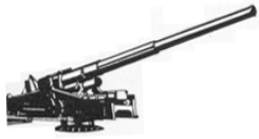
ARTILLERY TRENDS



DECEMBER

1959

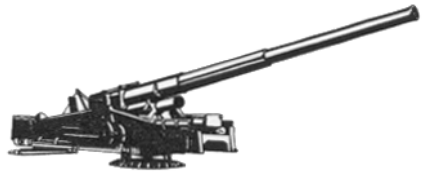
U S ARMY ARTILLERY AND
MISSILE SCHOOL

ARTILLERY TRENDS

CONTENTS PAGE

INSTRUCTIONAL AID NUMBER 11

WEAPONS OF THE ARTILLERY - 7



GUN CHARACTERISTICS

Weight--166,638 pounds, traveling position (carriage and transported units); 94,000 pounds, emplaced
Length--traveling position--84 feet 1.75 inches; emplaced--38 feet 5 inches
Height--12 feet 2 inches
Range--shell HE, 28,529 meters (31,200 yards)
Tube length--42 feet 8.5 inches
Muzzle velocity--shell HE, T122, maximum zone 2,500 feet per second
Firing mechanism--electrical contact, percussion hammer
Type breechblock--interrupted stepped thread
Maximum elevation--978 mils (55°)
Maximum depression--0 mils (0°)
Traverse--fine, right or left 7.5°; by moving float 360°
Recoil mechanism--primary and secondary hydropneumatic employing compressed nitrogen and oil, hydraulic, petroleum base
Equilibrator--hydropneumatic
Ammunition--HE, nuclear, dummy
Weight of projectile--shell HE, T122, 600 pounds

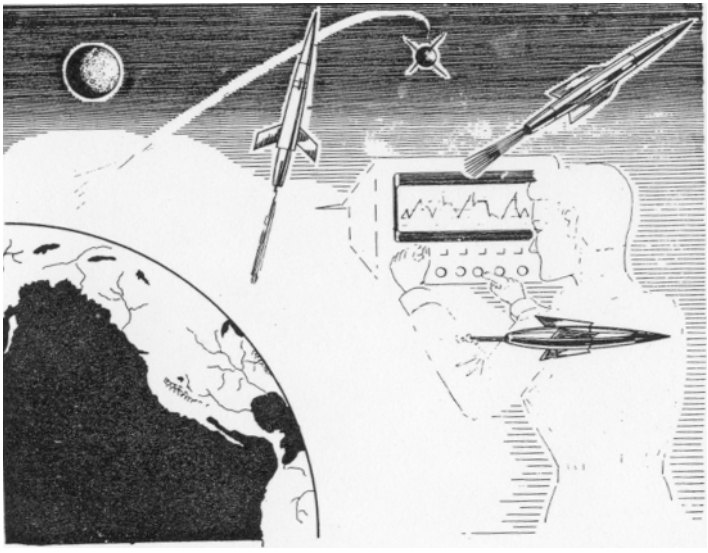
GUN CHARACTERISTICS-Cont'd

Time required to emplace weapon--approximately 12 minutes
Fire control equipment--panoramic telescope M12A7C, elevation quadrant M1, gunner's quadrant M1

TRAINING REFERENCES

FM 6-96, 280-mm Gun T131 on Carriage T72 (Jul 54)
TM 9-338-1, 280-mm Gun T131 and 280-mm Gun Carriage T72 (Sep 52)
TM 9-3019, 280-mm Gun T131 and 280-mm Gun Carriage T72 (May 53)
Tables of Organization:
6-535C, FA Bn, 280-mm Gun (May 57)
6-536C, Hq, Hq & Svc Btry, FA Bn, 280-mm Gun (May 57)
6-537C, FA Btry, 280-mm Gun (May 57)
Army Training Test:
6-8, FA Bn, 280-mm Gun

DEVELOPING FUTURE ARTILLERY



First Lieutenant Thoren J. Schroeck
Department of Training Literature and Nonresident Instruction

The field artillery of 10 years from now is basically planned now. To surpass the firing punch of any future aggressor, today's weapons and technology must not only be improved, but organizational and operational concepts transcending present-day thinking must be developed. This is the job of the Combat Development Department of the US Army Artillery and Missile School.

As an integral part of the Army's combat development system, the Combat Development Department of the School is meeting the challenge of everchanging artillery requirements. Specifically, it is responsible for the development of new doctrine, tactics, organizational and operational concepts, and materiel requirements. It also conducts tests and studies for the field artillery of the future. The department is responsible for coordinating the overall research and development program of the Artillery and Missile School and for coordinating liaison activities between the School, US Army Boards, and other military and civilian research, developmental, and manufacturing agencies.

The United States Continental Army Command (USCONARC) supervises the Army combat development system. Within this system, there are

more than 25 combat development agencies, besides the Artillery and Missile School, that represent other combat arms schools, the Command and General Staff College, the Army War College, and each technical and administrative service.

To cope with the onrush of constantly changing and ever-increasing military requirements, the School's combat development program uses the talents of both civilian and military personnel. In addition, technical and scientific guidance is provided by a Research Advisory Committee of the University of Oklahoma.

10 to 15 Years From Now

Because weapon and concept development depends on a clear construction of future military situations, the Combat Development Department must detach itself from today's Army problems and visualize future technical capabilities and organizational and operational concepts of the United States, its allies, and its potential enemies. The department's terms of reference are from 10 to 15 years from now.

All ideas concerning future field artillery fire support, regardless of origin, are forwarded to the US Army Artillery and Missile School for study and recommendation. Besides conducting these studies, the Combat Development Department usually prepares the field artillery portion of combined arms studies made by the Command and General Staff College or some other combat development agency.

The Department of the Army provides general guidance for all combat development studies to insure that all agencies are working toward a common goal. This guidance is disseminated formally in the Department of the Army publication, "Combat Development Objectives Guide," commonly referred to as the "CDOG." It outlines operational and organizational objectives for every aspect of warfare. The objectives pertaining to materiel are termed Qualitative Materiel Development Objectives (QMDO). They are defined as approved statements of military requirements for new materiel, with general characteristics specified to support long-term operational concepts. However, these concepts have not proven feasible enough to justify developing them.

A Qualitative Materiel Requirement (QMR) is a Department of the Army approved statement of military requirements for a new item or system, of which the development is believed to be feasible. The QMDO usually precedes formation of the Qualitative Materiel Requirement, although, because of the flexibility of the combat development system, this is not always necessary, practicable, or desirable. QMDO's may exist for a long time before action is taken on them to form Qualitative Materiel Requirements. During this period, a researcher may discover another facet to be explored. This can be only a small part of the original idea or can be fairly remote from it. A time frame must be indicated for each QMR; however, it may have to be changed during the development to keep pace with changes in related equipment and organizations.

Developing The Concept

These are the normal steps, but not necessarily the only ones, followed by the Combat Development Department in developing an organizational or operational concept of a materiel requirement. For example, a soldier submits an idea concerning Ordnance materiel for future ground fire support to his unit headquarters. Then, it is forwarded through channels to headquarters, USCONARC. If USCONARC determines that the idea provides a possible answer to a development objective listed in the chapter on ground fire support operations in the Combat Development Objectives Guide, the information is sent to the School where a detailed study and analysis is conducted, an appropriate time frame visualized, and a QMR prepared for submission to USCONARC. This QMR is studied and staffed within that headquarters.

If there is a doubt about the technical feasibility of the idea, USCONARC requests that the Chief of Research and Development, Department of the Army, verify its feasibility. The QMR (based on the result of the feasibility studies) is then approved, disapproved, or modified.

If approved, or modified, USCONARC recommends to the Chief of Research and Development, Department of the Army, that the proposed QMR be listed in the Combat Development Objectives Guide and assign a priority for development. USCONARC then directs the US Army Artillery Board to prepare military characteristics. These are coordinated with the School before they are sent to USCONARC. When USCONARC approves the military characteristics, they become the basis for technical characteristics prepared by the appropriate technical service. After the technical characteristics are prepared and approved by the technical service concerned, they are forwarded to the developing agency (subordinate part of technical service and responsible for development of equipment in that specific field) and finally to the developer (contractor who develops equipment that can be tested from technical characteristics).

Insures Compatibility

The Combat Development Department follows the development of the item through these various stages to insure compatibility with the original concept. Normally, this monitoring continues until engineer-user tests are started. By this stage of development, the project has usually become of great importance to the instructional departments of the School, because they must develop programs of instruction to adequately train personnel to operate and maintain the equipment when it becomes operational.

When a USCONARC directive for development of a concept is received, the Combat Development Department begins with the ideal concept or solution and then decides how much of it will be feasible in the time frame designated for the project. For example, if the time frame designated is 10 years hence, the project personnel must attempt to visualize the conditions which will exist and affect the concept at that time. The ideal concept

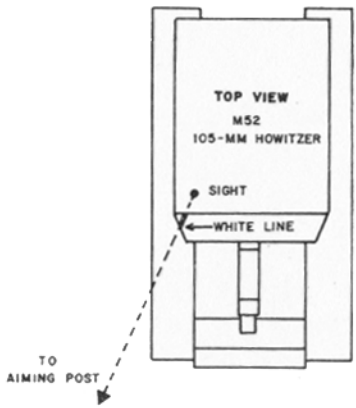
is then modified by these conditions. Equal consideration for the time frame designated must be given to both the capabilities of friendly forces and those of possible aggressors.

Improvements of today's weapons and equipment may not be adequate in future conflicts. Many times today's radical approaches and departures from convention in tactics and weaponry yield the best solutions to tomorrow's battlefield problems. Weapons systems normally do not evolve fast enough to meet the increasing demands of this military age in preparing for the future. The School must plan now for better methods and equipment to match the zooming pace of these demands.

The School's combat development program helps to insure that the artilleryman of the future will be properly organized, trained, and equipped to do his job. It is planning now for the field artillery of the future.

A GEM FOR THE 105-MM SELF-PROPELLED BATTERY

The process of emplacing the aiming stakes in a self-propelled 105-mm howitzer battery, may be slowed because of the gunner's limited visibility in the M52. The operation can be speeded by painting a one-inch wide white line diagonally down the left corner of the turret in the direction in which the aiming posts are emplaced. The periscope sight



and white line should appear to be a continuous line from a distance. When the number 5 cannoneer is placing the aiming posts, he sights back and alines his post with the painted line and the head of the sight. When the gunner looks through the sight, the aiming post should be in the field of vision of the telescope.

--Submitted by Capt Robert F. Miller
Hq 14th Armd Cav Regt, APO 26, N.Y.

LACROSSE – From Bunker Busting to General Support

The sphere hurtles through the air--a man is in position--the ball hits the racquet--in a split second the ball is slammed into the goal for a score. This is the game of Lacrosse; the Lacrosse missile system borrowed the idea of the game. The missile is fired towards the target--a strategically placed missile guidance central picks up the missile and guides it to the target.

The Lacrosse was developed as an assault weapon, or "bunker buster," but now it has been given a general support role. The missile recently has been placed in the hands of troops. Four Lacrosse battalions are now training at Fort Sill, Oklahoma.

After World War II, close support weapons were evaluated, and it was concluded that a new weapon system was needed. In 1947, the Marine Corps formed a requirement for a guided missile that could destroy reinforced concrete pill boxes, timber-reinforced, sandbagged bunkers, and other pinpoint targets. The Army was given the Lacrosse project in June 1950.

The Lacrosse system meets the military requirement for a fast, light, self-contained unit that can deliver tremendous firepower against an aggressor. The Lacrosse can deliver several types of warheads, which permits its use against a variety of targets. It has a nuclear capability.

The Lacrosse system is divided into three major components--the missile, the helical rail launcher and its associated test equipment, and the missile guidance central.

The missile is approximately 19 feet long and 20 inches in diameter, and it weighs about 2,300 pounds. It is divided into three main structural groups--body, wings, and fins. The body is further divided into three components--the warhead, the guidance and power section, and the rocket motor section. The warhead is delivered in a separate container and is mated to the missile body with fitted projections. The guidance and power section works with the missile guidance central to guide the missile and also supplies the power for operating the missile components. The rocket motor uses a solid propellant.

Wings Interchangeable

The four interchangeable swept-back wings are held in place by retaining spring clips and require no tools to install. The wings are mounted 90° apart and have a span of 9 feet. The four fins also are interchangeable and require no tools to install. The fins control the missile in yaw, roll and pitch throughout its trajectory. The fin span is 4.7 feet.

The missile guidance central equipment consists of an angular tracker (fig 1), a computer (fig 2), a range indicator (fig 2), an interrogator

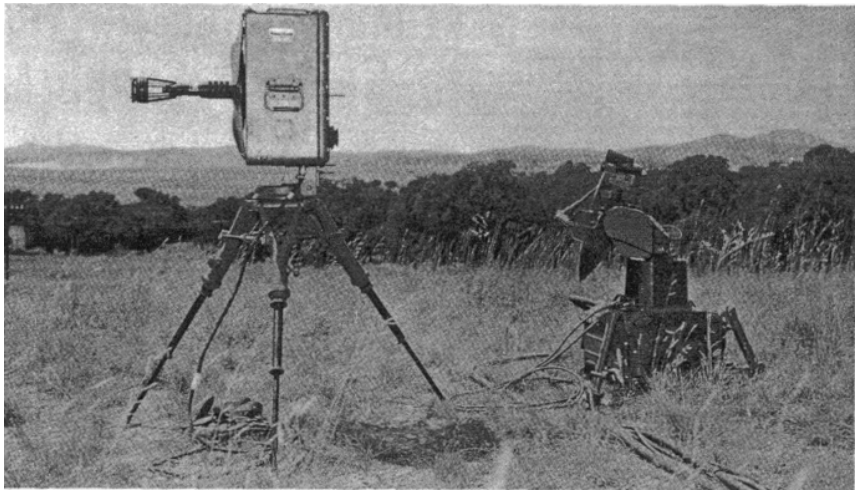


Figure 1. Two pieces of guidance equipment. At left is the target ranging set, which has a built-in monocular system. At right is the angular tracker, which is used to track signals from the missile.

set (fig 2) and a power supply (fig 3). Also, there is a target ranging set (fig 1) which can measure distance and elevation to a target. The guidance central equipment can be transported by vehicle (fig 4) or man-packed over rough terrain.

One of the features of the Lacrosse system is the small amount of equipment necessary to get a round on the way. A key point is that, when

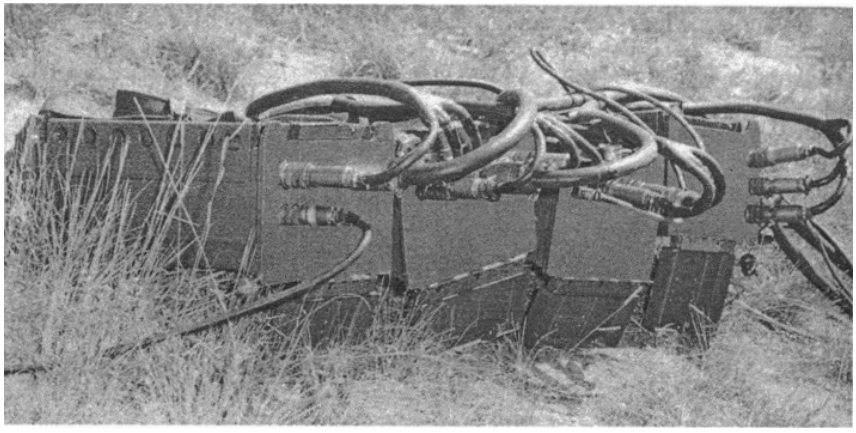


Figure 2. The computer and range indicator.

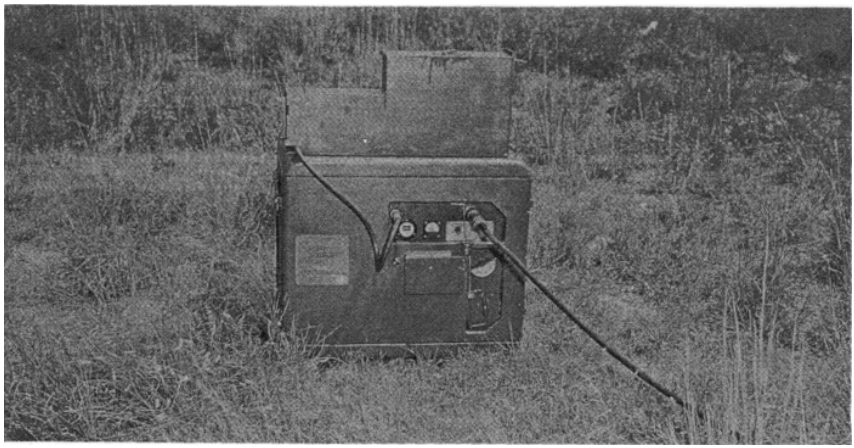


Figure 3. Power for the guidance equipment is provided by this generator.

the missile is ready to fire, the launcher is the only major item of equipment required in the firing area. The XM398E1 launcher has a helical rail and tube assembly fastened on a superstructure which is mounted on a modified 2½-ton truck. The truck serves as an assembly platform, a checkout platform, a firing platform, and a missile transporter. The missile can be transported with the wings on or off (fig 5). Test equipment, electrical cables, and missile wings can be stored on the superstructure. The missile is elevated and traversed by a hydraulic system that can be operated manually or by power.

Other vehicles in the firing section are a 3/4-ton truck and trailer (fig 6), which carry the checkout and assembly equipment, a 2½-ton wrecker (fig 7), and a 5-ton cargo truck (fig 8). As mentioned previously, the missile can be checked out on the launcher with a "go-no-go" indication. By using the checkout equipment in the 3/4-ton truck, it also can be checked out while it is in its container (fig 9). The 5-ton cargo truck carries

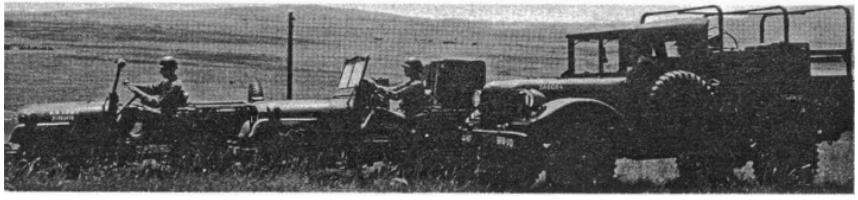


Figure 4. The preceding photographs have shown the Lacrosse guidance equipment ground-mounted. The equipment also may operate from the section's vehicles, shown here in traveling position, except for the angular tracker which must be operated from the ground.

Figure 5. The Lacrosse can be transported on its 2½-ton truck-mounted launcher with the wings off (top) or with the wings mounted (bottom).

2 complete unassembled missiles, housed in 2 missile containers. The missile is packed in a reusable metal container with one end that opens to permit the missile, wings, and fins to be removed. The warhead container opens from the top. Some of the containers are made of plywood, however, later models are made of metal.

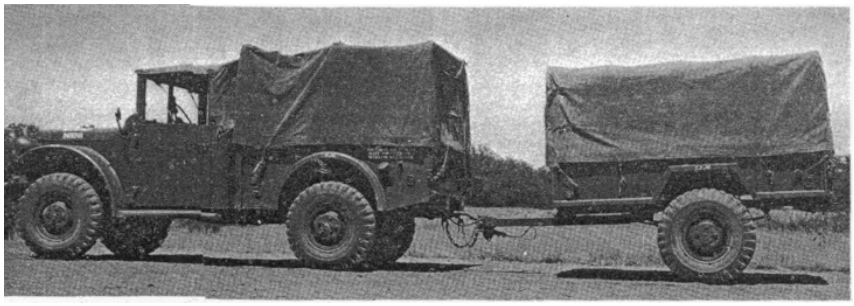


Figure 6. 3/4-ton truck and trailer which carry prefire checkout and assembly equipment.

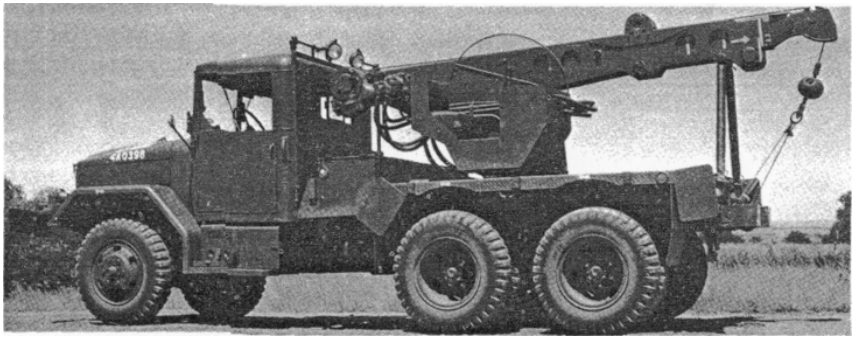


Figure 7. The 2½-ton wrecker M108 is used to transfer missiles and warheads from their containers to the launcher.

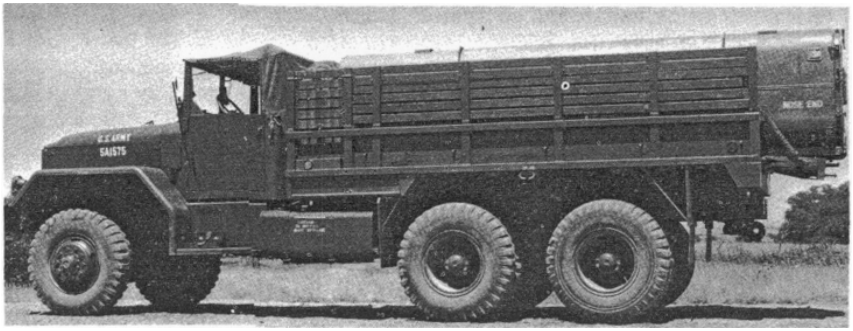


Figure 8. The 5-ton cargo truck can carry 2 complete missiles in their containers.

Figure 9. The Lacrosse missile has a dual checkout capability. The missile can be checked out on the launcher with on-launcher equipment or while it is in its container on an ammunition truck.

The 2½-ton wrecker is used to transfer the missile and warhead from the containers to the launcher. It also is used in the mating process (fig 10).

Organization and Tactics

The Lacrosse battalion is organized under the single fire unit principle (ARTILLERY TRENDS, February 1959). The battalion is the smallest tactical and administrative unit and is also the fire unit. Normal principles and techniques are employed during the reconnaissance, selection, and occupation of position (RSOP). However, the battalion commander must consider the technical aspects of the Lacrosse system. The missile characteristics and guidance system limitations are factors that must be considered during the RSOP. Also to be considered are two operation areas--one to be used in preparing the Lacrosse for firing and the other to be used for actual firing. The commander must select the general areas in which the battalion will be deployed. Then he must follow normal procedure for deploying a unit. The general outlines in FM 6-20, Field Artillery Tactics and Techniques, are followed with slight variations.

Whenever possible aerial reconnaissance of the assigned area should be made. However, if an aerial reconnaissance cannot be made, the commander should make a ground or map reconnaissance to determine if the area will permit the battalion to fulfill its mission.

The Lacrosse battalion commander must maintain close command liaison with the reinforced artillery unit, or artillery commander, and confer on matters pertaining to possible position areas from which the battalion can support the operations.

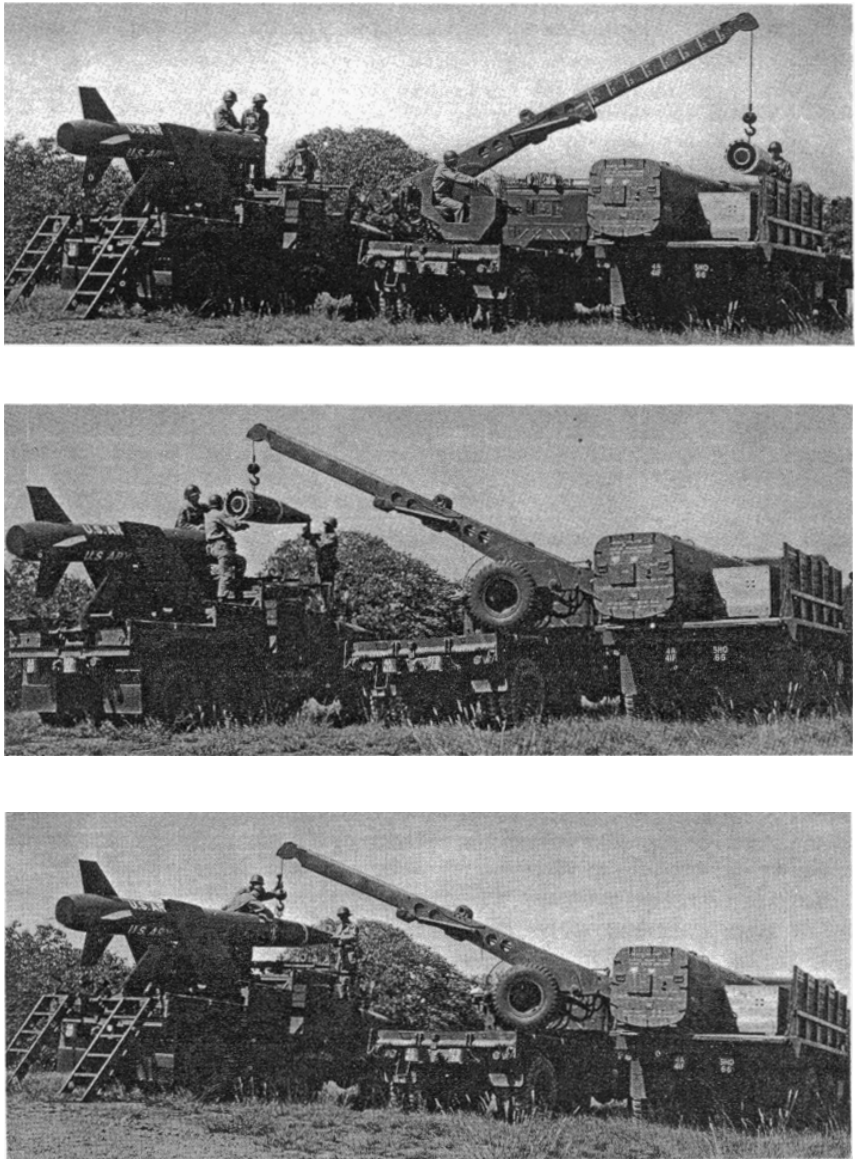


Figure 10. The 2½-ton wrecker is used to transfer the missile and warhead from the ammunition truck to the launcher. This sequence shows the warhead being mated. The warhead is removed from its container with a nose handling eye.

The commander chooses the personnel for his reconnaissance to fit the situation. A typical reconnaissance party that will meet most requirements is as follows:

Battalion commander
S3
Communications officer and wire crews
Reconnaissance officer and survey crews
Headquarters and service battery commander
Support platoon commander
Firing battery commander
Guidance section leader.

Generally, the reconnaissance party must consider the same points or requirements as for any reconnaissance, but there are some requirements peculiar to the Lacrosse system. The battalion commander is responsible for selecting the firing positions, assembly section positions, and guidance central positions. The firing position must accommodate a launcher, a 3/4-ton truck, crew personnel, and necessary section equipment. The position must be free from high obstacles and electronic devices which might affect the Lacrosse system. The rear of the position should be free of dry grass and other materials which could ignite when the missile is fired. Several positions should be selected, since a position may be used once and then vacated. The assembly section position must be located so that the section can support two firing sections.

The Missile Guidance Central

The guidance section leader normally selects the exact locations of the guidance central. He considers concealment, cover, defilade, security, routes to and from the areas, and the masking angle from acquisition point to target. Additional positions must be selected to obtain more flexibility in attacking targets.

With additional firing and guidance positions, the target to be engaged can be attacked by any combination of launchers and guidance sections. The fire direction center computes the firing data for the combination which can provide the greatest accuracy on the target.

Because the Lacrosse battalion is a high-priority target for the enemy, all possible measures are taken to avoid detection during the occupation. Therefore, the battalion displaces over many routes during periods when the enemy's observation is limited, such as at night or times of poor visibility. The new position area should be prepared before occupation as completely as time allows. When preparing a position area, consideration must be given to--

(1) Survey
(2) Communications

(3) Camouflage
(4) Local security, security of storage areas.

The operations required to deliver fire as soon as possible after occupying the position have first priority. These operations include--

(1) Checking out missiles and warheads
(2) Assembling the missile on the launcher
(3) Preparing guidance equipment
(4) Laying the missile.

The missile is laid using a panoramic telescope, a range quadrant, and an aiming circle in the same manner as cannon artillery (fig 11).

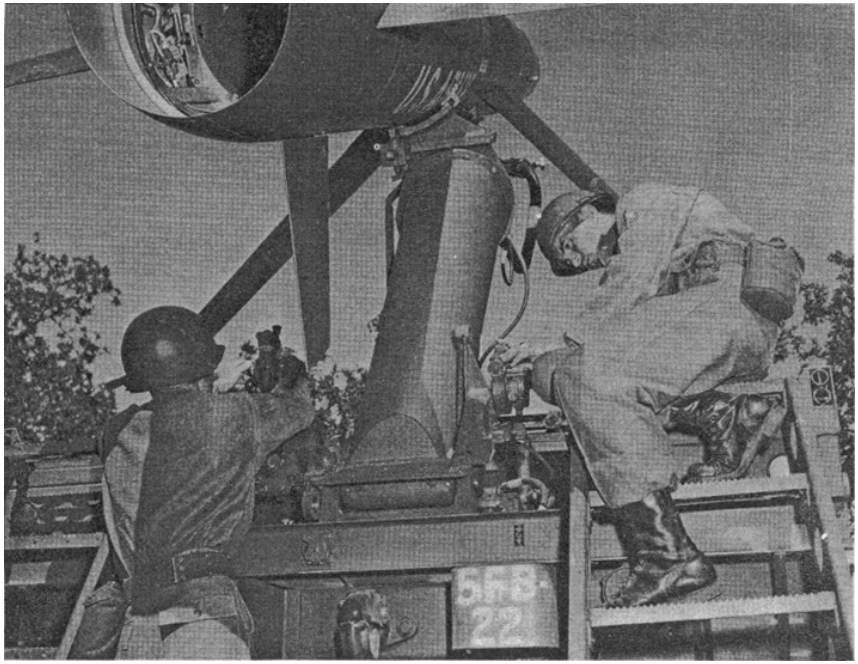


Figure 11. The Lacrosse missile is laid with the standard fire control equipment--panoramic telescope, range quadrant, and aiming circle.

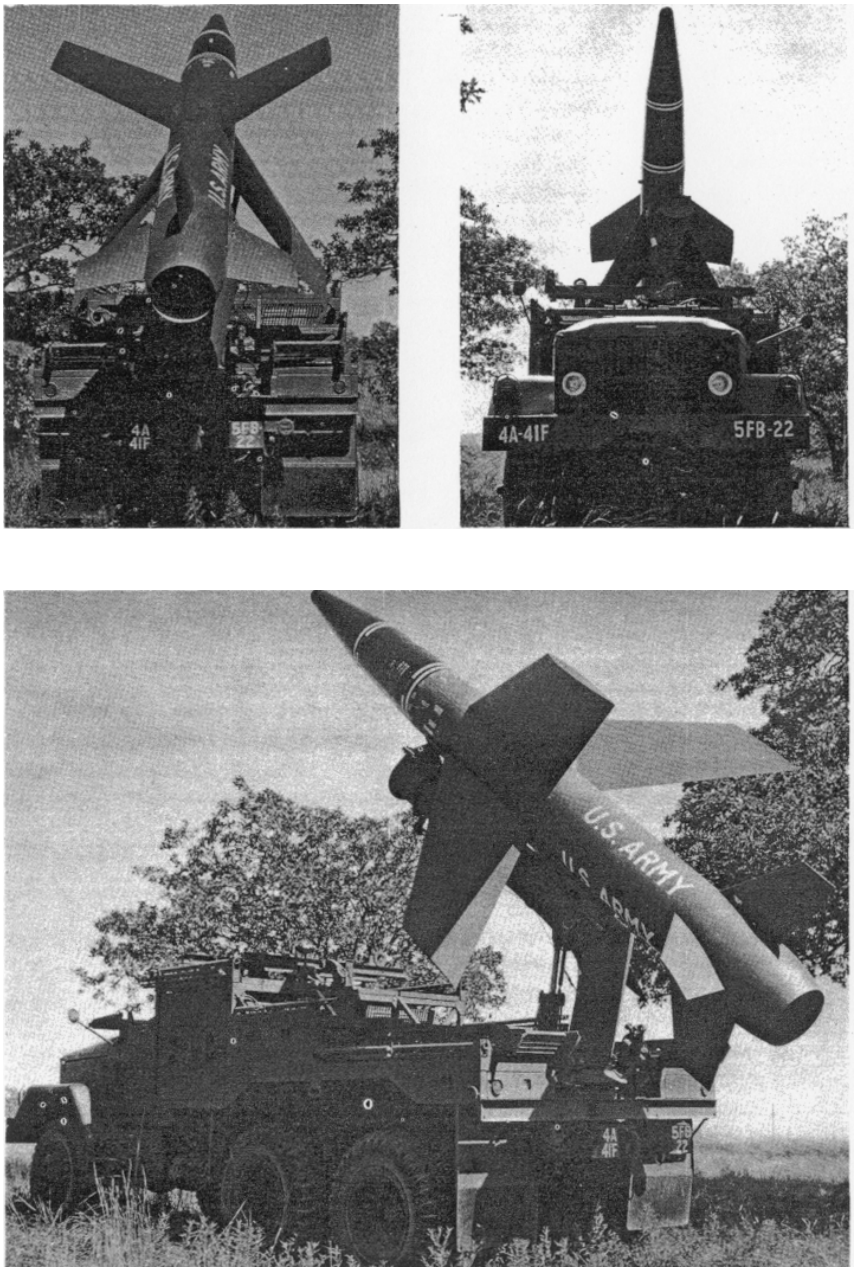


Figure 12. From every angle, Lacrosse--ready to fire.

The predetermined flight data is computed by normal artillery fire direction methods. This data is inserted into the various components of the guidance central, which in effect is an electronic brain. After the missile has been fired, it is acquired electronically by the angular tracker. The guidance central determines the exact location which is compared with the predetermined course. Any deviation of the missile from this course is corrected and the missile is brought back to the predetermined course.

The Lacrosse missile system gives combat commanders a weapon that can be relied on under all conditions of weather and visibility. It can knock out heavily fortified positions with one round, or it can serve as a general support weapon. Lacrosse units are self-contained, self-sufficient, and mobile. All units are vehicle-mounted, and the equipment can be airlifted. Lacrosse units can keep the enemy under constant fire from many directions, and because of its mobility, it presents a difficult target for the enemy to find. The Lacrosse is a welcome addition to the field artillery's arsenal of "in-service" weapons.

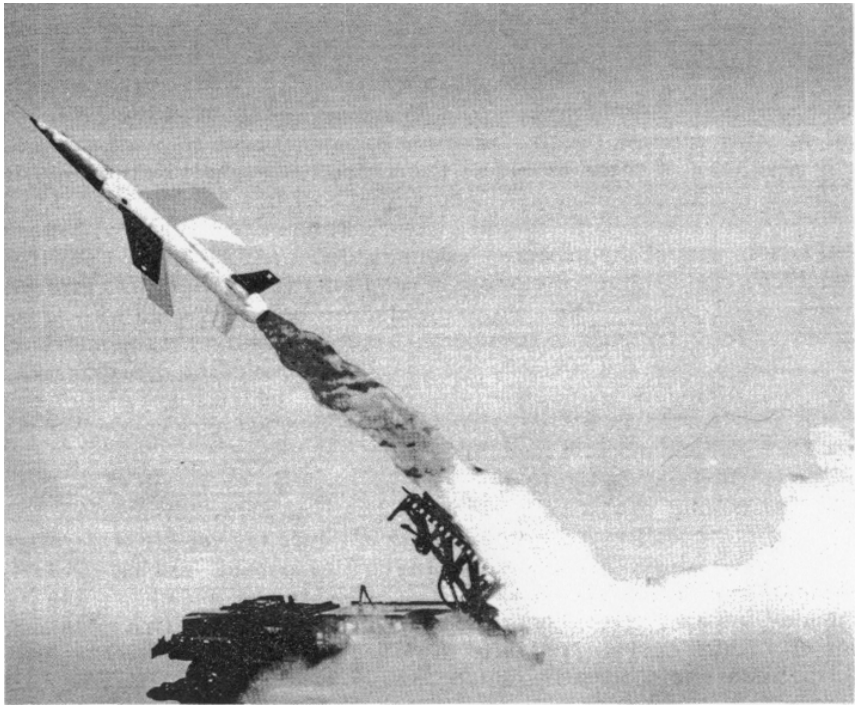


Figure 13. Lacrosse--ON THE WAY!

Mobile Fire Direction Centers

First Lieutenant John E. Rudzki
Headquarters, 1st Howitzer Battalion, 2d Artillery
APO 34, New York, New York

Experience of the battalion S3's and battery officers concerned with fire direction of the 2d Artillery in Germany has shown that it is not practical to use a tent as a shelter for the fire direction center (FDC). Artillery units no longer can expect a stable battlefield situation, such as in the Korean Conflict, where units are in position for weeks or months at a time. Instead, units must be ready to move easily and quickly on short notice. The mobile fire direction center developed by the 1st Howitzer Battalion through trial and error has simplified the problems of readiness and rapid movement.

A tent is a warm and roomy place to work, but it has many disadvantages. It is difficult to erect and dismantle under blackout conditions. If the tent is set up in snow, the area covered and heated turns into a quagmire when the soil thaws. Every time the tent is set up all radios must be remoted into the tent, and because of the varying locations of telephones and chart tables, the internal wiring is changed often. Finally, while the tent is being erected, the fire direction personnel have no place to work.

A solution to these problems, being used successfully by this unit, is to mount the battery executive's command post in a 3/4-ton truck and a 3/4-ton trailer with built-up cargo compartments (fig 14). The battery FDC now is part of the executive's command post (ARTILLERY TRENDS, June 1959). (A similar solution can be used for the battalion FDC and will be discussed later.) The compartments can be constructed with scrap lumber. They are built to comfortably accommodate a person standing, but not higher than the 109-inch external dimension of the 3/4-ton truck. If the compartments are no higher than the truck, the truck and trailer can be air transported in a C130 aircraft. The internal arrangement of the executive's command post may differ from unit to unit, but a possible arrangement is shown in figure 15.

The mobile executive's command post has many advantages. The foremost is the ability to operate at any time. Since the vehicle and trailer can be locked, all section equipment can remain mounted. During an alert, the doors are opened, radios are turned on and tested, and charts are put in place--the executive's command post is ready to accept fire missions. This eliminates carrying radios from the section room to the vehicle, connecting radio parts, installing telephones, and wiring the switchboard. All equipment is ready to operate at a moment's notice--push-button warfare at battery level.

Figure 14. Front view of the battery executive's command post in traveling position. A 28-volt generator is mounted in the 1/4-ton trailer at right.

Reduced Communication Problems

Since fire direction personnel must maintain their radio and wire equipment, permanent installation in the mobile executive's command post reduces the maintenance load. One of the primary reasons radios and remote equipment do not always function properly is because of frequent mounting and dismounting. Sometimes, during mounting and dismounting, parts are interchanged, wires are twisted, and connectors are lost.

In the 1st Howitzer Battalion when the equipment is mounted permanently, communications is reliable and presents few problems. When radios had to be mounted before each day's operation, radio trouble resulted about 30 percent of the time.

The mobile executive's command post is prepared for action easily and rapidly. The camouflage nets and poles, carried in the trailer, are all the equipment that must be removed when a position is occupied. A mission can be processed in less than a minute after a position is occupied. This can be done in blackout with no added problems.

A clean, dry, warm, and well-lighted work area is always available.

Figure 15. An internal arrangement of the mobile battery executive's command post.

A canvas blackout curtain covers the space between the truck and the trailer. A 24-volt lighting system furnishes ample light. A Coleman lantern keeps the installation warm during the coldest weather in Germany. The generator for the lighting system can be transported in the trailer, or it can be mounted in a 1/4-ton trailer, as indicated in figure 14.

The FDC can operate efficiently in the mobile executive's command post. The executive officer or his assistant still can supervise without interrupting the operation. The officer in charge of fire direction can watch the chart(s) without disturbing the operator. He also can check the computer's work, answer calls, and aid the computer and switchboard

operator. Since the equipment is mounted permanently, it will be in the same place each time the FDC is in operation. The radios are mounted on shelves allowing the crew to use both seats when the truck is traveling. Almost all of the cargo-carrying capacity of the trailer can be used because the charts fold up against the wall.

The only disadvantage of the mobile executive's command post is the lack of room for visitors. More than one person cannot observe the operations. In effect, this is an advantage because it discourages people from loitering in the executive's command post, where distractions are time-consuming and may often cause costly errors.

Battalion FDC Also Mobile

At battalion level, the disadvantages of a tent shelter for the FDC are amplified. Since the entire operations complex cannot be housed adequately in a command post tent; a medium, general purpose tent is used to house the FDC and the S2 and S3 activities. This tent is difficult to erect; therefore, it is not practical.

A solution to the problem is to use a 2½-ton shop van with a 1½-ton trailer. Besides the advantages of the mobile executive's command post, the shop van has a personnel heater and good lighting. A 2½-ton truck with

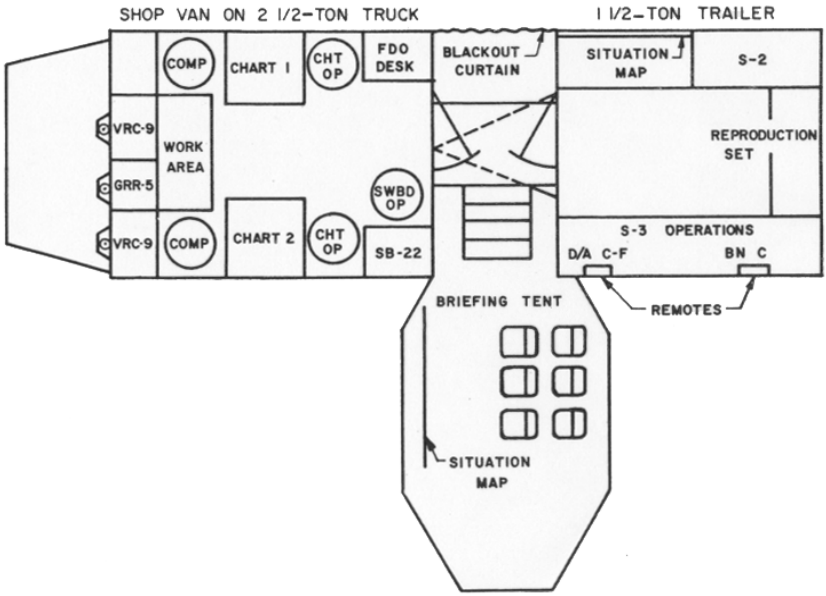


Figure 16. Sketch of a possible internal arrangement of the mobile battalion FDC, S2, and S3 sections.

Figure 17. Internal arrangement of the mobile battalion FDC.

a built-up cargo bed section can be used with almost equal effectiveness.

The S2 and S3 sections have adequate space in the trailer, and the FDC is located in the van (fig 16, 17, and 18). If the situation is stabilized a command post tent can be erected next to the van and trailer. The tent provides a briefing room for the battalion commander and keeps visitors away from the working area (fig 16). The truck and trailer are connected by a platform, or catwalk, which lies on the trailer's drawbar (fig 19).

Local restrictions prohibiting modification of the M59 armored personnel carrier for use as an FDC and command post, pending development of a standard model for that specific purpose, indicates that the trend is toward the mobile FDC. An FDC in an M59 would have all the advantages of mobile FDC's plus the mobility of a tracked vehicle. Self-propelled batteries already have the mobile facilities that towed outfits desire and need. However, until something better is developed, the mobile FDC's described in this article, using only authorized personnel and equipment,

Figure 18. The nerve center of the battalion (outside view of the mobile installation). Note the tarpaulin, for blackouts, over the space between the vehicle and trailer. The pole at the right of the van is a home-made folding RC292 antenna mast attached permanently to the side of the van. Ten-conductor cable studs are attached to the terminal strips, and when the studs are used with 10-conductor cable, wire lines can be established rapidly between the van and the wire head. Wire crews do not have to enter the command post area.

is a proven method that increases efficiency and the ability to shoot, move, and communicate.

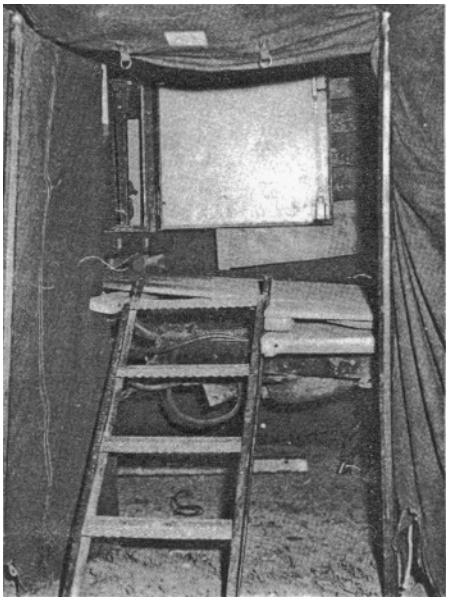


Figure 19. Catwalk connecting the truck and trailer with the steps leading up from the command post tent.

THE SOVIET UNION'S MISSILE ARTILLERY

"Russian Rocket Hits Moon"....."Big Soviet Missile Puts Huge Satellite Into Orbit"....."Another Sputnik Circles the Globe After Successful Shot".....These are familiar headlines. It is often asked.....How large are these Soviet missiles? What fuels do they use? What is their range? The answers to these questions are important to the artilleryman. He should know the characteristics of the weapons he might encounter on the battlefield, whether the weapons are in the hands of friendly or enemy troops.

ARTILLERY TRENDS strives to keep the artilleryman up to date on his weapons and those of his allies and potential enemies. The June 1959 issue of ARTILLERY TRENDS contained some information on French and Canadian cannon artillery pieces. As information becomes available on foreign weapons, it will be published in ARTILLERY TRENDS. In this article, artillery missiles of the Soviet Union are discussed.

M-2

The M-2 is a 2-stage surface-to-air weapon developed from the German Rheintochter. Now in service, it is fired from mobile units. The 25-foot missile can travel at more than 1,500 miles per hour propelled by solid fuel in both stages. It employs radar and infrared guidance systems.

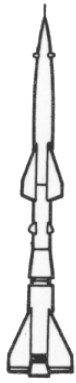
COMET

This is a family of surface-to-surface missiles which originated from a research vehicle. The Comet 1 is a short-range (100 miles) single-stage weapon in operational service. It reportedly also is used as a submarine-launched missile. It is powered by a single solid-fuel engine.

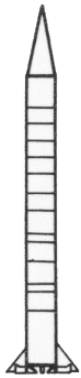
The Comet 2 has a greatly improved powerplant and an inertial guidance system. Its range is in the 500- to 600-mile class. The 44-foot missile presently is in production.

T-1

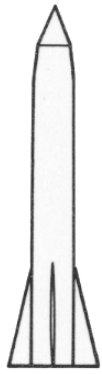
A Soviet copy of the German V-2, the T-1 is a surface-to-surface missile in the medium-range bracket. Frequently seen in Red Square parades, the T-1 has been operational for some time. It is equipped with a mobile, self-propelled launcher. About 50 feet long, the T-1 has a liquid-fuel rocket engine. Grossing about 20 tons, it is guided by a radio-inertial system and has a nuclear warhead.



M-2



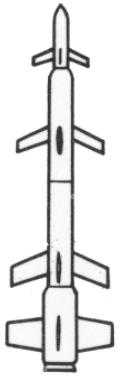
T-1



T-2

T-3

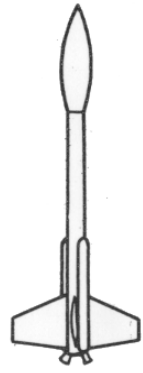
T-7A



T-5

T-5B

T-5C



T-8

T-2

The T-2 is the mainstay of the Soviet missile arsenal. It has been deployed to a number of bases in Soviet Europe. Although it stemmed from the German V-2, the T-2 is a greatly advanced version, with a range of more than 1,500 nautical miles. A 2-stage weapon, it grosses about 60 tons, and is more than 100 feet long. It has a liquid-propellant (oxygen/ alcohol) powerplant in each stage, and is guided by a radio-inertial system. The warhead is nuclear.

T-3, T-3A

The much-discussed Soviet intercontinental ballistic missile, the T-3, according to qualified authorities, is scheduled for operational service in 1959. Like the US Air Force missiles Atlas and Titan, it will carry a thermonuclear warhead more than 5,000 miles. It is a two-stage missile having high-thrust liquid-fuel engines in both stages. Estimates of the amount of this thrust vary widely. The missile is 100 to 125 feet long, and it grosses about 85 tons. It has radio-inertial guidance.

An advanced version of this weapon, the T-3A, is in development production status. It has an estimated range of more than 6,000 miles and a velocity of 16,000 miles per hour. Like the T-3, it is a 2-stage liquid-fuel missile with a higher thrust engine in the first stage.

T-4

Capable of delivering a 1-ton warhead over a distance of 1,000 miles, the T-4 is in the medium-range ballistic missile category. It is 50 to 55 feet long and has a diameter of 6.5 feet. It is a 2-stage liquid-fuel missile grossing 35 tons. It has a nuclear warhead.

T-5

A short-range unguided artillery rocket, the T-5 is one of the earlier Soviet missiles. It weighs about 2.5 tons and is 32 feet long and 3 feet in diameter. Each T-5 field battery has 6 launchers.

T-5B, T-5C

The T-5B and T-5C artillery rockets are later versions of the basic T-5. Both have been seen frequently in Moscow parades, and both are in operational service. They are carried on self-propelled, tank-like launchers. The T-5B is 30 feet long and has a range of 25 miles. The T-5C is 25 feet long and about 1.5 feet in diameter, and it has a solid-propellant powerplant. Both rockets are unguided.

T-6

The T-6, a surface-to-air weapon, is a 2-stage missile with a service ceiling of about 60,000 feet. The weapon grosses 2 tons, and its speed is more than 1,500 miles per hour. Its first stage has 4 solid boosters, and there are 2 more solid rockets in the sustainer, powerplant for the second stage. It is radar guided and carries a high-explosive warhead with a proximity fuze.

T-7A

The T-7A is an adaptation of a research rocket to military use as a short-range surface-to-surface missile. In service, it is about 25 feet long and about 2.5 feet in diameter. Although the original version was liquid propelled, the operational weapon has a solid-fuel powerplant. Comparable to the field artillery Corporal missile, it has a range of 70 miles.

T-8

An air defense weapon, the T-8 is the Soviet counterpart of the Nike Ajax. In service for several years, it has a range of 15 miles and carries a high-explosive proximity-fuzed warhead. Speed is Mach 2 plus. The missile is boosted by 2 solid-propellant rockets; a larger liquid-fuel rocket of 4,600 pounds thrust powers the second stage. Fired from mobile launchers, it is used by field batteries in nonpermanent positions.

In future issues, ARTILLERY TRENDS will give similar descriptions of the missiles of other nations. It is hoped that, through this medium, artillerymen will gain knowledge of artillery developments in other armies.

(All information on the missiles included in this article is reprinted from MISSILES AND ROCKETS MAGAZINE, Copyright July 20, 1959, American Aviation Publications, Inc.)

A GEM FOR THE FORWARD OBSERVER

The radio set, AN/PRC-9 may be tuned more accurately when you are in the vicinity of the net control station by the following method:

With the net control station's transmitter keyed, hold the OFF-REMOTE-ON-CAL & DIAL LITE switch of the AN/PRC-9 in the CAL & DIAL LITE position. Turn the tuning control slowly to the operating frequency. A zero beat will be obtained at the frequency of the net control station. Lock the dial and you are ready to operate.

--Submitted by Capt T. K. Greer
Department of Communication and Electronics,
USAAMS

Integrated Comunication

Major Edward A. Brass
Department of Communication and Electronics

Webster's definition of "integrate" is "to make whole or complete; to bring together, unify."

In the days of the pony express (messenger communication) there was a series of relief stations to receive the incoming traffic and with little delay pass on the messages to another rider. This then was a facility established to integrate, or unite, each link with the overall system.

For many years the artillery has realized the need for integrating radio and wire circuits to permit greater flexibility in artillery communication systems. A makeshift integration system was used during "Operation Sagebrush" in 1955. It was a maze of wires connecting double-pole, double-throw switches, and AN/GSA-6 control groups. The system was marginally satisfactory when it was properly connected and operated by trained personnel.

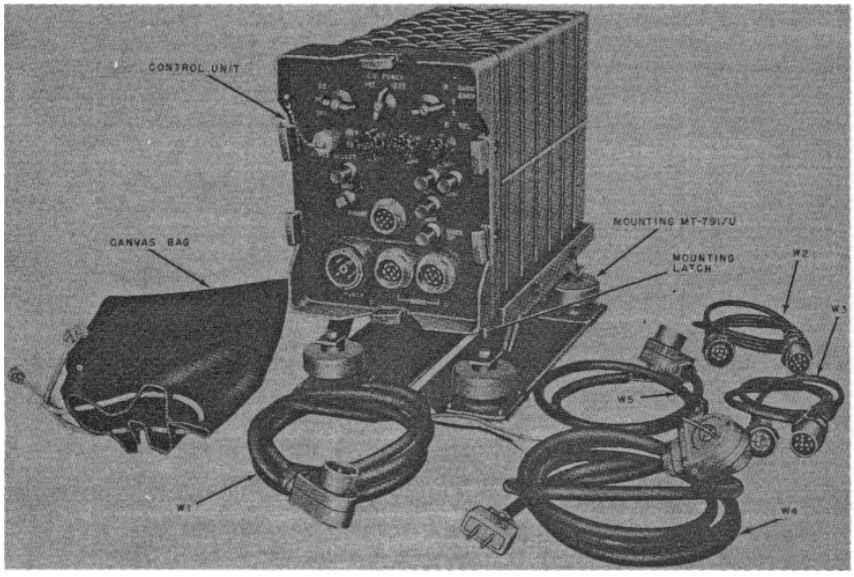


Figure 20. Radio set control AN/GSA-7.

Unit	Number of AN/GSA-7's
FA battery	1
FA battalion	4
Division artillery	2
FA group	2
Corps artillery	2

The use of the AN/GSA-7 permits a reduction in the number of radiotelephone operators physically located in the fire direction center. However, all personnel using an integrated radio-wire system must be trained thoroughly in radiotelephone procedure.

With this equipment, the artillery will have a communication facility "to make whole or complete, to bring together, to unify" the present radio and wire system.

A GEM FOR THE FORWARD OBSERVER

One of the most unrelenting sources of target intelligence for the forward observer is the infantry soldier; however, the observer cannot expect him to designate targets by the well known method of "take as a reference point the block house, go to the right 170 mils, and down from the skyline.....etc." A quick method of getting a target location from him is to have the infantrymen fire a round of tracer at or through the target. To insure that the infantryman has this round of tracer, the FO should obtain and carry a clip of it himself.

--Submitted by Capt James J. Coghlan, Jr.
Headquarters, US Army Artillery and
Missile Center, Fort Sill

The Catalog for Instructional Material, formerly called the Staff Training Catalog, was distributed in July 1959. The material listed reflects the latest organization and current artillery procedures. Address requests for this catalog to: Commandant; US Army Artillery and Missile School; Fort Sill, Oklahoma; ATTN: AKPSIDA-TP/RC.

To replace nonstandard integration methods, radio set control AN/GSA-7 (fig 20) has been adopted as a standard Signal Corps item. The AN/GSA-7 is a small, lightweight, electronic switching device used in radio-wire systems to interconnect radio sets with local battery telephones (TA312/PT) and switchboard SB22/PT.

Telephones used in conjunction with this system may be separated from the radio set control AN/GSA-7 by a maximum distance of 10 miles. The radio set is turned on by the telephone, or switchboard operator's push-to-talk switch. A 2,000 cycle "beep" is emitted by the AN/GSA-7 every 5 seconds while the radio transmitter is on the air. This warns the telephone operator that radio is being used and that radiotelephone procedure must be used. All FM radios in the AN/GRC-3 through 8 series have a built-in "ring" circuit enabling the operator to signal a switchboard or connected telephone. Three methods of employing this set are shown in figure 21.

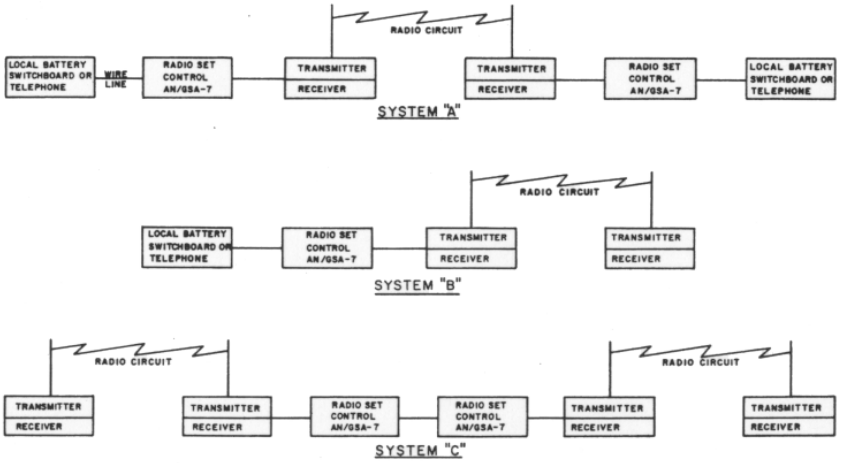


Figure 21. System applications of radio set control AN/GSA-7.

Utilization tests were conducted by the US Army Artillery and Missile School to determine specific application to artillery units. Based on satisfactory tests, recommendations have been prepared for submission to US Continental Army Command (USCONARC) that the AN/GSA-7 be issued to field artillery units on the following basis:

The New Infantry Division

Lieutenant Colonel Earl L. Harper, Infantry
Department of Tactics and Combined Arms

The infantry battle group is a flexible, compact, and lethal fighting machine that the artillery supports. Together they form a team that can be compared to a den of fighting lions.

Recognizing that artillerymen should be familiar with the elements they support, ARTILLERY TRENDS here presents the story of the new infantry battle group. The rifle company was presented in June 1959.

The battlefield of the future is visualized as wide, deep, porous, and possibly nuclear, with no lines of entrenchments, no masses of men waiting in reserve, no roads jammed with trucks moving to the front. In fact, there will be no front--only a battle area. Operations will be conducted by small, yet powerful, organizations executing semi-independent actions. Combat power will be derived from a blend of firepower and mobility applied in the proper amount at the right time.

The first step in meeting the requirements of this battlefield was the adoption of the pentomic infantry division. After 2 years of field test and evaluation, a number of changes have been made in the organization and equipment of the division. While these changes do not materially affect doctrine for employing the battle group, the revised organization results in considerable improvement in those areas essential to combat power--mobility, firepower, surveillance, and control. The changes in the battle group, coupled with an improved division artillery (ARTILLERY TRENDS, March 1959), provide an organization with an increased capability for existing, fighting, and winning on the modern battlefield. The extent of improvement can best be shown by a review of the organization of the new battle group (fig 22).

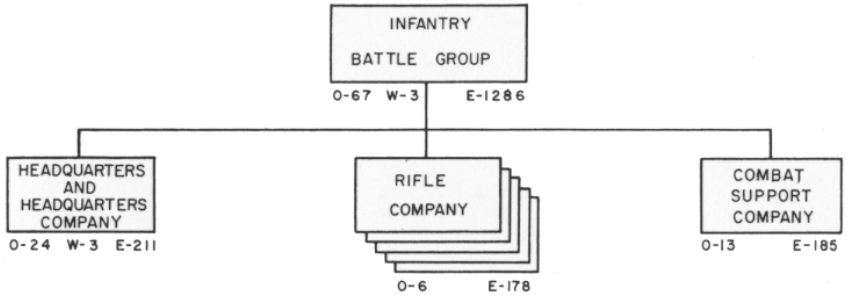


Figure 22. The infantry division battle group.

The most significant changes--addition of a fifth rifle company and the new combat support company--enhance the battle group's flexibility and increase its ability to achieve the necessary balance between dispersion and concentration. The addition of a deputy commander compensates for the battle group commander's increased span of control. The deputy commander always will be prepared to assume command of the battle group or to control any of its elements.

The headquarters and headquarters company now includes only the administrative, logistical, and control units of the battle group. Mobility and logistics are improved by having enough trucks in the supply and maintenance platoon to transport the battle group's basic load of ammunition and all of its kitchens. The medical platoon now can operate two aid stations simultaneously for limited periods. The communication platoon has equipment with greater range and reliability. This improves both tactical and administrative control. The mobility of the battle group is improved because the engineer platoon now has dump trucks, pole trailers, and earth-moving equipment.

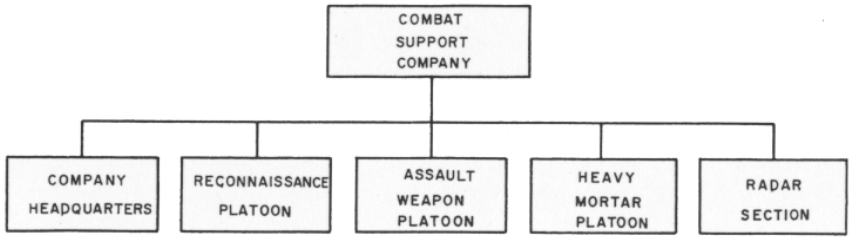


Figure 23. The combat support company.

Combat Support Elements

All of the battle group's combat support elements are incorporated in the combat support company (fig 23). The mortar battery has been replaced by an infantry unit--the heavy mortar platoon which has six 4.2-inch mortars (see page 50 of this issue). Thus, the battle group retains an organic fire support unit, while gaining the increased range and fire power of an additional and higher caliber battery in the direct support artillery battalion. The fires of the heavy mortar platoon are integrated with those of

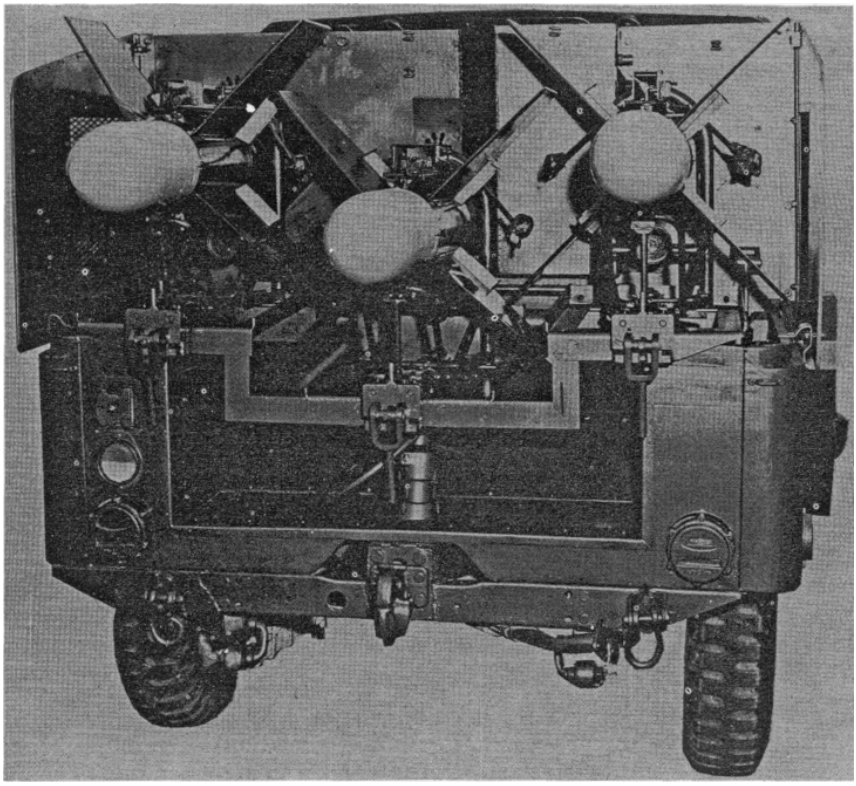


Figure 24. Assault weapon carrier prepared for firing. The French-manufactured SS10 missile weighs 33 pounds (approximately 90 pounds with container and launcher) and has a range of 1,650 yards. The SS10 also may be fired from a ground launcher.

the direct support artillery battalion. The platoon fire direction center (FDC) is tied in with the FDC of the direct support artillery. The heavy mortar platoon accepts missions from the direct support artillery battalion FDC to more effectively integrate the fires of both units.

The new assault weapon platoon, consisting of five squads armed with the SS10 missile (fig 24), provides the battle group its primary means of antitank protection. One launcher is organic to each of the squads. The assault weapon platoon may be placed in general support, or individual squads may be attached to subordinate elements of the battle group.

The addition of a radar section gives the battle group commander an electronic means to meet the urgent requirements for surveillance on the battlefield. This section is equipped with 5 short-range radars and 2 medium-range radars. The short-range device (AN/PPS-4 or "silent sentry") is an all-weather radar for detecting and locating moving targets within line-of-sight ranges up to 6,000 meters. The medium-range radar (AN/TPS-21) can detect and locate moving targets within line-of-sight ranges up to 20,000 meters.

Neither the organization nor the mission of the reconnaissance platoon, which performs reconnaissance and provides security for the battle group, has changed.

Employment of the Battle Group

Concepts governing the employment of the battle group are based on its organic weapons, munitions, communications, and surveillance capabilities. These concepts apply to both nuclear and nonnuclear warfare. Also, specific consideration is given to the possible employment by the battle group of sub-kiloton-yield nuclear weapons, and to the support that can be expected from higher headquarters in the form of fire support, mobility, and armor.

The effective employment of any unit depends on proper consideration of the mission, enemy, terrain, weather, and the available troops and supporting fires. Since, in this article, it is not feasible to consider all possible combinations of these factors, it shall be assumed that optimum conditions prevail in order to present basic doctrine. This doctrine is not to be applied as a template on any piece of terrain, since all the factors noted will modify its application to each specific situation.

The mission of the infantry--to close with and destroy the enemy--applies whether the infantry is on offense or defense. In the defense, the infantry strives for dispersion, flexibility, retention of the initiative, and maximum use of offensive action. The infantry is no longer tied to holding ground in a static position; instead, it skillfully uses terrain to help destroy the attacking enemy. The commander disposes his force so that the enemy mass is easily located and provides lucrative targets. However, he cannot afford dispositions that give the enemy an equal opportunity. To gain flexibility, he disperses his forces both laterally and in depth and insures

that his mobility is at least equal to that of the enemy. In order to cover wide areas, surveillance and fire must overlap. Also, the commander must have, and must provide his subordinate units with, the means to sustain semi-independent operations for limited periods.

Defense

In organizing for defense, the battle group commander considers a number of general principles governing the employment of the various elements available to him. Assault weapons are placed well forward in the area of the frontline companies to take maximum advantage of the SS10's range and to permit early engagement of enemy armor. The SS10's and attached tanks cover the most likely avenues of armor approach. Mutual support between missile squads is desirable; however, when the number of tank approaches and the distance to be covered does not permit mutual support, the squads may be employed individually. Most of the attached tanks usually are retained in reserve to capitalize on their offensive capabilities and, at the same time, provide antitank defense in depth. Nevertheless, tank platoons may be attached to forward rifle companies to bolster the antitank defenses or to cover armor approaches not covered by the assault weapon platoon.

The reconnaissance platoon is initially employed under battle group control to maintain contact with the security elements forward of the battle group defensive sector. When the security elements withdraw, the platoon may be employed in several ways--to maintain contact with flank units, to establish observation posts, as an economy of force element on the forward edge of the battle area, or to perform security missions in the rear portion of the battle group sector.

The radar section is used in a combination of attachment and general support roles. Normally, the short-range radars are employed well forward. Usually, they are attached to the companies in whose areas they are operating. The medium-range AN/TPS-21's are employed under battle group control. They are positioned to best extend the coverage of the shorter-range devices, and to provide surveillance in depth in the battle group sector. The requirement for unobstructed vantage points must be considered when positioning the radars because of their line-of-sight limitation.

When a company (or more) of division engineers support the battle group, the organic engineer platoon may be directed to accept missions from the supporting engineer unit commander. This insures close coordination of engineer activities. Otherwise, engineer units normally are retained under battle group control; however, on extended frontages, they may be attached to reinforced, company-size task forces.

The heavy mortar platoon normally is employed in general support of the battle group. Its fires and fire direction operations are tied to those of the direct support artillery battalion. However, the battle group commander may attach the platoon to a task force or employ its elements

separately. Regardless of how they are employed, the mortars remain immediately responsive to the battle group commander. The commander of the direct support artillery battalion, as the fire support coordinator, integrates the fires of the mortar platoon into the fire plan. Defensive fires, both nuclear and nonnuclear, are planned to bring the enemy under increasingly heavy fire as he approaches the battle area. Fires also are planned within the battle area to limit penetrations and to support offensive action needed to complete the destruction of the enemy.

Width of the Front

Under optimum conditions, a rifle platoon can defend a position up to 750 meters wide; a rifle company can control an area approximately 2,000 meters wide and 1,400 meters deep with 2 platoons forward and 1 platoon in reserve (ARTILLERY TRENDS, June 1959). Therefore, a battle group with an attached tank company can be expected to defend a frontage of approximately 8,000 meters (fig 25). Adequate means of firepower, surveillance, and communications are available to cover this area. Intervals between companies are covered by platoon and company weapons (81-mm mortars and 106-mm recoilless rifles), by battle group assault weapons and heavy mortars, and by supporting artillery fires. Devices

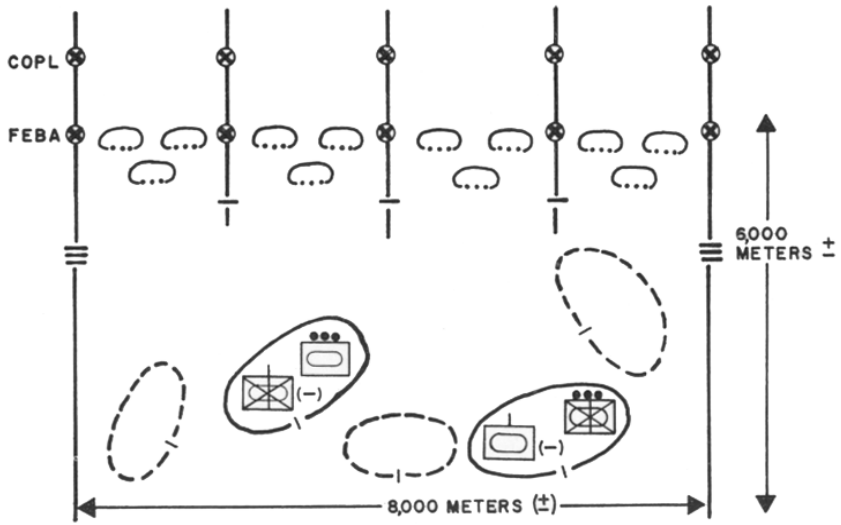


Figure 25. The battle group in the defense.

such as the AN/PPS-4 radar, one of which normally will be attached to each forward company, assist in surveillance of unoccupied areas. Depth and flexibility are provided by the retention of a sizeable, mobile reserve. Companies are positioned astride likely avenues of approach and are strong enough to force the enemy to mass if the enemy attempts a breakthrough. The fifth rifle company and the attached tank company are retained in assembly areas as the battle group reserve. Enough positions are prepared to permit reserve elements to assume a blocking role if required. By cross-attaching platoons between the mechanized rifle company and the tank company, the commander has two reserve forces of almost equal capability for both offensive and defensive action. Under certain conditions, the battle group may be required to defend a much wider frontage. In such cases the company reserves are committed first. This maintains an adequate battle group reserve.

In the defense, the deputy battle group commander may command combat outpost forces, reserve elements, a part of the forward edge of the battle area (FEBA), or rear area security forces when task forces are organized for these missions.

Offensive Operations

Plans for employment of the battle group in offensive operations must be based on the attack capabilities of the rifle company. Figure 26 shows the disposition of a mechanized rifle company in the attack under optimum conditions. The mechanized rifle company can attack on frontages up to 7,500 meters. The limiting factor is the range of the 81-mm mortar. The portion of this zone actually used depends on the mission, enemy, terrain, and fire support available. When adequate fire support is available from higher headquarters, emphasis is placed on seeking, locating, and determining suitable targets by the attacking forces. In situations where such fire support is not available, elements of the company may have to be concentrated to accomplish the mission. The same may be true when attacking in close terrain, or when clearance of the zone is required. Disposing attacking elements over the indicated frontages provides an excellent opportunity to develop nuclear targets and permits adequate dispersion to reduce vulnerability to enemy nuclear weapons. At the same time, the company is not so widely separated that it is unable to concentrate when required.

Under optimum conditions, the battle group can conduct offensive operations on frontages up to the range of the weapons under its control. Figure 27 shows the battle group attacking in two columns on such a frontage. Also shown is the close interrelationship between the battle group and its supporting artillery. The leading company in each column is disposed essentially as shown in figure 27 using multiple routes to gain maximum flexibility. Nonnuclear support for all elements of the battle group is provided by positioning the heavy mortar platoon in the column which is making the main attack, and positioning one of the two howitzer

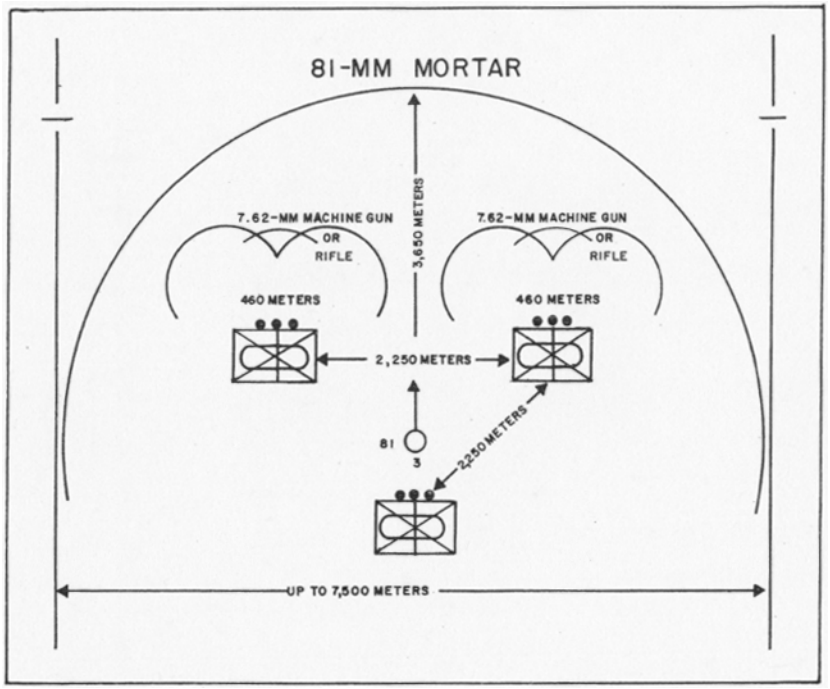


Figure 26. Mechanized rifle company in the attack under optimum conditions. Guide frontages are based on the effective ranges of organic weapons.

batteries of the direct support battalion in the other column. In addition, the leading companies are mutually supporting with 81-mm mortars. The force in each column is sufficient to sustain itself for limited periods. Therefore, this formation provides maximum flexibility, low nuclear vulnerability, and an excellent capability to develop targets.

Only necessary control measures are prescribed to insure that the attack is executed according to the commander's plan. The ability of a unit to control an area determines the size of the objectives assigned. The depth of zones of action depends on the ability of the unit to secure itself and keep lines of communication (logistical routes) open. If aerial lines of communication are used, the depth is limited only by the requirement to remain within reinforcing distance, which varies at each echelon according to the unit's capability for independent action. To insure close and continuous fire support, fire support elements displace by echelon. Once an objective is seized, only the forces needed to control the area and insure its retention against ground or airborne attack remain on it. The other forces move beyond the objective to provide security and effect maximum dispersion.

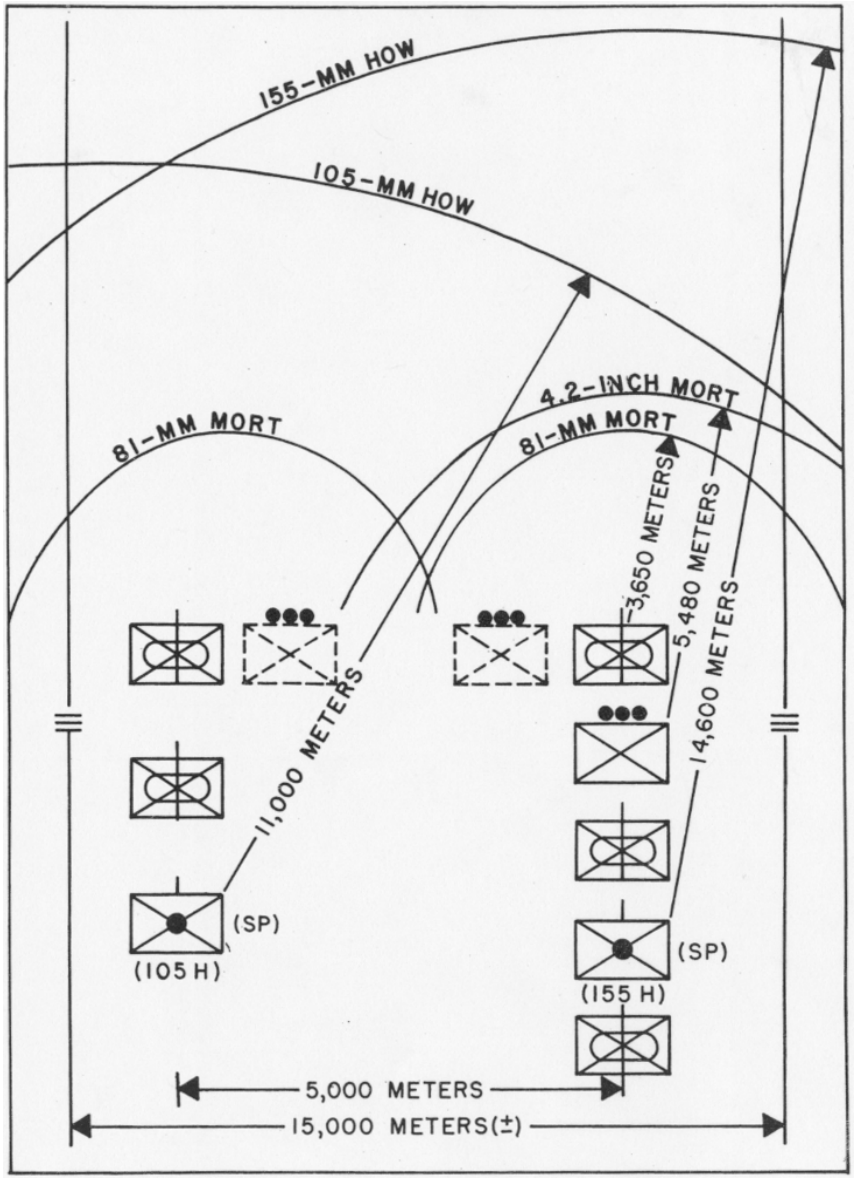


Figure 27. The mechanized battle group can attack on a 15,000 meter front.

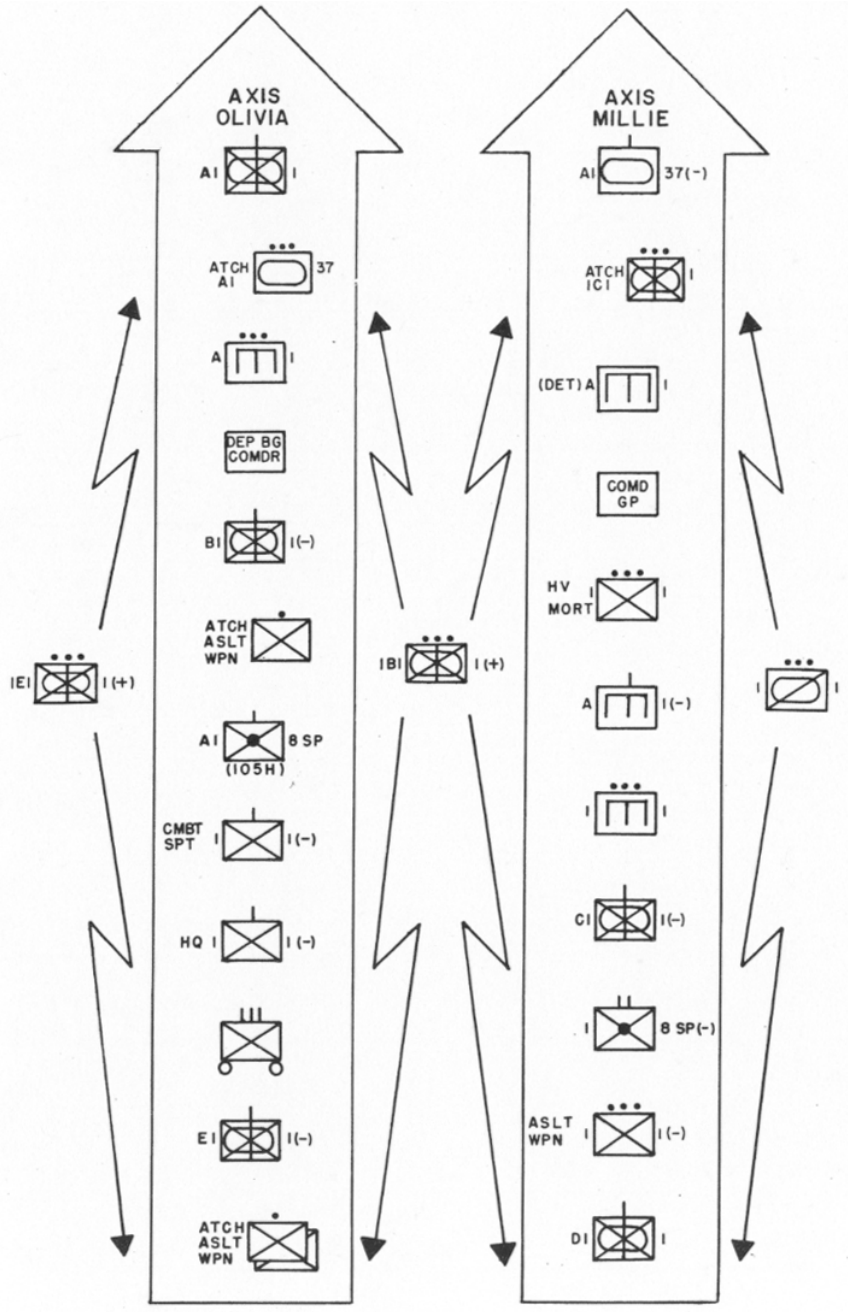


Figure 28. The mechanized battle group in the attack on two axes.

Attack on Two Axes

An organization of a battle group for an attack on two axes is shown in figure 28. Generally, this formation is used when the enemy situation is deteriorating, relatively detailed information of the enemy is available, trafficability is adequate, sufficient fire power is available, and there is a need to keep pressure on the enemy. In this particular situation, the battle group has enough personnel carriers to mechanize its elements, an engineer and tank company are attached, and a self-propelled artillery battalion is in direct support.

The battle group commander achieves flexibility in conducting the attack by making full use of all control headquarters available to him (6, including the tank company) and by providing 2 of the 6 companies with both infantry and tanks. The tank company, minus one platoon, forms the nucleus for a "tank-heavy" team to make the main attack on axis Millie. Company A, making the secondary attack on axis Olivia, has a platoon of tanks to increase its combat capability. The second rifle company in column on axis Millie attaches one platoon to the tank company. Fire support elements are split, but retained under centralized control, to insure adequate fire support, reduce the length of the columns, and reduce vulnerability to enemy nuclear weapons. The 105-mm howitzer battery marches on axis Olivia to support the secondary attack as the heavy mortars support the main attack.

Assault weapons are deployed on each axis to provide antitank protection in depth. Assault weapon squads are attached to those elements on axis Olivia which are responsible for flank security missions. The battle group commander's command group marches well forward on axis Millie where it can best influence the action of the main attack. The deputy battle group commander marches on axis Olivia, and, using the facilities of the combat support company headquarters, forms the nucleus of an alternate command group. He also may be provided with certain assistant battle group staff officers.

The reconnaissance platoon screens the right flank of the battle group, and Company E screens the left flank with a reinforced rifle platoon. Company B is responsible for screening the area between axes and maintaining contact with the forces on axis Millie. This leaves the leading elements free to focus their attention on the seizure of assigned objectives. Engineers are placed on each axis, with the bulk marching on axis Millie to support the main attack. Engineer reconnaissance detachments march well forward in each column.

Supporting elements of the division aviation company are employed in conjunction with security elements to assist in command and control and for resupply and medical evacuation.

Dismounted Attacks

Although mechanized operations are emphasized in the offense, dismounted attacks are still necessary--particularly against well-organized

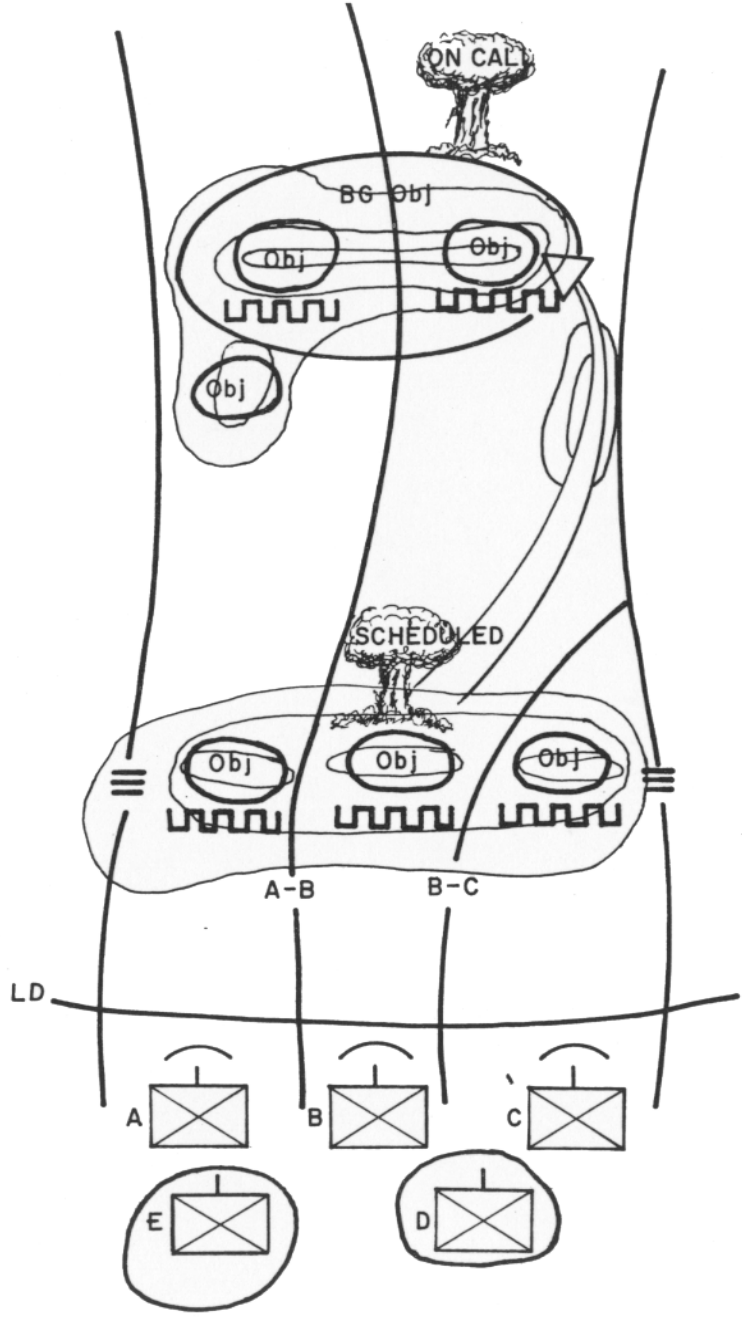


Figure 29. Dismounted battle group attacking.

positions, or where the terrain restricts the use of personnel carriers. The dismounted battle group frequently attacks with three or more companies in the attacking echelon (fig 29). By attacking with strong combat power forward, the possibility of finding and exploiting weak spots is increased. At the same time, a large reserve is retained. In nonnuclear warfare, the attacks are made on a narrow front with a heavy concentration of force in the zone of the main attack; however, the use of nuclear weapons permits a sizeable reduction in the depth and a corresponding increase in the width of the attack formation.

The battle group commander, faced with the dual requirement of conducting extremely fluid operations on wide frontages and seizing deep objectives, will turn more and more to the use of task forces. With communications and firepower available, the commander needs only the attachment of armored personnel carriers to readily organize task forces from elements of the battle group. Such task groupings, equipped with assault weapons, aircraft, surveillance equipment, and personnel carriers, will be formidable. When reinforced with tanks, division artillery, and the necessary service support elements, they can conduct semi-independent operations over long periods of time.

The recent changes in organization and equipment of the battle group, and in its supporting artillery, have expanded the battle group's influence on the battlefield and increased its versatility. It has greater internal flexibility for the formation of subgroupings around its rifle companies. It can, more easily than ever before, detach elements or accept attachments to accomplish missions not normal to its day-to-day employment. Through evolutionary progress in tactics, technique, and equipment, the infantry is approaching the day when it will achieve its stated objective-- "a superior differential of sustained, mobile combat power, capable of delivery at the decisive point in time and space, under any and all conditions of combat."

LOCATING ENEMY MISSILE FIRING POSITIONS

Captain Maxwell R. Conerly
Department of Target Acquisition

Locating enemy firing positions has been a major task of the field artillery throughout the history of warfare. In the Civil War observation balloons were used; in World War I sound ranging was first employed; and in World War II slow-moving light aircraft were invaluable for observing enemy weapons.

When Germany began firing V-1 and V-2 missiles in 1944, the problem of locating missile firing locations became critical because of the greater payload and longer range of the weapons and because firing positions were located farther behind the lines. New techniques and new equipment which could locate missile firing positions had to be developed. One technique now under development is the flash ranging system discussed here.

Generally, before a missile is fired, its position can be located by aerial observers or by drones equipped with airborne infrared devices or cameras. After a missile has been fired, the position can be located by using flash ranging set AN/TVS-1 (fig 30). Drones and the flash ranging method discussed in this article are equally effective against high- and low-trajectory missiles.

The flash ranging set AN/TVS-1 consists essentially of a tripod-mounted Polaroid Land camera with a horizontal field of view of 750 mils and a vertical field of view of 450 mils. The camera has a built-in grid system divided into 100 mil increments. The grids are fogged onto the film after the picture has been taken. A special instrument permits the reading of horizontal and vertical angles on the film (in the same manner as coordinates from a map) to an accuracy of plus or minus 1 mil. These angles are then applied to the clamping (orienting) azimuth and vertical angle to obtain the azimuth and vertical angle from the instrument to a target.

Locating a nuclear weapon before it is fired against friendly forces naturally is most desirable. A drone equipped with an airborne infrared device and camera can locate missile firing positions while they are being prepared.

When it is suspected that a firing position is being prepared somewhere within a general area, and when a map study shows that the area is suitable for a firing position, a drone is sent on a search mission. If a site is being prepared, an indication of activity is received on the drone's infrared device. This receipt automatically trips the shutter of a camera with a Polaroid back, and a photographic record of the area and activity is made. Facsimile equipment transmits the photograph to a central point for evaluation, and accurate location of the point.

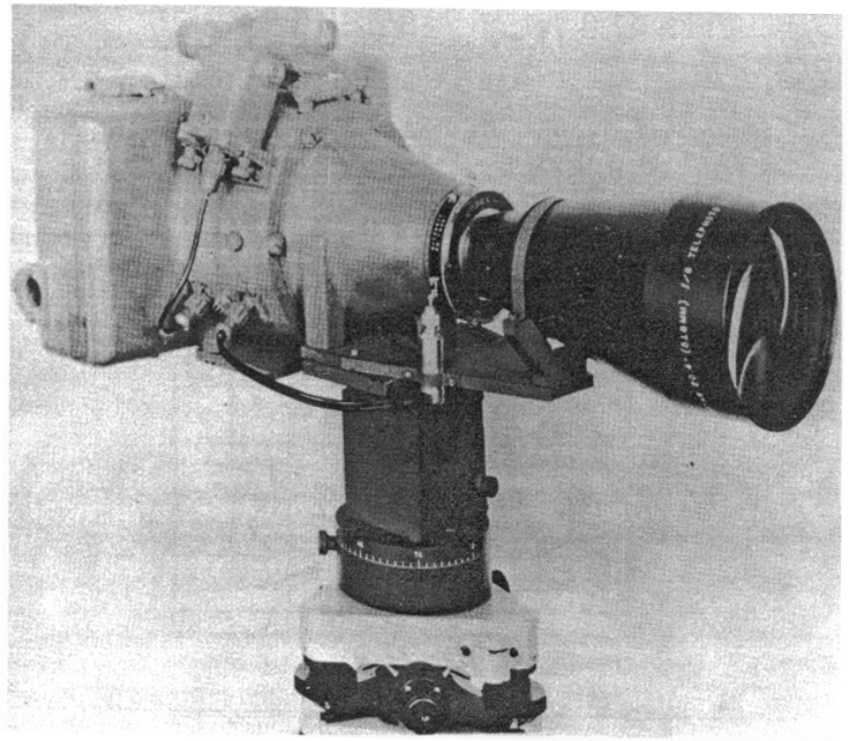


Figure 30. Flash ranging set AN/TVS-1.

After Firing

To locate a missile firing position after a missile is fired, 1 AN/ TVS-1 camera is installed (leveled, oriented, and during the hours of darkness the shutter opened) at each of 2 accurately located points, 01 and 02. The possible locations of enemy firing sites are determined from intelligence reports. With this information, the distance to a possible firing site is estimated. To locate firing sites accurately, 01 and 02 must be separated by at least one-half the distance from a line connecting the two points to the launching site (fig 31). For example, if the estimated distance between the line connecting 01 and 02 and the missile firing site is 30,000 meters, then the distance between 01 and 02 must be at least 15,000 meters. After the firing site is accurately located, the degree of accuracy

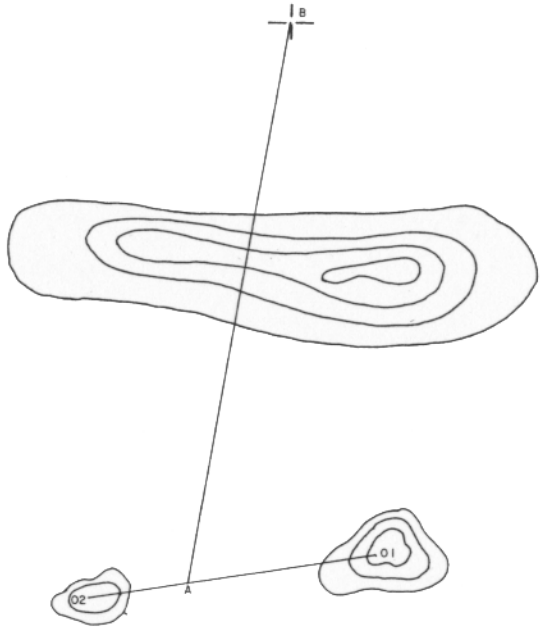


Figure 31. AN/TVS-1 cameras would be installed at 01 and 02. Point B is a possible or suspected firing site. For accurate locations, the distance between 01 and 02 must be at least one-half the distance AB.

of the plot can be checked by again comparing the two distances. If the distance from 01 to 02 is one-half of the length of a line connecting the two points with the firing site (fig 31), then the plot is located accurately.

When either observer (01 or 02) sees that a missile has been fired, the shutters are closed and the film developed. The path of the missile will appear as a streak or line on the film starting at a point where the missile clears defilade (point A, fig 32) and ending in a white dot of the missile burnout (point B, fig 32). In this case the missile would have passed between 01 and 02; however, it is not necessary that the missile pass between the two points.

Procedures and Techniques

Procedures and techniques for determining the missile firing position follow:

1. Observers determine and transmit to the plotting central the azimuths and vertical angles to points A and B.

2. The horizontal location of point B is determined by graphical intersection on a plotting board. The height is determined by computation.

3. The azimuths to point A from 01 and 02 are plotted. Since the point at which the missile clears the mask (point A) as seen by 01 may differ from the point as seen by 02, this will be a rough location.

4. The distance is scaled from point A to the control observation post, the one which measures the largest vertical angle to point A. In this case it is 02.

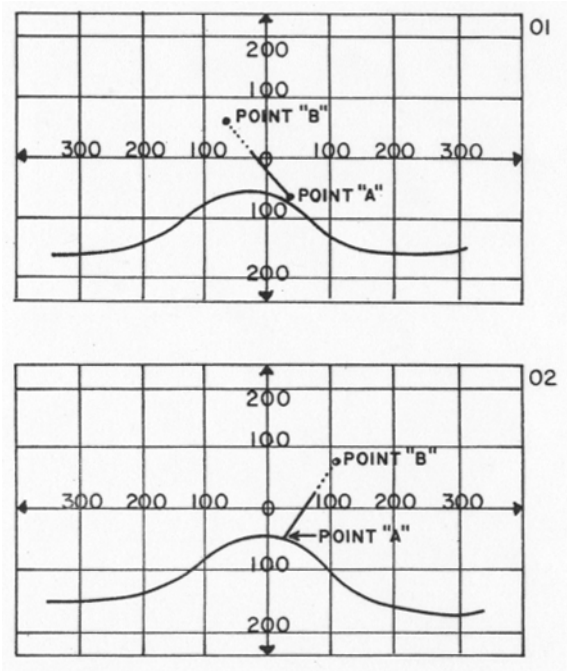


Figure 32. Missile trajectory as recorded by cameras at 01 and 02.

5. The height of point A is computed using the vertical angle and distance from 02 (the control observation post).

6. The distance is scaled from 01 to point A.

7. The vertical angle is computed from 01 to point A using the height determined in step 5 above and the distance that was determined in step 6.

8. On the photograph taken from 01, the azimuth is read from 01 to a point on the path of the missile at the vertical angle computed in step 7.

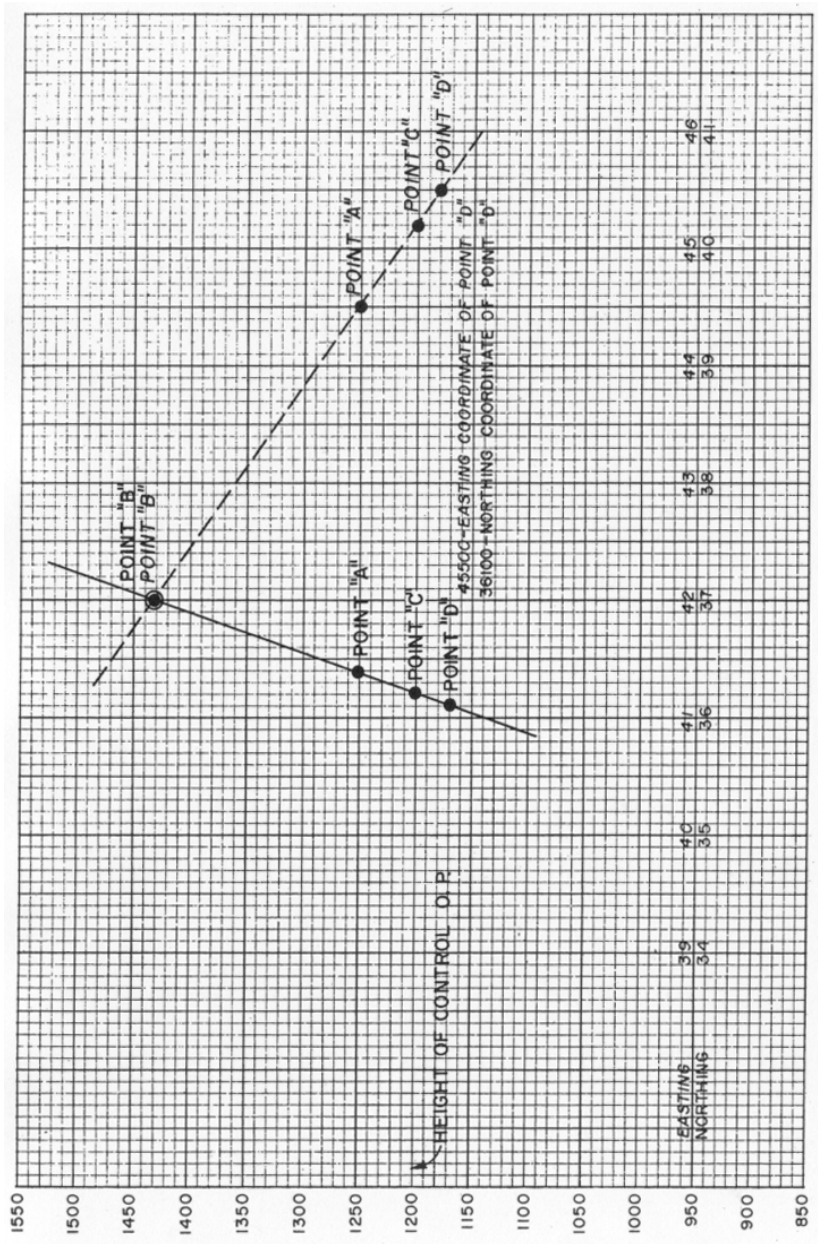


Figure 33. Plots made to determine coordinates of the missile launching site.

9. The azimuth determined in step 8 and the azimuth from 02 to point A is plotted (in some cases, the plot of point A may need further refinement). Now available are the true three-dimensional coordinates of points A and B on the path (considered a straight line during this portion of the flight) of the missile.

10. Using graph paper, the easting coordinates of points A and B are plotted against the height above the control observation post (02) (fig 33).

11. A straight line is drawn from point B through point A and extending through the line representing the height of the control observation post (02).

12. The easting coordinate of the intersection of these two lines (point C) is recorded.

13. This same procedure is repeated plotting the northing coordinate against the height.

14. The northing coordinate of point C is recorded.

15. Using the coordinates determined in steps 12 and 14, point C is plotted on a map showing relief, and its height is determined.

16. On the graph paper, the lines representing the missile path are extended to the height determined in step 15. This represents the true coordinates of point D--the firing position.

The above method works best at night; daylight makes the problem more difficult. However, it is believed, that by using the proper combination of film and filters, this system can be employed successfully during the day. Presently tests are being conducted to determine this proper combination of film and filters.

The discussion in this article illustrates a typical target acquisition problem. Further it briefly describes some of the methods and equipment presently employed to solve this problem. New and improved methods and equipment are being sought and developed to better solve the problems in the field of target acquisition.

The 1959 Army Ephemeris, TM 6-300-59, becomes obsolete on 31 December 1959. Survey officers who have not requisitioned TM 6-300-60 should submit requisitions immediately through adjutant general channels to insure the availability of up-to-date celestial information for their survey parties during 1960. The Army Ephemeris is not automatically issued to users.

"If, after the battle is over, your infantry don't like you, you are a poor artilleryman"

--Captain Henry Reilly

A New Team - The Artillery Direct Support Battalion and Infantry Mortars

When the Infantry Division organization (ARTILLERY TRENDS, March 1959) was adopted, a new team was created--the artillery direct support battalion and infantry heavy mortars. Under ROCID, the 4.2-inch mortars were in the artillery mortar battery. Now, the mortars are in the infantry heavy mortar platoon (fig 34), which is an infantry element organic to the combat support company of the battle group.

Since broad guidance for employing this platoon was published in ARTILLERY TRENDS, March 1959, a conference including representatives of the US Army Infantry School and the US Army Artillery and Missile School was held to determine employment procedures to be used until the appropriate field manuals are published.

Two general agreements provided a common base. First, the conference accepted the article "Tactical Employment of the New Division Artillery" (ARTILLERY TRENDS, March 1959) as doctrine governing the employment of the direct support battalion. Second, it was agreed that the direct support battalion commander, as battle group fire support coordinator, would advise the battle group commander on employing the heavy mortar platoon.

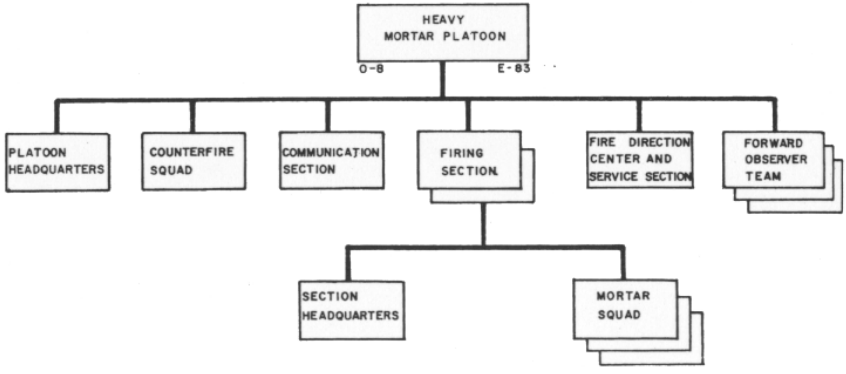


Figure 34. The heavy mortar platoon.

With these agreements serving as a point of departure, the conference reached agreement in the following areas:

(1) Coordination of fires. Heavy mortar and artillery fires are first coordinated by the rifle company commander. The coordination of heavy mortar fires between companies is done at the mortar platoon fire direction center (FDC), and the coordination of artillery fires between companies is done at the direct support battalion FDC. The final integration of heavy mortar fires into the artillery fire plan is done at the direct support battalion FDC.

(2) Observed fires. The means for attacking targets is selected by the company commander or his designated representative. When additional fires are required, they are requested directly through the artillery FDC or the mortar platoon FDC. Mortar and artillery forward observers send fire missions directly to their respective FDC's. Either observer may request and adjust fires of artillery or mortars. The mortar platoon fire direction officer requests artillery fires directly from the direct support battalion FDC.

(3) Communications. The direct support battalion establishes a forward switching central from which artillery forward observers lay their own lines. The mortar platoon may tie into this switching central to provide an alternate line to the mortar platoon FDC. The mortar platoon forward observers' wire lines are laid directly from their own FDC. A direct wire line must be maintained between the direct support battalion FDC and the mortar platoon FDC. Another AN/VRC-10 radio is needed to provide continuous radio communication between the heavy mortar platoon and the direct support battalion. It was determined that this could not be done with the men and equipment provided in either the infantry or the artillery table of organization and equipment (TOE). Therefore, the Artillery and Missile School proposed to US Continental Army Command (USCONARC) that one more wire team, its requisite communications equipment, and an AN/VRC-10 radio be added to each direct support battalion TOE.

(4) Survey. The survey control point for the heavy mortar platoon is established by the direct support battalion. This requirement is considered in the preparation of the division artillery survey plan.

(5) Observation. The battle group S2 coordinates infantry observation for the battle group, and the direct support battalion S2 coordinates artillery observation in the battle group zone of action. Artillery and mortar forward observers move on their own initiative to observe for the rifle company. The mortar platoon commander coordinates his own observers in that he directs them to observe for a particular company or in a certain sector.

(6) No-fire lines. No-fire lines are established by the direct support battalion commander after coordination with the battle group commander. No-fire lines will continue to be disseminated through artillery channels.

(7) Barrages. The mortar platoon may be assigned either a platoon barrage (6 mortars) or 2 section barrages (3 mortars each). The direct support battalion will be assigned 2 barrages--1 for each howitzer battery.

The agreements reached at the conference will govern instruction at both the Infantry School and the Artillery and Missile School until appropriate field manuals are published.

MOS PROFICIENCY TEST STUDY AIDS

In answer to queries from the field; study aids are published to assist personnel in preparing for MOS proficiency tests. The aids describe required job knowledge and appropriate study references. Individuals may obtain the proper aids from their unit personnel officers, who are responsible for procuring the test aids from the test control officer conducting tests for their unit. Extension course study is an excellent means of preparing for MOS proficiency tests.

AWARD OF CONSTRUCTIVE CREDIT EQUIVALENTS FOR RESERVE COMPONENT OFFICERS

The US Army Artillery and Missile School has received inquiries from officers concerning awarding of constructive credit equivalents. Department of the Army Circular 135-13, dated 24 July 1959, established criteria and procedures for award of constructive credit equivalents for company/battery, advanced, and Command and General Staff College courses to reserve component officers of the ready reserve.

Commanders of Zone of the Interior (ZI) armies or comparable commanders and the Chief, National Guard Bureau, are responsible for the awarding of constructive credits. Each officer concerned is to be notified of the constructive credit equivalent awarded, and an entry will be placed on the officer's DA Form 66.

DA Circular 135-13 has been distributed to National Guard organizations, down to and including company and battery sized units. Distribution has been made to USAR units and headquarters down to and including divisions.

Queries concerning this program should be made through command channels.

NEWS NOTES FOR ARTILLERYMEN

NEW FIRE DIRECTION PROCEDURE APPROVED

The new fire direction system submitted by the U S Army Artillery and Missile School (ARTILLERY TRENDS, June 1959) has been approved by US Continental Army Command (USCONARC).

The approved new procedures will be published as a change to FM 6-40.

A NEW WHEELED VEHICLE FAMILY--THE "GOER"

The US Army Armor Board at Fort Knox, Kentucky, is testing a new wheeled vehicle concept called the "Goer." The XM437 (fig 35) is a 15-ton payload cargo truck powered by a V8, 2-cycle, diesel engine which develops 274 horsepower.

Figure 35. The XM437, a member of the "Goer" family.

The "Goer" incorporates four features which should improve wheeled vehicle mobility--

(1) Large-diameter, low-pressure tires.

(2) Rear-wheel power assist (in low and reverse gears).

(3) Positive-powered wagon steering.

(4) Exoskeletal construction.

The four large-diameter powered wheels should improve mobility over ditches, boulders, chuck holes, and other rough terrain. The positive-powered wagon steering gives the vehicle good maneuverability. A "Goer" can make a "U-turn" on a road narrower than the vehicle is long. The exoskeletal construction permits the building of a vehicle that can float.

The XM437 resembles commercial earth-moving equipment and commercial automotive components have been used wherever practicable. The vehicle is driven by the two front wheels assisted by the rear wheels in low range and reverse. The torque from the engine is transmitted to the front wheels through the transmission while an engine driven alternating current (AC) generator provides power for driving the rear wheels and for steering. The vehicle has no suspension system.

The US Army Artillery and Missile School will evaluate the cargo "Goer" for artillery use.

UNCLASSIFIED NUCLEAR WEAPONS EFFECTS COMPUTER

The US Army Artillery and Missile School has developed a nuclear effects computer (fig 36 and 37), an unclassified device to assist in both classified and unclassified analyses of nuclear targets.

Target analysis can be performed rapidly with the computer. Also many yields and delivery systems may be considered simultaneously. Computations are simplified, and the possibility of "grocery store" arithmetic errors is reduced since values of certain parameters may be used directly on the computer. Therefore, ratios no longer need to be established.

Probability of fractional (P(f)) damage computations are made on one side of the computer. The other side is used for height-of-burst computations. Some uses of the nuclear effects computer are as follows:

a. With the given delivery error and required command guidance, the P(f) side (fig 36) gives the--

(1) Required radius of damage (R_D).

(2) P(f).

(3) Offset distance.

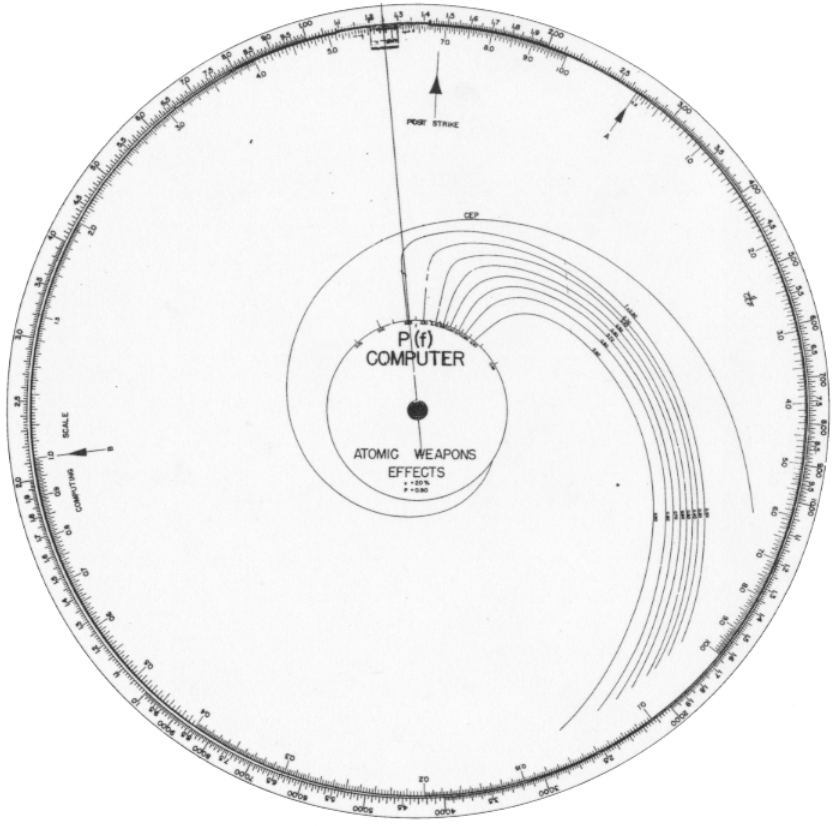


Figure 36. This side of the wheel is used for P(f) damage computations.

b. The height-of-burst side (fig 37), with pertinent information from the classified or unclassified nuclear table gives the--

(1) Minimum yield.

(2) 0.4 and 1/3 root scaling.

(3) Optimum height of burst checks.

(4) Minimum height of burst.

(5) Minimum safe distance (MSD) computation checks.

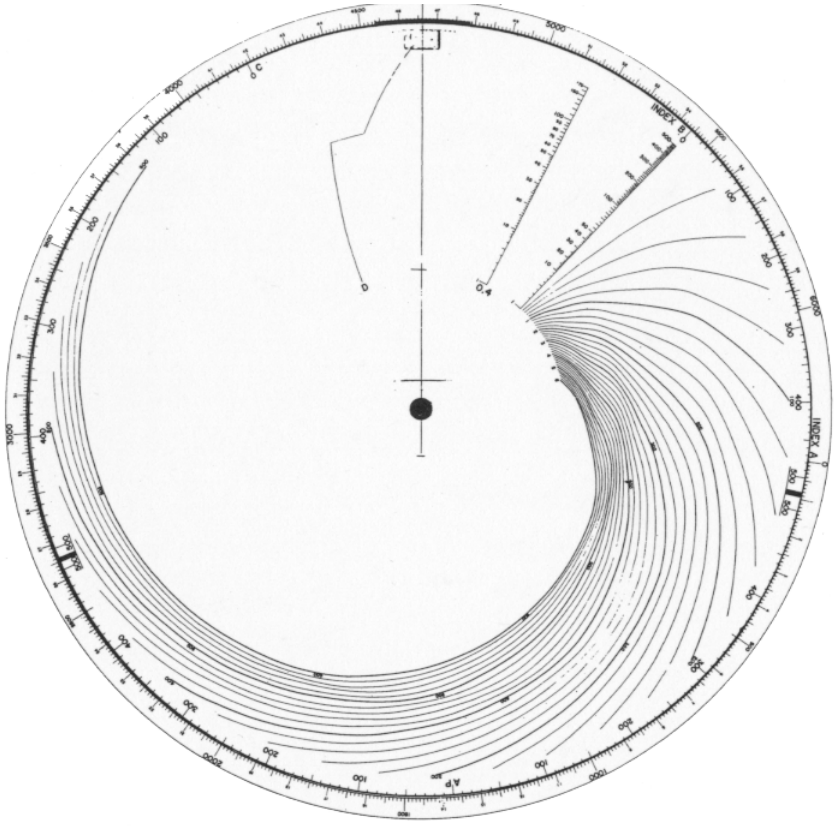


Figure 37. Height of burst computations are made using this side of the wheel.

The use of the nuclear weapons effects computer is being taught at the School. The computer may be purchased at the School bookstore for $5.90. Make checks or money orders payable to the "Book Department." Army regulations prohibit charge sales.

US ARMY ARTILLERY AND MISSILE CENTER REORGANIZED

Reorganization of the US Army Artillery and Missile Center became effective 15 July 1959. The new streamlined organization was designed for a threefold purpose--to reduce the span of control at Center level from 10 to 4 major units, to free the Center staff for additional policy and planning

functions, and to bring additional emphasis on Fort Sill's expanding surface-to-surface missile mission.

Major units of the new organization consist of the Artillery and Missile School; the 1st FA Missile Brigade; the Army Training Center for Field Artillery; and a newly organized 2d Artillery Brigade.

The Army Training Center for Field Artillery conducts worldwide replacement training for conventional artillery. The 2d Artillery Brigade includes the Center's tube artillery troop units, and the 1st FA Missile Brigade includes all missile units assigned to Fort Sill.

The organization of the US Army Artillery and Missile School, with the addition of the School Command, remains basically the same.

ACTIVATION OF TWO NEW LACROSSE BATTALIONS

Two new Lacrosse missile battalions have been activated at Fort Sill, Oklahoma. Ceremonies marked the activation of the 4th Missile Battalion (Lacrosse)(SP), 28th Artillery, on 22 July 1959, and the 6th Missile Battalion (Lacrosse)(SP), 8th Artillery, on 21 August 1959.

These two units are the third and fourth Lacrosse units activated at Fort Sill during 1959. The first two battalions, the 5th of the 41st and the 5th of the 42d, were activated earlier (ARTILLERY TRENDS, June 1959). The four battalions are attached to the 1st FA Missile Brigade at Fort Sill.

OFFICE OF DIRECTOR OF INSTRUCTION ESTABLISHED

On 13 April 1959, the US Army Artillery and Missile School established the Office of Director of Instruction. The new courses and modern techniques taught by the School necessitated the creation of a separate office to coordinate the efforts of all departments of the School in formulating instructional policy and doctrine.

The major functions of the newly organized office include preparation and revision of program of instruction (POI); scheduling classes and ammunition requirements; educational testing, research, and operation of the reading improvement laboratory; research on future instructional requirements; and preparation and manufacture of training aids and devices.

NEW AMMUNITION TRAILER

The XM332E1 is a cart-type, 1½-ton, 2-wheel ammunition trailer (fig 38). Following service testing the US Army Armor Board approved it for use by the Army. The test trailer accumulated 19,834 miles on all types of roads and terrain. It required no unscheduled second-echelon maintenance during the first 10,000 miles. Since there were no mechanical breakdowns, no field maintenance had to be performed. The trailer had no tendency to overturn, and there was no wheel hop or jack-knifing when brakes were applied.

The chassis has an underslung suspension and the drawbar is integral with the frame. The welded steel body and hinged tailgate is bolted to the frame. The air over hydraulic brakes are controlled by the driver of the prime mover, however the brakes can be hand set for parking. Brake and electrical connections plus a pintle make tandem towing possible. The caster landing gear can be raised or lowered by a jack screw. The axle angle is adjusted with respect to the longer axis of the vehicle by a small jack on each side.

The XM332E1 differs from the M10 presently being used. It is 8 inches longer, 9.5 inches wider, 6.5 inches higher, and 515 pounds heavier. The XM332E1 has 2 more square feet of cargo area, 8 more inches of tread width, the interior cargo body is 7 inches longer and 1 inch narrower, the side panels are 5 inches higher, and the loading height is 29 inches lower.

The XM332E1 carries 12 complete 8-inch rounds, twenty-four 155-mm rounds, and fifty 105-mm rounds. It can be towed by a 2½-ton truck; a 5-ton truck; the M59 or M113 armored personnel carriers; and the T195, T236, and M55 self-propelled howitzers.

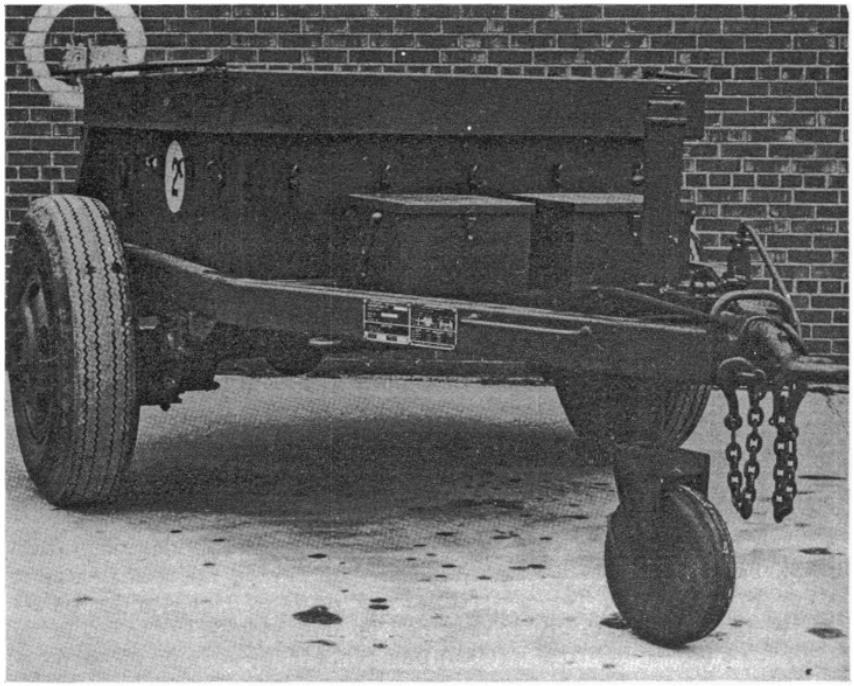


Figure 38. The XM332E1 ammunition trailer.

XM410 MAY REPLACE 2½-TON TRUCK

Another of a new family of Army trucks, the XM410, soon will be tested at Aberdeen Proving Grounds, Maryland. ARTILLERY TRENDS first presented this new concept in February 1959.

The XM410 (fig 39), a new "intermediate-duty" truck, has been reduced in weight by approximately 5,000 pounds from the weight of the 2½-ton truck, giving it approximately 30 percent greater payload-to-vehicle weight ratio and 50 percent better fuel mileage. This is in line with the effort to reduce weight for better air-transportability and greater fuel mileage.

Figure 39. The XM410 (left) is shown with a standard M35 2½-ton truck (right).

Using an aluminum integral body frame, the truck is constructed so that it will float when empty or loaded. An 8-cylinder, 165-horsepower engine, which eventually will be able to use gasoline, kerosene, or diesel fuel, is being utilized. All major components of the XM410 (an 8×8) will be interchangeable with the proposed 1-ton and 1½-ton members of the intermediate family. (The term 8×8 indicates that there are 8 wheels with power transmitted through all 8 wheels.) Greater mobility will be achieved through independent suspension on all wheels.

MUZZLE VELOCITY CHRONOGRAPH

The T7 muzzle velocity chronograph (fig 40) is a continuous wave X-band doppler radar chronograph. It was designed to measure the muzzle velocities of conventional field artillery and air defense artillery weapons of 40-mm calibers or larger; however after recent service tests it has been determined that the equipment will operate satisfactorily only with field artillery howitzers.

Velocity readings can be produced accurate to plus or minus 0.1 percent, or plus or minus 2 feet per second, whichever is greater.

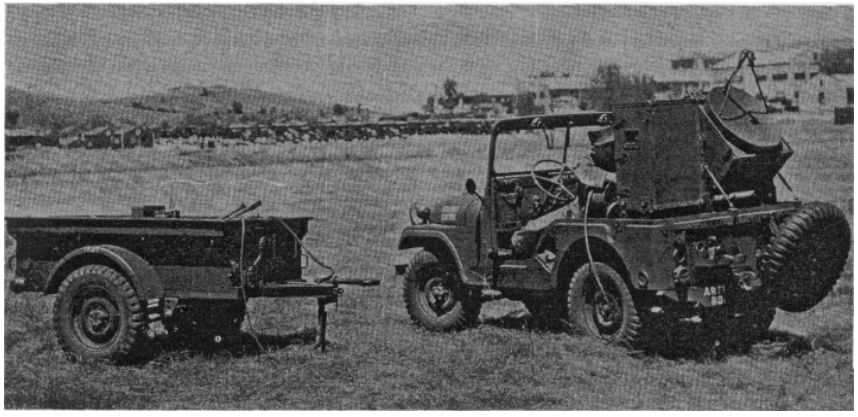


Figure 40. The T7 muzzle velocity chronograph mounted in operating position.

155-MM GUN, T245

The T245 self-propelled 155-mm gun (fig 41) is the second member of the T236 family (ARTILLERY TRENDS, February 1959) to be service tested by the US Army Artillery Board test team.

The T236 family has one carriage which mounts an 8-inch howitzer, a 155-mm gun, a 175-mm gun, or an armored or unarmored wrecker. These all have been built and are being service tested by Ordnance and the Armor, Artillery, and Arctic Boards. An additional member of the family, the XM491 is a cargo carrier. It will be built and tested in the near future.

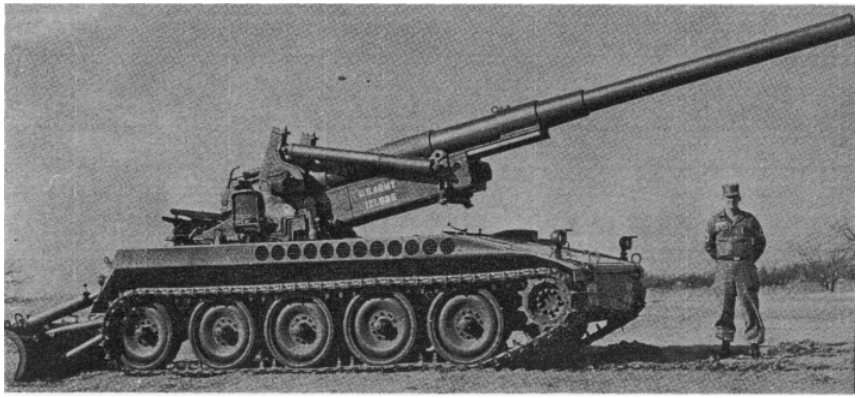


Figure 41. The T245 self-propelled 155-mm gun.

The T245 is an improvement over the previous models of the self-propelled 155-mm gun. The tube is the standard M2 tube, and the recoil system is a modified M4 type. The gun has oncarriage manual and power traverse which can be traversed 30° left and right of center. Its manual and power elevation limits are from 0° to 65°. The hydraulic spade mounted on the rear of the carriage and the suspension lockout cylinders provide an extremely stable firing platform.

TROPOSPHERIC SCATTER

A new communication technique should fill the gap, or skip zone (fig 42), that has long existed in radio communication between ground wave and sky wave. Military equipment has never satisfactorily bridged this gap. This new technique is called by several names--beyond-the-horizon, transhorizon, extended range transmission--but it is most commonly called tropospheric scatter, or tropo-scatter for short. All the names except "tropospheric scatter" are derived from the fact that the transmitting and receiving antennas are hidden from each other by the curvature of the earth. The patterns of the transmit and receive antennas cross common area in the troposphere (fig 43). A small part of the transmitted signal in the common area is reflected or scattered toward the receiver, hence the name "tropospheric scatter."

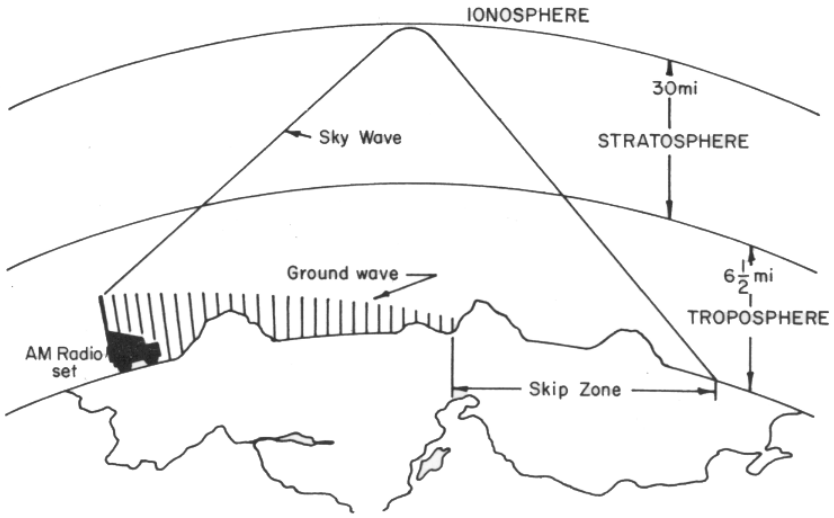


Figure 42. Skip zone in the troposphere.

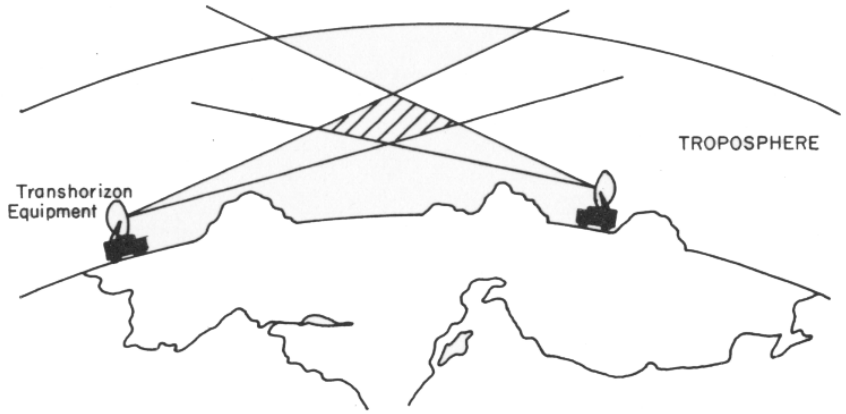


Figure 43. Technique of "tropospheric scatter."

Equipment to employ this technique is being developed. Higher power transmitters and larger antennas are necessary to compensate for scatter losses. The military requirement for mobility is met by mounting the radio equipment in a shelter and by mounting an inflatable parabolic antenna on top of the shelter. The shelter may be transported on a conventional wheeled or tracked vehicle. It is expected that this equipment will give a reliability of 99.9 percent at distances of 100 miles.

STATUS OF TRAINING LITERATURE

1. The following training literature is under preparation or revision by the US Army Artillery and Missile School.

A. Field Manuals:

6-20	FA Tactics and Techniques
6-25	FA Missile Group, Hvy (U)
6-35	FA Missile, Redstone
6-33	Warhead Section, M34 and M35 (Corporal) (U)
6-( )	Warhead Section, M24, M25, M26 and M29 (Honest John) (U)
6-( )	Warhead Section, XM18, XM30, XM31 and XM33 (Redstone) (U)
6-( )	Warhead Section, XM13, XM55 and XM16 (Lacrosse) (U)

6-( ) Projectile: Atomic, M366; and Atomic Training, M369; 280-mm Gun (U)
6-( ) Projectile: Atomic, T317E1; Atomic Training, T349E1; and T347; 8-inch Howitzer (U)
21-13 The Soldiers Guide

B. Training Circulars (TC):

TC 6-8 (SRD) Change 1, Atomic Ammunition for Field Artillery Guns and Howitzers
TC 6-( ) Nuclear Burst Data

2. Training literature submitted to USCONARC:

ATP 6-( ) Reserve Forces Act (Artillery)
ATT 6-5 FA Battalion, Light and Medium
ATT 6-( ) FA Howitzer Battery, 105-mm and 155-mm (Infantry Division)
ATT 6-( ) FA Howitzer Battalion, 105-mm and 155-mm (Infantry Division)
ATT 6-( ) FA Rocket/Howitzer Battalion (Infantry Division)
FM 6-18 Mortar Battery, Airborne Division, Battle Group
FM 6-40 FA Gunnery
FM 6-60 The FA Rocket, Honest John w/Launcher M289
FM 6-61 FA Missile Battalion, Honest John Rocket
FM 6-( ) Division Artillery (includes infantry, armored and airborne)
FM 6-( ) FA Missile, Lacrosse

3. Training literature at the Government Printing Office:

ATT 6-( ) FA Missile Battalions and Batteries, 762-mm

4. Training literature recently printed:

FM 6-30 FA Missile Battalion, Corporal
ATP 6-545 FA Missile Battalion, Corporal
ATP 6-585 FA Missile Battalion, Lacrosse
ATP 6-630 FA Missile Group, Redstone
ATT 6-10 FA Missile Battalion, Corporal
ATT 6-585 FA Missile Battalion, Lacrosse

5. Artillery training films currently under production and scheduled for release during calendar year 1960:

Artillery Orientation by Sun and Star
Part I. Altitude Method (20 minutes)

The Lacrosse Battalion
Part I. Operations and Functioning (30 minutes)

Weapons of the Field Artillery (30 minutes)

Extension of Direction for Artillery by Simultaneous Observation (25 minutes)

6. Artillery training films approved for release during calendar year 1959:

The Lacrosse Battalion
Part II. Description of Equipment (30 minutes)(TF 6-2798)

Artillery Survey
Part I. Methods (20 minutes)(TF 6-2800)

7. Non-MOS Army Subject Schedules (ASubjScd) published during calendar year 1959:

ASubjScd	6-3	Cannoneers' or Rocketeers' Instruction
ASubjScd	6-4	Combat Intelligence
ASubjScd	6-6	Communication Exercises for Artillery Units
ASubjScd	6-8	Counterbattery Operations
ASubjScd	6-9	Countermortar Operations
ASubjScd	6-11	Defense of Artillery Position Areas
ASubjScd	6-12	Field Exercises
ASubjScd	6-14	Fire Support Coordination
ASubjScd	6-16	Field Artillery Instruments and Duties of Instrument Operators
ASubjScd	6-17	Liaison
ASubjScd	6-21	Operation of Meteorological Sections
ASubjScd	6-22	Conduct of Observed Fires
ASubjScd	6-29	Artillery Survey
ASubjScd	6-30	Umpiring and Aggressor Forces

"Artillerymen have a love for their guns which is perhaps stronger than the feeling of any soldier for his weapons or any part of his equipment."

--S. L. A. Marshall

"Certainly, in all armies, it is in the artillery that the soldier can best perform his duty."

--Colonel Ardant du Picq

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