer than the A-7D and has other unique features. It will, however, retain about 80 percent of the same parts, including the precision navigation/weapons delivery system which was battle-tested in more than 10,000 Vietnam combat missions flown by Air Force and Navy A-7s. (National Guard Magazine)

Help!

Tactics Department, US Army Air Defense School, Fort Bliss, TX, is in need of pictures of Air Defense artillery units in the field and items of equipment. The photographs will be used in classes and numerous briefings. Of particular importance are nondesert shots of Hawk, Chaparral, Vulcan, and Redeye. If you can help, please send your developed or undeveloped film to:

Commandant
US Army Air Defense School
ATTN: ATSA-DTT-T
Fort Bliss, TX 79916
Submitted materials cannot be returned to sender.

Eagle's eyes sharpened by Hughes radar

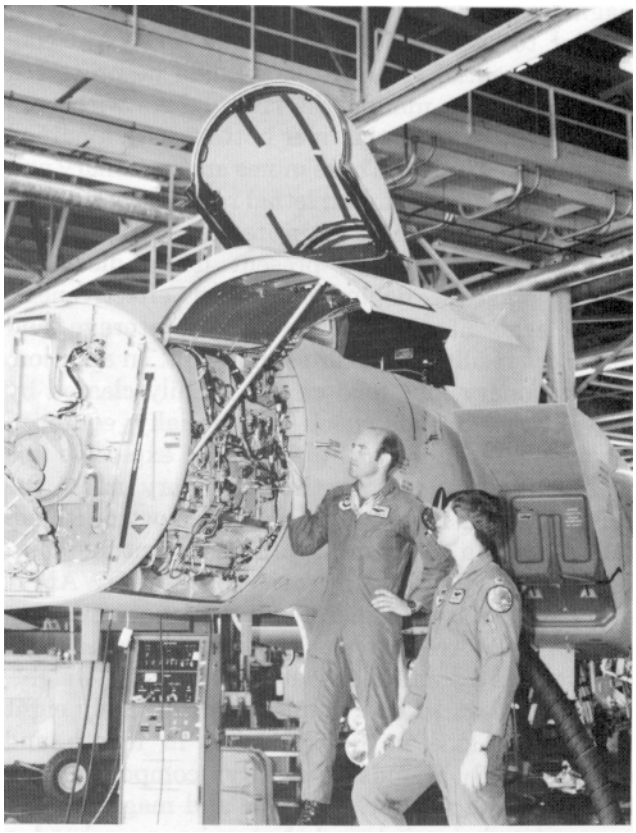
A fifth-generation Programmable Signal Processor (PSP), developed by Hughes Aircraft Company's Radar Systems Group, provides the US Air Force's F-15C Eagle fighters with the ability to change or add radar modes through software programming rather than by extensive hardware retrofit.

The PSP is composed of high-speed digital logic and memory elements under software control. Its instruction set is tailored specifically for efficient processing of repetitive radar functions with instructions altered in flight depending on mode selections.

The PSP architecture, featuring parallel arithmetic logic pipelines under software control, is suited to keeping pace with the exceedingly high rate of data flow from a wideband radar receiver.

Incorporation of the PSP enhances the Eagle's in-weather air superiority and beyond-visual-range capabilities through improved processing algorithms. A ground mapping mode is also included in the unit. Beyond these immediate enhancements, the PSP provides the potential to respond to new threats and accommodate improved modes and weapons through its reprogramming capabilities.

F-15Cs deployed prior to full-scale production of the PSP also are scheduled to receive the new equipment.



ENHANCED EAGLE EYES—US Air Force Captains Howard L. Pope Jr., left, and Fred Bell of the 36th Tactical Fighter Wing, Bitburg, Germany, examine the enhanced AN/APG-63 radar in a new F-15C Eagle at McDonnell Douglas Corporation in St. Louis. The 36th TFW and the 32d Tactical Fighter Squadron, Camp New Amsterdam, the Netherlands, are the first to receive F-15Cs with radars incorporating a Programmable Signal Processor (PSP).

The "Smart" mine

The EDO Corporation, Government Products Division, located in College Point, NY, has developed the Mobile Water Mine (MOWAM) which can be used to prevent or deter the crossing of rivers and streams by enemy tanks and amphibious vehicles. The MOWAM is a small, torpedo-like vehicle which, after being implanted on the river bottom, remains dormant until it senses the seismic and acoustic signals generated by the crossing vehicle. If these signals meet certain established criteria determined by the MOWAM, the mine self-activates. When the target is within lethal range, the MOWAM warhead is initiated and a mobility kill is accomplished on the enemy vehicle. Since the MOWAM has a considerable speed advantage against the crossing vehicle, it readily overtakes the enemy tank. MOWAM guidance is achieved by means of passive acoustic detection, and terminal homing is accomplished by utilizing a combination of high-frequency acoustic echo-ranging and magnetic proximity detection.

Prior to the development of the MOWAM concept, a potential river crossing could be protected only by heavily mining the river banks with land mines or by seeding the river bottom with modified waterproofed mines. These mines are stationary and have an extremely limited lethal range, therefore requiring a large number to protect even a moderate area. Stationary mines present many disadvantages: logistics, deployment, and effectiveness. Since large numbers are required, storage and transport facility needs are significant. In addition, the stationary minefield can be readily cleared by conventional means, such as specially equipped tanks or bulldozers, or by the use of explosive line charges. In contrast to the stationary mine, the MOWAM is a mobile weapon, and most of its advantages are a direct result of its inherent mobility. In a typical river crossing scenario, one MOWAM is equivalent to approximately 50 stationary mines.

The MOWAM, which includes a warhead explosive and a small rocket motor, is a lightweight, torpedo-like underwater mine, approximately eight inches in diameter by 32 inches in length and weighing 43 pounds. Primary components of MOWAM are seismic, acoustic, and magnetic sensors, printed circuit board electronics, a warhead, a battery module, and a rocket motor. Secondary components include anchor and parachute mechanisms, nose piece and shroud assemblies, a safe and arm module, and guidance control valves. The MOWAM is readily deployed in the river by means of a helicopter or small boat. After deployment, it anchors itself to the river bottom and, by means of control fins, faces either upstream or downstream. The seismic sensor is contained in the anchor mechanism and is firmly coupled to the river bottom. At this stage, only the signal conditioning electronics are energized to process seismic and acoustic sensor information. The acoustic sensor is positioned at the forward face of the MOWAM vehicle. Primary energy is supplied by a lithium cell battery, but electrolyte is not introduced into the cell until MOWAM deployment. An embedded microprocessor performs the functions of seismic and acoustic signature classification. Upon determination of a valid target, the MOWAM tether is severed and a small rocket motor is energized. The dimensions of this rocket motor are approximately five inches in diameter by six inches in length. It is capable of propelling the MOWAM at high speed. Horizontal steering is achieved by means of two pairs of reaction jets powered by a portion of the main propellant gas. The MOWAM terminal homing mode utilizes a high frequency, directional, active sonar in combination with a magnetometer.

The MOWAM vehicle, with its three sensor subsystems, an electronics subsystem, a primary power subsystem, and a propulsion subsytem, takes advantage of the recent technological developments. Advances in battery technology have drastically reduced size and weight while increasing performance and storage life. The same results have been achieved in the design of small rocket motors where size and weight are reduced while efficiency and thrust have increased.

Perhaps the most significant technological impact comes from the recent developments in the microprocessor area. The embedded microprocessor is ideally suited to perform the spectrum analysis of sensor signals. Since the microprocessor functions are programmable, processing algorithms can be readily incorporated and modified without the costly redesign or replacement of special purpose hardware.

The production cost of a MOWAM vehicle is estimated to be $5,500 in 1980 dollars. The current land mines run closer to $200 to $300, but it takes far fewer MOWAMs to do the job. In summary, the MOWAM is readily and rapidly deployed and requires a minimum of logistical support. By utilizing advances in diverse technologies, the MOWAM achieves a superior level of performance and cost effectiveness in riverine defense when compared to the conventional methods of stationary minefields. (*Armed Forces Journal, International*, © 1981)

NATO selects new 5.56 round

In a major and long-awaited decision, NATO has adopted the 5.56-mm round as a standard caliber for small arms, in addition to the existing 7.62-mm round. Further, NATO has selected the Belgian SS 109 ammunition as the basis for standardization of 5.56-mm ammunition.

NATO has been conducting an extensive technical evaluation program over the past several years to select a rifle and light machinegun round smaller than the standard 7.62-mm. The move was prompted by combat experience in Vietnam and the Middle East which proved that the 5.56-mm round was superior to the 7.62-mm round in terms of accuracy at shorter ranges.

The main competitors in the NATO evaluation program were the US-designed XM777 round—an improved, longer range of the standard M193—and the Belgian SS 109 round, both 5.56-mm. The United Kingdom and Germany offered even smaller rounds, 4.85-mm and 4.70-mm respectively.

The selection of the Belgian round does pose problems when it comes to interoperability since it is less effective when fired from several types of automatic rifles currently in service with NATO countries—the US M16 rifle, the Dutch MN1 rifle, and the French GIAT FAMAS rifle. The reason is that the Belgian round requires a different barrel rifling. As a result of NATO's selection, the US Army is now faced with the prospect of changing the barrels of nearly two million M16s already in stock.

While the M16 rifle is now the only standard infantry weapon in the US inventory which uses a 5.56-mm round, the Pentagon is expected to introduce other 5.56-mm weapons within the next several years. The NATO announcement, for example, coincided with the Pentagon's preliminary selection of Belgium's FN 5.56-mm Minimi Light Machinegun as the new US Army's Squad Automatic Weapons System (SAWS).

The NATO decision is also expected to accelerate the worldwide trend toward the adoption of the 5.56-mm round s the standard ammunition for light arms. As mentioned previously, GIAT is already producing the FAMAS 5.56-mm automatic rifle for the French Army and production will be accelerated next year as a result of an increased budget for that purpose proposed by the The French Government. In addition, several NATO members have started developing 5.56-mm weapons of their own. Among the major ones are the West German Heckler and Koch HK-33, the Italian Beretta AR70/.223, and the Belgian FN CAL. Some non-NATO countries—Austria, Sweden, and Switzerland—have also developed 5.56-mm weapons.

MX organization approved

A proposal that sets up a new, autonomous Corps of Engineers field operating activity to manage design and construction of the MX missile program has been approved by the Office of the Chief of Engineers (OCE).

According to the OCE's resource management office, the proposal was largely the work of the Corps' South Pacific division, which currently manages all Corps MX-related activities. The Corps of Engineers MX Program Agency (CEMXPA) will be collocated with Air Force program managers at Norton Air Force Base in Southern California.

The MX missile program, currently under close scrutiny by the current administration, calls for 200 intercontinental ballistic missiles concealed in a maze of 4,600 nuclear-blast-proof shelters. Site of the shelters is still under study, but most frequently mentioned are areas located in the western United States. The Corps' total projected construction cost for the program, adjusted for inflation, is $22 billion.

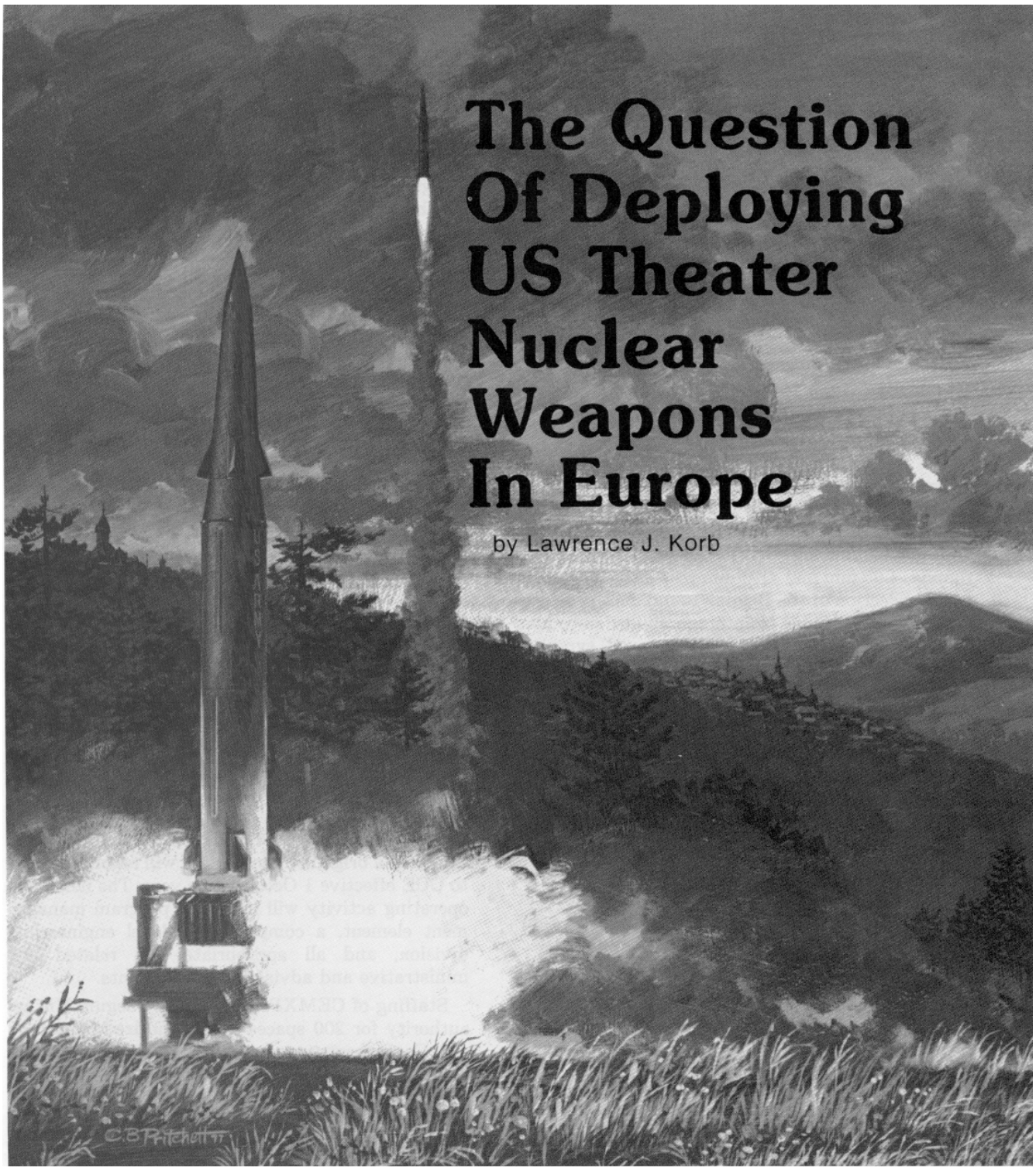
The Air Force is responsible for overall management of the MX weapon system, including system engineering, planning, and deployment. The Army, through the Corps of Engineers, is the designated construction agent, responsible for management and administration of design, construction, procurement, and real estate acquisition. Completion date for the program, still in the design phase, is officially 1989.

The Corps staff at CEMXPA will be directed initially by a brigadier general and will report directly to OCE effective 1 October this year. The new field operating activity will include a program management element, a complete staff-level engineering division, and all appropriate and related administrative and advisory staff elements.

Staffing of CEMXPA has already begun. Hiring authority for 200 spaces was authorized from present Corps resources some time ago in order to begin placing key planning personnel. Meanwhile, the Corps has sent a request to the Secretary of Defense for approximately 700 additional spaces for FY81 and 1,400 spaces for FY82.

According to the recruiting coordinator for the MX program at South Pacific division, the full range of engineering and support personnel "from GS-4 clerk-typists to GS-15 civil engineers" are being recruited for MX.

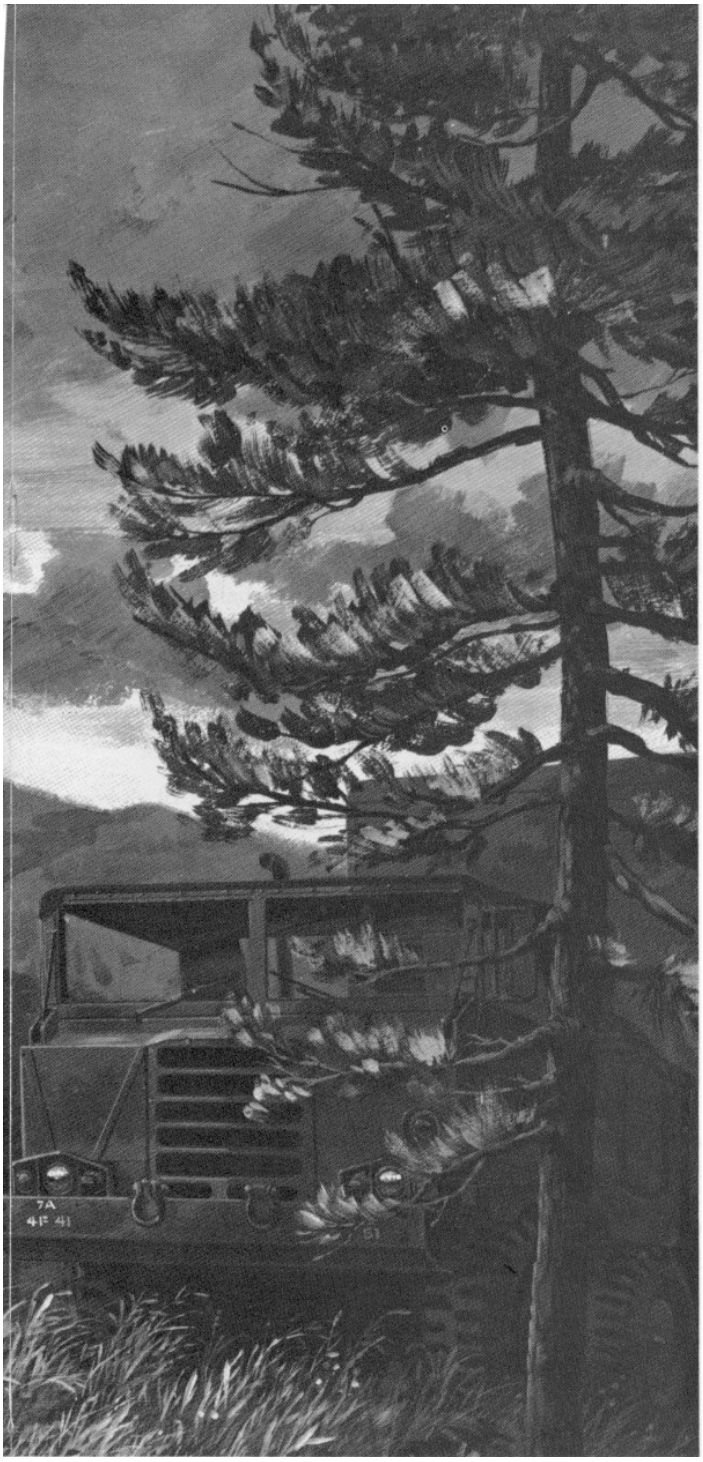
Personnel interested in working on the program may write to South Pacific Division, 630 Sansome Street, Room 1216, San Francisco, CA 94111 or call (415) 556-5219 or 556-5293.



The Question Of Deploying US Theater Nuclear Weapons In Europe

by Lawrence J. Korb

Although the SALT II agreement was presented to the Senate in 1979, strategic nuclear weapons were not the only nuclear weapons receiving attention during the past year. In fact, there was at least equal time given to the subject of deploying about 600 American-made long-range Theater Nuclear Forces (TNF) or weapons on the European continent. Indeed, many people contended that the TNF issue was more critical than SALT II. As one analyst noted: "At stake are not merely a few hundred extra missiles in Europe . . . the outcome is going to dramatically affect both the security of the



West and the entire future of relations with the Soviet Union."[1]

The issue of stationing long-range American theater nuclear weapons on European soil is not a new one. During the late 1950s, American intermediate-range ballistic missiles (IRBM), *Thor* and *Jupiter,* were emplaced in Britain, Turkey, and Italy with the consent of their governments. These weapons had sufficient range to cover many major targets in the Soviet Union. But, by the mid-1960s, when the USSR was fully targeted by the US strategic triad, those weapons were considered superfluous and withdrawn.

However, it is important to note that even though, since the mid-1960s, no long-range American theater nuclear weapons remained deployed in Europe, the United States has maintained a stockpile there of approximately 7,000 nuclear warheads that could be fired from about 1,000 ground launchers. As indicated in table I, these are basically low-yield, short-range weapons, useful only on the battlefield. The *Pershing I* missile with a

Table 1. US battlefield nuclear systems (ground-launched) in 1977.

Category	Code Name	Number Deployed	Warhead	Range (Miles)	Guidance
Short-range ballistic missile	Sergeant	20	low KT	2-80	inertial
	Lance	80	1-100 KT	2-70	inertial
	Pershing 1	180	60-400 KT	400	inertial
	Honest John	140	20 KT or less	20	unguided
Artillery	M-110 203mm	200	low-or sub-KT	10	
	M-109 155mm	300	low-or sub-KT	018	

Variable yield warheads are available

Source: Stewart W.B. Menaul, "The Shifting Theater Nuclear Balance in Europe." *Strategic Review,* Fall 1978, p. 41.

range of up to 400 miles and a yield of up to 400 kilotons (KT) is the most capable system. However, the vast majority of the delivery systems have ranges below 10 miles while most of the weapons possess sub-KT yields. In addition, this force was augmented by some 400 nuclear-capable F-4 tactical aircraft deployed to Europe, and A6s and A7s onboard the two aircraft carriers operating in the Mediterranean; 150 F-111s stationed in England and 400 *Poseidon* warheads assigned to SACEUR for use against Warsaw Pack military installations. Finally, the British had their own force of 56 *Vulcan* bombers and 4 *Polaris* submarines with 64 nuclear missiles.[2]

Up through 1977 it was considered that the battlefield nuclear weapons, augmented by the American and British aircraft and submarines,

[1]Fred Kaplan, "Warring Over New Missiles for NATO," *The New York Times* magazine, 9 December 1979, p. 46.

[2]For a complete analysis of these forces see: Justin Galen, "Can NATO Meet Its Toughest Test? Strategic and Theater Nuclear Forces for the 1980s," *Armed Forces Journal,* November 1979, p. 52.

which had the capability to strike some parts of the USSR, were enough to provide a precarious balance against the tactical nuclear threat posed to Europe by the Warsaw Pact.

As indicated in table 2, Warsaw Pact ground-launched nuclear systems, up through the mid-1970s, consisted of some 1,500 battlefield weapons with ranges of up to 500 miles and yields of up to 100 KT, and some 600 fixed site SS-4 and SS-5 intermediate-range missiles; that is, theater nuclear weapons, with ranges that exceeded 2,000 miles and yields in the megatonnage range. Like the NATO forces, these ground-launched nuclear systems were augmented by about 750 bombers with ranges of up to 400 miles and approximately 1,000 nuclear-armed tactical aircraft with ranges of up to 2,500 miles.

What changed the situation in 1977 was the introduction of two new advanced weapon systems, the SS-20 IRBM system and the *Backfire* bomber. The SS-20 has a range of 4,000 miles, carries three

Table 2. Soviet-Warsaw Pact theater nuclear systems (ground-launched) in the mid-1970s.

Category	Code Name	Number Deployed	Warhead	Range (Miles)	Guidance
Short-range battlefield missile	FROG-2-7	500	low-KT nuclear, HE or chemical	4-40	unguided
Short-range ballistic missile	Scud-A		low-yield nuclear, possibly sub-KT or HE	50	radio command
	Scud-B	750	nuclear 40-100 KT	175	simplified inertial
Medium-range ballistic missile	Scaleboard		nuclear high-KT variable yield or HE	500	inertial
Long-range cruise missile	Shaddock	100	nuclear high-KT	300	simplified inertial
M/IRBM	Sandal (SS-4)	500	nuclear MT	1,200	inertial
	Skean (SS-5)	100	nuclear MT	2,300	inertial
Artillery	M-55 203 mm	probably 150	low KT	16	

Source: Stewart W.B. Menaul. "The Shifting Theater Nuclear Balance in Europe," *Strategic Review.* Fall 1978, p. 38.

150 KT weapons, and is highly accurate, mobile, and reloadable. It is thus capable of destroying military and civilian targets anywhere in Europe from its staging areas in the Soviet Union and is practically invulnerable to counterattacks by NATO forces. The TU-26 *Backfire* bomber has a range of 5,500 miles and a top speed of MACH 2.5 and can carry 20,000 pounds of air-to-surface missiles or free-fall bombs. In the view of many European leaders, the introduction of these two systems, coupled with the conventional imbalance in Europe between NATO and the Warsaw Pact and the loss of strategic

Table 3. Balance of forces in Europe in 1980.

Category	NATO	Warsaw Pact	Warsaw Pact Advantage AMT	%
Ground Troop	1,176,000	1,331,000	155,000	13
Tanks	11,000	27,200	16,200	147
Tactical Aircraft	3,300	5,795	2,495	76
Artillery Pieces	6,200	14,000	7,800	126

Source: Derived from International Institute for Strategic Studies. *The Military Balance 1979-80* (London: 1979), pp. 3-30, 108-113.

superiority by the United States created a dangerously destabilizing situation for Western Europe. (The present conventional balance is displayed in table 3.)

The first European leader to voice his concern publicly about this situation was Chancellor Helmut Schmidt of West Germany. In a lecture delivered in London on 28 October 1977, the West German leader said,

> SALT . . . neutralizes their (Soviet and US) strategic nuclear capabilities. In Europe this magnifies the significance of the disparities between East and West in nuclear tactical and conventional weapons . . . . We must maintain the balance of the full range of deterrence strategy. The alliance must, therefore, be ready to make available the means to support its present strategy . . . and to prevent any development that could undermine the basis of this strategy.[3]

Although cloaked in diplomatic niceties, it was clear that the Chancellor was calling for an increase in Europe's theater nuclear capabilities. In addition, Schmidt was also trying to lay the groundwork for eventually including these weapons in the SALT process.

The Schmidt speech galvanized the Carter administration into action. In June 1978, the President issued Presidential Research Memorandum (PRM) 38 to study the issue. As a result of this study, a Presidential Decision (PD) on the subject was issued in the late spring of 1979. The PD concluded that the United States would produce two new intermediate-range missiles for deployment in Europe.[4] They would be the *Tomahawk* ground-launched cruise missile (GLCM) and the *Pershing II*

[3]Quoted in Robert Ball, "A Decision That Will Shape NATO's Future," *Fortune*, 17 December 1979, p. 4.

[4]For a complete list of the PRMs and PDs, see my "National Security Organization and Process in the Carter Administration," in *Defense Policy and the Presidency,* edited by Sam Sarkesian (Westview Press, 1979, Boulder, CO), pp. 120-122.

extended-range ballistic missile. The *Tomahawk* is a small, highly accurate, subsonic weapon with a range of 1,500 miles and a unit cost of $2.6 million. Although it is normally deployed in a hardened shelter, it can be moved around and fired from almost any field. The *Pershing II* is a supersonic, highly accurate, mobile weapon system with a range of 1,000 miles and a unit cost of about $15 million.

In the fall of 1978, the United States then asked the NATO nations to establish an *ad hoc* High Level Planning Group to consider the issue. This group, which was composed of civilian and military officials from each NATO nation, was tasked with developing a plan that all parties could agree on before it went to individual governments for approval, thus avoiding a repetition of the "neutron bomb" fiasco.[5] In October 1979, the group approved a plan to deploy 572 theater nuclear weapons in Europe. Of these, 108 would be Pershing IIs, while the remaining 464 would be GLCMs. The 108 Pershings would all be deployed in West Germany. This would place all of Western Russia up to the Ukrainian city of Kiev within their 1,000 nautical mile range. The GLCMs would be deployed to several countries: 160 would be placed in Britain, 112 in Italy, 96 in West Germany, and 48 each in Belgium and Holland. On 12 December 1979 the Foreign and Defense Ministers approved the plan with one exception — the Dutch would not decide whether to accept or reject the proposed stationing of 48 GLCMs until December 1981. The decision of the Netherlands will depend on progress in arms control negotiations with the USSR.[6]

The NATO decision means that the United States can begin deploying these weapons to Europe by 1983 and have complete deployment of all 572 weapons by 1988. The total cost of developing, procuring, and installing these systems will be $6 billion. The United States will contribute about $5.7 billion while the allies will contribute the remaining $300 million. As with all US nuclear weapons assigned to NATO, these weapons will remain in the positive control of the United States; that is, they cannot be fired without the permission of the President of the United States.

Despite the approval of the NATO ministers, several arguments have been advanced against deploying these weapons in Europe. Opponents to long-range TNF usually cite six factors to support their position.[7]

•First, the strategic rationale for the weapons rests on a very thin threat of logic. If theater nuclear warheads placed in Europe, but controlled by the United States, explode inside the USSR, the Soviets would consider it a strategic attack by the United States and launch a counterattack against the United States.

•Second, deployment of the SS-20 represents nothing fundamentally new. While it is a more refined weapon than the SS-4 and SS-5, the SS-20 does not change the fact that Europe has been a general target for Soviet missiles for over two decades. In fact, emplacing TNF will make Europe more of a target.

•Third, strategic parity between the United States and the USSR existed long before 1977. According to McGeorge 'Bundy, the Assistant for National Security Affairs to President Kennedy, both Kennedy' and Secretary of Defense Robert McNamara recognized that, in practice, strategic parity existed from the early 1960s; that is, since that time neither side could hope to get a first strike capability.[8]

•Fourth, if the United States refuses to retaliate with its ICBMs against an SS-20 attack on Europe, the British and French could employ their own several hundred nuclear weapons on submarines, aircraft, and IRBMs against the Soviets.

•Fifth, the 400 *Polaris* warheads and more than 1,000 nuclear bombs on US aircraft in or near Europe are sufficient to deter attacks by TNF of the USSR.

•Sixth, placing the *Tomahawk* and *Pershing* on European soil would signal a new level in the arms war between the superpowers. As evidence of this contention, many point to the speech of Soviet President Brezhnev on 6 October 1979. In this speech the Soviet leader warned that European acceptance of TNF would change the strategic situation on the continent and would undermine future

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[5]In early 1980, the Pentagon launched a new study on the neutron bomb. The study was ordered by Secretary Brown after Senator Sam Nunn (D-GA) argued that the Soviets had not shown the restraint demanded by President Carter when he deferred production in 1978.

[6]Cyrus Vance, "Strengthening NATO's Defense," *Current Policy No. 122,* 12 December 1979, summarizes the process and outcome of the negotiations.

[7]These are summarized succinctly by Kaplan, pp. 50-51. See also Lenard Downie, "Denmark Reevaluating Commitments to NATO Defense, *Washington Post,* 5 November 1979, p. 20.

[8]Cited in Kaplan, p. 51.

arms control negotiations. Brezhnev accompanied his warning with an offer to withdraw 20,000 Soviet troops and several hundred tanks from East Germany and to discuss the possibilities of limiting TNF.[9] About 6 weeks later, on 23 November 1979, Soviet Foreign Minister Andrei Gromyko said that stationing the new weapons in Europe would violate SALT II, destroy future arms control negotiations, and start a new spiral in the arms race.[10]

Proponents of TNF in Europe essentially embrace the rationale put forward by Chancellor Schmidt in October 1977.[11] NATO forces must have the capability to deter war at all levels—from the conventional to the strategic nuclear, linked by TNF. Simultaneously, these forces must be prepared to defend or fight at all levels if deterrence fails. The imbalance in long-range TNF that has existed since the mid-1970s adversely affects both deterrence and defense. Moreover, without the 572 *Pershing* and GLCMs, the gap will grow wider. As indicated in table 4, at the present time the Soviets have 900 delivery vehicles deployed within striking range of Western Europe, while the West has only 226 systems capable of reaching the Soviet Union. (Included among the Soviet total are 60 SS-20s and 40 *Backfire* bombers.) This gives them a 4 to 1 advantage over the NATO nations in warheads and a 3 to 1 lead in EMT. By the middle of the decade, the Soviets will increase the number of delivery vehicles to 1,300 by adding another 250 SS-20s and 100 *Backfires.* Even with the tactical deployment of *Pershing II* and *Tomahawk,* the comparative Soviet advantage in warheads and EMT will increase while the Soviets will gain a 2 to 1 advantage in hard target kill capability. A decade from now, if all the 572 TNFs are in place, the situation will remain similar to 1985 because the American TNFs will be offset by another 250 SS-20s and *Backfires.* Without the *Pershing* and GLCM, the Soviets would have an overwhelming advantage.

Table 4. Long-range theater balance (FY 1980-90)

	1980		1985		1990	
Category	NATO	Warsaw Pact	NATO	Warsaw Pact	NATO	Warsaw Pact
Vehicles[A]						
Delivery	226	900	435	1250	740	1500
Warheads	500	2100	775	3250	925	3880
EMT	1:3	3:1	1:4	4:1	1:4	4:1
Hard Target Kill Potential	1:1	1:1	1:2	2:1	1:2	2:1

[A]Includes only land-based missiles and aircraft based in Europe.

Sources: U.S. Dept. of Defense. *Annual Report—Department of Defense, Fiscal Year 1981* (Washington: 1980), pp. 93, 145-149: International Institute for Strategic Studies. *The Military Balance 1979-80* (London: 1979), pp. 114-119; and Justin Galen. "Can NATO Meet Its Toughest Test?". *Armed Forces Journal,* November 1979, p. 52.

Possession of such an advantage could lead the Soviets to believe that they have a sanctuary. They might assume that if they attack Western Europe with their own TNF, the West could respond only by unleashing its strategic nuclear forces and therefore would not respond. Such a belief could be destabilizing.

Proponents of TNF disagree with the Soviet contention that placing *Pershing* and GLCM will escalate the arms race and undermine future arms control. They point out that the Soviets acted first and that the last thing we need to do is to let the Soviets decide what weapons we deploy in order to deter the threat the Russians created. Moreover, history has shown that negotiations with the Soviets always are more successful when one negotiates from a position of strength. If NATO has not decided to go forward with TNF what would there be to negotiate? Finally, the Soviets unleashed the same propaganda barrage in 1957 when the alliance was considering placing *Jupiter* and *Thor* missiles in Europe and in 1977 when the allies were considering giving the neutron bomb (enhanced radiation weapon) to its forces.

Considering both sides of the issue, the decision of the NATO Foreign and Defense Ministers seems prudent. As indicated in table 3, the NATO nations have allowed the Soviets substantial advantages in conventional forces. At the present time, the Warsaw Pact has 155,000 or 13 percent more ground troops; 16,200 or 147 percent more tanks; 2,495 or 76 percent more tactical aircraft; and 7,800 or 126 percent more artillery pieces. In an era of strategic parity, or as some have argued Soviet superiority, it would not seem wise to allow the Soviets an overwhelming advantage in TNF as well. Moreover, if the Soviets should agree to meaningful arms negotiations on TNF or MBFR, *Pershing* and GLCM deployment on the European continent can be slowed or cancelled.

(Reprinted with permission from the May-June 1980 *Naval War College Review.*)

[9]Brezhnev's statement is quoted in Charles Corddry, "The Brezhnev Offer: To Whose Benefit?" *Baltimore Sun,* October 1979, p. 15.

[10]Michael Getler, "Gromyko Escalates Pressure Against NATO Arms Plan," *Washington Post,* 24 November 1979, p. 12.

[11]For an excellent summary of the reasons for TNF, see the interview with Bernard Rogers in *U.S. News & World Report,* 17 December 1979, p. 53.

Lawrence J. Korb is the Assistant Secretary of Defense for Manpower, Reserve Affairs and Logistics designee.

REDLEG NEWSLETTER

Associate degree program offered

Enlisted servicemembers and warrant officers can now earn job-related associate degrees by participating in the Army's new Servicemembers Opportunity Colleges Associate Degree (SOCAD) program. This is the first program of its kind in civilian and military adult education within the United States where colleges and universities are linked to major Army installations to provide training in specific occupational-education fields. Soldiers may contract with these institutions for associate degree producing programs and are assured a degree if the program is successfully completed even if they are transferred or separated from active service.

When the institutions join the SOCAD network, they agree to provide professional counselors to advise soldiers on enrollment, academic matters, and financial aid. They also help soldiers get college credit for the skills, experience, and knowledge already acquired in their career specialties.

Not all installations or curriculums are offered Army-wide. However, negotiations are underway to expand the program to more installations within the United States, as well as Europe, the Far East, and Hawaii. For further information on the program, contact your local Education Center or write: Servicemembers Opportunity Colleges, Suite 700, One Dupont Circle, Washington, DC 20036. (AUTOVON 227-2887 or commercial 1-202-697-2887)

Sergeants Major Academy Nonresident Course offered

This year's US Army Sergeants Major Academy (USASMA) selection board will meet in July to choose approximately 180 senior NCOs for the 1982 US Army Sergeants Major Academy (USASMA) Nonresident Course. Applications for the course, which begins in April 1982, are now being accepted and must reach the US Army Military Personnel Center before 1 June.

To be eligible, soldiers must be in the pay grade E9, E8, or be an E7 on a Department of the Army (DA) promotion list to E8 and have less than 23 years of active Federal service as of April 1982. This time requirement is waiverable, depending on the retention of the soldier. Also, soldiers who have applied before to the Academy and been rejected may reapply if they meet the current requirements.

Soldiers accepted for the USASMA Nonresident Course have two years to complete the course. The only travel required to the Academy at Fort Bliss, TX, comes during the last phase of the course, which is on a TDY basis for two weeks.

The USASMA is recognized by the Army for its role in the professional development of its senior noncommissioned officers. Graduates often receive key Army positions, as well as top NCO jobs within the Department of Defense (DOD).

Applications for the USASMA Nonresident Course must be indorsed by the applicant's immediate commander. Also, the application must include an updated copy of the soldier's DA Forms 2 and 2-1. Applicants should follow the application format shown in Appendix C, AR 351-1, to insure that their applications are processed.

Soldiers who wish to apply for the course should point out anything in their records they feel is important for consideration. Communications should be sent to President, DA USASMA Selection Board, C/O Commander, USAEREC, Fort Benjamin Harrison, IN 46249, before 15 June. The program of instruction for the USASMA Nonresident Course closely parallels that for the USASMA Resident Course, and both courses are equally accredited by the Southern Association of Colleges and the American Council of Education. As such, students enrolled in either course may receive up to 18 college credit hours. Also, both courses receive equal consideration when used to decide further personnel actions.

Sergeants Major courses offered to Reservists

Senior Army Reserve noncommissioned officers of the Ready Reserve are encouraged to apply for the 1982 US Army Sergeants Major Academy resident/nonresident courses.

According to DA officials, 12 Reservists will have an opportunity to attend the USASMA resident

course at Fort Bliss, TX, while a larger number will be selected for the nonresident course. The deadline for application for either course is 30 June 1981.

The objectives of the resident course are to prepare students to assist in the solution of command problems, to enhance senior NCO capability to develop and maintain discipline, and to provide instruction in the tactical, administrative, and training operations of divisions. Students will also receive an update on contemporary Army problems and will be given an opportunity to develop communication skills and analytical abilities.

Attendance at the resident course, which is approximately five months long, will be in an Active Duty for Training (ADT) status. The next resident class starts on 9 August 1982.

The nonresident course, which closely parallels material covered in the resident course, is self-paced but should be completed in two years. Students are expected to devote four to six hours a week to their studies. The seven nonresident phases are followed by a two-week resident phase at Fort Bliss. Reservists who wish to apply should —

•Have a maximum of 23 years of service, waiverable if the individual will have two years service remaining in the Ready Reserve upon completion of the course.

•Meet security clearance and physical examination requirements as specified in DA Pamphlet 351-4.

•Be in the grade of E8 or E9 for the resident course or be in the grade of E7, E8, or E9 for the nonresident course.

•Meet Army weight control standards.

In addition to completing a DA Form 145 or DA Form 1058, applicants must submit copies of their Enlisted Efficiency Reports for the past five years and a copy of their DA Forms 2 and 2-1 or DA Form 20. They must also include their current military photograph annotated to reflect height and weight.

Applicants for the resident course must give their choice of classes and they must include a statement that their employer will release them for active duty, if selected. Applicants who apply for the resident course will be automatically considered for the nonresident course.

Applications are to be submitted through command channels to Headquaarters, DA (DAAR-OTI). The announcement of selectees is expected by September 1981. For additional information, applicants should read DA Message, DAAR-OTI, Subject: US Army Sergeants Major Academy Resident and Nonresident Courses, dated 13211OZ February 1981.

Integration into Regular Army

The recent enactment of the Defense Officer Personnel Management Act (DOPMA) will allow the Army to integrate a number of OTRA (other than Regular Army) commissioned officers into the Regular Army. Implementation plans are being developed and notification of the officer corps and those individual officers who will be invited to integrate into the Regular Army will be made on or before 1 July 1981. By 31 January 1982, RA integration of officers should be complete.

As such, any OTRA commissioned officer whose mandatory release date is prior to 31 January 1982 as a result of 20 years service and who is interested in retention should contact his/her career manager or submit an application for extension of mandatory release date through 31 January 1982 for consideration.

TEC accounts

Currently, there are more than 8,000 Training Extension Course (TEC) account holders within the Active Army, Reserve Components, and Reserve Officers' Training Corps (ROTC) units. Almost daily, units change addresses or designation, add or delete major items of equipment or military occupation specialties (MOSs), or receive a change in mission. Additionally, units sometime receive lessons for which they are not scheduled, or separate TEC accounts are combined into a single account.

Whatever the reason, all existing TEC accounts should notify TEC Distribution at Fort Eustis when changes occur by calling AUTOVON: 927-2141/3728 (Commercial: 1-804-878-2141/3728) or by writing:

Commander
US Army Training Support Center
ATTN: ATIC-AET-TP
Fort Eustis, VA 23604

Please include the following information:

1) Unit designation and mailing address.

2) Unit Identification Code (UIC)

3) Modified Table of Organization and Equipment (MTOE) or Table of Distribution and Allowance (TDA) number.

4) A list of enlisted MOS (first three digits only) to be serviced by the TEC account and the number of personnel authorized in each MOS.

5) List other units using the account to include their UIC, MTOE, and MOSs.

6) A point of contact and AUTOVON or commercial telephone number if additional information is required.

Help for soldier education

Soldiers interested in the Army's Education Program may be interested in recent changes announced by the Adjutant General's Education Directorate.

Enlisted active duty soldiers in grades E5 and above are now entitled to receive 90 percent tuition assistance, provided they have less than 15 years of service. The rate for soldiers below E5 or those with more than 15 years service remains at 75 percent.

Tuition assistance allows soldiers on active duty to work toward a higher degree in their off-duty time and have the Army pay for part of their tuition. For example, if a servicemember enrolls in a college course which costs $300, the 90 percent tuition assistance pays for $270 of that amount.

To be eligible for tuition assistance, soldiers must be enrolled in an MOS-related course or be working toward a higher degree from an accredited school.

Also, soldiers participating in the service-members education testing program may be eligible for such entitlements as loan forgiveness, noncontributory VEAP (Veterans Educational Assistance Program), or the Educational Assistance Program.

The loan forgiveness program is open to both Active and Reserve Component enlistees who are high school graduates, score 50 or above in verbal math on the entrance exam, and opt for training in critical skills. Only those soldiers who have enlisted after 30 November 1980 and before 1 October 1981, however, are eligible to take part in this program. Members must have either a guaranteed student loan or a national direct student loan made to them after 1 October 1981.

The noncontributory VEAP is available to soldiers who enlisted after 30 November 1980 and before 1 October 1981. They must also have an entrance verbal math score of 50 or higher, be high school graduates, and choose training in a critical skill. Members in this program should have the Department of Defense pay their monthly VEAP contribution.

To take part in the new educational assistance program, enlistees, too, must have joined the Army after 30 November 1980 and before 1 October 1981, be high school graduates, have an entrance verbal math score of 50 or higher, and enlist for a critical skill specialty. Benefits of the educational assistance program include a $1,200 tuition assistance account which will be adjusted each year, a $300 monthly allowance to be paid if the member is no longer in the service, authority to use the benefits after two years of service and, upon reenlistment, the authority to transfer earned benefits to dependents or take a 60 percent cash-out option.

Combined arms advanced courses

In the future more combined arms officers will be scheduled to attend branch advanced courses other than their own. MILPERCEN's goal is to have a total of 233 officers attend either the Infantry, Field Artillery, Armor, Engineer, or Air Defense Advanced Course instead of their own basic branch advanced course.

The breakdown of numbers to be scheduled is shown here:

ADVANCED COURSE	OFFICERS BY BRANCH (PER CLASS)					TOTAL PER YEAR
	IN	AR	FA	ADA	EN	
Infantry (5 classes/year)	—	10	5	3	1	95
Armor (4 classes/year)	15	—	2	1	1	76
Field Artillery (4 classes/year)	6	3	—	1	0	40
Air Defense (4 classes/year)	1	1	1	—	0	12
Engineer	1	1	0	0	—	10
TOTAL						233

Hospital cost increases

The dependent rate for inpatient care at military hospitals has been increased to $5.50 per day. This charge is applicable to dependents of active duty members, dependents of retirees, and to surviving dependents of deceased members. The previous charge was $5.00 per day.

This change also affects CHAMPUS, since by law the inpatient cost-share requirement for spouses and children of active duty service members is based on the charge at military hospitals. Therefore, these individuals will be required to pay a minimum of $25.00 for services or, when charges for services exceed $25.00, the rate will be at a cost of $5.50 per day.

This change does not affect CHAMPUS cost-sharing requirements for retirees, dependents of retirees, or surviving spouses and children of deceased members. The law provides that these beneficiary categories are responsible for 25 percent of the reasonable cost/charges for both inpatient and outpatient services — with the Government cost/charge being 75 percent.

Military Personnel and Transportation Assistance Office

When you are traveling by commercial airlines or military aircraft, where can you go for help? As many military travelers do each year, you head directly to one of the MILPERCEN Military Personnel and Transportation Assistance Offices (MPTAO) located at the following airports:

•McGuire Air Force Base, New Jersey.

•Charleston Air Force Base, South Carolina.

•Seattle-Tacoma (SEA-TAC) International Airport, Washington.

•Travis Air Force Base, California.

•San Francisco International Airport, California.

•Los Angeles International Airport, California.

•St. Louis International Airport, Missouri.

These offices operate seven days a week, 24 hours a day, to answer questions and provide assistance to military travelers, and dependents and Department of Defense employees. In addition to the MILPERCEN representatives, members of the Military Traffic Management Command (MTMC) are also available at the MPTAOs to provide assistance in solving transportation problems.

Assistance provided by the MPTAOs for military personnel includes granting leave extensions when emergencies arise, issuing military ID cards, arranging for messing and/or billeting, and coordinating casual payments with an area Army finance office.

Enlisted Reserve retirement eligibility expanded

Army Reserve enlisted members who have completed a full 20 years of active federal service are now eligible to retire with the same benefits as Regular Army enlistees. Previously, only Reserve officers were eligible for retirement after 20 years of active duty while enlisted Reservists had to wait until age 60 to collect their retirement checks. The broadened eligibility is the result of recent legislation enacted by Congress.

The change will immediately affect an estimated 500 soldiers who have accumulated 20 years of active federal service through a combination of long tours, active duty for training, and annual training. (Active duty does not include inactive duty training such as monthly assemblies or any duty performed as a member of the Army or Air National Guard under state control).

For more information and retirement applications, interested Reservists currently on active duty should contact the Military Personnel Office to which they are attached. Troop Program Unit members may obtain information from the Military Personnel Office at the nearest Army installation or by writing to The Commander, Reserve Components Personnel and Administration Center, ATTN: AGUZ-RAD, 9700 Page Blvd., St. Louis, MO 63132.

Warrant officer career changes

Army warrant officers can look forward to several important actions concerning career opportunities, professional development, and pay in the coming years in an effort to improve warrant officer retention.

Although the major concern has been with the aviation warrant officer strength (the Army is currently short nearly 900 aviation warrants), the entire Warrant Officer Corps will benefit from several actions decided by a special study group. Representatives from the office of the Deputy Chief of Staff for Personnel (ODCSPER), US Army Military Personnel Center (MILPERCEN), and Major Command (MACOM) Headquarters worked together on the changes. Input was also provided by the Army Research Institute Field Unit at Fort Rucker, AL, and students attending the Warrant Officer Senior Course (WOSC) there. Those areas identified by the MACOMs as needing attention include:

•Warrant officer pay.

•Flight pay equalization.

•Direct commissioning of aviation warrant officers affected by the "10/20" rule.

•The single aircraft "track" policy.

•Improvements in MILPERCEN's Warrant Officer Division.

Also, two MACOM retention suggestions were replaced by these alternative solutions:

•The assigning of an Additional Skill Identifier for graduates of the WOSC.

•Pay step increases for chief warrant officers four (CW4) beyond the 20 years-of-service mark.

Along with the MACOM retention suggestions, a number of other areas were also noted for DA attention. Work on three of these actions has been completed which include:

•A warrant officer on the DCSPER staff.

•Field grade housing for CW4s.

The remaining area involves changing that part of Title 10, US code which deals with Army warrant officers. this prospect would require congressional action and would allow a single promotion system for warrant officers and also allow the commissioning of chief warrant officers two (CW2s) under certain conditions.

ROTC scholarships available to active duty soldiers

Active duty enlisted soldiers may now finish college and earn a commission—all at Army expense. As such, applications are now being offered by the Army's Reserve Officers Training Corps (ROTC) for the 1981-82 school year.

The new scholarship program is part of the Army's continuing effort to expand its ROTC program. In addition to paying full tuition for qualified students, the program covers fees for books and a subsistence allowance up to $1,000. Selected individuals will also be paid while attending the advance camp, normally between the junior and senior years. Further, scholarship winners who are eligible to receive GI Bill or VEAP (Veterans Educational Assistance Program) educational benefits may be able to use these funds while enrolled in the ROTC program.

To qualify for the program, soldiers must have completed at least one year of active duty and one year of college. They must also meet certain maximum age requirements; these, however, may be adjusted for soldiers with previous active duty service time.

Those soldiers applying for the two-year scholarship must have already completed at least two years of college and have two years left in a degree program. Those applying for the three-year program must have at least one year of college.

All applicants must have scored at least 115 on the GT portion of the Armed Forces entrance exam, be accepted by a college for the upcoming fall term, and be a US citizen. After graduating from college, participating members will be commissioned as second lieutenants and will incur a four-year active duty obligation.

Soldiers interested in further information and application forms may write Army ROTC Scholarships, Fort Monroe, VA 23651, or call AUTOVON 680-3071.

MALT rate increased

Soldiers can now receive more travel money when driving their privately owned vehicle (POV) while on temporary duty (TDY). In a change to the reimbursement rate under the monetary allowance in lieu of transportation (MALT) program, service members are now repaid at the rate of 16 cents per mile. Prior to the change, which went into effect in January this year, the rate was 7 cents per mile for members using POVs while traveling under official TDY orders.

Personnel Coordinators Office

The Personnel Coordinators Office is currently being organized to provide a centralized coordination effort for force structure changes. The Coordinators Office will monitor:

•The introduction of new materiel (e.g., equipment, to include automation systems and personnel systems).

•The activation, inactivation, and changes of station of units.

•Unit readiness status as it is affected by structure change.

The Personnel Coordinators Office will communicate with the Department of the Army, major commands, and other installations in an effort to provide maximum personnel support for future Army programs. Within this framework the coordinators office will provide a minimal planning capability.

Additionally, the Personnel Structure and Composition System (PERSACS) functions were incorporated in the Personnel Coordinators Office. The PERSACS element serves as a functional proponent for PERSACS and the MILPERCEN Authorization System; provides one-time and recurring authorization reports; and manages and updates the Personnel Occupational Specialty (POS) Master Edit file used for implementation of MOS/SSI changes into the authorization systems.

The MILPERCEN Personnel Coordinators Office will reach full operational capability in the second quarter of FY81.

SGLI/VGLI

By law, a soldier can only carry a maximum of $20,000 coverage in the Servicemen's Group Life Insurance (SGLI) and/or Veterans' Group Life Insurance (VGLI) programs. There are times, however, when a soldier can be eligible under both programs. If this is the case, he must choose to be either covered by "one program" for the full amount of coverage or covered in "both programs" for a combined amount not to exceed $20,000. One must carefully consider the premium amounts, as well as the length of time the coverage will last, before making a decision. If the soldier chooses to retain the VGLI coverage, he/she must complete a VA Form 29-8286 (Servicemen's Group Life Insurance Election) declining a SGLI coverage for the amount of VGLI he/she wishes to keep. Any VGLI coverage the soldier wishes to replace with SGLI may be converted to a commercial plan of insurance within 60 days after being insured by SGLI.

New EER form

A new enlisted evaluation report form which should be easier to prepare and read will be introduced Armywide on 1 October.

The new form, which is scheduled to be distributed to Army units this summer, is reportedly better organized and should make it easier for raters to be more specific on spelling out a soldier's job duties, performance and potential for future promotion, assignment and service school selection.

Under Army policy, E5s and above should be rated at least once annually. The information is used by commanders, career managers, and selection boards to make decisions on promotions, school selection, and assignments.

In addition to an annual rating, soldiers also are to be rated when:

•There's a change in rater.

•Newly promoted to E5.

•Information is needed by a selection board for promotion and school selection purposes.

•The rater wants to point to something "outstanding or deficient" in a soldier's performance.

Soldiers can receive up to 125 points for an efficiency report. These points are among the items used to determine a soldier's promotion point cutoff score for advancement to E5 and E6.

Another major advantage of the new form is that it will be easier to reproduce.

Company command tour lengths

For those officers who assumed command after 1 December last year, company command tour lengths for units in continental United States and overseas, long-tour areas are established as 18 months, plus or minus 6 months, at the discretion of the local commander. The objective is to stabilize commanders at this most critical operational level and enhance the cohesion among the members of those units.

If an officer is in command when Department of the Army initiates assignment action, the officer will not be removed earlier than 18 months for any assignment unless approved by the officer's commander. If senior commanders wish to extend an officer on station, three considerations should be reviewed before an officer is placed in command:

•An officer on PCS orders should not be placed in command at the losing installation.

•Officers who have been on station more than 24 months should not be placed in command without coordination with the Department of the Army.

•Department of the Army will approve requests for extension of 12 months on station or until completion of 18 months in command, whichever is sooner. However, Department of the Army will consider individual requests on a case-by-case basis to extend the total tour beyond the 36-month mark if local conditions warrant continuation in command.

It is clear under the new policy that not every officer will be guaranteed the opportunity for an 18-month company-grade command. The policy is intended to point officers toward an 18-month command tour while giving the local commander the flexibility to effect the change of command when it's in everyone's best interest.

Tactical Airpower

by COL Griffin N. Dodge

What is it? How does the ground maneuver commander use it?

Interesting, isn't it, that after discovering how to exploit the combat potential of airpower in support of ground operations during World War II (and reinventing it for Korea and Vietnam), we "Green Suiters" cannot always describe what airpower is and how the maneuver commander should use it. It is even more interesting that we of the Field Artillery Community claim the title of fire support coordinator for the ground maneuver commander — yet we have traditionally avoided our responsibility for the employment of tactical airpower by passing it to an "assistant G3/S3 air" or, even worse to an air liaison officer (ALO).

As a product of the Army's school system for the past 25 years, I have a ready response to the first question: Tactical airpower is an energetic young Air Force officer bounding onto the service school auditorium stage with pilot wings aglow pronouncing enthusiastically: "This is what the Air Force can do for you!" What followed was a "Gee Whiz" mass of spectacular slides and film clips showing vast quantities of swift, agile aircraft delivering with uncanny accuracy, tons of ordnance which puliverized everything in sight. This breathtaking event was punctuated by another instructor — usually some Army type — listlessly intoning some rather dull information about the Air-Ground Operations System (AGOS), the Tactical Air Control System (TACS), and the Army Air-Ground System (AAGS). However, it was common knowledge that we field artillerymen need not worry about all that because someone else does the air appendix to the fire support plan. Besides, the class was always a "freebie" and nothing from the presentation would be included on the exam.

It would appear then that beyond an exposure to the massive combat power potential of the Air Force, we Army types have a lot of trouble responding to the first question, and our collective answer to the second question is probably even worse.

During the last few years my duty assignment included visits to many tactical ground units where I took the opportunity to ask a number of unit personnel about their thoughts regarding the employment of tactical airpower in support of ground operations. For example:

•One corps G3 dismissed the use of tactical airpower in the European environment by noting that the Air Force would commit all its resources in the counter-air role leaving nothing to support ground operations.

•Senior officers in three division artillery organizations proudly reported their successses during field exercises in getting Air Force aircraft to conduct airstrikes controlled by fire support team (FIST) personnel. While this in itself is quite commendable, they described no use of tactical air resources beyond the classic close air support (CAS) strike.

•In discussing tactical airpower with members of another division artillery, I was advised that other than an occasional CAS strike, all employment of tactical air (TACAIR) was planned and executed at the corps level. I subsequently discussed the same matter with field artillerymen at the corps. They noted that they did practically no planning for the employment of

TACAIR since this was handled by the divisions, and the corps merely acted on the divisions' requests. Here I perceived some sort of a gap:

•One assistant division FSCOORD I talked with had developed a very close relationship with the supporting tactical air control party (TACP). While this was a very positive step, it was also clear that he was completely dependent on the ALO for recommendations on how to integrate tactical airpower into the scheme of maneuver.

•At one location I enjoyed a dialogue with a ground liaison officer (GLO) who was stationed with a tactical fighter training wing. His job was to familiarize the fledgling A-10 aviators with how ground commanders might use the potential of tactical airpower. He clearly had an excellent grasp of ground maneuver operations — but, as he explained, "There is just no doctrine which I can reference to tell these people what we want them to do."

The prevailing Army thought on the use of tactical airpower was epitomized a couple of years ago in an *Army Times* article citing congressional testimony by top US Army Research and Development officials. In an effort to get budget support for new Army hardware, a land combat scenario was presented which, although a joint environment was depicted, practically ignored the applicability of tactical airpower. Noting that bad weather precluded friendly airstrikes, the scenario went on to state that friendly operations were hindered by waves of enemy aircraft — but these were subsequently driven off by (the proposed) surface based air defense systems. It was never explained how these enemy aircraft were able to operate in weather which precluded USAF operations. That scenario, however, did much to perpetuate a myth long cherished by many "Green Suiters" that Air Force resources are never really available to support ground operations. Hence, requesting such support is simply a waste of time — it is sort of a self-fulfilling prophecy.

While these examples may not describe our official position on the use of tactical airpower, I think they accurately reflect the attitudes and perceptions of many of the troops in our tactical commands.

It's a shame, isn't it? What should we do? Initially, we must accept several principles:

•General Robert J. Dixon (commander of Tactical Air Command (TAC) during the early TACTRADOC dialogues) stated that, in a joint command, the job of the component (Army and Air Force) commanders was to accomplish the joint commander's mission. The meaning of this principle is that the components operate under a single command with a single focus. There is simply no room for interservice rivalry or competition — nor is there room for independent uncoordinated actions. The statement also means that all (air and ground) combat resources belong to that joint commander to employ as he sees fit.

•The second principle comes from FM 100-26, *The Air-Ground Operations System.* Chapter three of this manual discusses the apportionment-allocation process used in a joint command to establish the commander's priorities for the use of his tactical airpower resources. The salient features to remember are that the joint commander's apportionment decision (announced as a percentage) normally includes a commitment of air combat resources to support ground operations, and this decision is a directive to the Air Force component commander. The latter, in turn, converts the percentage to a number of sorties — sorties that he had been directed to set aside for support of ground operations. The source cited, FM 100-26, dated March 1973, is sorely in need of updating.

•The last principle for consideration is that someone at each level in the ground maneuver chain of command must, in the name of the commander:

1) Decide how airpower should be used to support the ground scheme of maneuver.

2) Determine how much airpower is required.

3) Request allocation/suballocation of the requisite airpower resources.

4) Develop the ultimate plans for, and proper use of, the sorties allocated. That "someone" ought to be the fire support coordinator — the field artilleryman — and he ought to be in the business of employing airpower in both the fire support and target acquisition modes.

After accepting these principles, we must educate ourselves by becoming intimately familiar with the capabilities and limitations of available aerial delivery and reconnaissance systems. To do this we can exploit the expertise of ALOs in the tactical units and the Air Force faculty at the Field Artillery School and other service schools. (I have found most of these individuals to be exceptionally competent professionals.)

We must also learn the mechanics of the Air-Ground Operations System. The Air-Ground Operations School does an outstanding job of teaching this.

Learning how the Air Force conducts tactical operations and manages its resources is of paramount importance. In my experience,

almost no Army personnel and very few Air Force officers are truly proficient in this area. One good way to learn is to participate in a Tactical Air Control Center (TACC) during a joint exercise or during a "BLUE FLAG" exercise (the TAC command post exercise). Field artillerymen in the corps artillery section can learn a great deal by actively participating in operations of the supporting Air Support Operations Center (ASOC) — called Direct Air Support Center (DASC) by the Marines. Assignment of field artillerymen as ground liaison officers with tactical Air Force units could also prove most beneficial and educational in this area.

Finally, and perhaps of greatest importance, we must reverse our traditional attitude that employment of tactical airpower is someone else's business. Additionally, we must emphasize the use of airpower within our own community and create an active dialogue on how to best exploit this available combat power. Articles on the use of tactical airpower have been rare in Army-oriented professional journals. For the past several years, my reading sample has found that journals oriented toward Air Force personnel have had far more to say about air-ground operations than have those with a predominately Army audience. In fact, the best discussion I have read on the ground commander's use of tactical airpower ("TACAIR: An Army View") was written by BG Charles E. Canedy, USA — but published in the February 1978 issue of *Air Force* magazine. General Canedy's discussion went far beyond CAS, exploring the use of tactical air resources in suppression of enemy air defense (SEAD), intelligence, electronic warfare, battlefield interdiction, and counterfire roles. It is worthwhile reading for any fire support coordinator.

I recently found an Army-oriented journal with two excellent discussions of tactical airpower in support of ground operations. The July-August 1980 issue of *Armor* magazine included: "What Is Close Air Support?" by Group Captain Ian Madelin (a reprint from the *Air University Review*) and "A User's Guide to Close Air Support," by Captain Charles E. Wright.

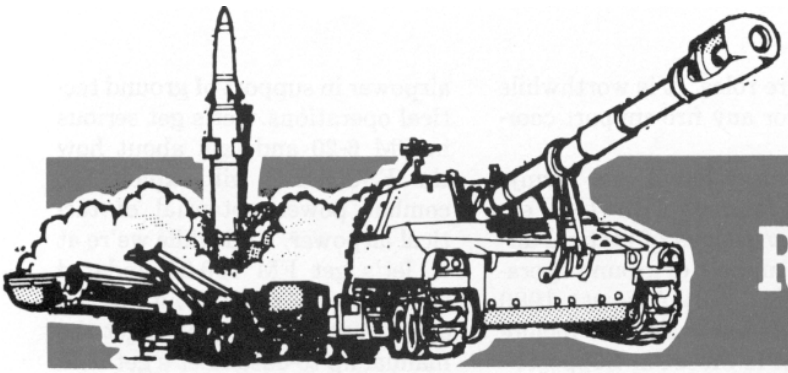
With the exception of some SEAD discussions and an occasional letter to the editor, the *Field Artillery Journal* has remained generally silent on the use of tactical airpower. Perhaps this is in keeping with the "air fire plan is someone else's job" syndrome.

I was delighted to see this silence broken in the November-December 1980 issue of the *Field Artillery Journal* with MG Edward A. Dinges' comments in his "On the Move" feature and an excellent letter to the editor in the "Incoming" feature by LTC (Ret) C. W. Montgomery.

It is time for the fire support coordinator — the field artilleryman — to provide answers to the two questions heading this article. It is time for us to pull the fire support and the target acquisition potential of tactical airpower out of the closet and bring it under the umbrella of the fire support coordinator. We must stop considering the Army and Air Force in a "we-they" relationship in land combat. Also, we can no longer sit quietly and listen to "what the Air Force is going to do for the Army." Rather, we should be developing the techniques for using tactical airpower in support of ground tactical operations. Let's get serious in FM 6-20 and talk about how the FSCOORD will exploit the combat power potential of tactical airpower. And while we're at it, let's get FM 100-26 updated (yes, I know it talks about tactical airlift, but someone must get the manual up-to-date). Let's get field artillerymen functioning in the ASOC's (or DASCs) and TACCS, and assigned as ground liaison officers (anyone ever hear how a GLO assignment was "career enhancing"?) Finally, let's get a good "how to" dialogue going on the employment of tactical airpower in the *Field Artillery Journal* among the discussions of TACFIRE, Copperhead, and aerial displacement of tube artillery.

Postscript: *The terms "tactical air power" and "US Air Force" may seem to be used interchangeably in this article, but this is not the case. Tactical airpower refers to a source of combat power available to a ground maneuver commander similar to conventional and nuclear fires, ground and airborne antiarmor systems, and electronic warfare systems. The US Air Force is a military service which has a sense of pride and tradition like that of the Army. It provides resources to the ground maneuver commander somewhat like the attack helicopter or field artillery units do. The Air Force also has concepts of doctrine and roles and missions — which are important as it competes with the other services at the national level for its share of the defense dollar. We must recognize the difference between the role of the Air Force and the employment of tactical airpower.*

COL Friffin N. Dodge is Chief of the Training Effectiveness Analysis Division, TRADOC Systems Analysis Activity, White Sands Missile Range, NM.



Right by Piece

Unit restores a "Schneider"

LINCOLN, AL—Upon my arrival in June 1980 for duty with Battery B, 3d Battalion, 15th Field Artillery, I noticed the only thing missing was a cannon in front of the Reserve Center to proclaim the existence of a field artillery unit assigned there.

As such, my counterparts and I looked around the surrounding area where we found several artillery pieces, all of which were in poor condition. We were somewhat discouraged but kept looking and finally found one sitting by an old schoolhouse which we thought we could use. Soon thereafter, permission was obtained from the county school superintendent to remove the howitzer, fix it up, and display it in front of the center.

About this time our unit received the November-December 1981 issue of the *Field Artillery Journal* which contained an extremely interesting article concerning the "American Schneider" by LTC Ronald E. Olson. We immediately noticed the similarity between our howitzer and the one mentioned in the *Journal* and decided to do some research to determine the history of this particular type howitzer. Most helpful were data taken from the "Handbook of Artillery Including Mobile, Anti-Aircraft and Trench Materiel," dated May 1920, which provided complete information on Models 1917 (Schneider) and 1918 howitzers and associated equipment.

Our howitzer has a data plate on the trail about halfway back to the spade that reads: "Carriage, Howitzer, 155-mm, Rock Island Arsenal, Serial Number 843, 1942 N.F.R." Other markings are as follows:

•On the left side of the breech: Howitzer, 155-mm, SCHNEIDER, Model of 1918; T. Beth Steel; J.S.F. Co. Steel.

•On the rear of breech: A.B.S. & Fdy Co.; Erie, PA.

•On right side of howitzer on the recuperator: No. 2184, St. Ouen 1919, M1917A2. (This information suggests that the recuperator was made in France as noted in LTC Ronald Olson's article).

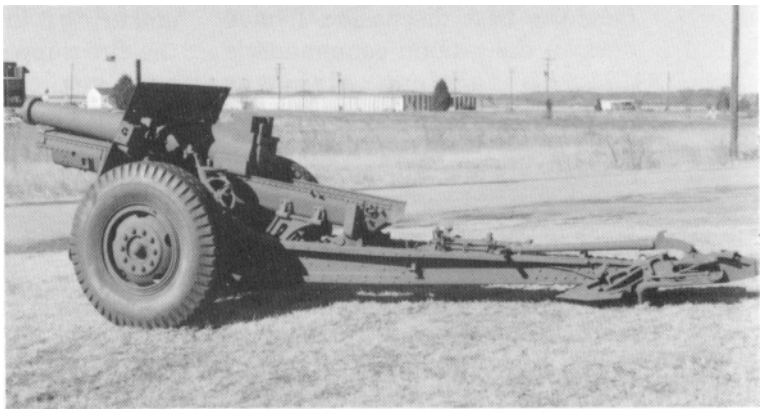
•On the cannon muzzle: 2690 lbs., No. 1977, J.H.C. & Fdy Co., 1919.

The carriage data that reads 1942 is somewhat confusing — perhaps the howitzer was either overhauled or reconditioned in Rock Island during 1942.

The piece was in extremely poor condition when we found it — several layers of OD paint were flaking off and rust was having a field day. The barrel was full of debris, the brake cables had completely rusted away, and the tires had rotted. We were not even sure we could move it!

First, we called several places to find two replacement tires so as not to damagae the rims when we tried to tow it. Since the cost of new tires was $350

The Schneider as we found it.



The restored Schneider.

apiece, I asked the supervisor of our Equipment Concentration Site at Fort McClellan if he could help and, in a few days, he had two serviceable tires, two new tubes, and a borrowed hand impact wrench to remove the lugs. With a jack, we raised the carriage enough to hook it up to the 5-ton truck for towing to the Reserve Center.

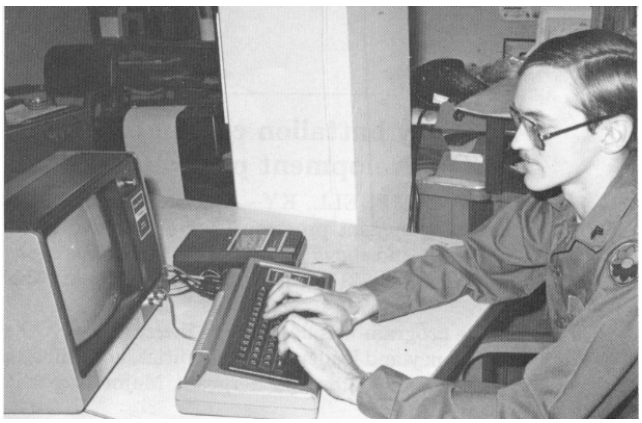
In our restoration effort, we gave the howitzer a good washing, sandblasting, and painting. No attempt, however, was made to replace the worn out brake cables and accessories, air hoses, etc.

Our "Schneider" now actually looks like a new one and I encourage all Reserve/Guard artillery units to try to locate one of these old howitzers—since like all once proud cannons of distant past — they need someone to take care of them. (MSG William C. Brown)

HARRISBURG, PA—1LT Alan W. Gallager (right) accepts a revolutionary-era cannon replica from Duane Roberts, Area Supervisor for Ponderosa System, Inc., as the piece was being donated to the Pennsylvania Army National Guard. Gallagher commands Service Battery of the 28th Infantry Division's 1st Battalion, 109th Field Artillery, in Wilkes-Barre, PA.

The presentation was made on a cold, blustery day in January this year and the non-working piece now graces the facilities of Service Battery's headquarters, just across the Susquehanna from Wilkes-Barre.

It could be that Gallagher's unit may be the only service battery in the Guard with its very own gun: (photo by MAJ Robert M. Fisher)



SGT John Junod from Headquarters and Headquarters Battery, 2d Battalion, 4th Field Artillery, works with the FIST training unit he built to train artillery forward observers. Junod built the unit in his spare time, costing him about 300 hours and $800. (photo by Karen Ruckman)

Video game enlivens FA training

FORT LEWIS, WA—Forward observers at the 2d Battalion, 4th Field Artillery, play video games on duty as part of their job.

SGT John A. Junod, a forward observer with the 2-4th FA, has written a computer program that lets 13F specialists fire rounds, see where they land, adjust fire, and try again — all of it taking place within the computer. The gunner can pick the ammunition type to most effectively destroy the intended target, whether it's APCs or ground troops.

A typical computerized mission goes like this: The gunner is shown a grid pattern of dots and bars of light that represent his location and the target. The computer asks for direction and distance given in mils and meters respectively, and then asks for type of round. The machine then prints a radio request for code authentication. If given the correct response, it fires the round and prints the results. If the strike is off, the gunner can adjust fire and then fire for effect, or let the computer correct his fire. Then the computer asks if the gunner would like to try another mission. He can punch "Y" or "N" on the keyboard to indicate yes or no, but if "N" is punched the computer prints "You ought to be a grunt! You will be reclassified immediately!"

According to CPT James Muri, 2-4th FA Fire Support Officer, "A soldier can train on the computer for a few hours and then go out and get good accurate fire from two or three rounds."

Sergeant Junod said the program took him about 300 hours to write in his spare time. Now he's working on modifications to the program, such as irregularly-shaped targets, to make it a little more complicated.

Perhaps the 2-4th has created a new MOS: Pinball Wizard. (Russell Robinson)

Artillery battalion conducts NCO development program

FORT CAMPBELL, KY—A noncommissioned officer development program for enlisted soldiers in grades E5 and above was conducted for NCOs of the 1st Battalion, 321st Field Artillery, in January this year.

The program was designed to increase the NCO's proficiency and leadership capabilities, according to the battalion Command Sergeant Major Roger P. Lucas.

The four-day training period consisted of 16 hours of formal and informal instruction, conducted by hand-picked instructors within the artillery battalion.

"We gave important training in subjects necessary for every NCO," said CSM Lucas, "but which many don't normally have time to study."

The first day's activities began with instruction in the Uniform Code of Military Justice, including one's rights in search and seizures and Article 15s.

Later, the battalion commander, LTC R. H. Stryjewski, spoke on the relationships between NCOs and officers and NCO responsibilities.

The next four-hour block of instruction consisted entirely of NBC proficiency, including masking and decontamination procedures.

Of course in the Battalion Training Management System followed, noting job books, assessment rosters, and other leader tasks. Counseling soldiers was also included in this block, as well as proper use of the chain of command.

Other instruction involved military customs and courtesy, uniform wear, inspection procedures, Champus benefits, line-of-duty investigations, Senior Enlisted Evaluation Reports, duty rosters, and a final review.

According to CSM Lucas, the NCOs were tested after each four hours of instruction, and test results were "outstanding."

"This is the third time we've run this program," noted CSM Lucas, "and they've all worked very well. From now on, we'll probably run this as a quarterly program."

He said the major importance of the NCO Development Program was that it brought the battalion NCOs up-to-date on various aspects of soldiering, as well as introducing new regulations to them.

SSG Freddy D. Spencer, section chief for Battery C, 1st Battalion, 321st Field Artillery, thought the classes gave some good training in subjects individuals didn't work with every day. "The program was great for the career development of the NCOs." he said, "and especially good for the junior NCOs who haven't had much experience in these areas."

Another participant, SSG Robert Legron Jr., a Personnel Administration Center supervisor and also acting instructor, said he got a little something out of every class, to include very important things that many NCOs aren't aware of. "Already, I've had about seven individuals visit my office to check over regulations that they'd been unaware of. That's proof that it did some good."

Another development program, according to SSG Legron, is tentatively scheduled within the next few months. (Steve Lawrence)

Redlegs train realistically

FORT CARSON, CO—The division artillery here recently initiated a new method, called the Non-Established Firing Point (NEFP) Program, to increase realism in field artillery live firing exercises. The NEFP allows more flexibility in determining firing positions. With the set firing points used in the past, training was basically the same since battery commanders knew exactly from where they would be firing.

With the implementation of NEFPs, however, the battery commander is now able to select the best tactical position within an area designated through command channels.

The 1st Battalion, 20th Field Artillery, was the first to train under the new program. "NEFPs is more realistic in our training," said 1SG John McConnell, Battery C. It enables us to obtain a more combat-like atmosphere."

"It forces a soldier to really know how to read a map and not just go to a certain firing point," says 1SG Jimmy Richmond, Battery A.

"With training commanders and sergeants to map spot for battery positions in the absence of survey," stated Richmond, "the entire process becomes more realistic and tests the abilities of all soldiers to camouflage and conceal their equipment using the natural terrain features."

Now you see it . . . now you don't — this division artillery howitzer is almost completely hidden as a result of new procedures. (Mountaineer photo)

"Big Red" moves to South Fort

These old barracks which were built 40 years ago are seven miles from the main post area.

FORT POLK, LA—At 1500 hours on 30 October 1980, the Commander of 2d Battalion, 21st Field Artillery, received a directive from the 5th Infantry Division (Mech) Artillery Commander which stated: "Move your battalion to South Fort immediately." At last a long awaited dream was about to become a reality. Left behind would be the World War II barracks of North Fort built 40 years ago as temporary, open squad bays. Also to be forgotten were such things as "No showers today in A, B, and C Batteries; water main broke last night" and "Careful when you walk guard, the skunks believe they own the place" (North Fort is seven miles from the main post area).

The world of the main post would be ours — new buildings, three soldiers to an air-conditioned room with a private bathroom, college campus atmosphere, main post exchange only three blocks away — the good life.

"Big Red" finally arrived at South Fort. The move was accomplished in eight days.

The new division artillery complex, cut into the pine tree woods of Fort Polk, presents a picturesque setting. The administrative area is entirely modern, and the motor pool, when completed, will be the most modern maintenance facility in the Army today — complete with solar heated maintenance bays and "car wash style" wash racks and steam cleaning.

In the center of the complex, is the division artillery consolidated dining facility which is solar heated with an atmosphere comparable to that at "McDonald's." Here booths with cushioned seats replace the old-fashioned square tables with straight-backed chairs.

In addition, there is a new officer's club, post exchanges, commissary, all-ranks club, and skill development, music and recreation centers. The old Fort Polk has been transformed and now offers a great tour for the field artilleryman. (CPTs Nelson Martin and Jeff Cundic, 2d Bn, 21st FA)

M198s go to Korea

CAMP CASEY, KOREA—Although described by soldiers as "monstrous," the four M198 155-mm howitzers that recently arrived make the "Second to None" division the first overseas unit to receive the US Army's newest howitzers.

These "top of the line" artillery weapons will replace the 105-mm howitzer now manned by the 1st Battalion, 38th Field Artillery, at Camp Stanley and the 2d Battalion, 17th Field Artillery, at Camp Pelham. Both direct support division artillery units will eventually be equipped with 18 M198s each.

COL Thomas J. P. Jones, division artillery commander said, "We are happy to receive the M198s because they give us much added capabilities in combat power multipliers and provide the Division Commander, MG Robert C. Kingston, much more flexibility in all his contingencies."

The M198 155-mm howitzer replacing the smaller 105-mm howitzer in the 2d Infantry Division weighs 4,850 pounds.

LTC James H. Foster, division artillery S3 said, "The firing range for the 105-mm howitzers is 11.5 kilometers; however, the M198 range is 30 kilometers. Also, the destructive power is three and one-half times greater with the M198 projectile than that of the 105-mm."

The guns will be de-processed by a New Equipment Training Team from Rock Island Arsenal, IL, and then moved to Camp Stanley for maintenance training. Meanwhile, the Division Artillery Operational Training Team is making preparations to train the gun crews. Each crew for the M198 includes a gunner, an assistant gunner, a 5-ton truck driver, a section chief, and seven cannoneers.

By the end of World War II, there were no interoperability problems since much of the equipment used by the Allies was either from the United States or United Kingdom. In the fifties, as Europe's industrial capabilities began to recover, countries actively produced and designed their own military equipment, and as a result there is a very keen competition among nations for the military market of the world today. What was once almost exclusively the market of the United States is now being supplied by an ever-growing industrial base.

Along with accrued national economic benefits comes a major concern that a multinational force such as the North Atlantic Treaty Organization (NATO), equipped with multinational equipment, will have difficulties in functioning efficiently as a fighting force. This worry has prompted a very hard look by the President, Congress, and Department of Defense as to where the problems lie and what can be done to solve them, both now and in the future. In keeping with this initiative, strong emphasis has been placed on interoperability of US equipment with that of our allies. Following then, the five major priority areas for the establishment of interoperability have been identified as:

- Command, control, and communications (C^3).
- Aircraft servicing.
- Ammunition.
- Target acquisition and surveillance.
- Replacement parts.

The expression of these priorities in the order listed is common to the Joint Chiefs of Staff, NATO and the American, British, Canadian, and Australian (ABCA) nations.

In response to these priorities, US Army Development and Readiness Command Materiel (DARCOM) tasked subordinate commands to develop interoperability plans with specific responsibility for formulation of the ammunition plan being assigned to the US Army Armament Research and Development Command (ARRADCOM). For the purpose of this article only, artillery will be discussed

Artillery Ammunition Interoperability in NATO

by Dr. Eugene L. O'Brien

but similar steps are being taken for tank and mortar ammunition and, eventually, other systems. Almost concurrent with this tasking but independently, Commander in Chief, US Army Europe (CINCUSAREUR) requested authority to exchange ammunition for live fire training within NATO for the purpose of building troop confidence in the ammunition stockpiles of other nations. This request provided the impetus for the development of the Army Ammunition Interoperability Plan (AAIP).

In the initial phase, CINCUSAREUR contacted the commanders in each of the corps/armies within and adjacent to Central Army Group, Central Europe (CENTAG), paving the way for a team of engineers to be sent by ARRADCOM to review technical data packages, safety related incidents, and quality acceptance procedures (among other things) of each of the nations visited. The nations being approached by the US have since been expanded to cover all of NATO. Here, it should be noted that the artillery ammunition being considered for exchange firing was that which had been developed by the United States and was either produced in the US or by other nations according to our technical data package. Additionally, engineers sselected for the reviews were those who had been closely associated with the ammunition components throughout their life cycle which reduced the complexity of the effort considerably. Over a period of 18 months, 12 artillery agreements (figure 1) were signed with seven nations providing the safety certification allowing for exchange fire of the complete round combinations authorized in training exercises. Since the primary purpose of the exchange was to instill troop confidence in other national stockpiles, only the current high explosive (HE) loaded projectiles were reviewed.

Shortly after the approval of the AAIP in July 1979, an implementation meeting was called by Department of the Army. Attending were representatives from DARCOM, US Army Forces Command (FORSCOM), and US Army Training and Doctrine Command (TRADOC) and their subordinate commands. Since, from the beginning, the bottom line of the interoperability program was to get information to the troops, an initial program of troop familiarization was established in all possible phases of troop training both within and outside the continental United States. This has taken many forms. To date, firing tables for artillery have been updated to include data related to 155-mm, 175-mm, and 203-mm artillery that can be exchanged during training exercises or in combat. An example of the type information

Round Category	Germany	United Kingdom	Canada	Netherlands	Belgium	France	Norway
8-inch (203-mm)	Yes	Yes	NA	Yes	Yes	NA	NA
155-mm	Yes	Yes	Yes	Yes	Yes	Yes	Yes
175-mm	Yes	No	NA	*	NA	NA	NA

Legend:
Yes—Agreement to fire in training.
NA—Does not have the caliber.
NO—Not interoperable.
*—Does not train with caliber.

Figure 1. Interoperability matrix.

provided for the 155-mm weapons is contained in figure 2. In addition, technical bulletins describing the physical characteristics of the projectiles, propellant charges, the fuzes along with pictorial representations of the markings used, firing restrictions, firing table identification, and other pertinent facts have been published by US Army Armament Materiel Readiness Command (ARRCOM) for those components for which there is a training firing authorization. Information has also been incorporated into FM 6-40 and FM 6-50. In essence, all educational means to create an ammunition interoperability awareness by the artilleryman has or will be taken. The documentation is already being released to the troops and, if not already in hand, should be received in the near future.

The interest in interchangeability of ammunition in training has spread to NATO, and the scope of the program has been expanded. For example, in December 1979, Commander, Northern Army Group, Central Europe (COMNORTHAG), directed armies under that command to follow the CINCUSAREUR initiative and arrive at agreements between nations (Belgium, Germany, Netherlands, and United Kingdom) which would allow exchange firings. This action was expected to be completed in the spring of this year.

In April 1980, the Conference of National Armaments Directors indorsed the US sponsored NATO Ammunition Interchangeability Plan (NAIP) and recommended a NATO-wide effort be made to bring all NATO efforts into focus under the leadership of the Military Agency for Standardization.

Essentially, the NAIP was an adaptation of the US plan, but one significant addition was made — an in-depth look at what could be interchanged during combat throughout NATO. Here, it is important

Type	United States	Belgium	Canada	Denmark	France	Germany	Italy	Netherlands	Norway	Turkey	United Kingdom
High Explosive	M107 M3A1	M107 (Notes 1,2,3) M3	M107 M3A1	M107 M3A1	M107 (Notes 1,2,3) M3	DM21 (Notes 1,4) DM62	M107 M3A1	M107C1 M107B2 M107 (Notes 1,2) M3C1	NM28 M3	M107 M3A1	M107 M3A1
	M107 M4A2	M107 (Notes 1,2,3) M4A1	M107 M4A2	M107 M4A2	M107 (Notes 1,2,3) M4A1	DM21 (Notes 1,4) DM42B1	M107 M4A2	M107C1 M107B2 M107 (Notes 1,2) M4C3	NM28 NM23	M107 M4A2	M107 M4A2
White Phosphorous	M110 M3A1	M110 M3	M110 M3A1	M110 M3A1	M110 M3	M110 DM62	M110 M3A1	M110 M3C1	M110 M3	M110 M3A1	M110 M3A1
	M110 M4A2	M110 M4A1	M110 M4A2	M110 M4A2	M110 M4A1	M110 DM42B1	M110 M4A2	M110 M4C3	M110 NM23	M110 M4A2	M110 M4A2
Smoke	M116B1/E1 M116 M3A1	M116 M3	M116B1/E1 M116 M3A1	M116E1 M116 M3A1	M116 M3	DM25A1 DM52 DM62	M116 M3A1	M116C1 M3C1	M116 M3	M116 M3A1	
	M116B1/E1 M116 M4A2	M116 M3	M116B1/E1 M116 M4A2	M116E1 M116 M4A2	M116 M4A1	DM25A1 DM52 DM42B1	M116 M4A2	M116C1 M4C3	M116 NM23	M116 M4A2	
Illum	M485A1/E1 M485 M3A1	M485A2 M3	M485A2 M485A1 M3A1	M485A2 M3A1							M485A2 M3A1
	M485A1/E1 M485 M4A2	M485A2 M4A1	M485A2 M485A1 M4A2	M485A2 M4A2							M485A2 M4A2

NOTES: 1—Must use M82 primer.
2—TNT loaded projectiles only.
3—Only US manufactured M107 projectiles to be exchanged.
4—Velocity corrections should be applied.

Figure 2. 155-mm ammunition authorized for exchange in training and/or combat.

to note that interchangeability of ammunition during wartime has been authorized by a series of Standardization Agreements (STANAGs) for years; however, these have since been replaced by a single publication in NATO—Allied Ordnance Publication 6 (AOP-6)—which is a logistician type document portraying what ammunition is in the inventory of each country that may be exchanged. The publication deals with form fit, function, and safety; and, although it does not relate to accuracy, AOP-6 has proved to be a valuable publication.

Using the data in AOP-6 as a baseline, a concerted effort was made to obtain a qualitative update of the stocks of projectiles, propelling charges, fuzes, etc., in the stock of each NATO nation. A format which had been established previously for reporting the progress of firing table development within the US was used to construct matrices for all the nations. Logistical data was verified with each nation and, based on analogy to US data, matrices for each nation were constructed. After a number of iterations, fire control matrices were completed and published (in the US and NATO) which provided each nation the permissible combination of projectiles, propelling charges, and fuzes for a given weapon within their inventory which could be fired in combat. To this is added the firing control information (FCI) that is used by that nation, both manual and computer, together with the firing restrictions to be applied. For planning purposes, information was also acquired on ammunition either being considered or actually planned for stocks and firing trials planned for determining the interchangeability of new ammunition being developed by various nations. This data provides a base which is already being used for a number of purposes.

After all this work, how do we analyze what we have? What does it mean to the field artilleryman? Taking each caliber and referring to figure 3, let us look at where we are now and then look to the future.

With the exception of United Kingdom weapons — the L118 (light gun) and FV433 (Abbott) which use separate loading ammunition — all 105-mm weapons fire the M1 cartridge family of ammunition (M1, M314 Series III, M24 Series HC, and M60 Series WP). In some cases, stocks will have unfamiliar fuze nomenclatures related to either old US lots (e.g., M51A5 PD) or foreign manufacture (e.g., French MLE 56 PD). Also, there are some British-made rounds related to the L5 Pack Howitzer. With some exceptions, US firing tables are used, and it is reasonable to say that, except as noted, there are no serious deterrents to interoperability other than creating an awareness among the troops as to what exists. There are presently no new developments in 105-mm ammunition, even though this caliber is likely to remain with some armies for a long time.

The 155-mm is by agreement the NATO caliber since the bulk of all NATO artillery is 155-mm. With the exception of some M1 guns that still remain, the current NATO weapons for the most part are M114 or M109 series made by the US, and in some cases modified by other nations. The M114/M114A1/M44, the M109/M109G, and the M109A1/A2/A3 form ballistic groupings and use US firing tables. All fire

Type	United States	Belgium	Canada	Denmark	France	Germany	Italy	Netherlands	Norway	Turkey	United Kingdom
105-mm towed	M101A1 M102	M2A1	M101A1 C1 L5	M101A1	M101A1 MOD1950		M101A1 MOD 56		M101A1 M101	M101A1	L118 L119
105-mm SP		M108			OB105/50 AU		M7			M7	FV433
155-mm towed	M114A1 M114A2 M198			M114 M1 (Gun)	BF 50	FH70 (L121)	FH70 (L121) M114 M114A1	M114 M114A1	M114	M114 M114A1	L121
155-mm SP	M109S A1/A2/A3 Zone 8	M109 M44	M109A1	M109	F3 AU F1 (GCT)	M109G	M109G M109S	M109A1/A2/ A3 Zone 8	M109G	M44	M109A1
8-inch SP	M110 M110A2	M110				M110		M110			M110
8-inch towed		M115		M115			M115			M115	
175-mm SP	M107						M107	M107		M107	M107(UK)

Figure 3. NATO artillery (March 1980).

the M107 family of ammunition (M107, M116, M110, M485, or M118 series) and can use M3 and M4 type charges and fuzes which are familiar to the US artilleryman.

Considering those weapons just mentioned and adding to that list the French BF50 howitzer and F3 gun, interoperability stands as follows: Most all NATO projectiles for these weapons are in the M107 family, and the only difference is in nomenclature as illustrated in figure 2. Although the shells and markings are colored the same and sequence of marking is the same, there is one major difference. The French fire the M107 family of projectiles in their weapons but they also fire their own projectiles — the OE 56/69 family. Other nations outside of NATO fire French projectiles in US-made weapons but safety certification does not exist for our use.

As for propelling charges, two differences are noted. First, the French have their own charges which can be used interchangeably with our projectiles by varying the firing tables. (The lack of safety certification of projectiles/charges prohibits the firing of French ammunition by US forces.) Second, due to a design variation in the use of propellant ingredients, the German charges give ballistic differences which require that a muzzle velocity correction be applied when using US firing tables. This, however, poses no serious problem and is so noted in the new changes to manual firing tables (figure 2) and in TACFIRE software.

A simple case cannot be made for fuzes. The most commonly used fuzes in NATO at the present time are the point-detonating M557 and the mechanical time superquick M500, M501A1, and M564 fuzes or equivalents. Additionally, there are old US-made fuzes in some national inventories that no longer meet US criteria of independent dual safety which, in some cases, might have to be used if there were no other alternative. Also, there are some foreign designed fuzes which our forces are not familiar with and therefore require setting training prior to their use.

Last, but not least, are primers of which there are three basic ones in NATO:

•MK2A4—used in most towed howitzers and in the UK M110 SP.

•M82—used in the M109 SP series.

•DM191A1—used in the M109G and FH70.

Interchangeability between the MK2A4 primers and other is not possible. Use of the DM191A1 in other M109 weapons is not possible, while use of the M82 in the M109G is possible, but not advisable. Simply described, the DM191A1 is significantly less sensitive then the M82 and requires a heavier firing spring to initiate; a spring of sufficient strength is available on the M109G and FH70, but not on the M109A1/A2/A3. There is also a problem of compatibility of the German primer with our initiating system. Conversely, the M82 primer contains black powder which fouls the obturating ring on the slide block of the M109G, thus requiring frequent cleaning. The solution? Carry your own primers! Unfortunately, there is no simple answer to this problem but, with the probable conversion of the M109G to the M109A3, it is possible that the slide block might be discarded, which would *alleviate* the problem. The problem will not *disappear,* however, because the new French and trilateral howitzers use the M191A1 primer.

But what about the newer 155-mm weapons now coming in service—the French AUF1 (GCT-AMX), the German/Italian/United Kingdom FH70 (L121), and the US M198? With respect to the old ammunition there is no problem, although the full range capabilities of the weapons cannot be realized. Each of these new weapon systems brings with it a new family of projectiles which will provide cargo capability, greater ranges, and/or increased lethality. Even though problems do exist, developing nations over a period of time have minimized or avoided them completely. The new ammunition nomenclatures, which have already begun to enter the national stocks, are shown in figure 4.

Exchange firings for safety certification in many cases have been conducted between nations, and others are still planned. For example, the new French combustible charge is electrically ignited and cannot be fired by percussion primers and therefore cannot be fired from other NATO weapons. Conversely, however, the French can convert

Type	Projectile	Propelling charges
M109A1/A2 /A3 (US)	M483A1 M692E1/M731 M718/M741 M549A1	M119A1
M198 (US)	M795, HE XM825, BE, SMK M712, Copperhead*	M203**
AUF1 (GCT/AMX) (FR)	OE, F1, HE OFUM, F2 WP	GCT cartridge
L121 (FH70) GE/IT/UK	L15A1, HE DM105, SMK DM106, I11	L2A1 (cartridge 1) L8A1 (cartridge 2) XL
M109G (BE)	DM 35 SMK, HC DM 45 SMK, HC DM 26 I11	DM52

*Copperhead restricted to Z7 M4A2 in M109A1 or Z8 M119A2 in M109A2/A3 and M198.

**Use restricted to M198.

Figure 4. New ammunition for NATO weapons.

to a percussion system and can accommodate NATO ammunition with some restrictions.

Now what about old weapons and new ammunition where problems now arise with the M44 SP and M114/M114A1 howitzers? The Belgian Army will phase out the M44, but a substantial number of the latter will remain; in fact several still remain in the US Army Reserve and National Guard. These weapons cannot fire the newer class of projectiles because of flight instability problems intrinsic in the tube rifling design, nor can they accommodate the newer charges because of limited chamber volume. A solution for the projectile problem is simple, the M114A2. There are also fire restrictions with the M549A1 and Copperhead, but they can be fired as can the M483A1 family. This weapon has been type classified and produced in limited quantities by the US. The charge problem does not have a simple solution and therefore a range benefit above 14.6 kilometers using M4A2 Zone 7 can only be obtained in the M114A2 with rocket assist (18 kilometers).

The M109/M109G has the same firing tables as the M114A2 and can fire the newer projectiles, but again only with the older charges. This capability will be increased with the planned upgrading to the M109A3 SP howitzer.

Maximum ranges, unassisted, of up to 18 kilometers can be realized with the M109A1/A2/A3. Additionally, new production M109A2 models and product improvements of the M109A1 to M109A3 will provide NATO with range improvements with Copperhead. An availability problem with the M203 in the A2/A3 models has resulted in a decision not to authorize firings and therefore the maximum unassisted range at 24 kilometers cannot be realized. Two new charges specific to the M109G and M109A1/A2/A3—the DM52(GE) and L6A1(UK) respectively—have appeared in other nations which will provide ranges equivalent to the M119A2.

Eight countries in NATO have 203-mm (8-inch) howitzers. All nations that have M110 models are expected to upgrade these to M110A2 in the near future, thus providing a broader selection of projectiles and greater range. However, nothing simple can be done to utilize the newly developed ammunition in the M115 towed weapon. (Future development and production of 203-mm artillery ammunition is expected to occur only in the US and therefore there are no ammunition interchangeability problems, except as noted for the M115 Howitzer.)

While some countries will soon phase out the 175-mm gun and convert them to M110A2 howitzers, some will remain in use. (Italy, Turkey, and Greece in particular have large numbers of the M107 gun.) During the interoperability review of this caliber, it was found that the UK had modified the M107 gun with a rammer and the projectile with a modification to the rotating band. As a result, interchangeability firings in training was not authorized (figure 1). Since the UK will convert their M107 guns into M110A2 howitzers, this is not a concern.

The conclusion, based on the foregoing, is that interoperability of artillery ammunition currently does exist between the NATO armies, although it is obvious that some problems do exist. There are some technical improvements that can be made to current weapons to more effectively use the capabilities being provided by new ammunition developments while other problems will disappear with equipment replacement. Training to familiarize NATO armies with the ammunition of other nations is gaining momentum which will overcome the central concern of getting information to the troops.

What about the new weapons already on the horizon? For example, the French "TRACTE" (TR) and the trilateral SP-70 (both of which will enter the inventory in the next five years) are not expected to have ammunition interoperability problems. Here, considerable effort has been made to insure that information regarding new developments will be introduced into a multinational forum early in the development. It is anticipated that agreements such as those affecting test and design principles will be adopted by NATO in the near future, thus insuring that artillery ammunition designed and tested by one nation will be acceptable to another. It is also expected that agreement will be reached regarding the design of future ammunition to be used in weapons currently in inventory. (There is already a NATO counterpart to the US Materiel Acquisition Guideline). Even the formulation of an agreement or a common Mission Element Need Statement (MENS) for the future NATO self-propelled howitzer is not beyond question; in fact, it has already been proposed that the US Enhanced Self-Propelled Artillery Weapons System (ESPAWS) be considered as the model on which to base the MENS for the NATO howitzer of the year 2000.

In summary, much has been accomplished in achieving ammunition interoperability in a short period of time, but there is considerably more to do. Pursuance of the ammunition interoperability goal has a major payoff in the effectiveness of NATO and, as such, will remain a worthwhile endeavor.

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Greek Fire

The Best Kept Secret of the Ancient World

by 1LT Richard Groller

It has been said that military secrets are the most fleeting of them all; yet, there was one which was so well kept that it was lost to antiquity. This is the secret of the composition of "Greek fire," the wonder weapon of the ancient world. Still somewhat of a mystery today numerous theories have been proposed to explain the enigma and the one advanced here seems to me to be the most plausible.

The first known use of Greek fire is recorded in Byzantine chronicles as having occurred at the end of the 7th century A.D. Theophanes (811-815 A.D.) in his Chronography tells of this event during the seven-year seige of Constantinople. There, emperor Konstantinos IV (Pogonatos) who reigned from 668-685 A.D. led the Roman forces against the Arabs led by Yazid, son of the Khalif of Syria. According to his account (and according to legends) an architect named Kallinikos (who undoubtedly was also a chemist) invented "Greek fire" and instructed the Romans on how to use it to do battle against the superior fleet of the Arabians. The battle which took place, circa 671 A.D., found the small Roman fleet greatly outnumbered by the forces of the Khalif. The Romans, however, now had a new wonder weapon to use and equipped their ships with "siphones" (tubes through which the liquid fire was projected) before going into battle. The results were devastating, as Greek fire enveloped not only the Arab fleet but also the surrounding water. The Arabs found

Hephaestus, Greek God of fire.

Greek fire to be inextinguishable, except by sand or vinegar or an amount of sand treated with vinegar, and as a result their fleet was destroyed.

Konstantinos VII (Porphyrogennitos) says that Kallinikos, who fled from the town of Heliopolis to the Romans, invented the art of projecting liquid fire through siphons but seemed to imply that he was not the inventor but one who found a better way of using it in war.[1] He attributed the origin of Greek fire to Constantine the Great, saying

[1]Partington, James R., A History of Greek Fire and Gunpowder (M.B.E., D.Sc.) copyright 1960 by W. Heffer and Sons, Ltd., Cambridge England, page 14.

that its secret had been given him by an angel and that "those imparting it (the secret) were anathema and one about to communicate it had been struck by lightning."[2] Because of the angelic nature of Greek fire, the earliest chemists called their science "the divine art."[3] The name "siphon" was used for "the double-action force-pump or fire engine invented by Ktesibios and improved by Heron. In Hesychois, the word "siphon" means a water-pump for extinguishing incendiaries (also means a bent tube for transferring liquids and a pipe through which water is forced like a fountain)."[4]

No doubt, on ships, the "pump" was connected to a metal pipe from which the Greek fire was projected by some flexible tube through which liquid was poured from earthenware pots. On land, a small hand siphon was created to project Greek fire and has been described by a Spanish Muslim physician in his book on surgery (1013 A.D.) as a cylindrical syringe with a piston. The siphon used aboard ship, however, was made of wood with an internal casting of bronze. It was mounted on a false floor above the deck of the ship and could be aimed left, right, or upward so that the liquid fire could be either thrown on enemy ships or in the faces of attacking troops. The *Byzantine Cheland,* a light vessel with a crew of 120 to 160, was fitted with tubes for the launching of Greek fire. "Each of the Byzantine galleys was fitted in the prow with a tube ending with the head of a lion or other beast (often a dragon) made of brass or iron, and gilded, frightful to behold, through the open mouth of which fire could be projected by the soldiers through a flexible apparatus."[5]

Greek fire was used to repel the invasion of Constantinople by Igor the Russian in 941 A.D. In this battle, a Russian flotilla of several thousand ships was defeated by 15 semifracta chelandria (chelands) which threw liquid fire on all sides, from the prow, the stern, etc. and the Russians, rather than burn, threw themselves into the water; those weighed down by armor were drowned, and those who were able to swim died a fiery death. Greek fire was also used in the seige of Durazzo in 1108, when the Normans under Bohemond had mined the walls, and the Byzantines had countermined, igniting it when they reached the sap. As Anna Komnena, the daughter of Emperor Alexios I Komnenos, described: "A battle between the Greeks and Pisans near the island of Rhodes in 1103 . . . the enemy ship was rammed in the stern and the fire pumped over it. The Pisans fled, having no previous experience of this device and wondering that fire, usually which burns upwards, could be so directed downward or towards either side according to the will of the engineer who discharges it."[6] In Anna Komnena's time, Greek fire was considered a state secret. The Emperor, who lent troops and liquid fire to his allies, reserved for himself its secret and sent it to them ready-made. Anna gives the composition of the incendiary material as follows: "This fire they made by the following arts. From the pine and certain evergreen trees, inflammable resin is collected. This is rubbed with sulphur and put into tubes of reed, and is blown by men using it with violent and continuous breath. Then in this manner it meets the fire on the tip and catches light and falls like a firey whirlwind on the faces of the enemy."[7]

In the meantime, the Saracens, who had been so surprised and horribly beaten because of the Greek wonder weapon during their seige of Constantinople, had become thoroughly familiar with Greek fire and used it against the Crusaders in Syria and Egypt. The Greek fire was used by special "naphtha troops" attached to each corps of archers in the Muslim army, who wore fireproof suits and threw the incendiary material. Army engineers had charge of catapults, mangonels and battering-rams. One engineer, Ibn-Sabir Al-Manjaniqi, left an unfinished book on the art of warfare showing that the Arabs were very well acquainted with petroleum.

In seige war, the method of attack consisted of filling up the ditch or moat surrounding a fortress with stones thrown by ballistae and then rolling forard a high wooden tower, close to the walls. At the top of the tower was a hinged drawbridge, which was lowered on to the rampart and across this stormed the Crusaders, concealed in the tower, ready to do hand-to-hand combat. This method was used by the Normans under Robert Guiscard in attacking the Byzantine army under Palaeologos at Dyrrachium in 1082 A.D.

> "The Norman tower, built from the wood of ships which had been put out of action by the Venetians, had inside a broad staircase and 500 troops in complete armour. During the building of the tower, the besieged had built on the ramparts a slender framework of masts and yards which excited

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[2]Ibid., page 21.
[3]Ibid., page 14.
[4]Ibid., pages 15-16.
[5]Ibid., page 19
[6]Ibid.
[7]Ibid.

the contempt of the Normans. The immense tower was pushed forward on an inclined plane and wooden tramway up to the wall. The framework on the wall descended and wedged the drawbridge firmly against the structure, closing the tower as by a door. At the same instant an immense quantity of incendiary material was poured and projected from the walls over the wooden tower, which was quickly enveloped in flames and smoke. As the tower, with its contents, collapsed, a sortie was made and the work of destruction completed."[8]

The famous seige of Acre in the Third Crusade (1190-91) is described by Ibn Al-Alathu as follows:

"The man from Damascus in order to deceive the Christians, first threw pots with naphtha and other things, not kindled, against one of the towers which produced no effect. The Christians, full of confidence, climbed triumphantly to the highest stage of the tower. The man from Damascus, waiting until the contents of the pots had soaked into the tower, at the right moment threw on to it a well burning pot. At once fire broke out over the whole of the tower and it was destroyed. The fire was so quick that the Christians had no time to climb down and they and their weapons were consumed. The other two towers were similarly destroyed."[9]

Greek fire was used during the Third Crusade against the Venetians at Constantinople, during the Fifth Cruasade during the seige of Damietta (1208), and against the French forces of King Louis IX (Saint Louis) during the siege of Mansure in the Nile Delta in 1249. Greek fire was also used, along with gunpowder and cannon, in the siege of Constantinople in 1453, when the Turks used a heavy gun (over three feet caliber) throwing stone balls weighing 600 pounds. A Turkish siege tower, according to Phrantzes and Doukas, protected by a triple covering of buffalo hides, was burnt down by Greek fire during the siege, but Constantinople fell and so did the Byzantine Empire.

The exact composition of Greek fire remains unknown to this day. Before its first use in the seventh century, other incendiary materials were used in warfare and often have been confused with or taken for Greek fire. Among these are:

•Liquid petroleum or naphtha, from oil wells in Iraq (Hit) or Kerkut (across the Tigris, in ancient Assyria), probably used together with burning pitch and sulphur by the ancient Assyrians. In Greek and later times the petroleum wells in Armemis and the shores of the Caspian Sea were also available.

•Liquid pitch, used by the Greeks from about 430 B.C. in fire-cauldrons, fire-ships, etc., and on incendiary arrows.

•Mixtures of pitch, resin, and sulphur, used by the Greeks from 424 B.C.

•A mixture of quicklime and sulphur, inflaming on contact with water (186 B.C.)

•A mixture of quicklime and sulphur with other inflammable materials such as bitumen, resin, naphtha, etc., inflaming on contact with water, mentioned in an interpolation (sixth century A.D.) in the *Kestoi* of Julius Agricanus.

J. R. Partington's central thesis concerning Greek fire (in

[8]Ibid., page 24.
[9]Ibid., pages 24-25.

his book *A History of Greek Fire and Gunpowder* is that the main ingredient was distilled petroleum since Greek fire is always described as a liquid or semiliquid. The liquid fire was also called incendiary oil. "Romocki had realized that petrol would be a very effective incendiary if projected by pumps and, since Julius Africanus had spoken of 'natural petroleum,' there must have been an artificial (distilled) kind, but he thought it was probably mixed with solid materials. The recipe given by Anna Comnena shows that the solids were pine resin and sulphur, but the essential ingredient, petrol, she deliberately omits."[10] Quicklime would not be a suitable material and is never mentioned as a component of Greek fire. Petrol, obtained by distillation, could be projected burning, or sprayed and then lighted by an incendiary arrow. It would float, still burning, on water. Both the effective range of projection and the stability of the flame would be increased by thickening the liquid, "even but not necessarily to the extent of producing a paste by dissolving in it resins or solid combustibles."[11]

In short, all the properties and effects of Greek fire and all fire and all descriptions of the methods of making and using it, agree with Partington's thesis: "Distillation is described by the Spanish-Arabic physician Abu'-1-Qasim (Abulcasis)(A.D. 1013 and 1107), and it could easily have been adapted to making petrol. Before this, knowledge of distillation had passed from Egypt to Syria and might have been known there to Kallinikos; it was already known in Constantinople. It seems probable that the process was used in Constantinople to make the essential constituent of the new invention."[12]

It is very probable then, that the basis of the earliest Greek fire was liquid rectified petroleum or volatile petrol. Petrol itself would not be very effective in flame-projectors since the projected jet dissipates too rapidly. But thickened almost to a jelly by dissolving in it resinous substances and/or sulphur the particular admixture, coupled with the mechanical means of projecting it, together constituted a great achievement of chemical engineering.

Oman, in an attempt to piece together the motley of the Byzantine writers, concluded that Greek fire was a "semiliquid substance, composed of sulphur, pitch, dissolved nitre (saltpeter) and petroleum boiled together and mixed with certain less important and more obscure substances."[13] If the saltpeter is omitted, this is not a bad description of Greek fire.

Conclusion

History, then, may regard the mystery of Greek fire from a variety of viewpoints. The general historian may view it as an invention affecting the very existence of nations or groups of nations. The historian of science may view it purely as a trivia of antiquity, an invention with little import today except as a footnote. The historian of technology may view it in the light of its application and the devices invented to help it produce a needed effect. Finally, the military historian may view it an explosive and propellant, an artillery weapon used for defense and offense which, through careful security and effective protection from enemy intelligence, faded into the mists of time and remains the subject of conjecture and wonder today.

1LT Richard Groller is a military Intelligence Reserve Officer currently assigned as Chief, Advanced Electronic Maintenance Division, Directorate of Training and Doctrine, US Army Intelligence School, Fort Devens, MA.

[10] Ibid., pages 29-30.
[11] Ibid., page 30.
[12] Ibid., page 31.
[13] Ibid., page 32.

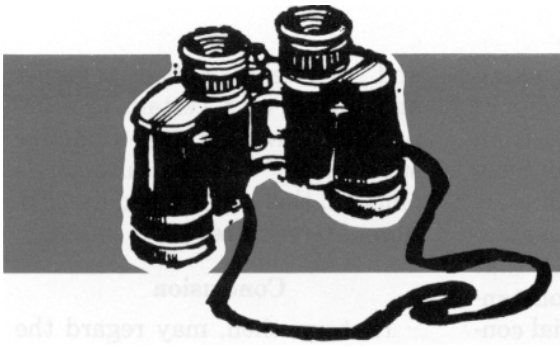
Reunions

144th Infantry Regiment (originally the 4th Texas Volunteer Guard — Annual reunion on 26-28 June 1981 in Dallas, TX. For more information, contact C. A. Austin (Secretary), 108 SE Tarrant, Burleson, TX 76028.

Texas 36th Infantry Division (T Patchers) — Fifty-sixth annual reunion and convention on 3-6 September 1981 in San Antonio, TX. All former members welcome. For more information, contact Leonard E. Wilkerson, 11121 Visalia Drive, Dallas, TX 75228. Please enclose a stamped self-addressed envelope.

255th Field Artillery Battalion — World War II members reunion on 5-6 September 1981 in Evansville, IN. Contact Marvin M. George, 44 N. Jackson Avenue, Apartment E2, San Jose, CA 95116.

Headquarters and Headquarters Battery, 8th Infantry Division Artillery — World War II veterans will meet 25-27 September 1981 at the Holiday Inn (downtown), P.O. Box 1856, 6th Avenue and Ocean Boulevard, Myrtle Beach, SC 29577. For information, contact james C. Woolley, 1011 Cliff Place, Baltimore, MD 21226.



View From The Blockhouse

notes from the school

NATO Artillery Working party

The 11th meeting of the North Atlantic Treaty Organization (NATO) Artillery Working party was held at Headquarters NATO during the week of 9-13 March. The US Army Field Artillery School, as the US Army Training and Doctrine Command proponent and Department of the Army action agency, provided US representation. Pending publication and receipt of the final formal report, the following information concerning the meeting is provided:

•The US delegation included an "On-the-ground" observer from Headquarters, V Corps. His purpose was to evaluate the degree of implementation of ratified Standardization Agreements (STANAGs) amongst US forces while operating in multinational exercises.

•STANAG 2932, "Artillery Procedures for the Use of Laser Range Finders": Between sessions (10th and 11th meetings) nations had generated considerable additional comments which will now be addressed by the United Kingdom as Custodian Nation, in a first draft.

•STANAG 2934, "Allied Artillery Procedures Publication": This publication, previously agreed on as an action at the 10th Meeting, will have 13 chapters and will include those STANAGs most often used or needed for interoperability in multinational exercises.

•Canada proposed and accepted custodianship of a study on "Coordination of Field Artillery Delivered Scatterable Mines." All member nations will become correspondents to this study.

•The US continued its initiative for expansion of STANAG 2099, "Fire coordination in Support of Land Forces," to include the major fire support coordination measures presently used by US forces.

•Field Artillery terms and definitions that had previously been considered for addition/change/deletion in the NATO Glossary (AAP-6) at the 8th, 9th, and 10th meetings, were to a great extent successfully resolved by the NATO Terminology Coordinator.

•The 12th meeting of the NATO Artillery Working Party is tentatively scheduled for 24-28 May 1982 at NATO Headquarters.

Mr. B. M. Berkowick, the USAFAS International Standardization Coordinator, coordinates the US Field Artillery input for NATO, America, Britain, Canada, and Australia for continuity. Any questions may be addressed to Commandant, USAFAS, ATTN: ATSF-CD-S, Fort Sill, OK 73503; AUTOVON 639-2900.

Field Artillery Branch Training Team

The Field Artillery Community has always recognized the requirement to maintain a close and continuous liaison with units in the field. Here active two-way communication is needed for the field to receive necessary support and for the Field Artillery School to obtain feedback vital to the validation, review, and modification of School products. The Field Artillery Branch Training Team (FABTT) is a major participant in this effort.

The FABTT, headed by the Director of Directorate of Evaluation and Standardization, is composed of members from School departments or directorates as appropriate. The team is tailored for each visit depending primarily on the type of unit to be visited, special areas of interest, and resources available. These visits are *not* inspections and no reports are sent through command channels. Some of the subjects discussed are artillery trainers (ADFT and M31), AR 385-63, FA School products, supply and maintenance procedures, FIST weapons, training, equipment and manning, Battalion Training Management System (BTMS), Army Training and Evaluation Programs (ARTEPs), Soldier's Manuals (SMs), Job Books, Training Extension Courses (TECs), and the status of Field Artillery equipment. The team also evaluates the impact on training of the shortage of middle level management (E5s, E6s, and captains), excessive distractions (post details, etc.) and shortage or lack of necessary equipment. Comments from all levels of command are solicited on the adequacy of FA School products and artillery training at Fort Sill to include training literature, courses, and exported aids.

The team also seeks comments from graduate artillerymen on how well they were prepared to meet the challenge of the field and to determine how confident they are in doing their job and advancing in their military occupational specialty (MOS). Here, most seem to agree that all courses should be extended to include more hands-on training, the amount of self-paced instruction be reduced, the group-paced lock-step method of instruction be used, FADAC training be incorporated into the 13E program of instruction, and more time devoted to maintenance. All comments are brought back to the School where they are reviewed and considered for action. The Assistant Commandant directs specific tasks to be accomplished and, if a recommendation is appropriate but cannot be effected due to resources, physical restrictions, or time available, it is held in abeyance until it can be effected. The US Army Training and Doctrine Command plans to periodically publish "Lessons Learned" with general comments pertaining to training problems in the field.

The FABTT has the mission of visiting active duty units worldwide as well as National Guard and Reserve Units. If possible, these visits are scheduled to coincide with an US Army Forces Command's Logistics Assistance and Assessment Team (LAAT) or Training Assistance and Assessment Team (TAAT) visit so that the unit will be distracted as little as possible. The FABTT requires no demonstrations, layouts, or drills. When a consolidated visit cannot be scheduled, direct coordination with the unit is effected and the unit selects a time which best fits their training schedule and the team then coordinates the visit with TRADOC and FORSCOM. The FABTT also provides follow-up assistance to the field if special help is required in either training or equipment readiness.

Training and combat readiness is an important element in the Field Artillery mission. The FABTT and Field Artillery School stand ready to assist the field in every way possible to insure that this mission is accomplished as effectively and efficiently as possible.

COUNTERFIRE SYSTEMS REVIEW

Sound ranging set AN/TNS-10

In October 1978, a field fix on the recorder RO-481/TNS-10 was sent to all units in the field to prevent damage to the converter-driver card in the recorder RO-481 TNS-10.

It was recently discovered that this field fix has not been applied to all AN/TNS-10s in use. Units should check their sets to insure that this modification has been applied. For further information, contact Mr. E. L. Lacy at AUTOVON 639-2408 (commercial 1-405-351-2408) for details or write:

Commandant
US Army Field Artillery School
ATTN: ATSF-CF-R
Fort Sill, OK 73503

Correction — Hand-held calculator applications in radar operations

The formula on page 17, top right-hand column, in the March-April 1981 *Journal* is incorrect. The "—Y" should not be included within the square root symbol. The formula should read as follows:

$$Z = \sqrt{Y^2 + \frac{Hl - Hw}{4.903 \times (Dt)^2}} - Y$$

$$\text{For } Dt = 0\text{: } Z = \frac{Hl - Hw}{Hu - Hl}$$

New Field Artillery Surveyor Course begins

An expanded Field Artillery Surveyor's Course designed to better train 82C10s began on 5 January this year during the first week of the One Station Unit Training (OSUT) program. The major improvement to the course is the requirement for all students to learn manual computations for all types of field artillery survey functions. Additionally, several astronomic subjects have been re-introduced to the 82C program of instruction after many years absence. After demonstrating proficiency in manual computations, all students will then learn all survey computations using the TI-59 hand-held calculator and associated forms. Hands-on training in the field will be accomplished by a two-day mid-course field training exercise (FTX) and a four-day end-of-course FTX. Students will also be familiarized with the Position and Azimuth Detrmining System (PADS).

A "course map" listing all subjects taught as well as method of instruction, hands-on practice, and method of testing has been prepared and will be mailed in five copies to each division artillery commander, both Active and Reserve. Others desiring information on the method of training for the 82C10 should call Major Rogers or MSG Lugo at AUTOVON 639-2805/6616 (commercial at 1-405-351-2805) or write to:

Commandant
US Army Field Artillery School
ATTN: ATSF-CF-SV
Fort Sill, OK 73503

Input to CFD systems review

To assist the weapons support radar repairer (MOS 26B) in his field tasks and training, a new educational television (ETV) program series is being produced and distributed through the Training and Audiovisual Support Center (TASC) at Fort Sill. Filming of this 18-program ETV series covering organizational, direct support, and general support maintenance on the AN/MPQ-4A radar system has recently been completed and the first five programs (listed below) are ready for worldwide International Logistics Center distribution.

221-061-0824-B: ORGANIZATIONAL CORRECTIVE MAINTENANCE ON THE POWER SUPPLIES OF THE AN/MPQ-4A RADAR (14:30) — covers organizational level maintenance for system low voltage power supplies.

221-061-0825-B: DS/GS CORRECTIVE MAINTENANCE OF THE POWER SUPPLY PP-1588, AN/MPQ-4A (12:26)—covers corrective maintenance of the PP-1588 power supply.

221-061-0827-B: COMPONENTS AND ADJUSTMENTS OF THE TRANSMITTING SYSTEM OF THE AN/MPQ-4A (9:16)—presents an explanation of the transmitting system circuits and adjustments on thyraton switches K1101, K1102, and K1103.

221-061-0830-B: TROUBLESHOOTING THE AN/MPQ-4A RECEIVING SYSTEM, PART 1, AFC SYSTEM (14:58)—covers organizational, direct support, and general support level troubleshooting and repair of the AFC receiving assembly.

221-061-0829-B: ORGANIZATIONAL CORRECTIVE MAINTENANCE ON THE DEHYDRATOR SYSTEM OF THE AN/MPQ-4A RADAR (13:42) — covers all organizational level maintenance tasks on the radio frequency dehydrator system.

For additional information of the ETV programs available from Fort Sill, call TASC at AUTOVON 639-4294/6901 (commercial) 1-405-351-4294/6901. A blank TV tape is required for each program requested.

Commanders Update

BG Donald Eckelbarger
Assistant Commandant,
United States Field Artillery School

COL Ross W. Crossley
5th Infantry Division

LTC Fletcher M. Lampkin
2d Battalion, 5th Field Artillery

LTC Oscar E. Holleque
6th Battalion, 9th Field Artillery

LTC Kenneth Wall
1st Battalion, 10th Field Artillery

LTC Richard E. Bailey
6th Battalion, 10th Field Artillery

LTC John R. Cary
2d Battalion, 17th Field Artillery

LTC John A. Dubia
1st Battalion, 22d Field Artillery

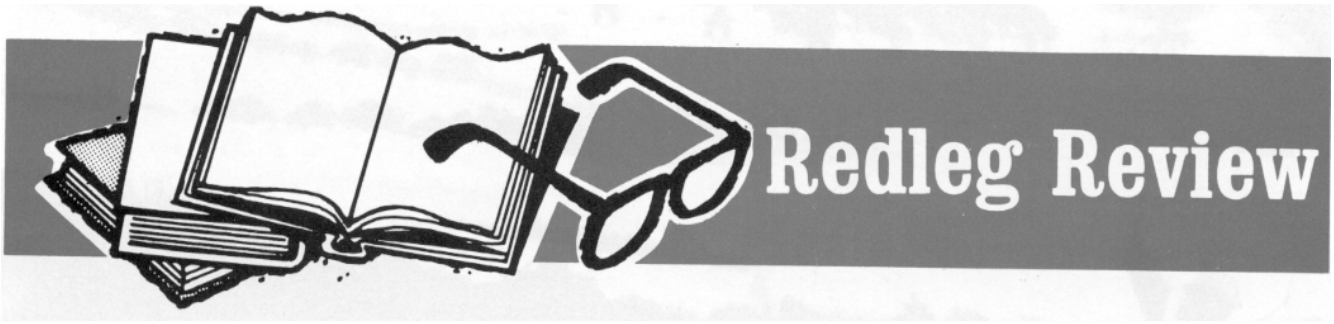
LTC Richard Swain
2d Battalion, 28th Field Artillery

LTC Washington Sanchez
2d Battalion, 33rd Field Artillery

LTC Tommy R. Franks
2d Battalion, 78th Field Artillery

LTC Harry R. Yarger
1st Battalion, 133rd Field Artillery

LTC Brion V. Chabot
Officer Student Battalion
Fort Sill, OK



ON THE ANALYSIS OF GROUND COMBAT, by Roland V. Tiede, Military Affairs/Aerospace Publishing, Kansas State University, Manhattan, KS, 1978, 280 pages, price unknown.

From the vantage point of being a retired Army colonel, Mr. Tiede states that since operations research techniques were first applied to military operations, communication between the experienced practitioners of the world's second oldest profession and the inexperienced newcomer is not always clear and intelligible. Therefore, his book was conceived as an endeavor to ease this problem. The book is intended to serve as a primer for the inexperienced analyst who has completed his technical education and is trying to apply his knowledge to the problems faced in modern land combat. It describes the rudiments of tactics in land combat (to include air-ground interaction) in a manner which permits the analyst to use his special skills and insights to grasp the essentials without having to wade through volumes of texts for the military professional.

Further, the author states the book may seem unduly weighted toward the systems that support and implement military decision making. However, such emphasis is necessary because it is at these levels that the objectives of war are as important as the tools and techniques. Decision making is far more complex than a reflex response to the enemy's or one's own national initiatives and too often has been an area neglected by the military analyst.

Throughout the book, the author has endeavored to concentrate on problem definitions and quantitative approaches to their solutions for the modern, complex battlefield. The author discusses functions of ground combat, firepower, management, structure of the battlefield, military modeling, and mission performance and combat effectiveness measures. The book is an ideal means to quickly orient the young officer or a civilian who has little training and experience as a professional millitary man but who has been trained as an operations research analyst (ORSA). With the insights provided by the book, the new military analyst can quickly adapt to his new ORSA duties.

COL (Ret) Robert S. Riley is a Department of the Army civilian assigned to the Directorate of Combat Developments, USAFAS.

THE THIRD WORLD WAR, AUGUST 1985, by General Sir John Hackett et al, MacMillan Publishing Company, Inc., New York, 1978, 360 pages, $12.95.

General Hackett and other senior NATO officers have collaborated to write a fictitious post-hostilities account of World War III.

The opening half of the book, reading like a scenario from a senior service college tactics class, seems plausible as it delivers a powerful message of what might happen if the signs of a weakened military posture are not heeded. The second half, however, takes on the character of a typical western as the "cavalry" mobilizes, reinforces, and arrives in the nick-of-time to assist the allies in stopping and counterattacking against the Soviet juggernaut despite impossible odds.

The authors' treatment of nuclear warfare is interesting; the Russians employ first-use for the same reason the allies have considered it for the past several years. And, because the book is written as a historical document *ex post facto*, it will be intresting to see whether the authors' comments on third world countries materialize as projected.

The book affords the reader an opportunity to peer onto the devastating battlefield of the future while thinking about chances for survival if some drastic changes in our military are not forthcoming in the first half of the 1980s.

MAJ David E. B. Husing (USAR) is Adjutant of the 1174th Transportation Terminal B, Fort Totten USAR Center, Fort Totten, NY.

MILITARY AIRCRAFT OF THE WORLD, by John W. Taylor and Gordon Swanborough, Charles Scribner's Sons, NY, 1979, 224 pages, $12.95.

Military Aircraft of the World offers a compact guide to all combat and support aircraft now flying throughout the world. This handy reference is divided into two sections, one for "first-line" aircraft and a second for less important or older types. For each first-line aircraft a single page is provided containing a photograph, a three-view silhouette, technical data, and a paragraph of interesting facts and historical information.

There is a chance that informed readers may have some difficulty with the introduction in which the author states that Harriers outfought F-14 Tomcats in simulated combat trials. Since entirely different tactics must be employed to exploit the characteristics of these two aircraft, results of these trials may be somewhat misleading in that the F-14's were required to play the Harrier's game. The statement might be correct but too much is omitted in the telling. Nonetheless, the book is well arranged, highly informative, and an easy-to-use reference well worth its price.

COL Warren E. Norman is the Senior US Air Force Representative at Fort Sill.

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