

CORG-M-281

COMBAT OPERATIONS RESEARCH GROUP

AD



CORG-M-281

CORG MEMORANDUM

CORG-M-281

AD 645160

**EVOLUTION OF THE US ARMY INFANTRY MORTAR SQUAD:
THE ARGONNE TO PLEIKU**

by

Virgil Ney

CLEARINGHOUSE FOR FEDERAL SCIENTIFIC & TECHNICAL INFORMATION	
Handcopy	Microfilm
\$3.00	\$6.65 128-22
/ ARCHIVE COPY	

July 1966

Distribution of this document is unlimited.

Prepared by
 TECHNICAL OPERATIONS, INCORPORATED
 COMBAT OPERATIONS RESEARCH GROUP
 under
 DA CONTRACT NO. DA-04-200-AMC-1623X
 for
 HEADQUARTERS
 UNITED STATES ARMY COMBAT DEVELOPMENTS COMMAND
 FORT BELVOIR, VIRGINIA

DISSEMINATED
A

F

COMBAT OPERATIONS RESEARCH GROUP



CORG MEMORANDUM

CORG-M-281

**EVOLUTION OF THE US ARMY INFANTRY MORTAR SQUAD:
THE ARGONNE TO PLEIKU**

by

Virgil Ney

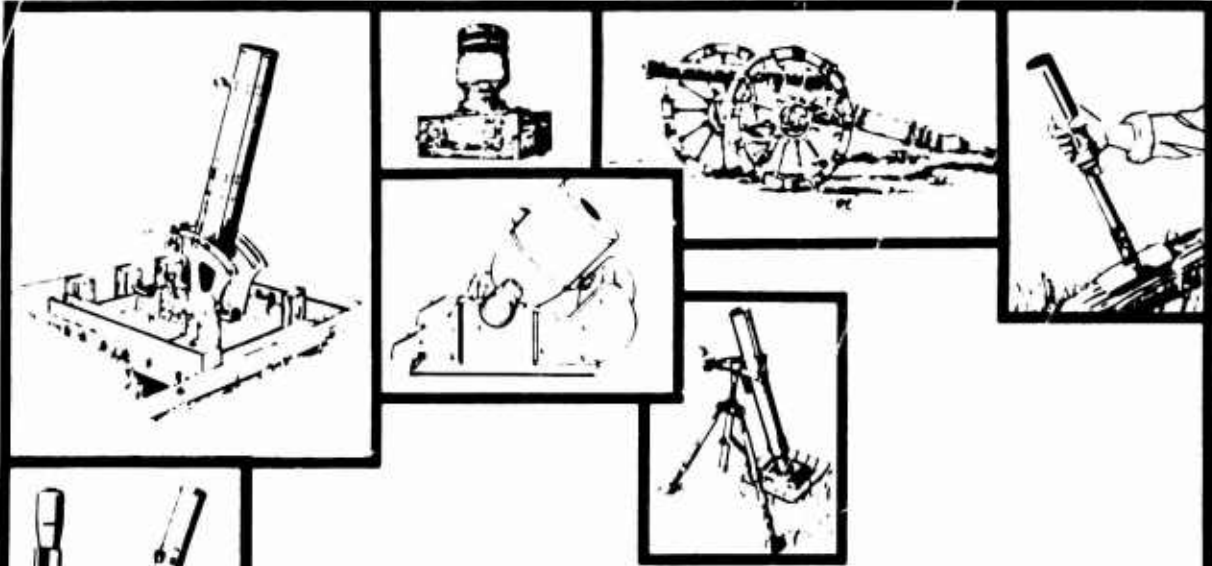
July 1966

Prepared by
TECHNICAL OPERATIONS, INCORPORATED
COMBAT OPERATIONS RESEARCH GROUP
under
DA CONTRACT NO. DA-04-200-AMC-1623X
CORG PROJECT NO. 13428
for
HEADQUARTERS
UNITED STATES ARMY COMBAT DEVELOPMENTS COMMAND
FORT BELVOIR, VIRGINIA

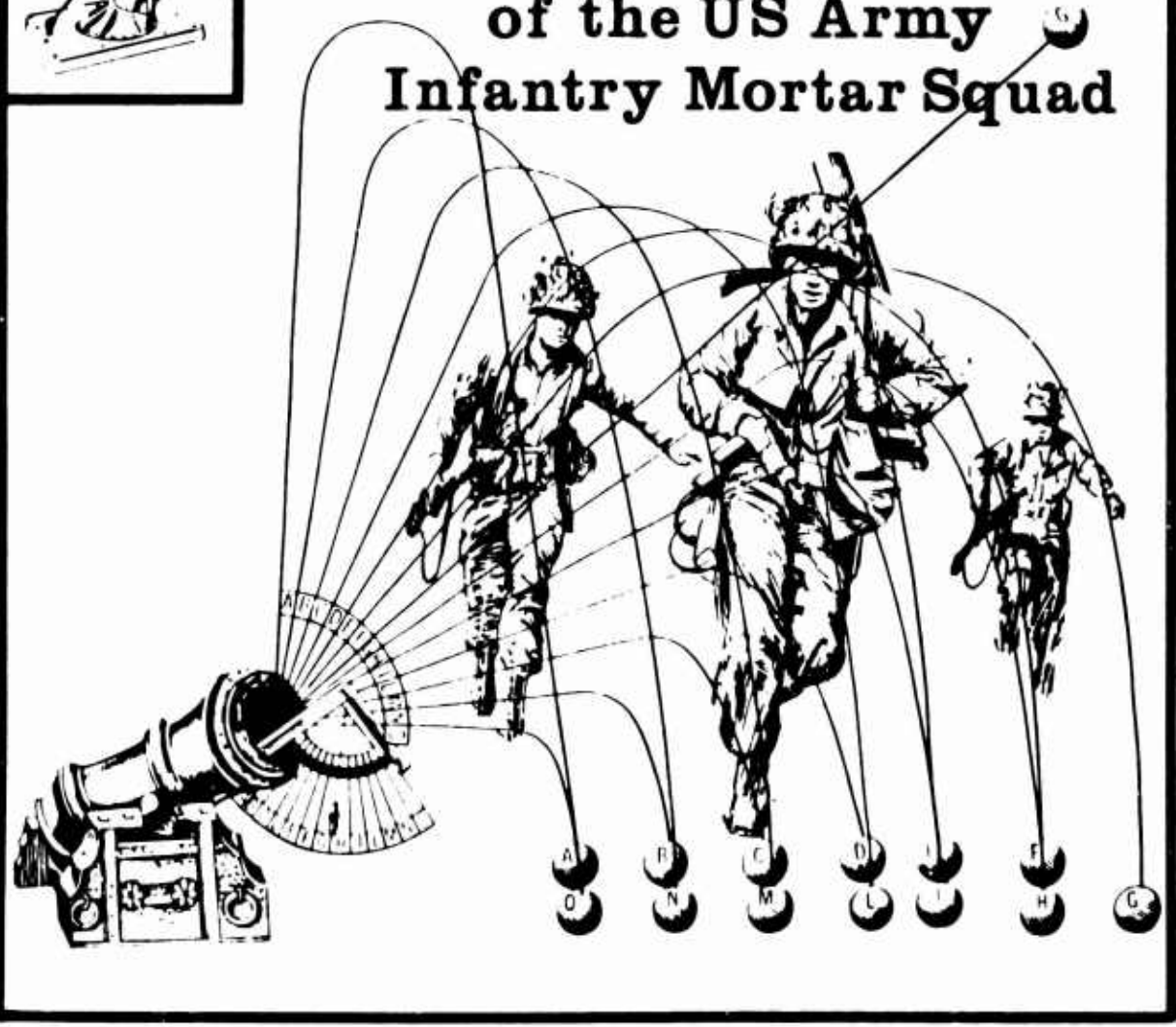
ABSTRACT

The infantry mortar squad evolved over a period of several centuries. Its basis rests in antiquity. Its present organization and function may be dated from the trench warfare of World War I. From the most ancient times, mortars have been identified with artillery. This traditional association continued generally until the advent of World War I.

The modern infantry mortar is essentially a product of the trench warfare of 1914-1918. In the postwar years, the mortar became a standard weapon of the infantry arm of all armies. The addition of the mortar to the infantry arsenal brought artillery characteristics and duties to the infantry. Mortars became highly portable artillery possessing great fire power to be used against targets often inaccessible to the infantry and patently unprofitable for engagement by heavier artillery.



Evolution of the US Army Infantry Mortar Squad



CONTENTS

	Page
ABSTRACT	ii
SUMMARY	vii
INTRODUCTION	1
LITERATURE CITED	13
WORLD WAR I	14
LITERATURE CITED	32
THE POST-WORLD WAR I PERIOD	33
LITERATURE CITED	41
WORLD WAR II PERIOD	42
LITERATURE CITED	55
THE KOREAN WAR	56
LITERATURE CITED	61
THE POST-KOREAN WAR AND VIETNAM WAR PERIOD	62
LITERATURE CITED	74
 APPENDIXES	
A. STUDY REQUEST	75
B. TABLES OF ORGANIZATION AND EQUIPMENT	77
C. DATA ON PRINCIPAL MORTARS IN USE IN EUROPE - WORLD WAR I	92
D. MOBILE MORTAR TO ACCOMPANY INFANTRY	94
E. TABLES OF ORGANIZATION AND EQUIPMENT	98
F. EXTRACT FROM CONGRESSIONAL MEDAL OF HONOR CITATION	107
BIBLIOGRAPHY	108
 LIST OF ILLUSTRATIONS	
Greek or Roman Catapult Type Ballista	1
"Pot-de-fer" - Early Iron Cannon	2
Cast Iron Mortar, 16th Century	3
Swedish Cast-iron Four Pounder, 17th Century	5
Siege and Garrison Mortars	7
13-inch "Dictator" Mortar at Petersburg	8
US Experimental Dynamite Gun, 1898	9
Filipino Guerrilla-made Cannon, 1900-1905	10
German "Minenwerfer" Trench Mortar, 1915	12
French 75mm Trench "Artillery," 1915	15
French 240mm Mortar, Model 1916	16
Tank Crushing a Strongpoint	19

CONTENTS (Concluded)

LIST OF ILLUSTRATIONS (Concluded)

Three-inch Stokes Mortar	20
Six-inch Newton Mortar	22
A "Fifty-Eight-Two" Mortar	24
Mobile Six-inch Newton Mortar, World War I	30
Mule-drawn Machinegun or Mortar Cart, M1917	35
Squad Organization, Howitzer Company, US Army, 1926	35
60mm Mortar Squad, US Infantry, World War II	37
81mm Mortar, World War II	43
60mm Mortar, M19	44
60mm Mortar Crew in Action	45
4.2-inch Mortar Crew in Firing Position, World War II	46
60mm Mortar Hand-held	48
Japanese 50mm Launcher	49
Mortars Sited in a Perimeter Defense	51
"Little David" 914mm US Army Mortar, World War II	54
Pusan Perimeter, 1 August 1950	57
4.2-inch Mortar Firing in Korea	58
Grenade Launcher, Vietnam	66
ROAD Division	67
Airmobile Division	67
Mortar Squad, First Cavalry (Airmobile) Division	69
Mechanical Mule, M274, 4x4	70

Illustrations by CORG Art Staff

SUMMARY

The infantry mortar squad has developed from the days of antiquity. Over the years, its basic functions have changed very little, if any. The mortar has remained much the same over the centuries and today, its tactics are basically those employed against the castles of medieval times. New and more powerful propellants and improved weapons created the need for skillful and competent mortarmen. The mortar squad changes over the years are essentially involved with the advancement of the weapon itself. The numbers remain few and mortar drill and combat tactics never became quite as technical as conventional artillery, but almost.

With present-day fire direction centers and forward observers for the conduct of mortar fire, the infantry mortarman is operating in much the same manner as the artilleryman. It must be concluded that the infantry mortar has made artillerymen out of a limited number of infantrymen. In a sense, this fact has helped to obliterate the sharp line of demarcation which existed formerly in the traditional and sacrosanct trinity of infantry, artillery, and cavalry.

Historically, the number of members in mortar squads has varied in accordance with the weight and caliber of the weapon organically assigned. The weight of the individual round of ammunition has had considerable bearing upon the number of men required to service the piece. The size and bulk of the mortar round also bears heavily upon the number of men needed to handle it at the mortar position. Another factor of importance, with reference to the number of personnel assigned to any mortar squad, is how the particular squad weapon breaks down for transport by hand. How it is loaded and secured on its transport vehicle will also determine, to a limited extent, the number of men required to perform the operation of loading and off-loading.

Basically, any infantry mortar, except the 60mm mortar, requires a minimal crew of three men to operate it in combat. However, additional men are needed to keep the ammunition moving from the rear to the gun position. With the elimination of animal-drawn transport, the motor vehicle driver must be added to the personnel total.

The need for heavier fire power caused the 60mm mortar to be abandoned by the United States Army as a rifle company mortar and its place taken by the 81mm mortar, the former battalion weapon. The 4.2-inch mortar has fallen naturally into line as the heavy weapon. The 81mm and the 4.2-inch mortars are both too heavy for the infantryman to handcarry for great distances. In terrain where mechanized carriers or vehicles cannot move with ease the mortars, of necessity, must be hand carried. This tends to inhibit or slow down the mobility of the infantry mortar squad and those to whom it may be attached or supporting in combat.

The requirements of counterinsurgency and the current operations in Vietnam indicate that the infantryman has expressed a desire for the return of the 60mm mortar. In view of this situation, it must be concluded that the

M-79 Grenade Launcher, which was the substitute for the 60mm mortar--at least, it was expected to fill the gap--has not done this to the infantry soldiers' satisfaction.* The lightweight and highly portable 60mm mortar is at home in the jungles and rice paddies. It is an easy load to carry in difficult terrain and it packs more punch than the grenade fired from the launcher. This must be concluded from the fact that the United States Marine Corps in Vietnam is now employing in combat the 60mm mortar and the 60mm mortar squad.

The new Army divisions under the ROAD and Airmobile concepts have caused some changes to be affected in the placement of the 81mm and 4.2-inch mortars. Personnel-wise, the squad organizations have been little altered. In numbers, the changes have been so slight as not to amount to more than the elimination of from three to four men from the squads. The leadership task of the mortar squad leader has steadily increased in responsibility. Further, technical advances in fire control methods and improvement of weapon tactics demand squad leaders of above-average military qualifications and leadership skills.

The infantry mortar has proved itself to be an essential weapon of modern warfare. Throughout its long history, it has enabled the infantry to place heavier fire upon enemy targets than that afforded by the traditional small-arms of the infantryman. The infantry mortar as developed after World War I, has remained basically the same. The requirements of modern warfare, including accelerated mobility on the ground and in the air, have lightened the weight of the mortar but has not changed its general characteristics.

The mission of the mortars has remained virtually unchanged--the placing of high-angle trajectory fire upon the objective or hostile target in support of attacking or defending infantry. Regardless of how the mortarman is organized, trained, armed, and transported to the combat area, there is no reason to believe that there will be any radical change in his historical mission in the foreseeable future.

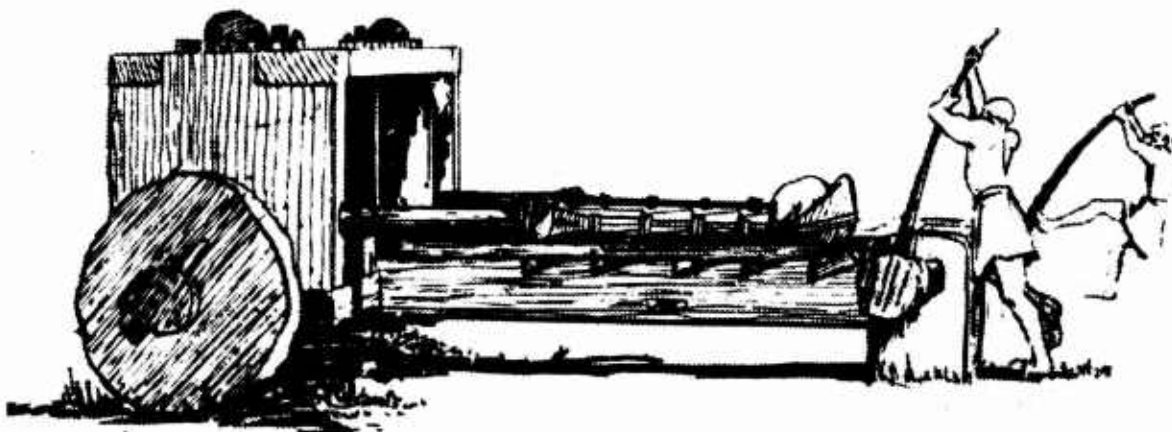
* Colonel S. W. Dziuban, "Choose Your Weapon," Military Review, Vol. XLVI, No. 10, October 1966. See Also: Brig. A. J. A. Arango-Jones, British Army, "An Exchange of Ideas," Infantry, Vol 56, No. 5, p 10, Sept-Oct 1966.

EVOLUTION OF THE US ARMY INFANTRY MORTAR SQUAD: THE ARGONNE TO PLEIKU

INTRODUCTION

From the days of antiquity, the delivery of lethal blows upon the enemy and his installations has been the primary function of organized military groups. As weapons improved, the struggle departed gradually from primitive man-to-man combat. With the advent of formations such as the Greek phalanx and the Roman legion, hand-to-hand combat became organized into a team and a mass effort.

However, the battle was joined when the masses and squares of spear- and sword-bearing infantrymen collided and clashed. There was little indirect combat except when rocks and javelins were hurled against the enemy by special machines. Among these pieces of crude artillery were the Grecian and Roman catapults and ballista, which supported the attack of the infantry and the cavalry. Dependent for their power upon the tension developed by the winding of cords of horse hair or fiber rope, these machines propelled various missiles with telling velocity and lethal effect.



Greek or Roman Catapult Type Ballista

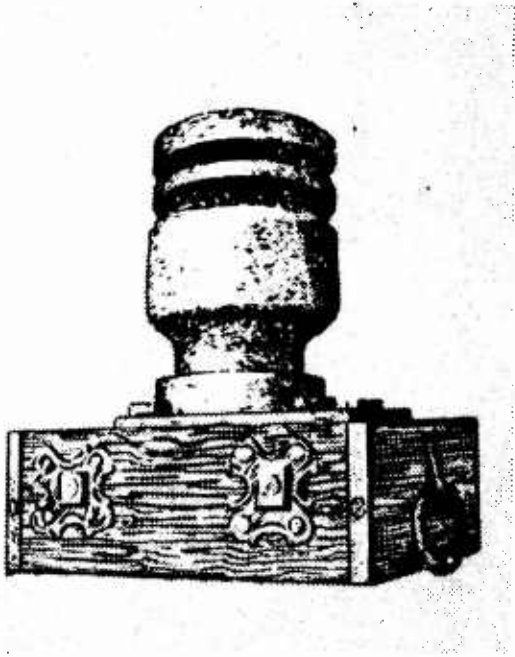


"Pot-de-fer" - Early Iron Cannon

Before the discovery of gunpowder the walled city and the castle offered considerable protection against the primitive siege weapons developed by the ancients. The catapult and the ballista were limited, in siege warfare, to hurling stones against walls and gates, or throwing large arrows into troop formations. The stones weighed generally about fifty pounds and when thrown by the catapult were destructive to fortress walls and highly lethal to all troops in the path of their trajectory up to a distance of 400 yards. In a type of primitive germ warfare, diseased corpses of men and animals were hurled over the walls by catapults to spread disease among the defenders and the civilian populace.

Eventually, the techniques developed and employed by these ancient operators of engines of war grew into a body of knowledge known as artillery science. The basic patterns of artillery operation developed from these crude and ancient weapons. Beginning with the use of gunpowder as a propellant in Western Europe in the 14th century the functions of the catapult and the ballista were taken over by crudely fashioned cannon and mortars. The high velocity and crushing power given the missile by the use of gunpowder revolutionized tactics and marked a great event in the history of warfare. Small cast-iron and bronze cannon and mortars of various sizes, shapes, and calibers eventually made their appearance. The pot-de-fer, or iron jug, fired an arrow which was propelled from its narrow neck by the ignition of powder packed in the bottom of the iron jug. Various classifications of the new field weapons were noted after their appearance upon the battlefield and upon the sea. The cannon and the mortar were both categorized by their function: one, direct fire and the other, indirect fire. These were the two broad, general groups of early heavy weapons. However, it should be noted that the range of the gun concerned had definite bearing upon its classification. Its purpose, whether battering or defending, was also considered in its ultimate designation.

The individual who influenced the development of the mortar proper was the Dutch soldier and inventor, Baron Van Menno Coehorn, who designed a small mortar in 1673. His design was the prototype of the mortar for a period of several hundred years. As the Coehorn mortar was portable in the small sizes, it should properly be considered the ancestor of the present-day infantry mortar found in all modern armies. Mortars of the Coehorn design were used by both armies during the American Civil War.



Cast-iron Mortar, 16th Century

The history of the mortar properly begins with the discovery of gunpowder in the 14th century. Traditionally, the first mortar was the vessel in which Friar Schwartz is supposed to have accidentally mixed saltpeter and charcoal and sulphur with a resultant explosion. Literally, this detonation was heard around the world--for it completely revolutionized warfare. Until the advent of gunpowder, warfare was largely a matter of organized, disciplined physical combat between massed armies of sword- and spear-bearing infantry or horse-mounted soldiers. The violence thus delivered upon the enemy, or his materiel, was personal and direct. The propellant power of gunpowder made battle more impersonal and indirect, with the blows delivered at long range by armies often out of direct, personal, physical contact.

When the first artillery developed, it was found that small projectiles could be fired more or less directly at the target. But heavier projectiles reacted to the 'pull of gravity' and dropped to the ground short of the mark. By increasing the angle of the gun it was found that heavy cannon-balls could be used but the path taken was an indirect one, (sic) a parabola. This led to the use of another type of gun, the mortar. This new trend of development led to short barrels, thicker walls to withstand the shock of exploding gunpowder, and wider bores or calibers. The wider mouth also permitted new types of projectiles to be used, such as balls and bar, and hollow shells filled with explosive mixtures which by means of a fuse went off in the air or on reaching the target. The mortar was useful in sieges because if a bombard could not batter its way through a wall or a gate, it could lob an explosive shell over the high wall and on to a powder store or some other vulnerable place.

(Ref 1, p 55)

The first use of artillery was for the purpose of battering or breaching the stone and brick walls of fortified cities and castles. An explosive missile for use against enemy personnel was soon developed. Personnel in the open were normal targets for artillery. Those behind the protection of walls were difficult targets for the usual field gun. Field guns

were required to deliver frontal, flat trajectory, fires. But guns were also needed which could lob a fire bomb in a high trajectory over fortification walls.

The eighteenth-century mortar looked like a fat cooking pot with thick walls. It was fired almost straight up into the air with an extremely high trajectory. Its projectile fell sharply downward on troops taking cover behind earthworks or positioned too close to friendly forces for safe use of a howitzer. Properly handled, it has always been an extremely accurate and effective weapon.

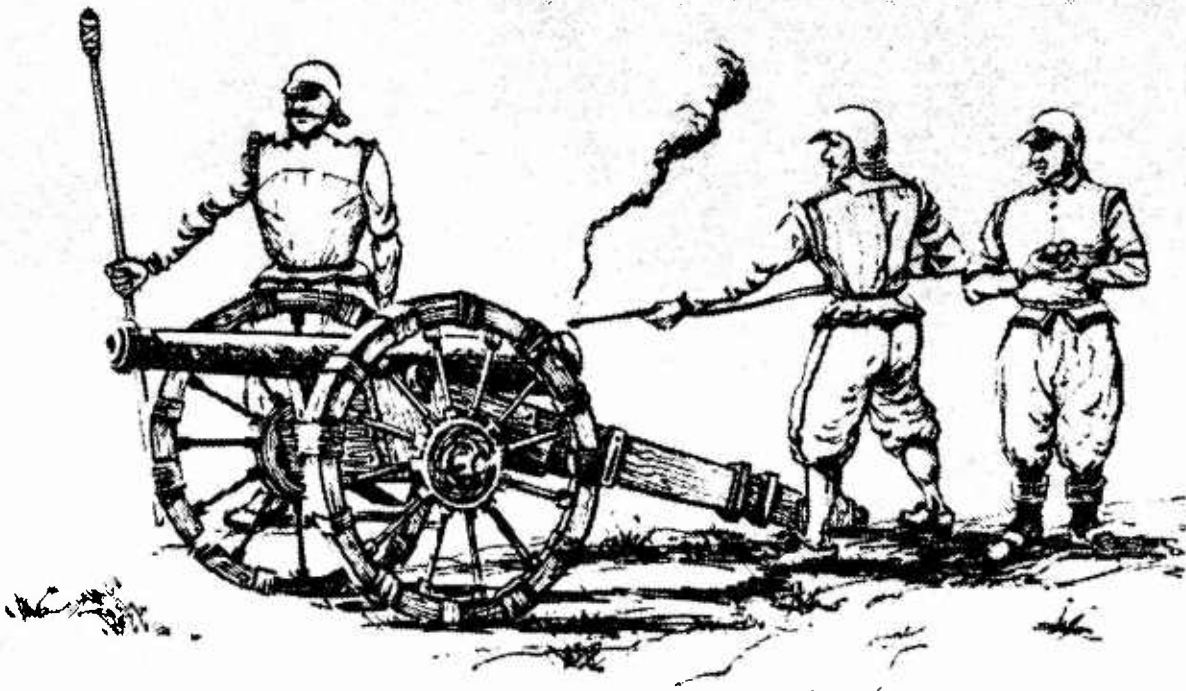
(Ref 2, p 48)

Thus the mortar with its high angle of fire became a separate and distinct type of artillery. Originally, the mortar was employed in static siege operations. The field gun was employed usually in mobile or siege combat in close support of the infantry or cavalry.

For centuries the infantry of all armies depended upon swords, spears, bows and arrows, muskets, rifles, and bayonets as the basic tools of its trade. The improvement of the lethal quality in the weaponry of each period of history contributed toward the need for heavier fire power. Eventually the breech-loading, multi-barrelled gun, the repeating rifle, and the machine-gun were to increase the accuracy and volume of infantry supporting fire but not, necessarily, its weight. Artillery, with its capabilities of throwing heavy projectiles against personnel, walled cities, and fortresses, gave the infantry a classical type of powerful support. Historically, this support was to become so important that out of it grew the principle of combined arms; that is, infantry, artillery, and cavalry teamed together to achieve fire and maneuver in order to defeat the enemy.

The idea of an infantry-accompanying gun or artillery piece assigned organically to an infantry unit is not new. The great Swedish soldier, Gustavus Adolphus, one of the earliest field commanders initiated this practice. His introduction of leather-bound iron field guns gave his infantry a tremendous advantage over enemy infantry armed with shoulder weapons only. However, it should be noted that Gustavus's field guns were flat trajectory weapons, not curved trajectory mortars. Essentially, they were for frontal fires delivered against personnel and static positions of defense. Their capabilities of inflicting casualties upon hostile troops behind walls and trenches were severely limited by their flat trajectory.

The greatest military value of the mortar was its ability to deliver high-angle fire upon targets which were situated behind castle and fortification walls or in terrain defilade. While the accompanying field guns of the artillery were useful against troops or in battering down obstacles, they were limited in their ability to strike within the confines of a fortified area. Hence, the mortar became an important adjunct to the field guns. In 1776, General Gribeauval, Inspector General of Artillery of the French Army, included a



Swedish Cast-iron Four Pounder, 17th Century

light mortar within his famous systeme Gribeauval:

A basic step in the direction of a related family of weapons was to establish a limited number of sizes and types and to supply them universally throughout the army. Until this was done, the army had a collection of weapons which was almost impossible to keep supplied in the field because of the many variances in size and type. Gribeauval's light field artillery, for instance, consisted of 4- and 6-pound howitzers and a mortar with a bore of about six inches. All these cannons were mounted on the same basic carriage so that many carriage parts were interchangeable.

(Ref 2, p 48)

In the American Revolution, mortars were identified with the artillery and were employed primarily in siege warfare. Today, various examples of mortars of the Baron Coehorn type are found emplaced on Revolutionary War battle fields such as Yorktown and Saratoga. Basically, the infantry of that day consisted of musketeers, riflemen, or grenadiers. The idea of the infantry-supporting gun of Gustavus Adolphus had not been carried out in the American forces. This lack of infantry organic supporting weapons was offset by the establishment of a separate artillery corps which included field guns and light and heavy mortars in its weaponry. This general approach to the addition of heavier fire power to assist the infantry obtained in the United States Army until the end of the Spanish-American War in 1898.

Infantry has always been an arm of maneuver, essentially, until the mid-twentieth century, by foot marches. The continual addition of heavier weapons to the burden of the foot soldier has been a controversial subject in the military profession for centuries. The advantages to be gained for the infantry by the fire power of heavier weapons were equated with the formula of fire and maneuver--especially in offensive warfare. The developing combined arms formula of Infantry, Artillery, and Cavalry served to solve the problem of close infantry support until the advent of almost total positional, stabilized warfare in World War I.

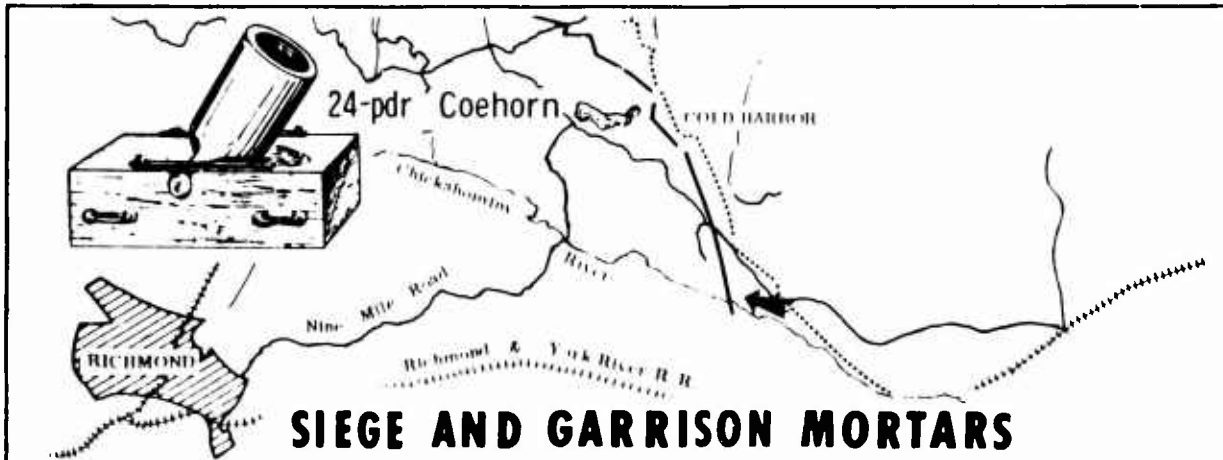
In the American Civil War (1861-1865), infantry was supported by separate artillery units which were attached to the regiments, divisions, and corps. Heavy and light artillery and siege guns were employed in offensive and defensive operations. There was no movement toward the establishment of an infantry-supporting gun and the artillery continued in its traditional separate role as an important member of the combined arms trinity. Mortars of various calibers were utilized by the artillery in support of offensive action by infantry and in siege operations, such as Vicksburg and, later, Petersburg.

Throughout the Civil War, the weapons of the infantry of both armies consisted of: the rifled .58 caliber musket, the bayonet, grenades, the .36 or .44 caliber pistol, the sword, and the saber. Any required heavier weapon fire support was furnished by the attached or assigned artillery.

The use of mortars against ships was an early tactic of the land-bound artillerymen. As all war ships were essentially wooden until the American Civil War, the crushing effect of a heavy projectile of stone or iron upon the deck was often disabling or fatal to crew and vessel. Hence, heavy caliber mortars were developed for seacoast defense and as such were continued in use well into the twentieth century. Whether of the muzzle-loading or breech-loading period, the seacoast mortar served as an effective deterrent to seaborne attack.

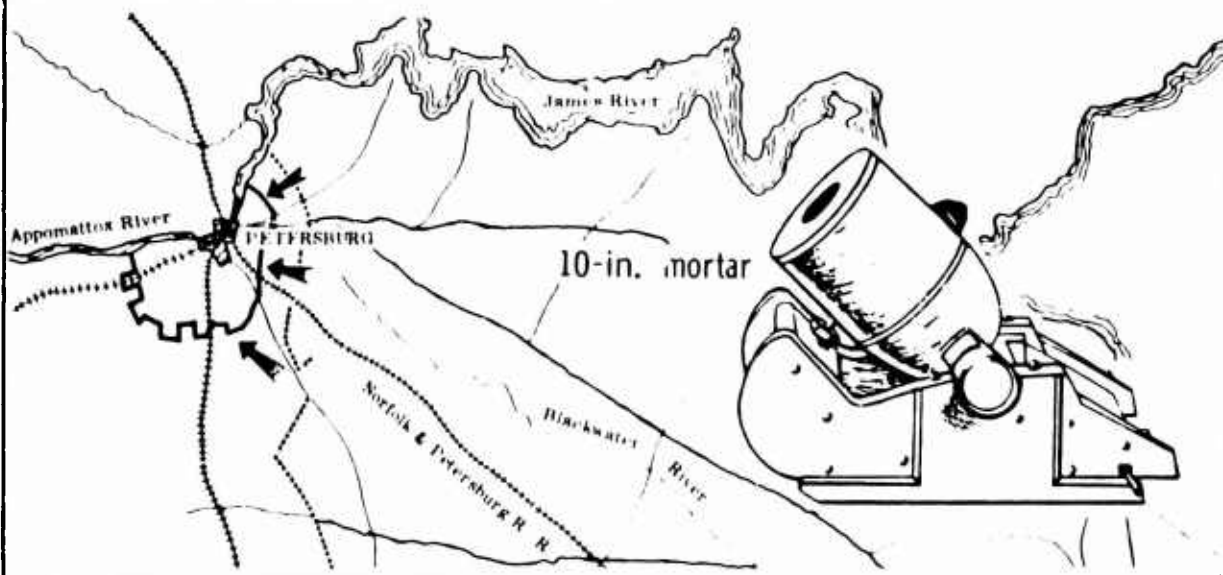
Of considerable interest historically was the use of railroad cars as highly mobile mortar mounts during the Civil War. An example of this employment was the mortar employed against the Confederate positions at Petersburg, Virginia. The 13-inch "Dictator" could throw its 220-pound bomb a distance of 4,325 yards. While this huge 13-inch weapon could not, in any sense, be construed as an infantry mortar, it did serve in support of the attacking or besieging infantry units.

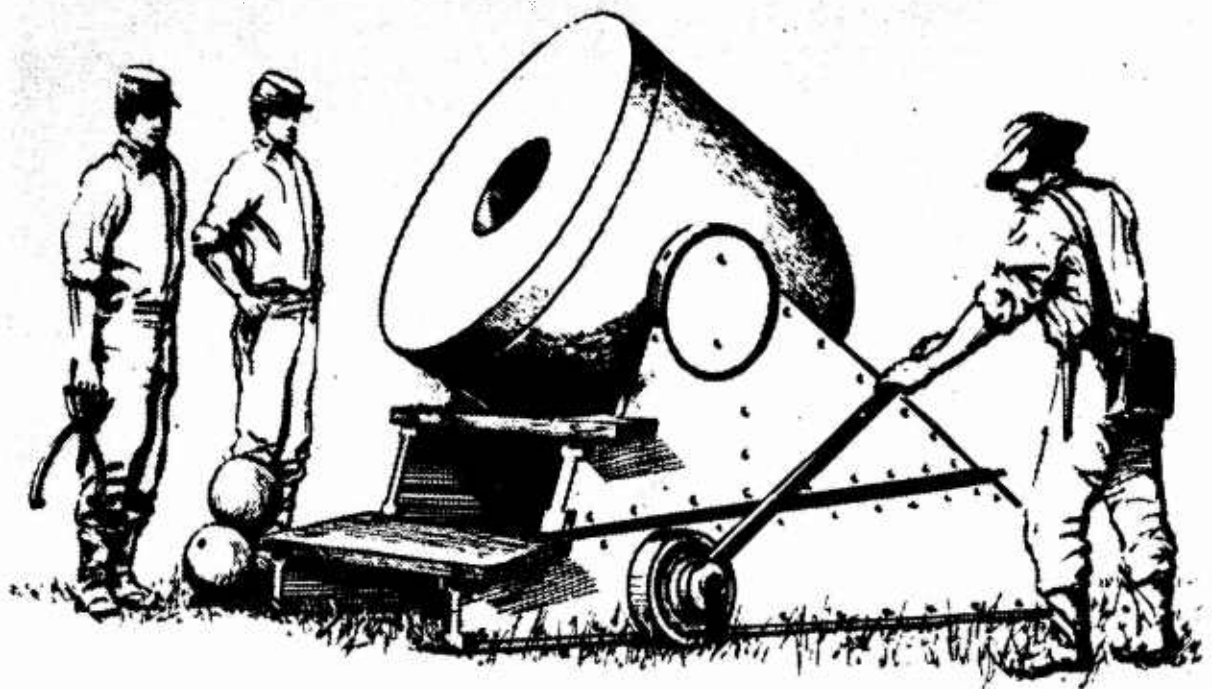
Mortars of various sizes and calibers were adapted to naval and amphibious warfare during the Civil War. Mortar boats and barges were in operation on the Mississippi and other rivers during the southward movement of the Federal Armies. Mortars were dragged and floated through the swamps of the Carolinas by the artillerists of both the Union and Confederate Armies. The smaller caliber mortars were mobile, but during the Civil War they were never considered as infantry weapons. The weight of both mortar and projectile of the Civil War period precluded their movement by other than tedious and laborious means. The following table is of interest in this connection.



SIEGE AND GARRISON MORTARS

	Bore diameter, in.	Length of tube, in.	Weight of tube, lb	Weight of projectile, lb	Weight of charge, lb	Bursting charge, lb	Range, yd 45° elevation
8-in. mortar	8.00	22.50	930	44.5	3.75	2.0	1200
10-in. mortar	10.00	28.00	1852	87.5	4.00	5.0	2100
24-pdr Coehorn	5.82	16.32	164	17.0	.50	1.0	1200
10-in. mortar	10.00	46.00	5775	87.5	10.00	5.0	4250
13-in. mortar	13.00	53.00	17,120	220.0	20.00	11.0	4325



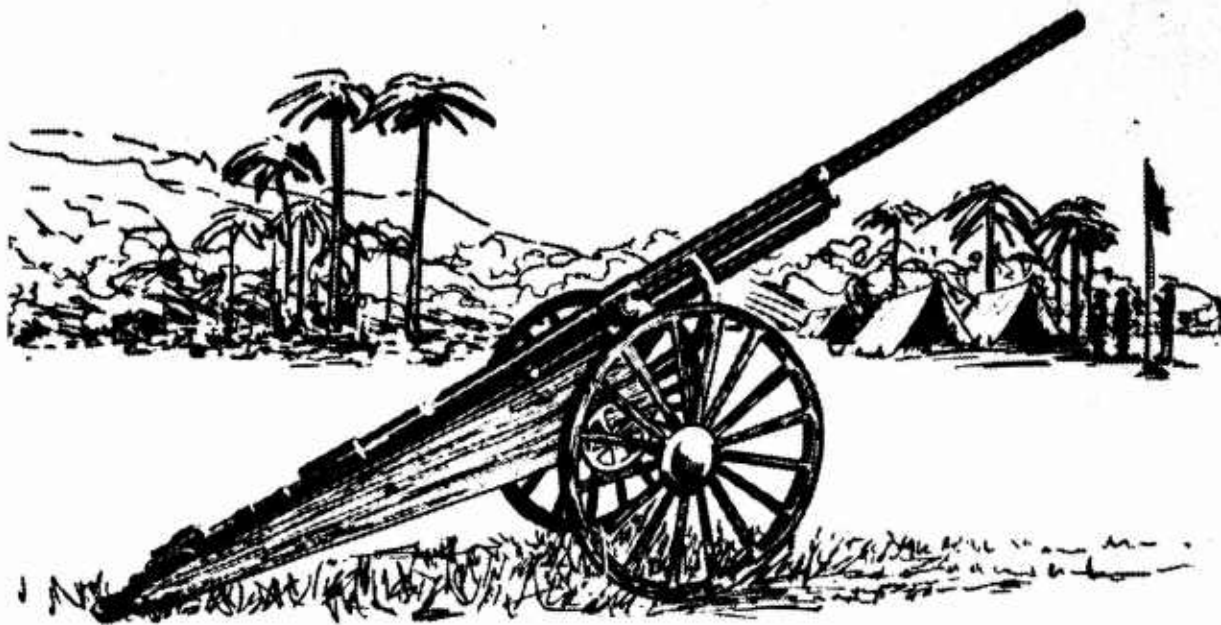


13-inch "Dictator" Mortar at Petersburg

From the table on the preceding page, it will be noted that the 24-pounder Coehorn mortar came close to satisfying the requirement for an accompanying infantry mortar. Its weight, and the weight of the projectile, and the fact that it could be operated by two men made it the most portable and mobile of the Civil War mortars. (It is of interest to note that the 60mm mortar squad of the United States Infantry of 1940 contained a mortar gunner and his assistant and three ammunition bearers.)

The military doctrine of Indian campaigns on the western plains called for little or no employment of artillery. However, artillerymen, or "wagon soldiers" as they were called by the Indians, were usually present within the log and adobe or stone forts which dotted the prairies of the Western United States from the Civil War to the beginning of the twentieth century. Obviously, in view of the final result of the Little Big Horn battle, General George A. Custer with a few artillery pieces would have been able to survive the total destruction of his command. Eight-inch Coehorns would have been invaluable for dropping a few rounds into the valleys where the Sioux were assembling for the attack. (The Gatling gun was available to Custer's unit but this early machine gun was not present with the troops.)

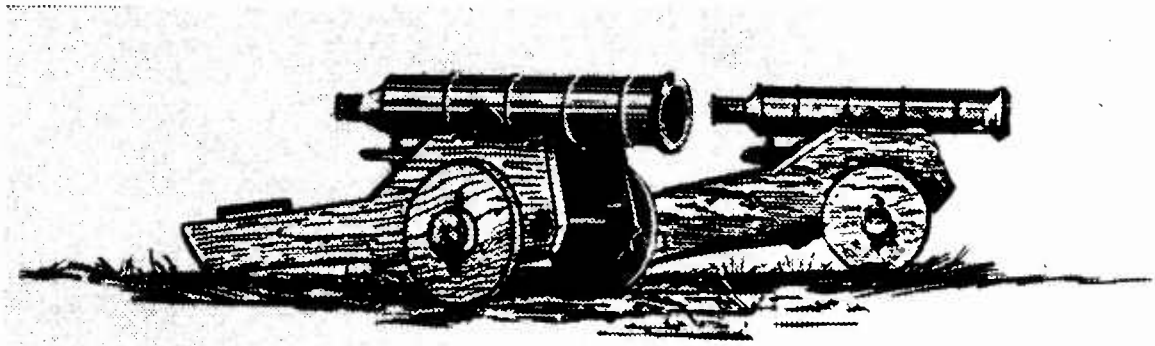
In the United States Army of the 1800's, mortars were considered weapons of the artillery and there they remained for another forty years. Seacoast defense mortars were emplaced on the coasts with the mission of lobbing bombs onto the decks of attacking vessels. This was a departure from the usual siege role of the mortar and was, in a sense, in direct support of the heavy artillery which was in position within the ramparts of the fortification. Until the early 1900's mortars were muzzle-loading. The advent of breech-loading artillery brought forth breech-loading mortars, especially those employed in seacoast defense.



US Experimental Dynamite Gun, 1898

During the period of the Spanish-American War (1898-1900), mortars were used rarely in the Army offensives in Cuba and the Philippines. Artillery support was close and effective in the usual infantry, artillery, cavalry combination. The Gatling Gun, which many of the old-time regular artillerists considered to be the "poor artillery," appeared in action at San Juan Hill. The other novel weapon to show up on the field in support of the Rough Riders was the mobile dynamite gun. This military oddity was fired by compressed air and it performed the function of a close-support infantry mortar in lobbing dynamite shells directly into the Spanish blockhouses. The following description of the short-lived weapon is of interest:

Guns of this type used a dynamite-filled projectile, which was driven from the gun by a charge of compressed air generated by discharging a blank cartridge in the lower barrel. The projectile had a screw propeller similar to a torpedo to steady it and give it direction. General Frederick Funston says of its use in Cuba: "When it gave its characteristic cough we saw the projectile sail through the air and strike the blockhouse squarely in the center, the shell penetrated and burst inside, killing the sixteen defenders, the structure was all demolished, portions of the roof being blown a hundred feet in the air." (Ref 3, p 94)



Filipino Guerrilla-made Cannon, 1900-1905

While the dynamite gun was not a mortar, it performed the essential mortar function of close support of the attacking troops. By its use they were given additional fire power by a weapon other than conventional artillery. The high-angle curved trajectory performance of the weapon qualified it for mortar classification. But the "coughing gun" was not destined for permanence in the arsenal of United States Army weapons. Although it fought its fight successfully and well, it was too novel to be accepted by a generation of professionals which had been "brought up" on black gunpowder as the accepted propellant for the missiles of warfare.

The military doctrine promulgated after the Spanish-American War was essentially that predicated upon the battlefield by the combination infantry, artillery, cavalry team. The pioneer work in the organization of the eight-man double-rank rifle infantry squad by Upton gave the infantry a mobility and maneuver capability it never before possessed. Yet, the infantry weapons were much the same as they had been during the Civil War; that is, the rifle and the bayonet. The breech-loading rifle was now of reduced caliber, from caliber .58 of the Civil War to .45 caliber in the Springfield rifle and to .30 caliber in the Krag-Jorgensen rifle which was breech-loading, bolt-action, and magazine-loading. "Fire superiority" was the condition to be obtained by the infantryman in battle and "fire distribution," or "musketry," became the subject of profound studies based upon mathematical computations and formulae (Ref 4).

In the Philippine Insurrection (1899-1900), American troops met with crude but effective and efficient guerrilla weapons. Aside from the native knives and bolos, bows and arrows, and spears, there were hand-fabricated rifles, mortars, and cannons. Often cast from the rough Philippine iron and brass, these weapons were modeled after the ancient Spanish muskets, Coehorn mortars, and swivel guns, or lantankas. It is of interest to note that the Filipino guerrilla, unlike the American Indian, endeavored to increase his firepower by the development, or improvisation, of supporting weapons. The gas-pipe cannon was a common improvisation captured by the US Infantry in the Philippines. The lethality of this and other make-shift guerrilla weapons was high. In many respects, the Filipinos were ahead of the armament inventors of the times--as they utilized the principle of reinforced and wire-wrapped guns in making crude mortars and cannons (Ref 3, p 102).

About 1906, the infantry machinegun became a reality in the United States Army tables of organization. Experimental tests and theoretical studies of the rifle and the machinegun were under progress. The trend of research and development was in the direction of a more rapid and accurate delivery of an increased volume of small arms fire by the infantry. Consideration was now given to the need of the infantry for an organic heavy weapon to be under its exclusive control on the battlefield. The Army proceeded with the machinegun and in 1916 established experimental machinegun schools of instruction. It should be noted that the war in Europe had been in progress for nearly two years and that the skillful employment of machineguns and supporting mortars by the Germans had destroyed hundreds of thousands of Allied troops and made the trenches the symbols of stalemate and defensive, positional warfare (Ref 5).

The Army Lineage Book notes that:

...the expanding use of machine guns required reorganizations which reached from divisions down to companies. The other weapons exacted changes, but they were not so widely disseminated. For example, infantry mortars and one-pounder (37mm) guns found a place in the headquarters companies of regiments.
(Ref 6, pp 38-39)

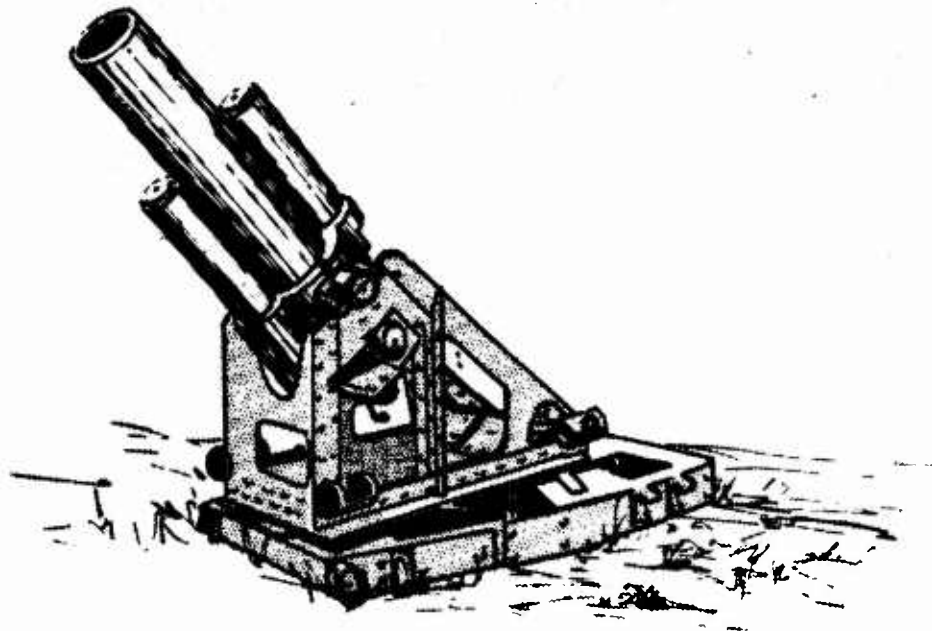
In response to the German increase of infantry heavy firepower, the French and British developed improvised and often ineffective weapons. These were fabricated by the troops in the trenches out of old shell casings, ration tins, and other crude materials. This attempt of the frontline soldier to answer the enemy weapon threat with improvisation pointed out succinctly the need of the troops for a comparable or similar weapon (Ref 7, p 18).

The answer to the above dilemma was the development of the trench mortar by the French and the British Armies.

Supporting weapons of great killing power were developed early in the war by the French, and the British followed suit. This weaponry, in a sense, supported locally the infantry platoons and sections in their static defense. Specifically, they were heavy machine guns and the infantry mortars. Machine guns were usually of infantry rifle ammunition caliber and the mortars and infantry cannon were normally of the three-inch types, such as the Stokes mortar and the 37-mm gun (1 pounder). These weapons were essentially crew-served and hence were considered to be specialized and normally not to be found in the infantry platoon, section or squad.
(Ref 7, p 29)

World War I marks the changeover from the simple infantry squad of eight riflemen in the United States Army to a more complex group consisting of riflemen, grenadiers, machinegunners, automatic riflemen, and mortar-men. Included in this development was the mortar section and squad of the headquarters company of the infantry regiment.

The placing of the mortars in the headquarters companies of the infantry regiments was essentially for the purpose of giving the regimental commander great flexibility in their assignment, attachment, and control. The needs of the companies and battalions of the regiment thus could be met by temporary assignment or attachment of mortar sections and squads to units for specific operations. This method was very much like the assignment of separate batteries or sections of artillery to infantry units requiring their close support in operations. For trench warfare this arrangement was patently satisfactory, but when the troops got out of the trenches into open mobile warfare there was often difficulty in displacing the conventional artillery guns. The need for heavy artillery fire power with infantry portability was soon apparent to both the Central Powers and the Allies. As noted, the German Army had operational mortars, Minenwerferen, which were emplaced in close support of the frontline infantry (Ref 7, pp 19-22).



German "Minenwerfer" Trench Mortar, 1915

LITERATURE CITED

1. W. Y. Carman, A History of Firearms, London: Routledge and Kegan Paul, Ltd., 1955.
2. Albert Manucy, Artillery Through the Ages, Washington: United States Government Printing Office, 1949.
3. Francis Bannerman, Catalogue of Military Goods, New York: Francis Bannerman Sons, 1938.
4. Virgil Ney, Organization and Equipment of the Infantry Rifle Squad: From Valley Forge to ROAD, Technical Operations Research, Combat Operations Research Group, Fort Belvoir, Virginia, CORG Memorandum CORG-M-194, January 1965.
5. Captain Julian Hatcher, et al, Machine Guns, Menasha: The Banta Publishing Company, 1917.
6. The Army Lineage Book, Volume II: Infantry, Office Chief of Military History, Department of the Army, Washington, 1953.
7. Major P. H. Ottosen, Trench Artillery A. E. F., Boston: Lothrop, Lee, and Shepard Co., 1931.

WORLD WAR I

Working on fifty-eight-twos,
You can die any death that you choose,
Get hit by a shell, the gas gives you hell,
Grenades wake you up when you snooze.
But your family is proud of you now,
They are sure to collect that ten thou'
Ten days to each man is the average span,
Working on mortars, those jolly trench mortars,
Those damnable fifty-eight-twos.

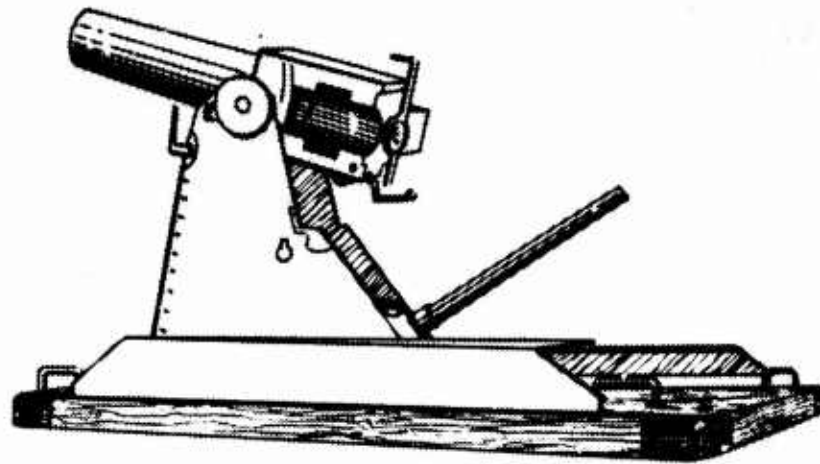
Anon

The effect of the stalemate of the trenches upon weapon development and tactics was profound during World War I. In place of light, but powerful accompanying guns, heavy artillery was used to pound the enemy positions into masses of mud, tangled wire, and smashed emplacements and trenches.

The first rough trenches of the winter of 1914-15 were later improved with dug-outs, revetting, trench boards, and an increasingly complicated system of support trenches. From time to time, attempts were made by both sides to straighten the line or to remove an enemy bulge, and battalions, brigades, or divisions would scramble out of the trenches with fixed bayonets and hand grenades ready, to advance through the hell of shells and bullets. Major attacks were mounted to try to break through the enemy's lines, but always the defenses proved stronger than the offensive. The cost of the battles on the Western Front, and in the German-Russian battles on the Eastern Front, was appalling. To take but two examples, both from the Western Front: at the second Battle of Ypres, in April and May, 1915, the British casualties alone were 2,150 officers and 57,125 other ranks, of whom 10,125 were killed; at the Battle of Loos, in September, 1915, the British losses in twenty-four days were 2,407 officers and 57,985 other ranks.
(Ref 1, p 47)

The light artillery of that day was centered around the 3-inch cannon of the Germans, the 75mm of the French, and the 25-pounder of the British. In position warfare, mass artillery preparation fires preceded the infantry attack. Synchronized with the "creeping or rolling" barrage, the infantry moved forward through machinegun and rifle fire and prearranged artillery and mortar trench concentrations. The machinegun ruled the battle field or "No Man's Land," and human flesh and sinew could not long survive their withering fires. The infantry found that

Trench warfare brought with it a pressing need for weapons that were decisive in close combat. Out of this need came hand grenades, rifle grenades, the submachine



French 75mm Trench "Artillery", 1915

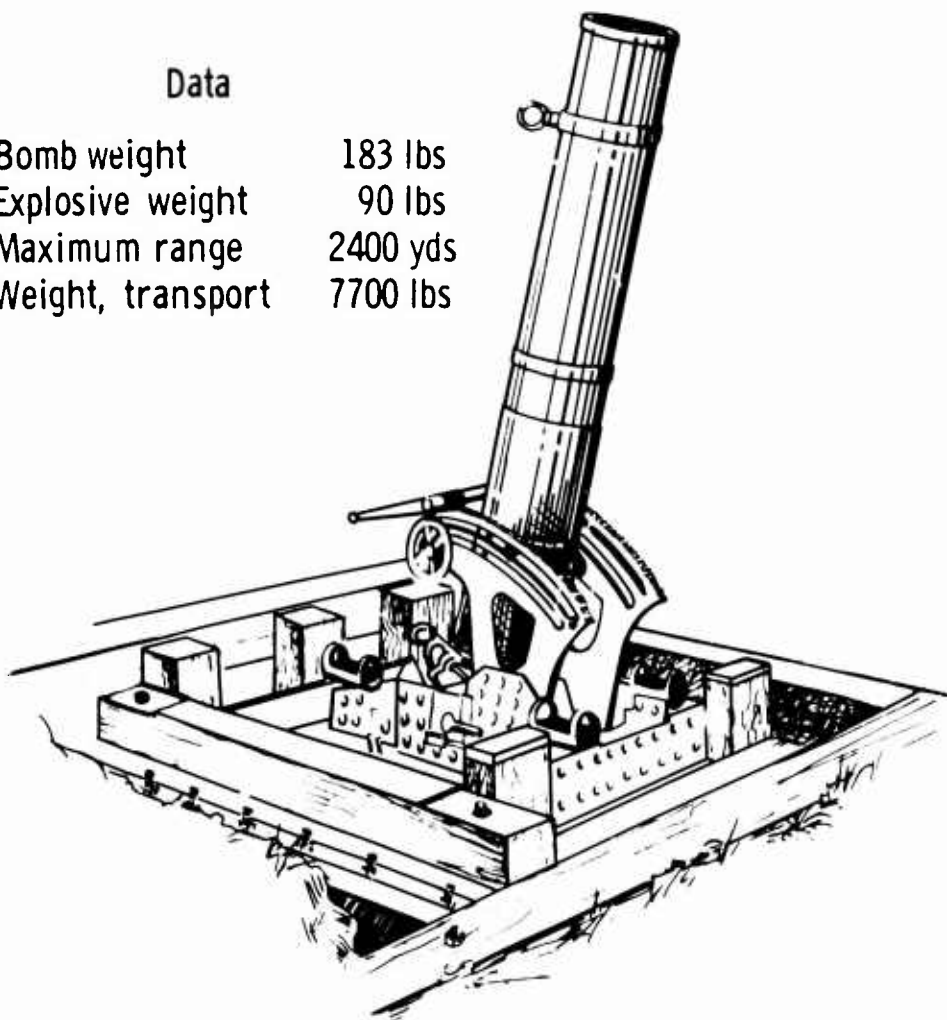
gun, and a more extensive use of pistols and revolvers. Such short range weapons tended to supercede cold steel and rifle butts as the tools of shock action, but American doctrine considered proficiency with the bayonet as still indispensable because it gave confidence and aggressiveness to foot soldiers.

(Ref 2, pp 37-38)

With both armies dug in and facing each other in heavily wired and fortified lines of trenches, the need for some type of close artillery support controlled by infantry units asserted itself almost immediately. Mortars with their high angle of fire supplied a partial answer to the inflicting of damage and casualties upon deeply entrenched enemy forces. Essentially, the first trench mortars were either crudely fashioned and improvised weapons, or artillery pieces brought in and emplaced within the trenches. The German concept of such a weapon was the Minenwerfer or minethrower. Literally, this weapon did throw a bomb rather than a mine, but its effect was that of a mine when employed against hostile entrenchments. In retaliation, the French engaged in trench mortar warfare on a large scale. Over a period of several years the French Army developed lighter and more satisfactory trench mortars which were strictly divorced from the conventional artillery arm. Because of the nature of stabilized trench warfare and its consequent lack of mobility and maneuver, the trend was toward heavy, nonportable mortars. Larger caliber missiles brought greater crushing power and lethality to these frontline supporting weapons. But increased fire power meant that mobility of the weapon and the unit had to be sacrificed for the maximum fire effect. Hence there was an impasse. Immobile, heavy weaponry, as well as unimaginative strategy and tactics, contributed to the continuation of the dug-in armies fighting in position and gaining or losing little local actions of no tactical or strategical significance. The great offensives on the Western Front called for hundreds of thousands of infantrymen to "go over the top" of the trenches and move through a hell of artillery, machinegun, mortar, and rifle fire to gain, or regain, a few yards of worthless mud and muck.

Data

Bomb weight	183 lbs
Explosive weight	90 lbs
Maximum range	2400 yds
Weight, transport	7700 lbs



Bomb



Detonator Casing



Detonator



French 240mm Mortar, Model 1916

The first Battle of Ypres began on the 19th of October (1914) and lasted five weeks. The Germans attacked with the utmost violence, with heavy artillery and masses of infantry, in an attempt to break through and win a quick victory. The French and British armies fought with equal tenacity, their line becoming thinner as their casualties rose, determined to guard the Channel ports and Great Britain a few miles beyond.

The line held, through the superhuman endurance of the troops, and Paris, the Channel ports, and Britain were saved. But the cost was appalling. For example, the 1st Battalion of the Gloucestershire Regiment marched to Ypres with twenty-six officers and more than a thousand other ranks. Four weeks later they marched back with two officers and less than two hundred men. The terrible losses of the Gloucesters were by no means unique. The British Expeditionary Force, the highly trained and splendid army of 160,000 men, was virtually destroyed at Ypres. It had sacrificed itself by stopping the onslaught of the mighty German war machine. By its sacrifice it had saved Britain and, although it could not then be perceived, it had laid the foundations of the final victory over Germany.
(Ref 1, p 47)

By 1917, and even earlier, it was obvious to most observers that the war was wearing on with no apparent end in sight. Professional military thought in Europe had hardened into an inflexible pattern of defensive, stabilized, trench-type warfare. The ancient battlefield combination of infantry, artillery, and cavalry had lost its most mobile member, the cavalry.

After the Battle of Ypres, the two armies dug themselves in with defensive trench systems, protected by barbed wire, defended by machine-gun posts, and supported by massive artillery. Between the trenches was the hideous desolation of No-man's land--a waste pitted with shell craters. In the winter, the trenches were often knee-deep in water and mud; raids were made across No-man's land, swept by machine-gun fire. The men in the trenches were mercilessly mortared and shelled. All the colour, glitter, and romance was drained from war, to be replaced by grim and sordid discomfort and death.

The expectancy of life of a junior officer in the trenches was three days. After ten days in the front line, troops marched back to their comfortless billets, utterly exhausted by their vigil, filthy, and often with nothing dry but their rifle-breeches and ammunition. Ten days' rest followed, and then back to the front line, with raids, attacks over the top, and bullets, grenades, mortar bombs, and shells. Steel helmets were issued as a protection against shrapnel.
(Ref 1, p 41)

The war, if it was to be won, must, of necessity, be gotten out of the trenches and into the open. There the traditional doctrines, that is, fire and maneuver, could be again employed to break the stalemate.

In 1914, at the beginning of World War I, neither of the principal armies possessed effective, operational armored vehicles. There were several reasons for this lack, namely, apathy on the part of military professionals who believed that the cavalry was the answer to the problem of mobility and that motors, when used in war, were for the hauling of supplies to the front. The situation at the front was essentially a stalemate caused by the firepower of the machine gun and artillery. The armies dug in and began a siege war that was marked by tremendous slaughter and no decision. The infantry and the artillery, those two stalwarts of the ancient trinity of infantry, cavalry, and artillery, were lacking in the power of maneuver to be decisive in combat. The cavalry had begun the war but it had withered away in the blasts of the machine guns. Thus the doctrine of mobility was lost in the muddy, fire-swept terrain of Flanders and France.

(Ref 3, p 4)

Certain farseeing British military minds were searching for a solution to the problem confronting the infantry and artillery. How this solution was found is one of the great stories of military history. Captain B. H. Liddell Hart, the distinguished British military historian, in his outstanding work, The Tanks, credits the solution to Major General E. D. Swinton.

In his book, Eyewitness (1932), he (Swinton) tells the story of how a solution of the problem came to him. The vague idea of an armored vehicle crystallized into the more definite idea that it should be capable of destroying machine guns, of crossing country and trenches, of breaking through entanglements, and of climbing earth-works. Then while resolving possible means of fulfilling these conditions, he suddenly remembered a report he had received just before the war about an American agricultural machine, the Holt Caterpillar Tractor. A friend of his who was a mining engineer, Mr. Hugh Marriott, had suggested that it might be of military value for transport purposes because of its remarkable performance in crossing broken ground.

(Ref 4, p 22, parentheses supplied)

With his idea rejected by the War Office, the then Colonel Swinton returned to the battlefield in France. But there was one member of the Committee of Imperial Defense who would not reject Colonel Swinton's plan for employment of the Holt Tractor as the chassis for an armored, weapon-bearing, trench-crossing machine. This person was Winston Churchill,

the First Lord of the Admiralty. The following quotation is significant:



Tank Crushing a Strongpoint

On 24 February 1915, Colonel Swinton's idea was adopted, not by the War Office, for whose benefit the plan was intended, but by the Royal Navy. Winston Churchill, the only member of the Committee of Imperial Defense in favor of the idea, continued Colonel Swinton's fight... Because of this naval origin even today (a naval designer was chairman of Churchill's committee, The Landship Committee) tankers all over the world use a jargon peculiar to the Navy in referring to parts of the tank. We have such nautical terms as the hatch, the ports, the hull, the deck, the bow, and the superstructure.

(Ref 4, p 4, parentheses supplied)

The subsequent history of the tank is too well known to be recounted here in detail. On 15 September 1916, modern tanks were employed by the British Army in battle for the first time along the Somme front in France. While the numbers engaged in this action were small, there being only 49 in all, they did surprise the Germans. Moving ahead of the infantry, the tanks, as they were so designated for security reasons, fulfilled their mission of breaking through the wire and advancing with impunity against machine gun and small arms fire. But there was little or no precedent for their tactical employment. Where did tanks fit into the ancient and sacrosanct trio of infantry, cavalry, artillery? With their restoration of a degree of mobility to the struggle, the tanks, in a sense, exhibited some of the characteristics of the almost defunct cavalry. What was the relationship of infantry to this new and effective weapon of warfare? The following extract will serve to answer this question partially and to indicate the requirement for armored infantry at that early date.

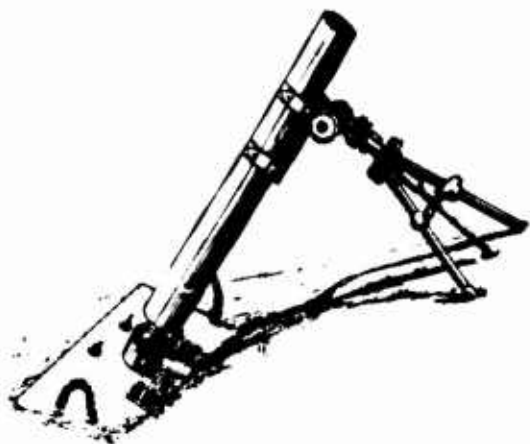
Tanks were first employed on a large scale on 20 November 1917, when the British used 378 tanks in their attack on Cambrai. The tanks went forward on a seven-mile front, followed by six infantry divisions. At the end of 12 hours a penetration nearly six miles deep had been made, and 7,500 prisoners and 120 guns captured. The attack with tanks in the Third Battle of Ypres, although it penetrated deeper than other trench warfare attacks, fell short of complete success because no plans had been made for exploitation, and no reserves, either tank, or infantry, were available to keep up the momentum which had been gained.

(Ref 3, p 5)

In 1917, the French soon realized that tanks alone could not function successfully without the support of infantry riflemen. The immediate solution was to organize and attach a special company of infantry designated as "infanterie d'accompagnement" to each 16 tank "groupe." The mission of the infantry companies so assigned was to provide the necessary close-in protection, to mop up nests of enemy resistance with small arms and grenade fires, and in general, to function as infantry, to complement mortars and the action of the tank.

The tank restored partial mobility to the battlefield of World War I but the full potential of the tank as an offensive weapon was not realized. The tactical role of the tank, even after the stunning effect of Cambrai, did not seem clear. Actually, in the absence of a doctrine, and based upon a conservative professional military point of view, the tank was consigned a secondary role to the infantry, the "Queen of Battle." Tanks would be used to support infantry by reduction of enemy strong points of resistance and to put automatic weapons out of action and, by sheer vehicular weight and crushing power, to reduce obstacles.

(Ref 5, p 20)



Three-inch Stokes Mortar

mobility, required portable mortars and machineguns. Thus, the restoration and mobility had the direct effect of causing the "Trench Artillery," or heavy mortars, to be replaced by lighter, more portable weapons, such as the Stokes.

Unlike the French and the Germans, the British developed a lighter and more portable trench mortar. This weapon, familiarly known as the Stokes, after its inventor, was a simple muzzle-loading weapon. In essence the Stokes was a highly portable three-inch-diameter steel pipe which threw a

The partial restoration by the tank of a degree of mobility to the battlefields of World War I, and the accelerated speed of the infantry rate of advance, brought forth an immediate requirement for a light, portable infantry mortar. This weapon, of necessity, must be one that could be served by a crew of one, two, or three men and carried by hand as they displaced forward. In reality, the tank became a light artillery and machinegun, mobile, armor-covered platform. As such, it was effective against troops in trenches. It could crush wire obstacles, pillboxes, and strongpoints. But the number of tanks was limited and the infantryman, taking maximum advantage of the newly restored

round of high-explosive shell. The propellant charge was in reality a shotgun charge (without load) inserted in the base of the projectile. By gravity, the mortar shell slid rapidly down the tube, and the charge detonated upon hitting a fixed striker, or firing pin, in the base of the tube. The burning powder gases at the base of the mortar shell forced the projectile out of the tube and on its way to the target. Increased range was assured for the projectile by the addition of ring-type bags of powder which were burned, thus adding to the gas pressure when the basic propellant charge was exploded. As the tube required some degree of stability, especially in firing barrages, the fixing of a simple base plate to the tube by means of a ball and socket joint helped to solve the problem of platform stability.

The fixed trench warfare of the First World War again brought the mortar into use but in a new form. The pattern was now little more than a simple tube into which an already "fixed" or primed mortar shell was dropped. As it struck the base of the tube, the fuse was ignited and it immediately leapt out again. By such means a high rate of fire could be maintained. Accuracy was not a strong point but a barrage of such mortars could pin down an opposing party of men.
(Ref 6, p 2)

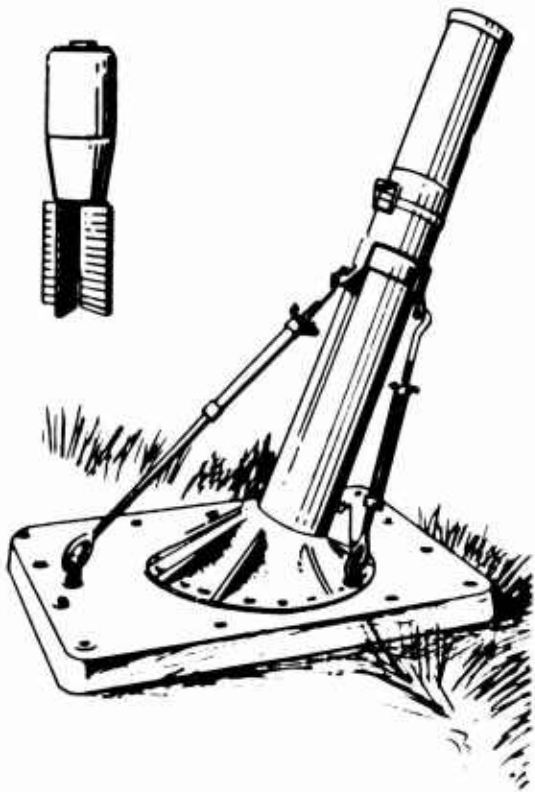
Mortars were found to be of considerable value in destroying enemy protective barbed wire entanglements in front, or on the flanks, of the hostile main line of resistance. At first, the artillery was charged with the operation of what was known as "trench artillery." The mortars decreased in caliber and were made highly portable, as developing combat mobility proved the need for an accompanying infantry mortar. Weight and caliber were sacrificed for mobility with the growing use of the mortar as an antipersonnel weapon. Mortar concentration fires were employed for frontal protection in close cooperation with machineguns, automatic rifles, and in conjunction with tactical barbed wire entanglements. On the Allied side of the line, the British Army devoted a maximum of research and development in the area of the trench mortar. While there was much in common mortar-wise between the Allies, the British developed a mortar which became the prototype of future infantry mortars.

The Stokes mortar was a simple but ingenious invention which contributed significantly to the evolution of the infantry mortar in the United States Army. As is well known, the United States in 1917 was woefully unprepared in the matter of armament. In the three years previously, when the nation was not involved in the war, American industrial power and ability was devoted to large-scale production of small arms and ammunition for the Allies. Rifles, on British, French, and Russian patterns were turned out by the hundreds of thousands. However, there was little or no artillery produced in the United States and the American Expeditionary Forces had to depend upon the French 75mm field gun and French and British mortars and machineguns for infantry armament, other than rifles. Once the United States was committed to the conflict, a determined attempt was made to manufacture trench mortars on the British and French patterns for the troops of the

American Expeditionary Forces. The following extract is significant of the American industrial effort.

Some seven different types of trench mortars were in use when we came into the war. Our ordnance program contemplated the manufacture of all seven of them, but we actually succeeded in bringing only four types into production. These four were the British Newton-Stokes mortars of the 3-inch, 4-inch, and 6-inch calibers, and the French 240-millimeter mortar, which had also been adopted by the British. As usual in the adoption of foreign devices, we had to redesign these weapons to make them adaptable to American shop methods. We encountered much difficulty throughout the whole job, largely because of insufficient information furnished from abroad, and because in spite of this handicap we had to produce mortars and ammunition that would be interchangeable with French and British munitions stock.
(Ref 7, p 212)

As early as 1916 there was a trend toward giving the improving trench mortar shell aerodynamic characteristics, that is, fins or stabilizers, to compensate for the fact that the tube was smoothbore and not rifled and, therefore, did not impart a twist or rotation to the round as it left the muzzle. The following extract explains the reason for the "streamlining" of the projectile.



Six-inch Newton Mortar

We were dissatisfied with our 3-inch shells, for the reason that they tumbled in air and were visible to the eye. The French had developed a mortar shell on the stream-line principle which was invisible in flight and had twice the range of ours. Had the war continued the Trench Warfare Section would have produced a stream-lined shell for mortar s.
(Ref 7, p 213)

The production of mortar ammunition by American industry was an additional achievement. Inasmuch as the shells could be fabricated of cast iron and not steel, numerous American commercial stove manufacturers converted their foundries to mortar shell factories. During World War I, the following American firms manufactured 6-inch mortar shells:

Firm	Amount
Foster Merriam Co., Meriden, Conn.	33,959
U. S. Radiator Corporation, Detroit, Mich.	240,700
Globe Stove and Range Co., Kokomo, Ind.	17,460
Rathbone, Sard & Co., Albany, N. Y.	97,114
Michigan Stove Co., Detroit, Mich.	100,000

Source: America's Munitions

Essentially, the mortars were considered artillery until World War I. At that time, the operation of mortars in the trenches was initially in the hands of the artillerymen. However, the requirement for an infantry-operated mortar, under the control of the local infantry commander, dictated that steps be taken to organize infantry mortar batteries. Before the war became bogged down in the trenches, artillery mortars of large caliber were used in their classical role by both the Allies and the Germans.

The French and the Germans began trench mortar warfare with the concept of a mortar-launched bomb which was employed generally against enemy strongpoints and dugouts, personnel, and heavy weapons, such as machine guns. In the British service, the Stokes mortar was preceded by several models and types of trench artillery--essentially muzzle-loading, smooth-bore, tubular steel weapons of three-inch caliber. The Stokes was the answer in World War I to the infantryman's prayer for organic support fire as he went over the top of his trenches into the enemy fire. Mortar squads, or teams, were organized as integral units of infantry rifle companies. Their importance was recognized in the tables of organization. By virtue of their performance they achieved a permanent place in the arsenal of modern infantry weaponry.

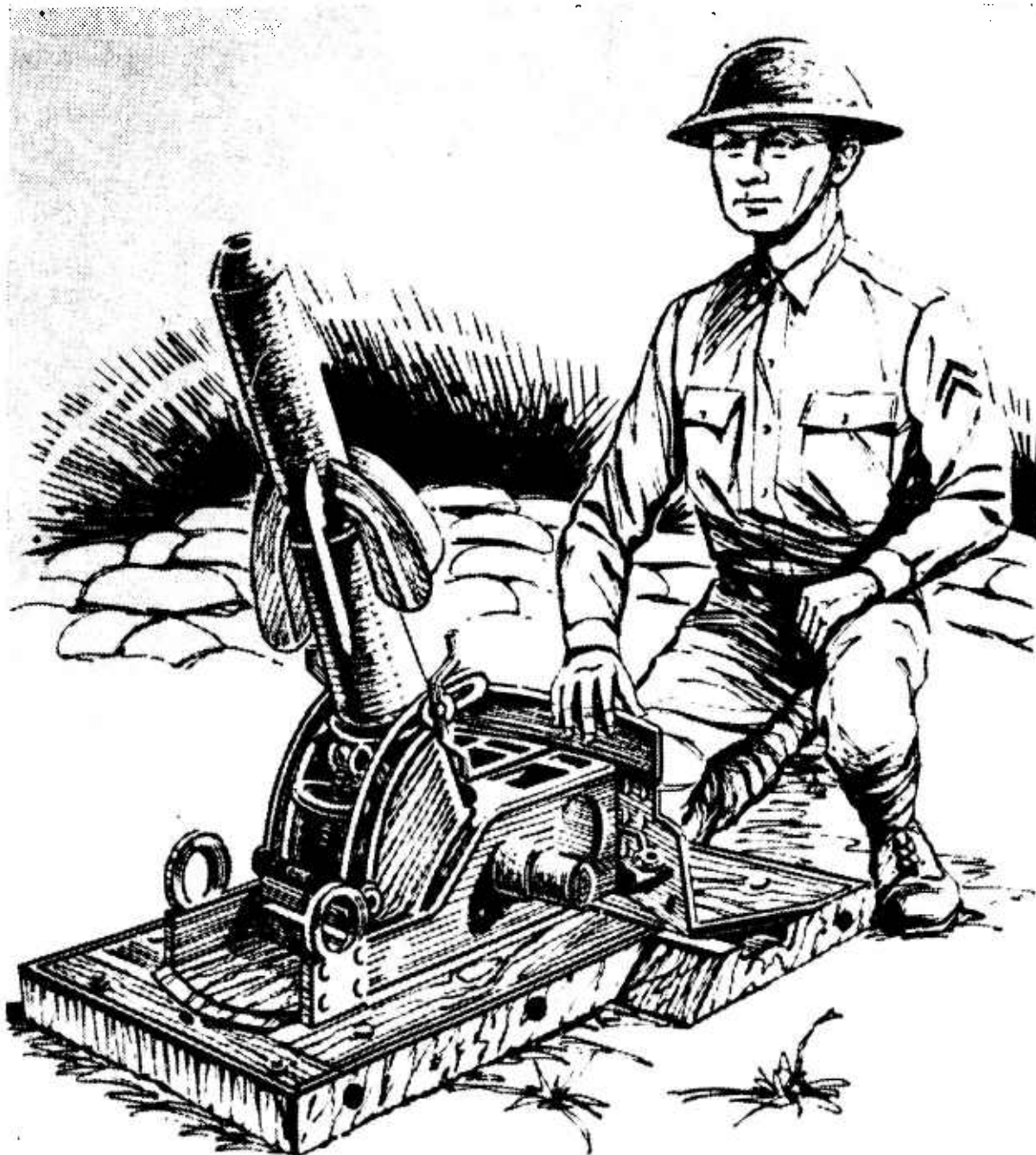
The Stokes mortar and the one-pounder cannon created the need for the organization of individual soldiers into specific mortar and gun squads. The individual had to handle his own weapon and also be able to function as a member of a crew:

In addition to the weapons that infantry men handled as individuals were two they used as crews. One, also a creature of trench warfare was the Stokes mortar, which could lob projectiles into enemy trenches and shell holes. Another was the one-pounder cannon, an anti-tank and anti-machine gun piece. These weapons were placed together in a platoon of the headquarters company of every infantry regiment.

(Ref 2, p 38)

Major James E. Hicks, in his definitive book, Notes on French Ordnance, describes the establishment of trench artillery by the French in World War I. He notes that the requirement for the supplemental fire power of trench artillery was created primarily by the stabilized positional warfare of the times. Improvisation of suitable trench artillery from existing weapons was the order of the day until more effective mortars could be devised. Hicks states:

At first there was used the smoothbore bronze mortars of 15 cm. cannon of Model 80, modified, to fire mine



A "Fifty-Eight-Two" Mortar

bombs, type Gatard, the mortars Cellierier, etc. These were for high angle fire to drop projectiles into the enemy trenches. Then came, in March 1915, the first material of trench warfare artillery known as the Mortar, .58 caliber, No. 1. Soon a study was made at Bourges on trench warfare artillery and this resulted in the adoption of bombs with guide fins of 16 and 45 kilos in weight corresponding to Mortar of 58 caliber, No. 1, and Mortar of .58 caliber, No. 2. The three models of projectiles for the Mortar, caliber 58-mm had the tail shaft only entering the bore of the mortar. The Mortars of 240-mm and 340-mm had the projectile enter clear into the bore. In order to obtain a greater range, the 240-mm Mortar (short) was replaced by the 240-mm (long) ranging up to 2000 meters.

In the middle of 1915, the Mortar, Caliber 150 T was studied, and also Mortar, Van Deuren. Trials were given the following types in 1916 and 1917, viz: Archer; Jouhnandean-Deslandres; Fabry; Stokes; 75 T du Creusot. At the close of the World War, the pieces of trench artillery in use were: 58 No. 2; 150 T, Model 1916; 150 T, Model 1917; 240 CT; 240 LT. Actually the trench artillery consisted only of the light material of 150 T and the heavy material of 240 T, also a Mortar of 75T, used only by mountain defensive organizations.
(Ref 8, p 212)

From the above reference it will be noted that the search for a satisfactory trench mortar for the Allies was a long and thorough one. Obviously, the need for trench artillery eventually created new and powerful weapons. What these weapons did to the traditional military trinity of infantry, cavalry, and artillery was to be observed in the reorganization of the various military establishments after the end of the war. During the fighting there was not time to develop an infantryman who was also a trench artilleryman. The answer to the requirement that infantry receive closer artillery support than that afforded by brigade, division, or corps artillery was found in the resurrection of the ancient mortar principle and applying it, as in the past, to siege warfare. The Germans with their powerful Minenwerfer were far in advance of the Allies in this field of weaponry. These German mortars

... had the following features: rifled bore, recoil mounting, huge projectiles thrown at a high angle (determined very accurately by means of a common field sight), great destructive ability against earthen works of all kinds, due to their power of penetration. At the Marne, on the first occasion, these mortars were introduced chiefly with the idea of producing a bad effect upon the Allied troops. The results were more far-reaching than had been expected, for it was found that in reducing trench organizations, the minenwerfer was superior to other artillery pieces.
(Ref 9, p 19)

The artillery because of its general location did not lend itself readily to direct countermortar fires. The result of this situation was considerable improvisation on the part of the frontline soldier in his efforts to meet the challenge of this new German weapon. The mortars of the past were, in reality, brought forth--even museums were ransacked for the answer to the German trench mortar. Ordnance experts, chemists, inventors, and others devoted their full time to the development of a trench mortar and to its subsequent improvement. The result of their combined efforts was

...the 58-mm., invented in February, 1915, and appearing on the Western Front in April of the same year. The French developed, soon after, the 75-mm., 159-mm., 240-mm., and larger calibers less commonly known. The British meanwhile developed the 3-inch Stokes and 6-inch Newtons. All of these types of mortars were used at various times by the American Expeditionary Forces. The features of these early mortars were: smooth bore, no recoil on the mount, solidly constructed bed and foundation to withstand the shock of discharge, clinometers, goniometers, quadrants and graduated plates to lay the piece, and standardized ammunition charges and fuses. The lack of mobility and range was compensated for in a measure by the great ability of these mortars...for destruction. Streamlined bombs, smooth bores, recoils, mortars on small carts with considerable mobility, capable of opening fire with but few minutes preparation, occupied the thoughts of trench artillerymen long before the close of the war. (Ref 9, pp 20-21)

Major P. H. Ottesen in his cited history of the trench artillery in the American Expeditionary Forces comments upon the effect of the division of the trench mortars into different classes. He points out that the eventual location of the mortars within an organization depended, usually, upon their weight classification. His description follows:

The Trench Mortars were divided into three classes, namely, light, medium and heavy caliber.

The light mortar (3-inch Stokes) formed a part of the Headquarters Company of each Infantry Regiment. It is essentially an infantry weapon. There were 12 of the mortars to each Infantry Brigade and 24 to each Infantry Division, and they were under the tactical control of the infantry regimental commanders. This mortar is very mobile. Its effect against material was inconsiderable, but it was particularly effective against massed troops, or troops driven into the open. As a rule, it took little part in the preliminary bombardment, but it was used to advantage to harass the enemy in the final stages of the bombardment, for which its rapidity of fire rendered it particularly effective. It was also used to form up a barrage

behind the hostile lines to prevent the bringing up of reserves and ammunition.
(Ref 9, pp 21-22)

In the American Expeditionary Forces, the solution to the trench mortar problem was, at first, the assignment of Coast Artillery Corps officers and men in organized trench mortar batteries. These units were stationed at strategic points along the front in the trenches and furnished supporting fires for the infantry units in the immediate vicinity. The service in the trench mortars was considered to be extremely hazardous as hostile artillery was constantly searching the area for possible trench mortar sites or emplacements. In the beginning, the artillery retained control of the trench mortars and the established and traditional role of artillery was preserved. However, this situation was satisfactory and workable only as long as the war remained static. When the infantry moved out into open warfare, the requirement was for lighter and more mobile accompanying mortars.

At first, the trench artillery of the United States Army found itself an organization in being without armament with which to conduct elementary gun drill. Prior to departure from the United States for France, this unusual type artillery unit was trained from improvised, simulated weapons. The following account will tell the story, so often and unfortunately repeated in the American military experience.

...in April 1918...we received the first copy of a booklet showing pictures of the Newton Stokes Mortar. Until that time we did not know what the guns we were to use later looked like. Through the ingenuity of our Chief Mechanic, Nathan C. Posey, we were furnished with wooden mortars contrived from tree trunks and lumber arranged with guy-wires and turn buckles. With this equipment we were able to hold standing gun drill and learn the rudiments of our job. The non-commissioned officers were given instruction in figuring firing data and laying the guns.
(Ref 9, p 210)

The problem of organization of the Trench Artillery was complicated further by the presence of two types of equipment, French and British. The British equipment was eventually established as regulation issue for the American Forces, but initially, the French equipment was the only equipment immediately available. The Tables of Organization were therefore published by the United States War Department to cover all available types of equipment. For example: Table of Organization 105, War Department, Washington, March 25, 1918 provided:

240-mm Trench Mortar Battery (Corps Artillery) French Equipment¹

Section (Personnel)

1 sergeant, mounted on a horse (Pistol)
2 corporals, one gunner, one corporal

¹ To be equipped with French material after arrival in France.

240-mm Trench Mortar Battery (Corps Artillery)
French Equipment (Concluded)

Section (Personnel)

6 privates, first-class (Rifle)
12 privates, 5 drivers, 5 cannoneers, and 8 ammunition carriers
per Section, included within the privates, first-class
Total 21

Equipment

1 mortar, trench	1 horse, riding
1 pistol	4 mules, draft
21 rifles	3 carts, combat, 1-mule

NOTE: Following the French organization there were no squads:
Sections only.

The Table of Organization 105 of Series B also provided, optimistically, for equipping the 240mm Trench Mortar Battery with American equipment. This table was predicated upon America's capacity to produce the required number of trench mortars. It is of interest to note that the Ordnance Department of the United States Army reported that twenty-nine 240mm mortars had been fabricated by the time of the Armistice (November 11, 1918) and that, by February 1, 1919, a total of 30 of these weapons had been completed. None was shipped to France. Hence, the T/O for American Equipment proved to be mere "wishful thinking" (Ref 7, p 217).

By May 10, 1918, Table of Organization No. 21 had been published for the trench mortar battery equipped with the six-inch Newton Stokes (British) mortar. This was still the era of the noninfantry trench mortar units operated by the Coast Artillery of the United States Army. The Table No. 21 specified as follows:

Trench Mortar Battery 6-inch Newton-Stokes

Section²

1 sergeant (pistol)
2 corporals, two gunners
1 wagoner
6 privates, first-class, five cannoneers, three ammunition
carriers, one armorer
11 privates, one assistant chauffeur or wagoner
Total 21

1 First or Second Lieutenant³ commands platoon of two sections.

² The Section was the smallest unit in the trench artillery at this time; there was no squad as such.

³ Commands leading section of the platoon, a sergeant commands the other section.

To give attacking infantry units the direct and close fire support of mortars, the United States Army organized the mortars into infantry formations. To give the mortar sections and squads the flexibility of assignment required in a war of fire and movement, the mortars were assigned to the Headquarters Company of the infantry regiment by Table 5, Headquarters Company, Infantry Regiment, War Department, Washington, D. C., 1918.

The above-cited table established the basic pattern of a mobile and man-couverable infantry mortar unit which was completely divorced from the artillery. Here, for the first time, infantry of the United States Army had, in effect, its own accompanying artillery for close support for both offensive and defensive warfare. The flexibility of the Section may be noted:

Table 5, Headquarters Company-Infantry Regiment
War Department, Washington, D. C., 1918

Sappers and Bombers Platoon
2nd Section (Bombers)

Personnel

3 sergeants, (rifle)
6 corporals, (rifle)
11 privates, first-class (rifle)
19 privates, (rifle)
Total 39

Equipment

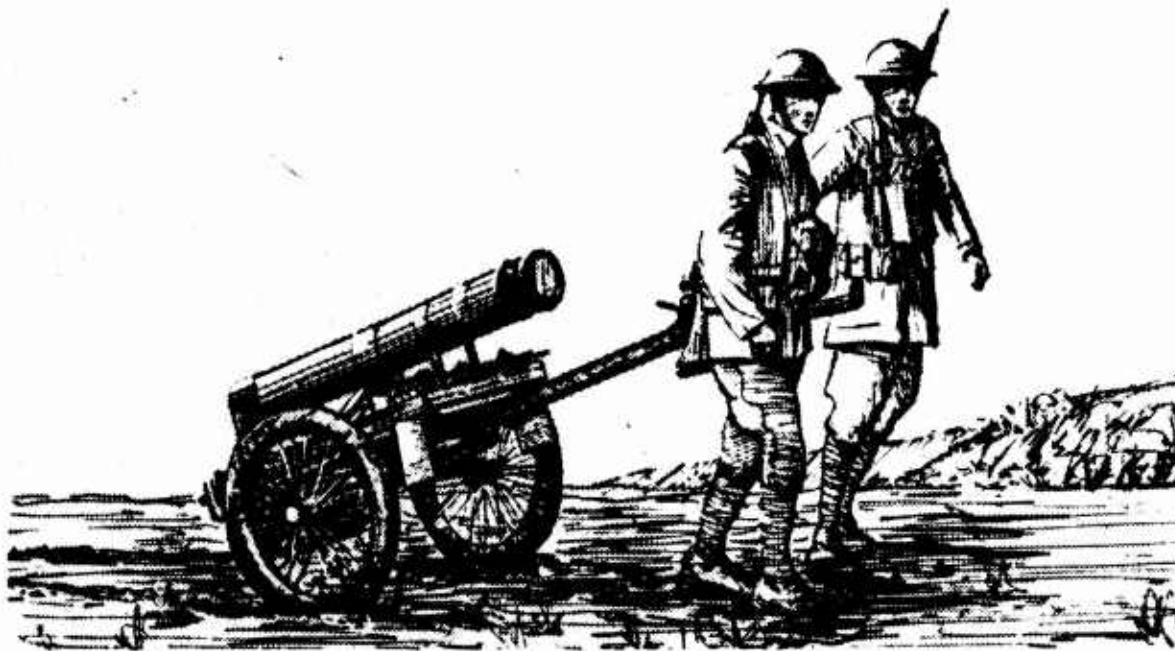
6 Mortars, 3-inch, Stokes
30 Grenade dischargers, rifle
39 Rifles, .30 caliber
1 cart, combat, 1-mule
1 wagon, combat, 4-mule

Animals⁴

4 mules, draft

⁴ Animals not furnished until further orders.

The Mortar Section as indicated by Table 5, was capable of furnishing close support mortar fires in a variety of combinations. Squads, or teams, of one or two mortar men could be organized and attached to units of a regiment for specific fire missions. Mortars could be fired in pairs or singly, and each of the three sergeants could function as squad, or team, leader. Corporals were trained to function as mortar gunner and assistant. One corporal supervised the transportation as transport corporal. Basically, the tactics and techniques of the mortar section were those inherited from the British. It was not until the postwar era that the United States Army established the mortar as an infantry accompanying weapon down to the



Mobile Six-inch Newton Mortar, World War I

company and platoon levels. As trench mortars developed during World War I, they were divided into three broad, general classes: light, medium, and heavy. The light mortar was the English three-inch Stokes mortar which was found in the infantry regimental headquarters company. This mortar was an infantry weapon entirely independent of the trench artillery. There were six 3-inch Stokes mortars in each headquarters company of each infantry regiment; 12 in the brigade, and 24 in the United States infantry division of 1918. Separate and distinct weapons, they were controlled tactically by the infantry regimental commanders in each infantry brigade and infantry division. The allied medium mortars of World War I were the British six-inch Newton and the French Mortar 58, No. 2. These were not infantry mortars, but were operated by artillerymen, and as such, were under the tactical control of the artillery brigade commander in the infantry division. Not highly mobile, the medium mortars were sited permanently in support of the Infantry. They were particularly effective against trenches, lightly protected strong points, and machinegun nests. They were especially useful in the destruction of enemy barbed wire preparatory to launching an attack. Medium mortars were transported in mule-drawn escort wagons, each of which could carry

three type 58, No. 2 mortars. Mortar carts, similar to the Vickers Machine Gun Cart, M 1917, were also employed, either animal-drawn or hand-drawn by the mortar-men. In the narrow trenches all mortars had to be moved by hand. The heavy mortars were of the French 240mm, or the English 9.45-inch calibers, and were assigned to corps artillery. The heavy mortar batteries consisted of six mortars; four batteries were assigned to the corps, comprising a total of 24 heavy mortars. These weapons were under the direct control of the corps artillery commander. Because of its heavy projectile, which weighed 183 pounds, and its range of 2240 yards, the 240mm heavy mortar was especially effective against well-protected positions and strongpoints.

LITERATURE CITED

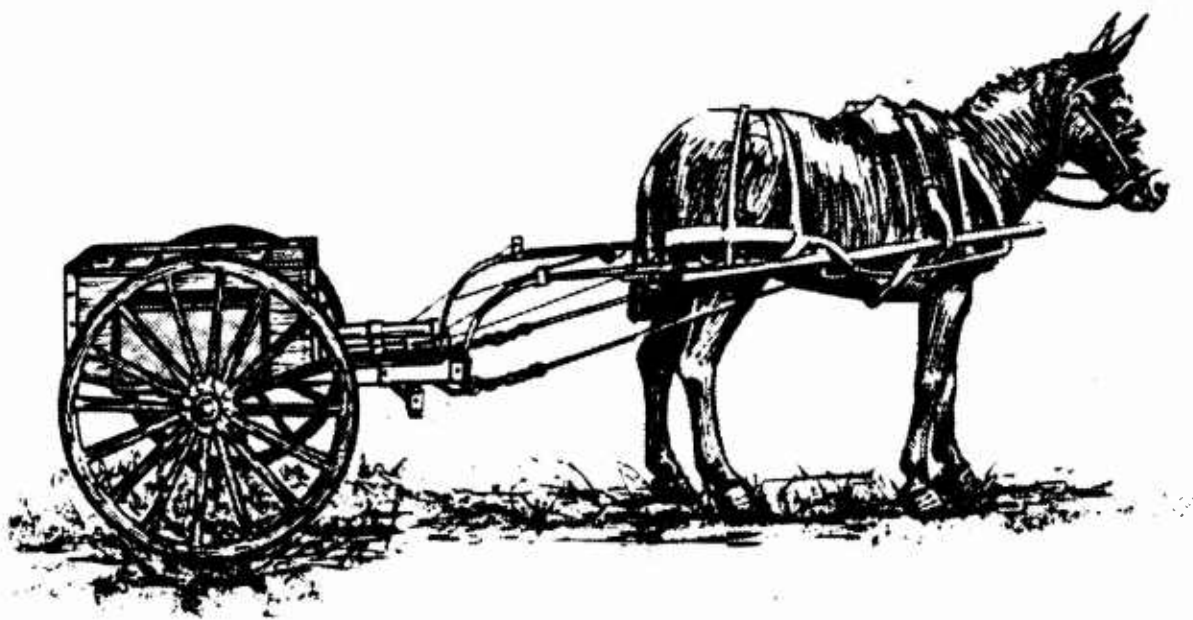
1. Richard Bowood, Soldiers, Soldiers, London: Paul Hamlyn, 1965.
2. Army Lineage Book, Volume II, Infantry, Washington: Office, Chief of Military History, Department of the Army, 1953.
3. History and Role of Armor, The United States Army Armor School, Fort Knox, 1960.
4. Captain B. H. Liddell Hart, The Tanks, Vol. I., New York: Frederick A. Praeger Company, 1959.
5. Virgil Ney, The Evolution of the Armored Infantry Rifle Squad, Technical Operations Research, Combat Operations Research Group, Fort Belvoir, Virginia, CORG Memorandum CORG-M-198, 19 March 1965.
6. W. Y. Carman, A History of Firearms, London: Routledge and Kegan Paul Ltd., 1955.
7. Benedict Crowell, America's Munitions 1917-1918, Washington: The United States Government Printing Office, 1919.
8. Major James E. Hicks, Notes on French Ordnance, Mount Vernon, New York: James E. Hicks, 1938.
9. Major P. H. Ottosen, Trench Artillery, A. E. F., Boston: Lothrop, Lee, and Shepard Co., 1931.

The combat experience of the United States Army in France during World War I introduced a whole arsenal of new weapons to the American infantryman and his squad. The automatic rifles, rifle grenades, hand grenades, and trench mortars of World War I survived in the armament of the United States infantry in the post-World War I reorganization. In addition to the basic infantry rifle squad, the machinegun squad, the mortar squad, and 37mm gun squads were the small units met in the infantry organizations. In addition, heavier fire power for the infantry was provided by the formation of the regimental howitzer company which was especially designed to handle the Stokes mortars and the one-pounder or 37mm cannon. This organization was, in reality, the unit in the infantry regiment where the long-desired infantry howitzer, or accompanying cannon, would properly be located. But in the interim between the wars, the infantry cannon was not developed and the howitzer company continued to carry on the mortar functions of the old regimental headquarters company of 1918. In 1939, the howitzer company was eliminated and the 37mm gun was placed in the newly activated, regimental antitank company. The machinegun companies, D, H. and M of each infantry regiment were renamed heavy weapons companies. They retained the heavy Browning machineguns but were assigned the two 81mm mortars of the old howitzer company. In the years from 1937 to 1941

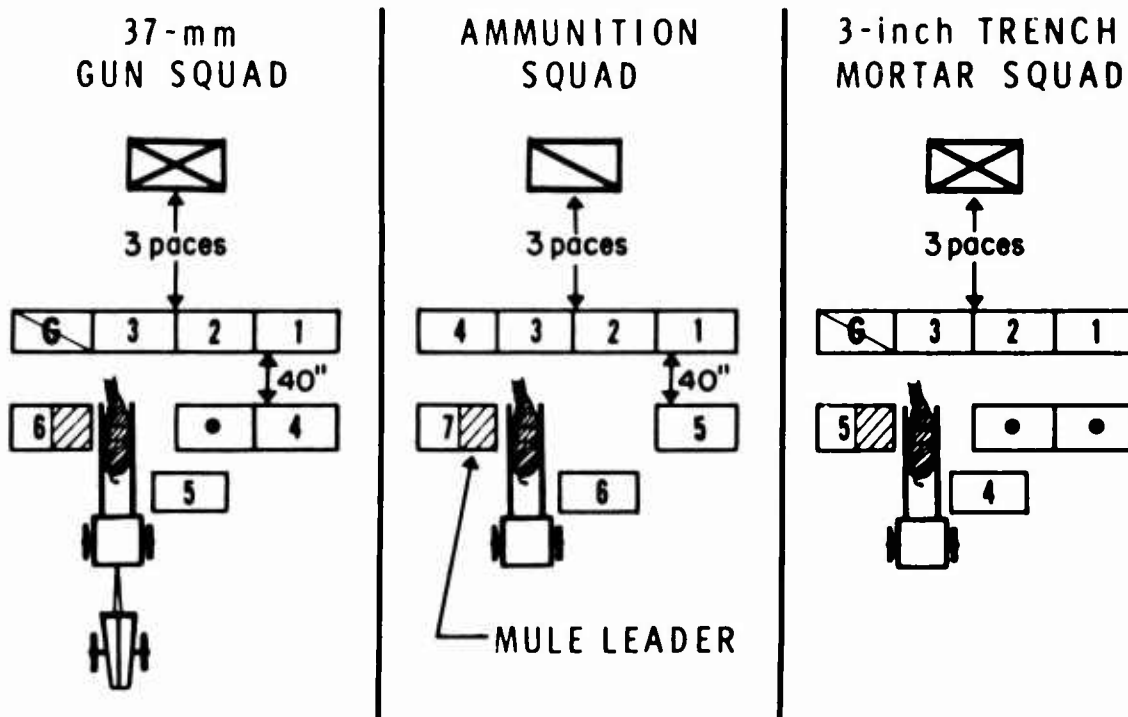
American infantry had undergone a real revolution. Organizationwise, the foot establishment was arranged along lines that had been more carefully tested than ever before in peacetime. As for weapons, they were turned over completely, except for the .30-caliber heavy machine gun. In other words, the 60mm mortar (first adopted as standard in 1937, but remaining scarce) had replaced the old Stokes and its successors, while a heavier mortar, 81mm, had been introduced.
(Ref 1, pp 47-48)


During the years of austerity from 1920 to 1940, the United States Army carried on with its reduced companies, battalions, and regiments. Within the infantry companies there were seldom more than 40 men available for duty and training. In the pursuit of training, the troops performed their daily drills and seasonal target practice under the command of their officers and non-commissioned officers. On the green parade grounds of the small red-brick forts scattered throughout the United States and elsewhere in the Islands, the mortar squads practiced their drills and simulated firings. The strength of the mortar squad, in the first half of the period, was tied directly to the eight-man squad concept enunciated by Emory Upton.⁶ The rationale for the mortar squad strength was based upon the constant need of the mortar for ammunition which was heavy and awkward to handle. Thus, the ammunition bearers made up the bulk of the squad's membership. The squad leader, the mortar gunner, and the assistant gunner were the key members of the squad.

⁶ See Virgil Ney, Organization and Equipment of the Infantry Rifle Squad: From Valley Forge to ROAD, Technical Operations Research, Combat Operations Research Group, Fort Belvoir, Virginia, CORG Memorandum CORG-M-194, January 1965 for account of Upton, pp 13-16.



Mule-drawn Machinegun or Mortar Cart, M1917



NOTE  Runners are not members of howitzer squads but may be assigned for purposes of drills and formations - as shown.

Squad Organization, Howitzer Company, US Army, 1926

In addition to the ammunition bearers, in the days of the mule-drawn carts, the mule leader was another important member of the mortar squad. With the gradual phase-out of animals in the military establishment, the truck driver took the mule leaders place as the driver of a weapons carrier or "jeep." The 75mm mortar squad, which was an experimental one, increased the strength to a total of 11 members. Organized in 1930, this squad was an integral unit of the Cannon Company of the Infantry Regiment (Ref 3).

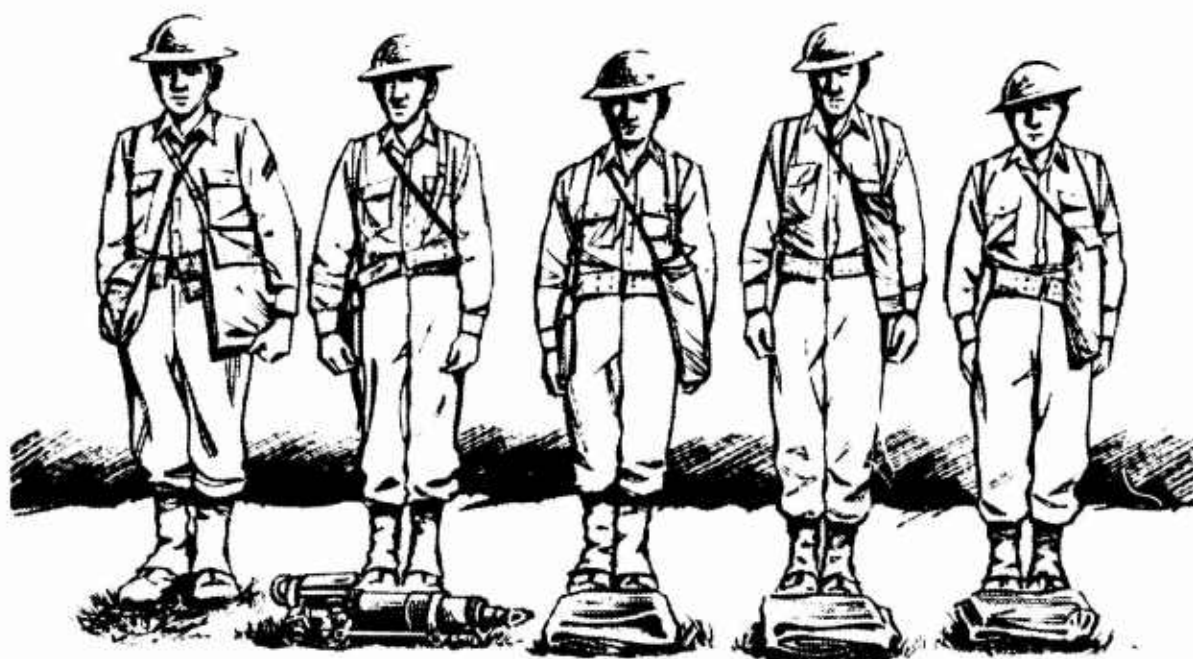
Mortar firing with live ammunition was not possible, of course, with the area limitations imposed by the boundaries of the average military post of the twenties. Practice firing was done usually on the rifle range during the summer training camp period. At this time, practice rounds filled with sand were employed to give the trainees an impression of the effect of mortar fire. In the winter, in barracks, ingenious officers and non-commissioned officers devised subcaliber (.22 caliber) firing devices which permitted the mortars to be fired at indoor landscape targets.

In the experimental period from 1920 to 1940, the infantry mortar squad's strength appeared to vary with the caliber of the mortar concerned. This relationship of caliber of ammunition to squad size may be ascribed to the fact that heavier weight ammunition required more personnel to manhandle it in combat. By virtue of this fact, the 60mm mortar squad has always been small in numbers. Throughout its long career with the United States Infantry, the 60mm mortar has been served by a five-man squad. The light weight of the mortar and bipod (approximately 45 pounds) and the ammunition (3 pounds) permitted this highly desirable weapon to be handled in drill or combat by a minimal crew. Prior to World War II, experimentation by the Infantry Board and the Weapons Section of the Infantry School at Fort Benning, Georgia developed techniques of fire wherein the 60mm mortar became operable as a one- or two-man weapon. This type of operation was to be observed during the campaigns of World War II in the Pacific and the European Theaters.⁷

The old three-inch Stokes trench mortar was replaced by the 81mm mortar in 1937. Wholesale introduction of the 81mm mortar soon followed and by October 1940 the 81mm mortar squads of the Infantry Heavy Weapons Company were organized to include: 1 corporal, squad leader, armed with the automatic pistol, caliber .45; 4 privates, or privates, first-class, ammunition carriers, armed with the automatic pistol, caliber .45; 1 chauffeur, armed with the rifle, caliber .30 M1; 1 mortar gunner, armed with automatic

⁷ See account of the exploits of Gunnery Sergeant "Lou" Diamond, USMC., in Marc Parrot. Hazard: Marines on Mission, Garden City, N.Y.: Doubleday, 1962, pp 185-225; See also: Schoun, Karl (ed), U.S. Marine Corps Biographical Dictionary; The Corp's Fighting Men, What They Did, Where They Served. New York: Watts, 1963. This story is deemed by some authorities to be apochryphal. See also Appendix F for the citation for the Medal of Honor awarded to Technical Sergeant Charles E. Kelly of the United States Army in World War II.

pistol, caliber .45; 1 assistant mortar gunner, armed with automatic pistol, caliber .45. Squad total was eight. For transporting the mortar and ammunition, a 1/2-ton truck, a weapons carrier, was provided. The mule and the World War I-type mortar cart were phased out, and the motor vehicle took over the task of weapon transport (Ref 4).



Mortar

**Ammunition bags -with cleaning staff,
aiming post, and aiming stakes**

60mm Mortar Squad, US Infantry, World War II

In 1939, the firepower of the infantry rifle company was augmented by the addition of the weapons platoon to the three rifle platoons. The 60mm mortar squad was continued with a total of five members. There were three such squads in the 60mm mortar section of the weapons platoon. The rationale for this somewhat unusual reorganization of the infantry rifle company may be found in the following.

This weapons platoon (new in 1939) was part of a trend . . . to integrate all necessary weapons except artillery and tanks into the basic tactical unit, the battalion. That trend made every element of an infantry battalion, even the squad a more complex organization than before, and at the same time, vastly increased its firepower. The heightened complexity, of course, brought with it the need for better communications, better training, and above all, better leadership.
(Ref 1, p 44)

But the period from 1920 to 1941 had been a time of austerity for the Army. The people of the United States were tired of war and they wanted nothing more than to withdraw to and to stay in "splendid isolation" from the rest of the world and its political problems. This general neglect of the Armed Forces and their proper equipment was to have its repercussion when the nation was surprised at Pearl Harbor on December 7, 1941. In anticipation of the conflict, there had been a partial mobilization of National Guard troops and testing in maneuvers in Louisiana and elsewhere. But heavy infantry equipment such as mortars and heavy and light machineguns was in short supply or nonexistent and

...as late as 1941, U. S. infantry mortar squads used stove pipes as simulated mortars. Machineguns were improvised from broom sticks.
(Ref 1)

The lack of appropriations for military "hardware" in the interval between the First and Second World Wars caused the production of weapons for the Army to be drastically curtailed. But the Army Ordnance Department went on with research, experiment, and development activities in the interests of national defense. Observers were sent abroad to note the new and changing military armament and equipment of foreign governments to ensure that the development of American ordnance items would not be left behind. Current plans of foreign armies were of vital importance to those charged with the design and planning of new weapons for the United States Army.

The effect of the war in Europe before Pearl Harbor was to cause the United States to partially mobilize the National Guard and to call in individual Reserve officers to active duty. The Regular Army was being brought to full strength by intensive recruiting. As indication of the changing trend in the attitude of the Congress and the Appropriations Committee, the Ordnance Department appropriation jumped from 24 million dollars in fiscal year 1938 to 112 million dollars in fiscal year 1939.

With reference to the weapons of the infantryman of 1939 and 1940, the following comment from the Infantry School is highly significant of the trend in weaponry and tactics developing in the war:

The progress of the war made increasingly apparent the necessity for supporting the advancing Infantry with increased and accurate firepower. Close support weapons were required to supplement the artillery coverage to prevent the enemy from manning his weapon in the interval between the lifting of the artillery barrage and the attainment of the objective.

Since hostile forces are normally entrenched in defensive positions, high angle plunging fire is essential. The need was for weapons readily transportable, capable of immediate action, and suited to fire from defilade in front-line emplacements.
(Ref 5)

To fill this gap in firepower which had existed since the time of World War I and the mass attacks of trench warfare, the Ordnance Department of the United States Army developed two infantry mortars--the 60mm and the 81mm mortars. The 81mm mortar was the lineal descendent of the old Stokes three-inch mortar of World War I. As such, it became the main source of heavy fire power within the prewar infantry regiment. Located in the regimental howitzer company and later in the battalion heavy weapons company it was an effective substitute for the long-hoped-for infantry howitzer. It complemented the 60mm mortar which was assigned to the weapons platoon of the infantry rifle company. The 60mm mortar was developed and produced in limited quantities prior to the outbreak of World War II. The improved M2 model departed from the usual infantry mortar in that it could be fired by a trigger mechanism as well as by the conventional drop fire method. The 60mm mortar survived as the organic indirect fire weapon of the rifle company until 1957. At that time, the 60mm mortar was phased out and replaced by the 81mm mortar which was formerly found in the heavy weapon company of the infantry battalion.

The advent of new weapons during the period created the need for new organization and techniques. The basic infantry rifle squad of eight men commanded by a corporal was to be converted into a twelve-man squad commanded by a sergeant.

Transportation for the mortar has always been a problem. The weight of the soldier's battlefield load must be considered in relationship to his potential and actual mobility. After World War I there ensued a general reorganization of the infantry of the United States Army to conform to a pattern developed basically in the campaigns in France. The machineguns and mortars were found in the machinegun companies, howitzer, and heavy weapon companies of the infantry battalions and regiments. The machinegun and mortar were transported on the march and in the field in the mule-drawn Machinegun Cart M1917, which was essentially the cart developed by the British Army for the Vickers machinegun. With slight alteration the one-mule cart could be used for the heavy Browning Machinegun M1918 and the Stokes or Stokes-Brandt three-inch trench mortar (Ref 6).

The mortar squad of the 1930's and 1940's was organized for drill and combat around the cart and the mule. The mortar could be carried for short distances "off carts" and "by hand" --the theory was that the mule-drawn carts could maneuver the mortars close to the firing position and then withdraw "unloaded" to the protection of a defiladed position in the immediate rear area. Consequently, the mule leader and his assistant were important members of the squad. Upon their skill with the animals and carts depended squad mobility and maneuverability. The instructions for the mule

leader were explicit:

(1) The chief duties of the mule leader are:

(a) Leading the mule during drill, combat and on the march.

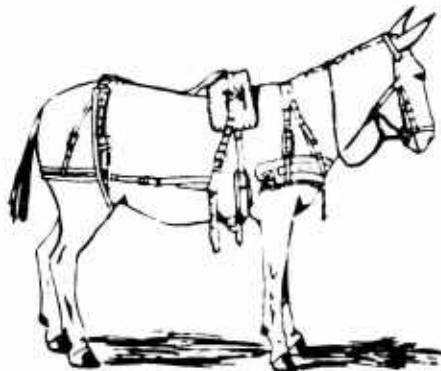
(b) Training and care of the mule.

(c) Care and adjustment of the harness.

(d) Harnessing and unharnessing.

(e) Hitching and unhitching.

(f) Care of the cart.



(2) As a general rule, while mule leaders are harnessing and hitching, the remainder of the squad will be loading the carts for the drill or march.

(3) The mule leader must be thoroughly trained in his duties, because the greatest value cannot be obtained from the weapons of the howitzer company unless the mule leader can maneuver his cart boldly and skillfully in action. The carts of the howitzer company should work close to the enemy to effect, by their proper handling, a great saving of physical exertion on the part of the personnel of the howitzer company squads.

(Ref 7, pp 108-110)

The infantry drill of the post-World War I period integrated the machinegun and mortar squad and the 37mm gun squad into one of the last formations of the United States Army to employ lead animals. The M1917 machinegun cart survived to the last, with some attempts made to improve it. In the 1930's, a Captain Matthews devised a light, rubber-tired, wire-wheeled cart which permitted the weapons to be hauled, mounted and locked into firing position. Experimental mortars with fixed wheel carriages were also produced in limited numbers but they did not last past the experimental stages. A few of these oddities were rifled and breech-loading--others possessed fixed base plates.

For this period of the Army's long history, the mule was again the partner of the soldier. In spite of the partial conversion of the Army to motor-driven vehicles in the 1930's and 1940's, the machinegun and mortar carts and mules were retained until after the attack upon Pearl Harbor. It is of interest to note that the mule served on all the fronts during World War II, not as a drawer of machinegun and mortar carts but as a pack animal. As such, he carried guns, mortars, ammunition, rations, and casualties in the mountains of Italy and the jungles of Burma. His value as a tough veteran campaigner shone forth again in innumerable combat actions and operations. The substituted weapon carrier or the jeep was not as adaptable, nor as sure-footed, as the mule--there were places where wheels could not go. In some

instances, as noted, the terrain caused the mule to be brought back as an important part of the combat infantry elements (Ref 8, pp 430-436, 452-504).

Drill for the mortar squads was divided into three types--ceremonial, cart drill, and combat gun drill, in extended order. Mortar squads were drilled until they were capable of assembling and disassembling their weapons in either daylight or darkness in a minimum of time. Every man in the squad was trained in the precise performance of the duties of the next number in the squad above him. Once precision was attained, accuracy was stressed. The drill of the mortar squad was not as precise as that of the rifle squad. However, it did exemplify fine teamwork. The term "crew-served" weapons conveyed this connotation. The mortar squad, as conceived after World War I, never faced the test of combat. With its animal-drawn equipment, it participated in the prewar field tests and maneuvers and survived until the motorization of all infantry units. Personnel and weaponwise, the mortar squad entered World War II as an effective and highly essential combat unit.

LITERATURE CITED

1. The Army Lineage Book, Volume II, Infantry; Washington: Office of the Chief of Military History, Department of the Army, 1953.
2. Table 30 W, Howitzer Company, Infantry Regiment (War Strength), Washington: War Department, April 15, 1921.
3. Table 30 W, Cannon Company, Infantry Regiment, Washington: War Department, July 30, 1930.
4. Table of Organization and Equipment, Infantry, Heavy Weapons Company, Washington: War Department, October 1940.
5. Development of Mortars, Mortar Committee, The Infantry School, Fort Benning, Georgia, (unofficial manuscript paper)
6. Handbook on Machine Gun Cart Model 1917, Washington: War Department, March 25, 1918.
7. Basic Field Manual, Volume II, Infantry Drill Regulations, Washington, D. C.: War Department, 1929.
8. Brooks E. Kleber and Dale Birdsell, U. S. Army in World War II, The Technical Services, The Chemical Warfare Service: Chemicals in Combat, Washington: Department of the Army, Office of the Chief of Military History, United States Army, 1966.

WORLD WAR II PERIOD

Our mortars and our artillery are superb weapons when they are firing. When silent, they are junk--see that they keep firing!

Patton

The United States Army, and especially the Infantry arm, entered World War II with a tighter and better-conceived organization than in any previous wars in the Nation's history. As noted, the Army had undergone a tremendous transitional period a crucial time that was to see the deletion of the horse and mule from the Tables of Organization and Equipment and the complete motorization of all units. Of considerable value in the prewar years was the vigorous leadership of the Infantry arm by the Chief of Infantry. As the zealous guardian of the basic interests of the "Queen of Battle," the Chief was instrumental in giving the infantry an effective organization and weaponry. This task, begun in the twenties, came to fruition as we entered World War II. The following comment is highly significant of the direct contribution of the Chief of Infantry:

The Chief of Infantry, the Infantry School, The Infantry Board, the Department of Experiment, the Tank Board, and The Tank School engaged vigorously in the development of infantry. The earliest fruit of their attention was a complete revision of the tables of organization. In this alteration, made during the twenties, the square division survived, but some of its infantry components were considerably modified. The most extreme change took place in infantry battalions, where one rifle company was eliminated and replaced by a machinegun company. The alteration corrected the confusion of World War I in the use of machineguns by placing heavies under the control of infantry battalion commanders. Almost as extreme was the reduction of the numbers of platoons in a rifle company from four to three. Both the changes were in the direction of what was later called "triangularization," although it was not yet accepted as a broad principle.
(Ref 1, p 42)

In 1939 two major changes occurred in infantry organization which were to have a profound effect upon the future of the mortars in the infantry arm. Significantly, these were the addition of a weapons platoon to the rifle company and the conversion of the old machinegun companies, the last lettered company of each rifle battalion, to heavy weapons companies. But there was more than just the idea of change contained in this latest move to improve the organization and firepower of the infantry.

...the old machinegun companies of the battalions were reorganized to become heavy weapons companies, still designated D, H, and M. They absorbed the heavy machineguns of the old-type company and, in addition, acquired



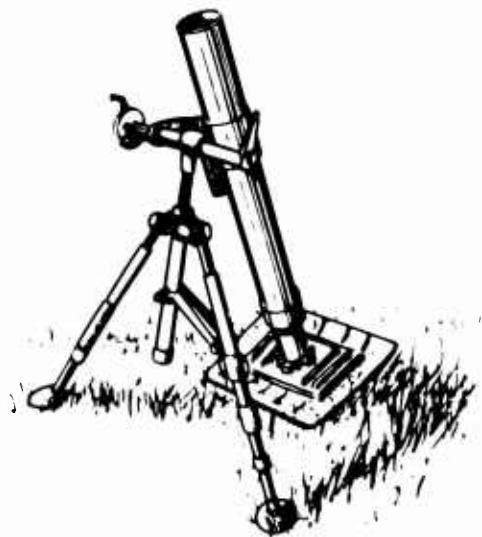
81mm Mortar, World War I

two 81mm mortars, and two .50 caliber machineguns. The creation of the battalion heavy weapons company was part of the trend...to include all weapons within a battalion that it would need to use whether attacking or defending. The process added greatly to the firepower of a battalion. (Ref 1, pp 44-45)

Essentially, the rationale behind this drastic reorganization of the infantry was found in the desire to consolidate all necessary supporting weapons, except artillery and tanks, in the infantry rifle battalion. This move, of course, complicated the organization of the rifle battalion, but it vastly increased its firepower. More complex than ever before, higher ranking and better professional leadership was required for the battalion. The organization of the weapons platoon exemplified this new trend within the infantry rifle company.

The Chief of Infantry contended and rightly, that in the years from 1937 to 1941 American Infantry had undergone a real revolution. Organizationwise, the foot establishment was arranged along lines that had been more carefully tested than ever before in peacetime. As for weapons, they were turned over completely, except for the .30 caliber heavy machinegun. In other words, the 60mm mortar (first adopted as standard in 1937, but remaining scarce) had replaced the old Stokes and its successors, while a heavier mortar, 81mm, had been introduced. A light machinegun had actually been adopted and the BAR so much improved as to be virtually made over. Finally, the Springfield 1903 shoulder rifle had yielded place to the semi-automatic M1. In addition, new small arms such as carbines and submachineguns had entered infantry armament, together with the larger machinegun, the .50 caliber. (Ref 1, pp 47-48)

World War II was a global war fought on many fronts in every type of terrain. The United States Army faced foes who were tough, skillful, and often fanatically brave. Enemy weaponry, especially that of the infantry, had been proven in battle. The use of mortars in place of conventional artillery gave the infantry of all armies additional firepower of considerable strength and volume. Germany and Japan had employed infantry and mortars extensively. In the American Ground Forces the mortars were, first, the 60mm mortar in the Weapons Platoon of the rifle company and second, the 81mm mortar in the Heavy Weapons Company of the rifle battalion. The following general comment on the use of mortars by certain participants in World War II is revealing as to the state of the art at the time of America's entrance into the conflict.



60mm Mortar, M19

Like Japan, Germany and Russia both equipped their infantry with light, portable 50mm mortars. Both used the weapons in close combat at ranges of 100 yards and less. Germany also used a 50mm mortar which was operated by remote control. Dozens were installed in the pill-boxes of the Siegfried Line. The U. S. 60mm mortar weighed 20 or 45 pounds depending upon baseplate, elevated 45 to 60 degrees, and fired 3-lb. projectiles at rates of 18 rounds per minute sustained or 30 rounds per minute maximum rapid-fire to ranges of from 1,600 to 2,000 yards. The Japanese 50mm grenade launcher could fire smoke grenades or demolition bombs weighing about 2 lbs. about 700 yards at a rate of 18-20 rpm.

(Ref 2, pp 264-267)

At the beginning of the 1940's, the infantry company of the United States Army was organized and functioning under the authority of T/O 7-27, War Department, Washington, November 15, 1940. This organization was to set the basic organizational pattern for the mortar squad within the infantry rifle company. Under its provisions, the organization of the mortar squad within the three-squad 60mm mortar section was as follows:

60mm Mortar Squad

1 corporal, squad leader and gunner (pistol)

4 privates, first-class and privates

(3 ammunition carriers) pistols

(1 gunner's assistant) pistol

Total: 5

Equipment

1 mortar, 60mm

5 pistols, automatic, caliber .45

Just prior to the Japanese attack upon Pearl Harbor, there were several different types of squads within the infantry organization. These were: The Rifle Squad, The Rifle Squad With Automatic Rifle, The Light Machine-gun Squad, The 60mm Mortar Squad. With the exception of the first squad, which was the conventional rifle squad at war strength of 12 members, the others were anticipatory of the types of squads thought to be adequate to wage combat against skillful and determined enemy forces (Ref 3, p 45).

The 81mm mortar was initially the heaviest caliber mortar found in the prewar United States infantry regiment. Not as portable as the 60mm mortar, the "81," as it was called, gave the infantry battalion commander a powerful weapon for attack and defense.

In the infantry rifle company, as organized by TO/ E No. 7-17, War Department, Washington, D. C., 15 July 1943, the weapons platoon included a 60mm mortar section of three 60mm mortar squads. The 60mm mortar squad was organized as follows:

60mm Mortar Squad

1 corporal, squad leader

4 members, including:

1 technician, grade 4

1 technician, grade 5

1 private, first-class

1 private



60mm Mortar Crew in Action

2 ammunition bearers armed with carbine, cal. 30.

1 gunner, mortar, armed with automatic pistol, cal. 45.

1 gunner, mortar, assistant, armed with rifle, .30 caliber, M1.

Equipment

2 carbine, cal. .30

1 mortar, 60mm

2 pistols, automatic, cal. .45.

1 rifle, cal. .30, M1

(Ref 4)

In the years between the end of World War I and World War II the Chemical Warfare Service of the United States Army carried the 4.2-inch chemical

mortar as the basic weapon of the chemical battalion. Originally charged with the missions of delivery of gas and smoke shells upon the enemy positions, the chemical battalion found itself delivering high-explosive shells against Japanese caves in the islands of the Pacific. Experience of the infantry units engaged in "digging out" or "sealing up" the tenacious Japanese demonstrated that the 81mm, the old reliable heavy mortar weapon of the infantry battalion was not powerful enough for this mission. Firing white phosphorous smoke shells, the chemical mortars were effective in screening infantry attacks but ultimately their heavy caliber and consequent power were capitalized upon for high-explosive fire missions. The Chemical Warfare Service: Chemicals in Combat has this to say about the employment of the 4.2-inch mortar in the Pacific:

The employment of chemical mortar units in the Pacific differed considerably from that in the Mediterranean and European Theaters. With the halt of the general Japanese advance at Guadalcanal, Allied forces faced the prospect of subjugating or bypassing the many island groups that lay between them and Japan. Because some of the islands were not very large certain of the campaigns were to be fought by small task forces, with a single mortar platoon attached to a regimental combat team. The islands also dictated that there would be a great many amphibious operations in which the 4.2-inch mortar, mounted on landing craft, was gradually to assume an important role. In many cases the advancing Allies were confronted by thick jungle growth which hindered the use of artillery and enhanced the value of the more mobile 4.2-inch mortar. This terrain, consisting of dense vegetation broken only by an occasional path, created problems of observation and transportation even for chemical mortar units. The climate



4.2-Inch Mortar Crew in Firing Position, World War II

of the Pacific added to the difficulties of mortar operations; the heavy rain, intense heat, and high humidity of the tropics made it difficult to insure effective employment of the mortar and proper maintenance of the weapon and its ammunition. (Ref 5, p 493)

In connection with the firing of high-explosive missions by 4.2-inch chemical mortars, it is noted that permission to fire such missions was not received by the Chemical Warfare Service until the 19th of March 1943. At this time, the landings of the United States Marines and Army troops were seven months past and the Allies were looking forward to the beginning of the island-hopping campaigns that were to wrest the control of the Pacific from the Japanese. Before authorization for high-explosive missions, the 4.2-inch mortars were usually occupied in delivering smoke, that is, white phosphorous shells, in support of infantry attacks. Once the authorization was received, the 4.2-inch mortars became almost indispensable as excellent jungle and mountain artillery. The versatility of this weapon was astounding. For example:

... in close support of the 27th Infantry, 25th Division another platoon of the mortar battalion, moved up to Bamboe Peninsula on Arundel Island. The men used jeeps, hand carry, and a variety of boats to negotiate the difficult terrain. Once in position the mortars fired at the enemy barges and troops. Despite the extreme range mortar fire destroyed three barges, causing loss of enemy troops and supplies. From 25 September to 4 October the mortars placed cross-channel fire on the air field on Kolombangara Island and on enemy shipping in the narrow waters between the islands. (Ref 5, p 493)

The appreciation of the infantry commanders in the field for the 4.2-inch mortar was noted in their recognition that the mortar could engage the enemy with a shell which was comparable to that of the 105mm conventional field artillery. This was especially valuable to the unit commander whose troops faced enemy targets which could not be reached by the artillery 105's and 155's. The 4.2's were particularly valuable in defense when used linked together by field telephones around a perimeter.

The maneuverability of the mortar was one of its greatest assets from the point of view of the infantryman. Fire and maneuver, those constants of infantry tactics, required that, wherever the "doughboy" went into combat, his mobility must not be reduced by excessively heavy weapons. The mobility of the rifle squad was, in effect, limited by the ability of the automatic rifle team to move. The mobility of the mortar squads of all types was limited by the carrying weight of the specific mortar in use by the squad. The light weight 60mm mortar posed no problems with reference to mobility. With a minimal number of five members, the 60mm squad was compact, highly maneuverable, and easy to conceal under cover. The ammunition round was not heavy and it was easily handled by the soldier from any position on the ground.



60mm Mortar Hand-held

The statistics of the 60mm mortar:
Weight - 45 pounds; Ammunition - HE, smoke; Rate of Fire - 30 rds/min maximum, 18 rds/min sustained; Range - 1,600 - 2,000 yards
(Ref 6, 1 25)

With such a lightweight weapon available to the infantry squad, the additional punch needed for the final "softening up" of the enemy resistance was always present within the infantry platoon.

The Army realized early in the war that the mortar could be operated by one man by eliminating the baseplate. This gave the infantry man an additional capability which was of particular value in the close combat of the jungles of the Pacific in World War II and later in Korea.

Among unusual enemy weapons of World War II was the so-called "knee mortar" of the Japanese. Actually, this weapon was not a mortar, but a 50mm grenade launcher. Highly effective, this weapon when captured was often misunderstood by the American troops who tried to fire it using the knee as a rest. Those who did, often suffered from a broken thigh as a result of the violent recoil of the weapon. Because they had divorced the grenade discharger from the rifle, the Japanese were quite far in advance of the Allies in the development of a grenade discharger. Those who fought the Japanese infantryman considered that he was a superb mortar man. His skill with mortars and grenade launchers was never doubted by those who faced him in the jungles and on the beaches of the South Pacific. An artilleryman, the Japanese soldier left much to be desired, but, as an infantry mortarman, he was a professional.

Within the United States Army infantry heavy weapons company, were the battalion heavy mortars of World War II, the 81mm mortars. While these weapons were not the heaviest caliber to be used eventually by the infantry, they were the regulation heavy weapons company mortars. The 4.2-inch mortars of the Chemical Warfare Service have been noted as supplementing those of the infantry for specific missions, other than chemical, when authorized. In his book, War As I Knew It, General George S. Patton had many things to say with reference to the tactical employment of the infantry mortars. Coming from a soldier and commander of his stature, they are worthy of noting. Among these trenchant observations are the following:

When a small unit disposes both 60mm and 81mm



Japanese 50mm Launcher

Much time is wasted in mounting and dismounting mortars and machineguns. Standing gun drill will be practiced so that the operation will be automatic and can be accomplished in the dark. The ladder method of ranging with mortars is recommended.

In the battalion the heavy weapons company paces the battalion. In the regiment the cannon company paces the regiment, but it is the function of the rifles and the light machineguns to see that the heavy weapons have a chance to move. In other words, the rifles and machineguns move the heavy weapons in to do the killing.

A battalion of 4.2 chemical mortars, when available, should be attached to an infantry division. An infantry regiment in combat should have a 4.2 chemical company attached.

Mortars use great quantities of ammunition. The 81mm will fire 800 rounds and a 60mm 500 rounds in 24 hours. To provide this ammunition, transportation of all kinds must be utilized, and infantry riflemen in the vicinity

mortars in an attack, the 60mm mortars should fire on the front line of the resistance while the 81mm fire for depth and to hit the supports and heavy weapons.

In marching fire, all weapons must be used. The light machineguns can be used while walking--one man carrying the belt, the other man carrying the gun. The same is true of the Browning automatic rifle, and, of course, as previously stated, of the M1. The 60mm mortar, advanced by alternate sections, can do much in the same way. The 81mm usually should support from one position.

Infantry mortars should be provided with an illuminating device for night firing.

Patton



of the mortars should each carry one round which they can dump at a predestined spot on going into the fire fight. When not on the move, all mortars, machineguns, and antitank guns of the infantry must be emplaced to fire. (Ref 7, pp 339, 341, 363, 408, 410)

The observations of General Patton cited above are included because they point up a successful pattern of mortar squad employment in World War II combat. Those principles are as sound today as they were a quarter of a century ago. It is noteworthy, that General Patton was an Army commander who concerned himself personally with the details of the operations of his mortar and other weapons squads. His dictum was proven valid in the Korean War, especially in the matter of "marching fire."

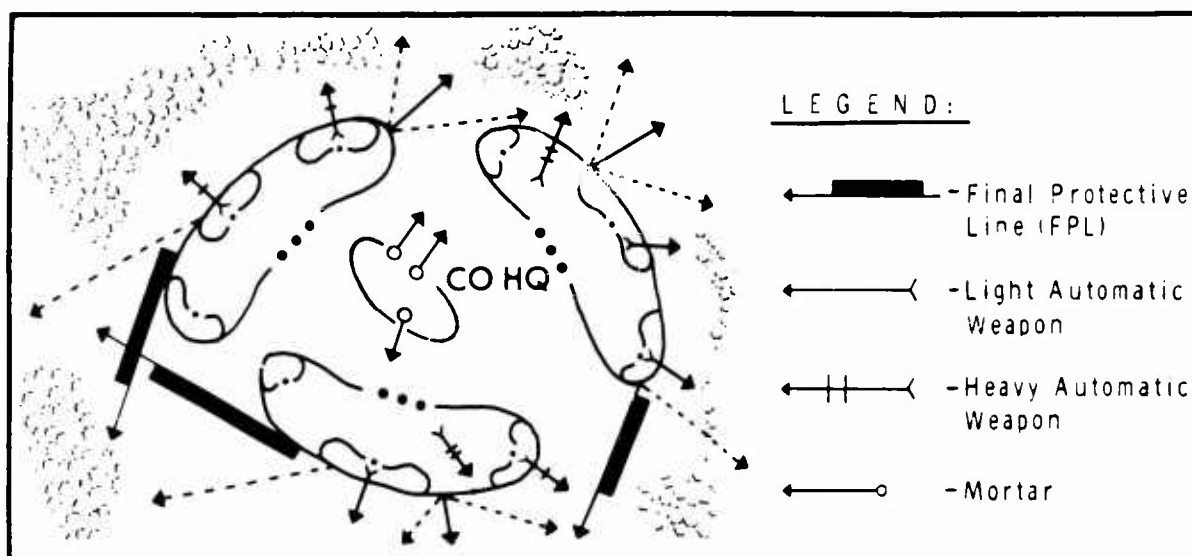
Current wartime combat experience and manpower requirements dictated certain changes and reductions in the organization of the smaller infantry units. Rifle and other infantry companies and platoons were reshuffled and trimmed of personnel and a weapon was added here or there to increase combat effectiveness. By March 1943, the following had taken place in the Infantry Table of Organization and Equipment down to squad level:

The smallest infantry unit, the rifle squad, remained unchanged in the new AGF (Army Ground Forces) tables. It remained a team of twelve men, armed with ten M1 (Garand) rifles, one automatic rifle, and one M1903 (Springfield) rifle. Three such squads formed a rifle platoon. Three rifle platoons were grouped with a weapons platoon to form a rifle company. The weapons platoon was modified slightly. It retained two .30 caliber light machineguns and three 60mm mortars as its primary weapons. It lost two automatic rifles but gained three antitank rocket launchers (bazookas) and one .50 caliber machinegun, the latter for anti-aircraft defense.

The heavy weapons company, with which three rifle companies were grouped in the infantry battalion, was cut into more deeply than the rifle company, being reduced from 183 to 162 officers and men. Thirteen of the twenty-one men removed were truck drivers. Armament was strengthened by adding seven antitank rocket launchers and three .50-caliber machineguns to the prior quota of six 81mm mortars and eight .30-caliber heavy machineguns.
(Ref 10, pp 300-301)

By 15 July 1943, the squad leader of the 81mm mortar squad of the Infantry Heavy Weapons Company was no longer a corporal but a sergeant and the gunner was now a corporal. An ammunition bearer who doubled as truck driver maintained the squad strength at eight members.

The need to recognize the hard service and combat performance of the Infantry by increased rank and pay for the various squad leaders found a firm friend in General Lesley J. McNair, Chief of the Army Ground Forces. The promotion of the mortar squad leader from a corporal to a sergeant and eventually to staff sergeant was a belated recognition of the importance of small-unit leaders in combat. The traditional concept that the infantry squad must be lead by a corporal was lost in the increased combat responsibilities of the squad leader. This was especially so with reference to the leadership of men and the technical handling of weapons. In the infantry rifle squad the number remained constant at 12 members. The "span of control" of the squad leader, particularly in the rifle squad with the tactic of fire and movement, was limited by human factors and by battlefield conditions to 11 men. In the weapons squads, the problem was somewhat simplified by the fact that weapons, both machineguns and mortars, were "crew-served." As such, they operated basically from fixed firing positions and did not usually assume in the offensive the almost constant mobility of the rifle squad with



Mortars Sited in a Perimeter Defense

its automatic rifle team and riflemen. The basic mission of mortars is to fire in support of the maneuver units of the infantry. When mortars are firing they do not move. When they displace they must go out of action. In the mortar section, squads could displace while covered by the mortar fire of adjacent mortar squads and riflemen.

The mortar squad leader not only commanded his squad but the weapons as well. Disposition of weapons and conduct of fire including adjustment were among his important combat duties. In the small five-man 60mm mortar squad, the command function is personal and highly direct. In the larger 81mm mortar squads, the problems of command were essentially the same as those in the 60mm mortar squad. The exception was that when the 81mm mortars were grouped to fire barrages in support of attacks, or in defense

of positions, fire control of the squads came within the purview of the forward observer. The same comment applies to the 4.2-inch chemical mortar squads on high-explosive fire missions.

On June 1, 1945, Table of Organization and Equipment, 7-17, established the squad leader of the 60mm squad of the infantry rifle company as a sergeant armed with rifle, M1, caliber .30. There was no assistant squad leader designated and the other members were assigned as follows: one mortar gunner, technician 4 or 5, armed with pistol, automatic, caliber .45; one assistant mortar gunner, private, first-class, armed with pistol, automatic, caliber .45; two ammunition bearers, privates, completed the squad.

The M1 rifle carried by the sergeant, in addition to personal protection, served the squad for target designation using tracer rounds.

In the larger mortar squads, the "span of control" was recognized by the promotion of the squad leader to staff sergeant. In the 81mm mortar squad of the infantry heavy weapons company by 1945, the squad was organized under Table of Organization and Equipment, 7-18 as follows: one staff sergeant, squad leader armed with rifle, M1; one corporal mortar gunner armed with a carbine, caliber .30; six members including one technician, grade 5; three privates, first-class; one private. Among these is the assistant mortar gunner, who is armed with a pistol, automatic, caliber .45. The number three man is also armed with the pistol and serves as an ammunition bearer. One of the two ammunition bearers also serves as truck driver for the $\frac{1}{4}$ -ton truck and $\frac{1}{4}$ -ton trailer.

The above mortar squad organizations continued stable until the end of the war. Of considerable interest is the fact that World War II was the first real test of the United States Army infantry mortar tactics and techniques. While it is historically correct to state that the United States Army first became involved with the infantry mortar as developed by the French and English armies in World War I, the infantry mortar's first widespread use by American infantrymen was in World War II. The long period of peace between 1920 and 1940 gave the United States Army an opportunity to select and develop mortars and squads suitable for combat. The mortar training and techniques carried on by the small United States Army and National Guard paid off on the innumerable battlefields of the global conflict of World War II.

The 4.2-inch mortar was, as noted, developed originally for the Chemical Warfare Service for the delivery of chemical and smoke rounds. As the war progressed, the 4.2-inch, authorized to fire high-explosive rounds, became the standby of the infantry. As a support weapon it was employed extensively in all the Allied offensives in Western Europe, Poland, Austria, Czechoslovakia, and Germany. It was highly effective in the mountains of Italy and in the post-Normandy-landing campaigns in France.

The 4.2-inch mortar was not only larger in caliber than the infantry mortars but it was rifled. The barrel was five feet long and the weapon was muzzle-loaded. The shell, weighing 24 pounds, was sped to the target as far as 4,500 yards in one minute. In fire for effect, the most skilled mortar crews have been able to have seven shells in the air and on the way

before the first round has landed on, or near, the target. This rapid fire

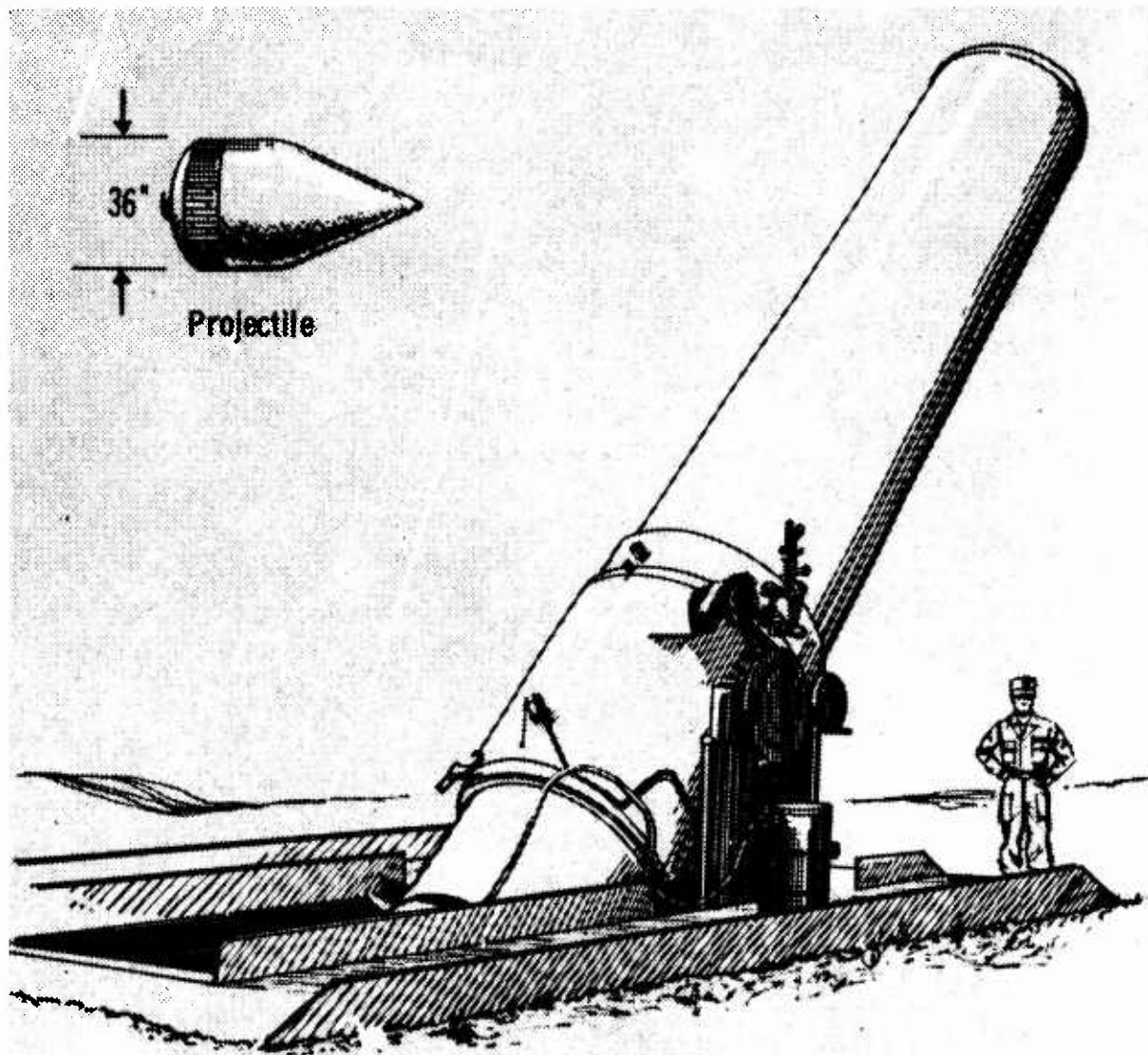
...in Italy, until they learned what weapon was being used... had the German troops convinced it was an automatic cannon. Also, it was during the fighting in Italy that a 4.2-inch mortar scored a hole-in-one. With phenomenal precision, it lobbed a high-explosive shell up, over and straight down into a German tank through its open turret hatch. On another occasion, a dozen well-aimed rounds destroyed a battery of Germany's famous 88mm guns in less than three minutes. (Ref 2, pp 270-271)

On the Eastern Front, the Red Army employed huge numbers of mortars of varying calibers against the Germans. The highest caliber noted was a 305mm mortar but the usual Red Army mortars were of 50mm, 82mm, and 120mm calibers. Mortars in the Soviet forces were also found with the conventional artillery regiment which included in its organization a brigade of one hundred and eight mortars of 120mm caliber.

During World War II, the United States continued to experiment with mortars with the objective of giving the infantry the firepower required to defeat the enemy in Europe and in the Pacific. Larger mortars were produced in 105mm caliber and 155mm caliber. Both of these heavier caliber weapons were designed for supporting the infantry and they were employed by that arm in battle. The 105mm mortar was of particular value to the initial landing forces which "hit the beaches" without organic artillery. This artillery was generally of 105mm or 155mm caliber. The 105mm mortar served effectively as artillery until the conventional and less-mobile artillery of equivalent caliber could be landed and placed in operation (Ref 8, pp 168-171).

While the light, medium, and heavy mortars performed well in their own roles, there were tasks which were too difficult for them to achieve. Among these were heavily fortified enemy positions which resisted all efforts of the infantry mortars. What was required was a mortar of sufficient caliber, and power to drop a maximum of high explosive upon these works. The result of the experimentation for such a mortar was the 914mm (36-inch) bore, which was called "Little David." The following facts are from the Infantry School:

The "Little David" 914mm Mortar is the largest ever built. It was intended for the destruction of enemy subterranean fortifications, fortified cities, industrial targets, and important supply installations. This weapon, had the war lasted, would have given the land forces a powerful, mobile weapon with an accuracy and all-weather capability comparable to those of artillery, with a far greater explosive effect. It fires a projectile weighing 3,700 pounds, with 1,600 pounds of high explosive. The crater caused by the "Little David" projectile is roughly 13 feet deep and 39 feet in diameter.



'Little David' 914mm US Army Mortar, World War II

Just before VJ Day (1945), ammunition for "Little David" was being rapidly produced, and production facilities were in a position to expand if the need had arisen.
(Ref 9, p 81)

LITERATURE CITED

1. The Army Lineage Book, Volume II, Infantry, Washington: Office Chief of Military History, Department of the Army, 1953.
2. John Kirk and Robert Young, Great Weapons of World War II, New York: Walker & Co., 1961.
3. Virgil Ney, Organization and Equipment of The Infantry Rifle Squad: From Valley Forge to ROAD, Technical Operations Research, Combat Operations Research Group, Fort Belvoir, Virginia, CORG Memorandum CORG-M-194, January 1955.
4. T/O & E No. 7-17, Infantry Rifle Company, Washington, D. C., War Department, 15 July 1943.
5. Brooks E. Kleber and Dale Birdsell, U. S. Army in World War II, The Technical Services, The Chemical Warfare Service: Chemicals in Combat, Washington: Department of the Army, Office of the Chief of Military History, United States Army, 1966.
6. Will Eisner, America's Combat Weapons, New York: Sterling Publishing Co., Inc., 1960.
7. General George S. Patton, Jr., War As I Knew It, Boston; Houghton Mifflin Co., 1947.
8. Major General G. M. Barnes, Weapons of World War II, New York: D. Van Nostrand Company, Inc., 1947.
9. Development of Mortars, Mortar Committee, The Infantry School, Fort Benning, Georgia, (unofficial manuscript paper)
10. Kent Roberts Greenfield, et al, The Organization of Ground Combat Troops, United States Army in World War II, Office of the Chief of Military History, Department of the Army, Washington, D. C., 1947.

THE KOREAN WAR

After the end of World War II in 1945, the rapid demobilization of the wartime army drastically reduced the military establishment. There was little time for reflection on the lessons of World War II. There was no durable period of "peace" for the Army. The "Cold War," and other post-World War II political situations, and confrontations with the Soviet Union required a strong, widely dispersed military force in both Europe and Japan and other parts of Asia. This period of uncertain political and military unquiet was rudely interrupted in June 1950 by the invasion of South Korea by the armies of the North Korean Communist State.

The trend, even before the outbreak of the Korean War, was to give the infantry regimental, battalion, and company commanders sufficient fire power to accomplish any and all combat missions assigned. The removal of the 4.2-inch mortars from the control of the Chemical Corps was a step in the direction of making the infantry organically independent weapon-wise. This independence was necessitated by the advent of atomic weaponry.

The Korean War has been aptly termed a war of small infantry units and small unit leadership. As such, the smallest units of the infantry and other arms often found themselves in operations which were highly vital to the overall success of the parent unit. Rifle and mortar squad leaders were often faced with crucial decisions and independent operations which squad leaders of previous wars had not often encountered. The following comment is significant:

The Korean War, by reason of both geography and enemy action, was a unit commander's war. The fate of a regiment or of a division might and frequently did depend upon the ability of a particular platoon commander to solve his particular problem in the heat of action. So--perhaps vital as one considers the possibilities of the future in dispersement--the necessity for trained, capable, and courageous small-unit commanders from the squad level up, was reaffirmed.
(Ref 7, p 690)

Korea was an infantry, artillery, and armor war. The rifle, mortar, and the machinegun and grenade were the basic tools with heavier recoilless rifles and rocket launchers added to the arsenal as the war progressed. The artilleryman with his 105mm and 155mm guns and the associated rocket batteries was as usual in direct support of the infantry. The infantry mortar squads were essentially the same as they were during World War II.

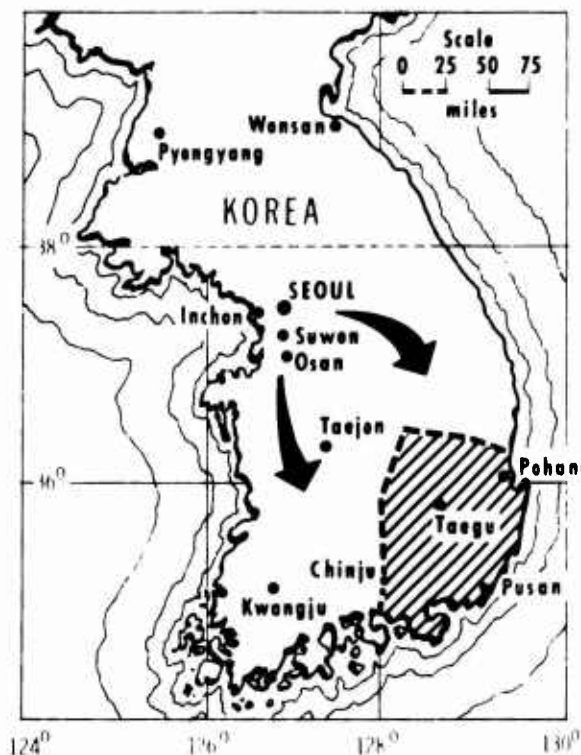
Korea offered a bitter school of experience for the Infantry of the United States Army. Hurriedly pulled from occupation duties in Japan, infantry regiments, companies, and squads, from June 1950 on, found themselves in combat with a ruthless and cruel enemy whose regard for the rules of land warfare was nil. Both offensive and defensive warfare were waged by the US Infantry. At one time, in January 1951, the bunker warfare in the mountains of Korea resembled the trench warfare of 1914-1918 (Ref 1, p 215 and Ref 2, p 654-692)

The United States Army entered the Korean War with much the same organization with which it had fought World War II. Fortunately, there were still on active duty combat experienced officers and noncommissioned officers and men who had fought all over the world during the global conflict of 1941-1945. Many of the lessons learned from World War II combat were to be of value, but many were not too applicable to the Korean situation.

No U. S. combat units were in Korea when the communists began their invasion, and the four divisions of the Eighth US Army in Japan had been concerned chiefly with occupation duties. Most of the men in uniform were very young and few had ever been exposed to hostile fire when the first of the four divisions in Japan were alerted for combat in Korea. Since time was of the essence, General MacArthur was forced to commit his command piecemeal.
(Ref 3, p 14)

The initial hard fighting was born by Task Force Smith, approximately one-half a battalion combat team which was detached from the US 24th Division (in Japan) and flown to Korea on 1 July 1950. At Osan on July 5, it was struck by a large force of North Korean infantry and tanks. The following extract explains how American infantrymen and artillerymen and their weapons faced up to combat:

For seven long hours the outnumbered Americans poured their howitzer, bazooka, mortar, and small arms fire at the Russian-made tanks. Five of the tanks were knocked out by howitzer shells, but the North Koreans flowed around the American flanks in great numbers, forcing the surviving infantry to abandon their heavy weapons and withdraw. Hopelessly outgunned and outmaneuvered, the tankless Americans had received a grim baptism of fire. Two rifle companies, a battery of 105-mm howitzers, two 4.2-inch mortar platoons, a platoon of 75mm recoilless rifles, and six attached teams equipped with World War II type 2.36-inch bazookas held an entire



Pusan Perimeter, 1 August 1950

enemy division from 0800 until 1500. The Americans who lived through the rigors of this battle lost their contempt for the fighting abilities of the North Koreans.

... They lacked the numbers and weapons to defeat the North Koreans, and Major General William F. Dean, the temporary ground commander in Korea, had the unhappy task of sacrificing space to gain time for a series of hard-fought delaying actions.

(Ref 3, pp 14-15)

The Army had to literally feel its way with varying successes and failures. Until the intervention of the Chinese in 1951, brilliant maneuvering and hard fighting enabled the United Nations Forces to save the Korean peninsula, drive the Communist troops back, and invade across the Yalu river.

The combat experiences of the infantry in World War II and the Korean War indicated the pressing need for heavy mortar support from weapons of greater caliber than the regulation 81mm infantry mortar. Essentially a battalion weapon, the 81mm gave the battalion commander additional and effective fire power when he needed it the most. As noted in Italy, in World War II, the 4.2-inch mortar was particularly valuable in the campaigns and operations in the mountains. Its use was further observed in the advance to the Rhine and into Germany. It was natural, therefore, that the post-World



4.2-Inch Mortar Firing in Korea

War II reorganization of the Army and, in particular, the infantry, should find a definite place for the 4.2-inch mortar as an organic infantry weapon. TOE 7-14 N of 26 March 1948 established the infantry heavy mortar company with a company headquarters consisting of a headquarters section and an operations and fire direction section plus a communications section. The company consisted of three heavy mortar platoons, each with a platoon headquarters and four heavy mortar squads. Each heavy mortar squad contained the following personnel: one staff sergeant, squad leader; one sergeant, mortar gunner; one corporal, assistant mortar gunner; four technicians, grades 3, 4, 5 or privates, first-class, ammunition bearers; one technician or private first-class, light truck driver. The total strength of the squad was eight members (Ref 4). Authorized during World War II to fire other than chemical missions, smoke, etc., the heavier 4.2-inch mortar became a favorite weapon for the destruction of well-protected enemy strongpoints.

Under the provisions of TOE 7-17 N of 9 December 1947, the mortar section of the weapons platoon of the infantry rifle company was organized into a section headquarters and three 60mm mortar squads. Each squad consisted of one sergeant, squad leader; one corporal; mortar gunner; two technicians, grades 3, 4, or 5, and one private or private, first-class, assistant mortar gunner. The total strength of the squad was five.

The infantry heavy mortar company made readily available to the regimental commander an extra punch for difficult missions. Supplementing the light 60mm mortars of the rifle companies and the heavy 81mm mortars of the infantry battalions, the 4.2-inch mortars gave the infantry regiment of the Korean War its heaviest fire power in history. The addition of the weapons squad to the rifle platoon by the cited TOE gave the rifle platoon leader additional firepower of the light .30 caliber machinegun and the 2.36-inch rocket launcher. In the weapons platoon of the rifle company, the two light machineguns were replaced by three 57mm recoilless rifles, in reality, hand-carried, short-range artillery pieces. The machineguns, increased by one, went to the rifle platoons, which, as noted, gained a weapons squad armed with the machinegun and the 2.36-inch rocket launcher, primarily an antitank weapon. Eventually, during the Korean War, the recoilless rifles in the infantry regiment included those of 75mm caliber (Ref 5, pp 43-54 and Ref 6).

The conduct of the Korean War is now military history to be read and absorbed as "lessons learned." The defense of the Pusan perimeter, the intervention of the Chinese, the master strategy of the landing at Inchon, the successful withdrawal from the Choisin Reservoir, the Outpost battles, all demonstrated the combat proficiency of the American and United Nations mortarmen. In the United States Army, the infantry mortars of 60mm, 81mm, and 4.2-inch calibers were important supporting weapons of the rifleman. As in World War II, the mortar squad proved itself to be necessary to the successful conduct of modern land warfare (Ref 7 and Ref 8).

Korea served as a proving ground for men, weapons, and organizations. Instead of atomic warfare, the United States Army found itself plunged into traditional but often unorthodox land warfare. Infantry, artillery, armor, and air were all employed initially in conventional tactical patterns. Fire, maneuver, and static defense--amphibious and airborne warfare all had their parts to play in the conflict. In the tactics of infiltration and guerrilla warfare the enemy excelled. The United States Army was again faced with the fighting of a many-faceted type of warfare. This hard fact of military life meant that organization had to be flexible and responsive to sudden and unforeseen circumstances of combat. In the same vein, the weaponry had to be suitable and capable of efficient and effective performance when operated by the organization to which it was organic (Ref 9 and Ref 10).

The Korean War marked a considerable advance in the military art in that it was essentially the first time in US Army history that performance of men and weapons in combat was subjected to scientific investigation and evaluation. By use of post-combat interview techniques, developed by combat historians during World War II, operations analysts were able to gather weapon performance and human factor data in the field and in the environment of combat. These data when evaluated were often important factors in the determination of present and future organizational patterns and weaponry.

The importance of the infantry squads of all types in Korea was pinpointed by General Mark W. Clark, United States Army, former Commander-in-Chief, United Nations Forces in Korea, when he noted that

The backbone of our Army is the nine-man infantry squad. That is the basic fighting unit of our ground forces. It is the accumulated successes of a lot of these little teams that brings victory to an army. A general executing a plan of battle may find all of a sudden that he has had a victory. The reason is that these little squad teams have done their stuff.

(Ref 11, p 196)

LITERATURE CITED

1. R. E. Dupuy and T. N. Dupuy, Military Heritage of America, New York: London: Toronto: McGraw-Hill Book Company, 1956
2. Matthew B. Ridgway, Soldier, New York: Harper & Brothers, 1956.
3. Korea 1950, Office of the Chief of Military History, Department of the Army, Washington, D. C., 1952.
4. Table of Organization and Equipment, 7-14 N, The Infantry Heavy Mortar Company, Washington, D. C., Department of the Army, 26 March 1948.
5. Virgil Ney, Organization and Equipment of The Infantry Rifle Squad: From Valley Forge to ROAD, Technical Operations Research, Combat Operations Research Group, Fort Belvoir, Virginia, CORG Memorandum CORG-M-194, January 1965.
6. Table of Organization and Equipment 7-17 N, The Infantry Rifle Company, Washington, D. C., Department of the Army, 9 December 1947.
7. S. L. A. Marshall, The River and The Gauntlet, New York: William Morrow & Company, 1953.
8. S. L. A. Marshall, Pork Chop Hill, New York: William Morrow and Company, 1956.
9. Commentary on Infantry Operations and Weapons Usage in Korea, Winter 1950-51, by Marshall, The Johns Hopkins University Operations Research Office, Technical Report ORO-R-13, 27 October 1951.
10. The Job of The Combat Infantryman, The Johns Hopkins University Operations Research Office, Technical Memorandum ORO-T-250, 18 September 1952.
11. Mark W. Clark, From The Danube to the Yalu, New York: Harper and Brothers, 1954.

THE POST-KOREAN WAR AND VIETNAM WAR PERIOD

Use of the helicopter to deliver men and weapons on the battlefield will result in greater freedom of movement and exploitation of the principles of surprise to an unprecedented degree.

Secretary of Defense R. S. McNamara

In 1957, the 60mm mortar squad came to the end of its distinguished career in the United States Army. The reorganization of the Army, made necessary by the threat of nuclear war, called for more and heavier supporting fire power for the rifleman. Primarily, the Atomic Age indicated a strong overall requirement for dispersion of ground forces. In the Army, the "Pentomic" structure was tailored to meet this basic challenge. In the process, the 60mm mortar was discarded within the company level in favor of the 81mm mortar which was formerly located in the battalion heavy weapons company. This organizational change caused the 60mm mortar squad to be eliminated from the infantry and the 81mm squad moved into the rifle company as its replacement (Ref 1).

Under the provisions of the "Pentomic" concept, the regiment and battalion were dropped and a more applicable formation, "The Battle Group," was established. This move, of course, abrogated over one hundred and fifty years of American regimental tradition. Controversial as this departure from tradition was, it appeared to be an expedient and proper solution to the problem of infantry combat under nuclear conditions. Briefly, it may be described as follows:

Under the "Pentomic" doctrine there is no longer a battalion complex. The new basic organization is made up of about 1,500 officers and men--approximately three-fourths again as large as a WWII complex battalion, but smaller than the old regiment. Under the new concept, support weapons are not permanently attached to any particular group, but instead are an integral part of a combat team and assigned to any area within the attacking five-sided cell as tactical situations arise on the battlefield.

Although 60's are being pared from the new Army, there will be no less in combat support for the Infantryman since the 81's fire at distances long enough to meet the demands of extended areas of operation. In addition, greater effectiveness is achieved by use of a more potent round of ammunition which has been developed for the 81mm mortar.

(Ref 2)

These important and far reaching changes within the Army organization created a definite gap in the fire power of the infantry. To close this gap, the 4.2-inch mortar and the 106mm recoilless rifles were made heavy support weapons within the new combat formation.

With the threat of atomic war the massing of troops in battle formations, as in former wars, was not permissible because of the high lethality of the atomic weapon. The rationale for the "Pentomic" concept is well-expressed in the following extract from the Army Information Digest:

A primary consideration in constructing the pentomic division was that any massing of units in width or depth during atomic operations would be disastrous. Yet, to destroy the enemy, concentration of combat power was essential. Units in atomic conflict would have to be small, powerful, and self-sustaining. They would have to deploy rapidly, destroy the enemy and withdraw. Success would depend on high mobility, rapid and efficient communications, and devastating combat power.

(Ref 3, p 59)

Innumerable tests and field exercises were organized to determine the worth of the various organizational concepts advanced for the infantry units of the Army. Mobility and dispersion were the chief considerations in view of the constant and continuing emphasis upon the quality of "flexible response." The "Pentomic" concept, basically the first radical departure from traditional US military organization, was discarded in favor of the ROAD (Reorganization Objective Army Division) concept.

The "Pentomic" concept of divisional organization provided armored divisions as well as the conventional and airborne infantry divisions. However, military planners at this time believed that there should be, in the interests of simplicity, just one basic divisional type. Of interest is the fact that while the "Pentomic" reorganization was underway, the armored divisions were left essentially as they were in World War II. This was the armored division consisting of a division headquarters and three combat commands. From this basic concept grew the idea of the ROAD Division with its division headquarters and three brigades.

But the search for a suitable organization for the Army Division continued unceasingly, and "Pentomic" was soon to be replaced by another concept, ROAD, which was even more revolutionary. However drastic, ROAD did retain the traditional battalion but did not return the regiment to the Infantry. By May 1964, all United States Army divisions were reorganized under the ROAD concept. Basically, the ROAD divisions

...have a semifixed common base that includes a division headquarters, three brigade headquarters, division artillery, a support command, an aviation unit, an engineer battalion, a signal battalion, a cavalry squadron, and a military police company.

Initially, four types of divisions were organized under ROAD, infantry, armored, airborne, and mechanized. A fifth type, the airmobile division, under test for the past two years, was recently organized at Fort Benning, Georgia, as the 1st Cavalry Division (Airmobile). This division contains sufficient helicopters to provide its own airlift, in and out.

(Ref 3, pp 62-63)

The ROAD division is organized around a common base which contains a division headquarters, three brigade headquarters (similar to the old armored division three combat commands), division artillery, a support command, an aviation unit, an engineer battalion, a signal battalion, a cavalry squadron, and a military police company. Infantry, armor, mechanized, and airborne battalions in any numbers required by the mission may be attached to each of the three brigades. The mission and the location, geographical and environmental, of a particular division would determine the types of battalions assigned to the common base noted above. The reason for the change from "Pentomic" to ROAD is well-explained in the following comment:

The change from the pentomic to ROAD was made not because the pentomic division was not well designed for our defense, but rather because ROAD is thought to be an even better structure for the current requirements of the Army. It is more flexible internally and more versatile in employment. Its forces are tailored to environment and mission. It has an improved limited war capability and an improved non-nuclear combat power. It allows armored, infantry and airborne separate brigades to be used in special situations. It has improved command and control facilities. With versatility, speed, mobility, and strength it is designed for modern defense and offense.

(Ref 3, p 64 and Ref 15)

The impact of the changes introduced by the "Pentomic" and ROAD concepts was felt throughout the military structure down to and including the infantry squads. Under the "Pentomic" and ROAD reorganizations, the nine man rifle squad of the Korean War was replaced by a ten man rifle squad led by a staff sergeant and consisting of two fire teams Alfa and Bravo. The fire team comprised: one sergeant, fire team leader; one corporal, automatic rifleman; one corporal, grenadier; one private, first-class, rifleman. One team contained four men and the other an additional rifleman making its total membership five (Ref 4, pp 61-69).

Under the provisions of Table of Organization 7-18 E (Draft), Headquarters, Department of the Army, Washington, D. C., the rifle company of the infantry battalion included within its organization a weapons platoon which contained an 81mm section. The 81mm section contained a section headquarters of one section leader, E-7; three forward observers, E-5; two fire direction computers, E-6; three radio telephone operators, E-3. Three 81mm mortar squads comprised the section. Each 81mm squad was composed of the following: one squad leader, E-5; two gunners, E-4; two ammunition bearers, E-3. Total squad strength was five.

Under the ROAD structure, the mortar squads appear in the Infantry Rifle Company Armored Division as follows:

The Weapons Platoon consists of a Platoon Headquarters and an 81mm Mortar Section and an Antitank Section. The 81mm Mortar Section is comprised of a Section Headquarters and three 81mm Mortar Squads. The 81mm Mortar Squad is

commanded by a Sergeant and personnel as follows:
one Specialist 4, Gunner; one Specialist 4, Mortar
Carrier Driver; one Private, First-Class, Ammunition
Bearer; one Private, First-Class, Assistant Mortar
Gunner. Total strength of the squad is five. The 81mm
mortar is selfpropelled in the Mortar Carrier SP FTRAC
which also provides transport for the five-man mortar
squad.
(Ref 5)

It is interesting to note that the traditional five-man 60mm mortar squad strength has been retained. Although the squad is now armed with the 81mm mortar, the old 81mm mortar squad's strength has been reduced by three men. Reduction of the number of ammunition bearers has brought the squad strength in line with the old 60mm mortar squad organization.

When the 60mm mortar was dropped from the Army in 1956-57, there was need for a substitute weapon to take its place. The 40mm grenade launcher as developed and improved appeared to be the most suitable arm for this purpose and it was adopted and issued to the squads of the infantry rifle companies and other applicable user units. The claims made for the M79 Grenade Launcher are impressive and under conventional conditions the weapon should be almost as effective as the 60mm mortar. However, recent combat experience in Vietnam indicates that the grenade launcher is not quite as effective as the 60mm mortar in combat. As a result, a move to bring back the little infantry mortar has been started. In the Marines, it is past the talking stage--the 60mm mortar has been restored to front-line duty. Information from the United States Marine Corps indicates that each Marine infantry company now contains a mortar section commanded by a sergeant. The mortar section comprises two 60mm mortar squads, each commanded by a corporal. The other members of the squad are a mortar gunner, an assistant mortar gunner, and three ammunition bearers.

The following comment on the 40mm grenade launcher is of value in explaining the position of the M79 in today's infantry squads:

The 40mm grenade launcher is capable of destroying enemy machine gun nests, bunkers and small troop concentrations out to a maximum range of 400 meters. The new 40mm weapon supplements the M14 rifle and the M60 machinegun. Combined with these weapons, it provides increased mobility, firepower, and independence of action to the infantry platoon. Designed to fill the gap between the hand grenade and the mortar, the grenade launcher uses a 9-ounce round high explosive shell.

A delay arming fuse protects the firer from the deadly effect of the exploding projectile. The 40mm launcher is an extremely simple weapon. It has a double action mechanism of the break-open type and resembles a single barrel shotgun in appearance. It is the first Army weapon to use an aluminum barrel.
(Ref 6, p 29)



The dropping of the infantry heavy weapons company of the infantry battalion under the "Pentomic" concept brought into being the newly formed combat support company. This unit supported the battle group in much the same way as the old heavy weapons company supported the infantry battalion. Table of Organization and Equipment 7-19 D, Headquarters, Department of the Army, Washington, D. C., 1 February 1960, Combat Support Company, Infantry Division Battle Group, provided a heavy mortar platoon with the mortars organized as follows:

◀ Grenade Launcher, Vietnam

Fire Direction Center and Survey Section

Three Forward Observer Teams
(1 Officer (Lt), 1 EM (E-5))

Two Firing Section Headquarters

2 section commander (Lt)
2 section sergeants (E-7)
2 light truck drivers (E-3)
2 radio telephone operators (E-3)

Six Mortar Squads (4.2-inch mortar)

Mortar Squad

1 squad leader (E-5)
1 mortar gunner (E-4)
3 ammunition bearers (E-3)
1 assistant mortar gunner (E-3)
1 light truck driver (E-3)

Total 7 members

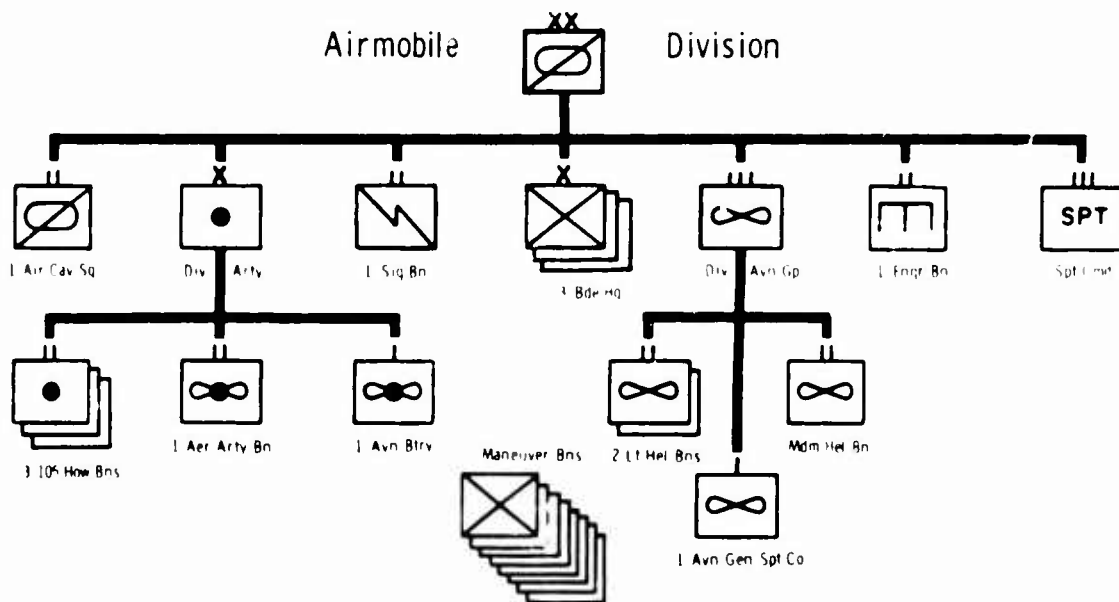
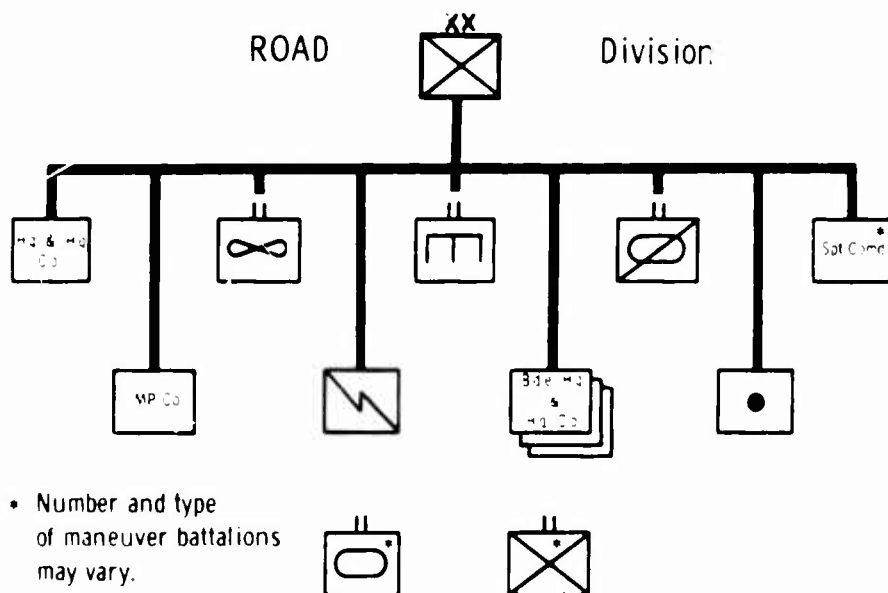
Equipment

1 mortar, 4.2-inch, on mount
1 first aid kit, general purpose, 12 unit
7 bayonets, knife, w/ scabbard, carbine
1 compass, mil graduations
2 pistols, cal.45, semiautomatic
5 rifles, 7.62mm, semiautomatic, light barrel
1 trailer, cargo, 3/4-ton, 2-wheel
1 truck, cargo, 3/4-ton, 4x4
1 axe, single bit

Equipment (concluded)

- 1 goggles, M1944
 - 1 pick, mattox
 - 1 shovel
 - 1 reel, equipment, C-11
 - 1 tool, equipment, TE-33
- (Ref 7)

Under the ROAD concept the combat support company was organized to support the battalions of the ROAD divisions' brigades. It was an integral part of each battalion and performed many of the functions of the old heavy weapons company of the old regiment type battalion of the pre-Pentomic and pre-ROAD period in our military organizational history.



During World War II, and in Korea, the United States Army possessed airborne mortar squads. In the main, they were organized much the same as the standard infantry mortar squads with some differences as to weight and types of equipment. Essentially, they contained the same numbers as did their counterparts in the standard infantry and armored divisions. Basically, their mode of transportation varied from that of the standard infantry squads--this was the essential great difference. These highly mobile troops with their equipment were delivered on the objective by glider or parachute. Once on the ground they were again standard infantry and fought as such.



The continued development and improvement of the helicopter in the United States eventually gave a new dimension to the Army infantry division. With mobility and dispersion as the chief desiderata of any new plan for the Army in the Atomic Age, various experiments and trials and boards were held and convened, charged with the responsibility of giving the modern United States Army mobility. In 1962, the Army was directed by the Defense Department to look into the subject of tactical mobility with a view toward its improvement. The Howze Board, which was headed by General Hamilton Howze, studied the problem and made recommendations which were evaluated and approved by the Secretary of Defense. To carry out the recommendations of the Board, the 11th Air Assault Division (Test) and the 10th Air Transport Brigade were organized to test the airmobile concept in the field. Comparison between the Airmobile and ROAD Divisions show:

	Airmobile	ROAD
Men:	15,787	15,900
Aircraft:	434	101
Vehicles:	1,600	3,200

Source: Army Information Digest, August 1965

In July 1965, the 1st Cavalry Division, minus men and equipment, was transferred from Korea to Fort Benning, Georgia. It was reorganized as the 1st Cavalry Division (Airmobile) (Ref 9). Absorbing the 11th Air Assault Division (Test) and the 2d Infantry Division at Fort Benning, the new division was activated and deployed to the combat area in a record time. The Division Commander, Major General Harry W. O. Kinnard comments that

Somewhere in the annals of military organizations there may have been outfits activated, organized and moved 12,000 miles to combat all within the space of 90 days, but none comes immediately to mind.
(Ref 10, p 24)

Deployed to Vietnam and currently in combat in Vietnam, the 1st Cavalry Division (Airmobile) is upholding the World War II and the Korean War combat reputation of its illustrious ancestor. Dealing with a crafty and skillful enemy who is at home in a jungle environment and who fights with guerrilla and conventional tactics, the Division has carried out the promise it held. The Secretary of Defense noted this when he said:

The tactics, the techniques, the procedures that will be employed by this new division will result in a markedly different approach to the solution of tactical problems. The use of aircraft to bring combat personnel directly to the battlefield, to remove them from the battlefield, provides a capability which neither we nor any other army in the world possess today.

Secretary of Defense
Robert S. McNamara, 16 June 1965.



Mortar Squad, First Cavalry (Airmobile) Division

Under the airmobile concept, each maneuver battalion is supported by a combat support company. This unit contains the heavy mortar platoon and the heavy mortar squads. The platoon and squads are organized as follows:

Personnel

Mortar Platoon Headquarters

1 platoon leader (Lt)
1 platoon sergeant (E-7)
1 fire dir chief (E-6)
3 forward observers (E-5)
3 fire dir cmpt (E-5)
7 radio telephone op (E-3)
Total 16

Personnel

Heavy Mortar Squad

1 squad leader (E-5) (pistol, auto., cal .45)
1 mortar gunner (E-4) (rifle, 5.56mm, XM16E1)
5 ammunition bearers (E-3) (rifle, 5.56mm, XM16E1)
1 assistant gunner (E-3) (rifle, 5.56mm, XM16E1)
Total 8

Mechanical Mule, M274, 4x4

Wt. 2075 lbs (fully loaded)
27 1/2 inches ground to bed
Width - 49 inches
Length - 118 1/4 inches



Equipment

1 decontaminating apparatus, portable, 1 1/2 -quart
1 compass, magnetic, unmounted, mil graduations
1 mortar, 81mm w/ mount
2 pistols, automatic, cal .45
1 truck, platform utility, 1/2 -ton, 4x4, mechanical mule
5 packboards, plywood, w/ tongueless buckles, shoulder strap
8 pads, shoulder, packboard, felt w/ ctn drill
15 straps, quick release, packboard
8 bayonets, knife, XM7 w/ scabbard, M8A1, for 5.56mm rifle
6 rifles, 5.56mm, XM16E1
(Ref 12)

The mortar squads within the rifle companies of the maneuver battalions of the airmobile division are organized as follows:

Mortar Platoon Headquarters

1 platoon leader (Lt)
1 platoon sergeant (E-7)
3 forward observers (E-5)
2 fire dir cmpt (E-5)
2 radio telephone op (E-3)
Total 9

Personnel

81mm Squad

1 squad leader (E-5) (pistol, automatic, cal .45)
1 gunner (E-4) (pistol, automatic, cal .45)
3 ammunition bearers (E-3) (rifle 5.56mm, XM16E1)
1 assistant gunner (E-3) (launcher, grenade, 40mm and
pistol, automatic, cal .45)
Total 6

Equipment

1 compass, magnetic, unmounted, mil graduations
1 launcher, grenade, 40mm
1 mortar, 81mm on mount
1 cook set, field, 4 components
1 packboard, plywood, w/tongueless buckles, shoulder strap
24 lg
2 pads, shoulder, packboard, felt w/ctn drill, 11 3/4"
lg, 3" w
1 stove, gasoline burner, 1102, fuel tank cap, cylindrical case
3 straps, quick release, packboard
1 tool kit, general use tools, sig-drawing, note-33
1 reel, equipment CE-11
3 rifles, 5.56mm, XM16E1
6 bayonets, knife, XM7 w/ scabbard, M8A1 for 5.56mm rifle
(Ref 13)

It is of interest in connection with this study of the United States Army infantry mortar squads to note that the Vietcong guerrilla is a skilled mortarman. In fact, many of his attacks against American posts and positions have been made successful by his skillful use of mortars. For the Vietcong guerrilla the mortar is economical and effective artillery. From all evidence available, he apparently prefers the 60mm mortar because of its light weight of tube and ammunition. How the Vietcong secure mortars and mortar ammunition is simple -- they make them. Malcolm Brown in his book, The New Face of War,⁸ explains how these cottage armories function:

The mortar works were more complicated. The mortar tubes themselves were precisely bored from heavy steel tubing legally purchased in Saigon. Each tube was reinforced by welded bands of steel. Mortar bipods and base plates were made of scrap steel, all welded neatly together. Finished mortars were professionally painted and oiled.

American 60 millimeter mortar shells are abundant in Viet Nam and easy to capture, and that was why this was the caliber of choice for the homemade guns.

The former chief of An Xuyen Province, Lieutenant Colonel Pham Van Ut, thought so highly of these Viet Cong mortars that he issued them to his own troops whenever they were captured.

"They're every bit as good as American or French mortars," he told me. "They lack optical sighting devices, but good mortarmen don't need gadgets like that. We can't afford to be proud about using enemy weapons, even if they're homemade."
(Ref 14, pp 18-19)

The period following the Korean War witnessed important changes in the organization of the United States Army. This was a period of "cut and try" experimentation to determine the form of military organization most applicable to operations in the Atomic Age. Other considerations were involved. The Cold War and its insurgencies caused the leadership of the United States Army to emphasize the urgent need for qualities of flexibility, mobility, and dispersion. The flexible response, as advocated by General Maxwell Taylor, former Chief of Staff, United States Army, and Chairman, Joint Chiefs of Staff, received a maximum of attention from planners at all levels. New dimensions of military operation were advanced, established, and tested, as never before in our military history.

The ROAD and the Airmobile concepts are now undergoing their final test on the field of battle in Vietnam. How well they will score will depend

⁸ From The New Face of War, copyright (c) 1965, by Malcolm W. Browne, reprinted by permission of the publishers, The Bobbs-Merrill Company, Inc.

to a great extent upon the combat performance of the infantry squads, both rifle and mortar. New and better weapons for the infantry have given the infantryman firepower of greater strength and destructive force than he has ever possessed. Mobility of unbelievable speed is now afforded the soldier by means of the helicopter. The ROAD concept gives the field commander flexibility, mobility, and firepower in compact units of battalion size. These battle units are self-sufficient, self-sustaining, and capable of independent combat action.

In summation, the modern United States Army is meeting the challenge of the Atomic Age. The response will be that of the individual soldier in the rifle or mortar squad. How he performs as a member of the team under the organizational pattern established for him and his weapon will govern the ebb and flow of combat. In any event, the victory will be of his making. With his mortars, rifles, and other weapons he and his squad will write the history of these times.

LITERATURE CITED

1. Table of Organization and Equipment, 7-17 T, Headquarters, Department of the Army, Washington, D. C., 20 December 1956.
2. Army-Navy-Air Force Journal, 2 November 1957.
3. Myles G. Marken, Sr., "The Atomic Age Division", Army Information Digest, Volume 20, No. 9, September 1965.
4. Virgil Ney, Organization and Equipment of the Infantry Rifle Squad: From Valley Forge to ROAD, Technical Operations Research. Combat Operations Research Group, Fort Belvoir, Virginia, CORG Memorandum CORG-M-194, January 1965.
5. Table of Organization and Equipment, 7-47 F, (Draft), Rifle Company Armored Division, Mechanized Infantry Battalion, Department of the Army, Washington, D. C., 1962.
6. W. Eisner, A Pictorial Arsenal of America's Combat Weapons, New York: Sterling Publishing Company, 1960.
7. Table of Organization and Equipment 7-19 D, Combat Support Company, Infantry Division Battle Group, Headquarters, Department of the Army, Washington, D. C., 1 February 1960.
8. Infantry Reference Data, ROAD, United States Army Infantry School, Fort Benning, Georgia, February 1964.
9. Army Information Digest, Volume 20, No. 8, August 1965.
10. Major General Harry W. O. Kinnard, "Activation to Combat--in 90 Days", Army Information Digest, Volume 21, No. 4, April 1966.
11. Department of the Army Pamphlet, Troop Topics, DA PAM 360-216, The Airmobile Division, Headquarters, Department of the Army, 30 November 1965.
12. Table of Organization and Equipment 7-58 T, Combat Support Company, Airmobile Division, Headquarters, United States Army Combat Developments Command, Fort Belvoir, Virginia, 22 June 1965.
13. Table of Organization and Equipment 7-57 T, Rifle Company, Infantry Battalion, Airmobile Division, Headquarters, United States Army Combat Developments Command, Fort Belvoir, Virginia, 22 June 1965.
14. Malcolm Browne, The New Face of War, Indianapolis: Bobbs-Merrill Company, 1965.
15. Lt. Col. Y. Y. Phillips, Jr., "The ROAD Battalion in Vietnam", ARMY, Volume 16, No. 9, September 1966.

APPENDIX A

COPY

STUDY REQUEST
HEADQUARTERS

UNITED STATES ARMY COMBAT DEVELOPMENTS COMMAND

Fort Belvoir, Virginia 22060

Directorate of Evaluation

CDCRE

MEMORANDUM TO: Director, CORG

SUBJECT: Combat Developments Study Request: CORG Program of Study
in Military History: History and Development of the U. S. In-
fantry Mortar Squad

1. General. It is requested that CORG provide under its military history study program a complete and documented record of the evolution of the infantry mortar squad from World War I to the present time.

2. Objective and Scope. The purpose of this project is to show the various changes which have taken place in the organization and equipment of the infantry mortar squad, including the major duties of each individual, the armament of each individual, the squad mission and capabilities in attack and defense, and for each change in squad organization the rationale and/or justification for the change.

3. References. Memorandum for Director, Evaluation to Director, CORG, subject: Combat Developments Study Request: "CORG Program of Study in Military History", dated 24 June 1965.

4. Administration.

a. Coordination is authorized as appropriate with offices and agencies, records depositories, military libraries, and other sources of information within the Department of the Army.

b. The expenditure of four man-months of technical effort is authorized. This study should be initiated on or about 1 January 1966.

c. A draft report is required for staffing and coordination by 15 March 1966. Final report of study should be published by 30 April 1966.

d. Mr. J. E. Keith, Chief, Historical Division, Directorate of Plans, this headquarters is project Laison officer.

e. No computer time is required.

f. Action Control Record information is not applicable to this study.

COPY

COPY

CDCRE

SUBJECT: Combat Developments Study Request: CORG Program of Study in
Military History: History and Development of the U. S. Infantry
Mortar Squad.

g. This task is assigned CORG Project No. 13428.

VAIL

Coordination:

Plans Directorate _____
Scientific Advisor _____
Program Coordination Office _____
ORS Division _____

COPY

APPENDIX B

TABLES OF ORGANIZATION AND EQUIPMENT

Table 5
January 14, 1918

Headquarters Company - Infantry Regiment

Sappers and Bombers Platoon
2nd Section (Bombers)

Personnel

3 sergeants, armed with rifle
6 corporals, armed with rifle
11 privates, first-class, armed with rifle
19 privates, armed with rifle
Total 39

Equipment

30 grenade dischargers, rifle
6 mortars, 3-inch Stokes
39 rifles
4 mules, draft*
1 cart, combat, 1-mule
1 wagon, combat, 4-mule
* Animals not furnished until further orders

TOE 21
May 10, 1918

Trench Mortar Battery - 6-inch Newton-Stokes

1 first or second lieutenant* (commands platoon of two sections)

Section**

1 sergeant, armed with pistol
2 corporals, two gunners
1 wagoner
6 privates, first-class, five cannoneers, three ammunition carriers, one armorer
11 privates, one assistant chauffer
Total (enlisted) 21

*commands leading section of the platoon, a sergeant commands the other section.

**the section was the smallest unit at this time. There was no squad, as such.

TOE 105
March 25, 1918

240mm Trench-Mortar Battery (Corps Artillery)

Series B

American Equipment Section

Personnel

1 sergeant, armed with pistol
2 corporals
3 wagoners, or chauffeurs
5 privates, first-class
12 privates, three assistant chauffeurs, or wagoners
Total 23*

Equipment

1 trench mortar
1 pistol
23 rifles

* All members, other than the sergeant are armed with the rifle.

TOE 105
March 25, 1918

240mm Trench-Mortar Battery (Corps Artillery)

Series B

French Equipment Section

Personnel

1 sergeant, armed with pistol, mounted on a horse
2 corporals, (1 gunner, 1 ammunition corporal)
6 privates*, first-class
12 privates** 5 drivers, 5 cannoneers, and 8 ammunition carriers
per section, included with the 6 privates, first-class
Total 21

Equipment

1 horse, riding
4 mules, draft
3 carts, combat, 1-mule
1 mortar, French
1 pistol
2 rifles

*To be equipped with French material after arrival in France

**Armed with rifle

Table 30 W
April 15, 1921

Howitzer, Company, Infantry Regiment
(War Strength)

Light Mortar Section

1 corporal, section leader
10 privates, first-class and privates including: 1 gunner,
9 miscellaneous
Total 11

Equipment

2 mules, draft
2 carts, mortar, 1-mule
1 mortar, 3-inch
11 pistols

Table 30 W
July 30, 1930

Cannon Company, Infantry Regiment

Mortar Squad

Personnel

1 corporal, squad leader, armed with pistol
10 privates, first-class, including: 1 gunner, armed
with pistol, 9 basic, privates
Total 11

Equipment

2 mules, draft
2 carts, ammunition, 75mm
1 mortar, 75mm
11 pistols

TOE 7-18
October 1, 1940

Infantry Company, Heavy Weapons

81mm Mortar Platoon

81mm Mortar Squad

Personnel

1 corporal, squad leader, pistol
4 privates, or privates, first-class, ammunition and water
carrier, pistol
1 chauffeur, rifle
1 gunner, pistol
1 gunner assistant, pistol
Total 8

Armament

1 mortar, 81mm
7 pistols, automatic, caliber .45
1 rifle, US caliber .30, M1

Transport

1 truck, $\frac{1}{2}$ -ton, weapon carrier

TOE 7-17
October 1, 1940

Weapons Platoon

60mm Mortar Section

60mm gunner
1 corporal, 60mm gunner, pistol
3 ammunition carriers, pistol
1 gunner, assistant, pistol
Total 5

Armament

1 mortar, 60mm
5 pistols, automatic, caliber .45
2 trucks, $\frac{1}{2}$ -ton, weapon carrier to each
weapons platoon headquarters

TOE 7-18
March 1, 1943

Infantry Heavy Weapons Company

81mm Mortar Platoon

81mm Mortar Squad

1 corporal, squad leader, rifle
4 privates, ammunition bearers, carbine
1 gunner, pistol
1 gunner, assistant, pistol
Total 7

Armament

4 carbines, caliber .30
1 mortar, 81mm
2 pistols, automatic caliber .45
1 rifle, caliber .30, M1
Truck $\frac{1}{2}$ -ton in section headquarters

TOE 7-18
July 15, 1943

Infantry Heavy Weapons Company

81mm Mortar Squad

1 squad leader, sergeant, armed with rifle, caliber .30, M1
1 corporal, gunner, mortar
6* members including:
1 technician, grade 4
1 technician, grade 5
1 private, first-class
1 private,
1 private, ammunition bearer**
1 gunner, mortar, assistant***
Total 8
* 5 armed with carbine, caliber .30
** Drives truck, $\frac{1}{4}$ -ton
*** Armed with pistol, automatic, caliber .45

Equipment

5 carbines, caliber .30
1 mortar, 81mm
2 pistols, automatic, caliber .45
1 rifle, caliber .30, M1
1 trailer, $\frac{1}{4}$ -ton
1 truck, $\frac{1}{4}$ -ton

TOE 7-17
July 15, 1943

Infantry Rifle Company
Weapons Platoon
60mm Mortar Section (3 squads)

60mm Mortar Squad

Personnel

1 corporal, squad leader
4 members including:
 technician, grade 4, gunner, mortar**
 technician, grade 5, gunner, mortar, assistant**
 private, first-class, ammunition bearer*
 private, ammunition bearer*
Total 5
*Armed with carbine, caliber .30
**Armed with pistol, automatic, caliber .45

Equipment

2 carbines, caliber .30
1 mortar, 60mm
2 pistols, automatic, caliber .45
1 rifle, caliber .30, M1

TOE 7-18
February 26, 1944

81mm Mortar Squad

Personnel

1 staff sergeant, squad leader
1 corporal, gunner, mortar
6 members including:
 1 technician, grade 4
 1 technician, grade 5
 3 privates, first-class
 (1 ammunition bearer*
 1 ammunition bearer**
 1 gunner, mortar, assistant**)
1 private
Total 8
* Drives $\frac{1}{4}$ -ton truck
** Armed with pistol, automatic, caliber .45
(The number three man in the 81mm squad
is armed with a pistol.)

TOE 7-17
(Concluded)

Equipment

4 carbines, caliber .30
1 rifle, caliber .30, M1
4 carbines, caliber .30
1 mortar, 81mm
1 truck, $\frac{1}{4}$ -ton
1 trailer, $\frac{1}{4}$ -ton

TOE 7-17
June 1, 1945

Infantry Rifle Company

Weapons Platoon

1 sergeant, squad leader
2 ammunition bearers, carbine
1 gunner, mortar, pistol, caliber .45 - technician 4 or 5
1 gunner, mortar, assistant, pistol, caliber .45 - 1
private, first-class
Total 5

Squad Armament

1 mortar, 60mm
2 pistols, caliber .45
1 rifle, M1, caliber .30

TOE 7-17N
December 9, 1947

Infantry Rifle Company

Personnel

60mm Mortar Squad

1 sergeant, squad leader
1 corporal, gunner, mortar, pistol
2 technicians, grades 3, 4, 5, carbine
1 private, first-class or private, assistant gunner,
mortar, pistol
Total 5

Armament

4 bayonets, knife, M4 w/ scabbard, M8A1
1 bayonet, M-1, w/ scabbard
2 carbines, caliber .30, M-2
1 mortar, 60mm, M19 on mount, M5
2 pistols, automatic, caliber .45, M1911, A1
1 rifle, caliber .30, M1

TOE 7-18N
December 30, 1947

Heavy Weapons Company

81mm Mortar Squad

1 staff sergeant, squad leader, rifle
1 corporal, gunner, mortar, pistol
6 technicians
private and private, first-class
ammunition bearers - pistols and carbines
1 truck driver, light
1 assistant mortar gunner
Total 8

TOE 7-14N
March 26, 1948

4.2-inch Mortar Squad

Personnel

1 staff sergeant, squad leader
1 sergeant, mortar gunner, pistol
1 corporal, assistant mortar gunner, pistol
4 technicians, grades 3, 4, 5 or private, first-class,
ammunition bearers, carbine, caliber .30
1 technician or private, first-class, truck driver, light
Total 8

Armament

1 mortar, chemical, 4.2-inch
2 pistols, automatic, caliber .45, M1911, A1
2 rifles, US caliber .30, M1
2 bayonets, M1, w/ scabbard, M7

Transport

1 truck, 3/4-ton, 4x4, weapons carrier
trailer, 1-ton, 2W, cargo

TOE 7-17
May 15, 1952

60mm Mortar Squad

Personnel

1 squad leader, E-5 (sgt)
1 mortar gunner, E-4 (corp)
2 ammunition bearers, E-3 (pfc)
1 assistant mortar gunner, E-3 (pfc)
Equipment the same as TOE 7-17R except plotting board,
M10

TOE 7-17
December 9, 1947

60mm Mortar Squad

Personnel

1 sergeant, squad leader, rifle
1 corporal, mortar gunner, pistol
3 technicians or privates, first-class
 (1 assistant mortar gunner, pistol
 2 privates, first-class or private
 ammunition bearers, carbine
 1 private, first-class or private, pistol)
Total 5

Equipment

5 masks, gas, service, combat, M5-11-7
1 compass
4 bayonets, knife, M-4 w/ scabbard, M8A1
1 bayonet, M1, w/ scabbard
1 binocular, M13, A1
2 carbines, caliber .30, M2
1 mortar, 60mm, M19 on mount, M5,
2 pistols, automatic, caliber .45, M1911A1
1 rifle, US caliber .30, M1
2 attachments, packboard, plywood, cargo
5 carriers, grenade, 3-pocket
3 packboards, aluminum
6 shoulder pads
9 straps, quick-release, packboard
1 whistle, thunderer

TOE 7-17R
February 1, 1955

60mm Mortar Squad

Personnel

1 squad leader, E-5
1 mortar gunner, E-4
2 ammunition bearers, E-3
1 assistant mortar gunner, E-3

Equipment (Section)

15 masks, protective, field
3 compasses, lensatic, luminous dial, damped 5 degree
and 20 mil graduation with scale, in case
12 bayonets, knife, w/ scabbard, carbine
3 bayonets, knife, w/ scabbard, rifle
6 carbines, caliber .30

TOE 7-17R
(Concluded)

Equipment (Section) (Concluded)

3 binoculars, 6x30
3 mortars, 60mm, on mount
6 pistols, automatic, caliber .45
3 rifles, US caliber .30
18 attachments, packboard, plywood, cargo
9 packboards, plywood
18 shoulder pads
27 straps, quick release, packboard

TOE 7-16E
July 15, 1963

Headquarters and Headquarters Company

Infantry Battalion, Infantry Division

Battalion Heavy Mortar Platoon

Mortar Section (4 squads)

Personnel

1 section leader, E-6
4 squad leaders, E-5
4 mortar gunners, E-4
12 ammunition bearers, E-3
4 assistant mortar gunners, E-3
4 light truck drivers, E-3
Total 29

Mortar Squad

Personnel

1 squad leader, E-5
1 mortar gunner, E-4
1 assistant mortar gunner, E-3
3 ammunition bearers, E-3
1 light truck driver, E-3
Total 7

Mortar Section

Equipment

4 decontaminating apparatus, portable, 1 $\frac{1}{2}$ -qt.
29 bayonets, knife w/ scabbard, for 7.62mm rifle
4 compass, mil graduations
4 launcher, grenade, 40mm
4 mortar, 4.2-inch, on mount
12 pistols, automatic, caliber .45
17 rifles, 7.62mm, semiautomatic, light barrel
4 trailers, cargo, 3/4-ton, 2-wheel
4 truck, cargo, 3/4-ton, 4x4

TOE 7-16F
(Concluded)

Equipment (Concluded)

4 goggles, sun, plastic lens, 1 colorless, 1 polarized green
20 packboards, plywood, w/ tongue, less buckles, shoulder
strap, 24 LG
40 pads, shoulder, packboard, felt w/ cotton drill, 11 3/4 lg 3W
60 straps, guide, release, packboard
4 reels, equipment, CE-11
4 wires, WD-1/ TT on DR-8 1/4, M1

TOE 7-18E
July 14, 1963

Rifle Company, Infantry Battalion

Infantry Division

Weapons Platoon

81mm Section (3, 81mm squads)

81mm Mortar Squad

Personnel

1 squad leader, E-5
1 gunner, E-4
1 assistant gunner, E-3
2 ammunition bearers, E-3
Total 5

Equipment

1 decontaminating apparatus, portable, 1 1/2 -qt.
5 bayonets, knife, w/ scabbard, for 7.62mm rifle
1 compass, mil graduations
1 launcher, grenade, 40mm
1 mortar, 81mm, on mount
3 pistols, automatic, caliber .45
2 rifles, 7.62mm, semiautomatic, light barrel
1 trailer, cargo, 3/4-ton, 2-wheel
1 truck, cargo, 3/4-ton, 4x4
1 goggles, sun, 2 plastic lens, 1 colorless, 1 polarized
green
1 reeling machine, cable, hand, RL-39
1 telephone set, TA-1/ PT
1 wire, WD-1/ TT on DR-8 1/4, M1

TOE 7-37F
August 15, 1963

Rifle Company, Infantry Battalion, Airborne Division

Weapon Platoon

81mm Mortar Section (3 squads)

81mm Mortar Squad

Personnel

1 squad leader, E-5
1 gunner, E-4
2 ammunition bearers, E-3
1 assistant gunner, E-3
Total 5

Equipment

2 decontaminating apparatus, portable, 1 $\frac{1}{2}$ -qt.
5 bayonets, knife, w/ scabbard, for 7.62mm rifle
1 carrier, light, weapons, infantry, $\frac{1}{2}$ -ton, 4x4
1 compass, mil graduations
1 launcher, grenade, 40mm
1 mortar, 81mm, on mount
3 pistols, automatic, caliber .45
2 rifles, 7.62mm, semiautomatic, light barrel
1 trailer, amphibious, cargo, $\frac{1}{4}$ -ton, 2-wheel
1 truck, utility $\frac{1}{4}$ -ton, 4x4
2 goggles, sun, 2 plastic lens, 1 colorless, 1 polarized green
*1 wire, WD-1/ TT on DR-8 $\frac{1}{4}$, M1
*Issued to two squads of the section

TOE 7-46E
July 15, 1963

Headquarters and Headquarters Company
Infantry Battalion (Mechanized), Armored Division

or

Headquarters and Headquarters Company
Infantry Battalion (Mechanized), Infantry Division (Mechanized)

or

Headquarters and Headquarters Company
Infantry Battalion (Mechanized), Separate Armored Brigade

or

Headquarters and Headquarters Company
Infantry Battalion (Mechanized), Separate Infantry Brigade

or

Headquarters and Headquarters Company
Infantry Battalion (Mechanized), Separate Infantry Brigade (Mechanized)

Battalion Heavy Mortar Platoon (4 mortar squads)

Heavy Mortar Squad

Personnel

1 squad leader, E-5
1 mortar gunner, E-4
1 mortar carrier driver, E-4
1 ammunition bearer, E-3
1 assistant mortar gunner, E-3

Total 5

Equipment

1 decontaminating apparatus, portable, 1½ -qt.
5 bayonets, knife, w/ scabbard, for 7.62mm rifle
1 compass, mil graduations
1 launcher, grenade, 40mm
1 mortar, self-propelled, full-tracked, 4.2-inch
3 pistols, automatic, caliber .45
2 rifles, 7.62mm, semiautomatic, light barrel
1 flag set, M-238
5 goggles, sun, 2 plastic lens, 1 colorless, 1 polarized green
1 intercommunications set, AN/ VIC-1

Equipment (Concluded)

1 radio set, AN/GRC 125, mounted in carrier, heavy mortar
1 reel, equipment, CE-11
1 wire, WD-1/TT, on DR-8 $\frac{1}{4}$, M1
5 life preservers, yoke, oral inflation, trapped air,
adult, 26 $\frac{1}{2}$ -in. H

TOE 7-47F
July 15, 1963

Rifle Company

Infantry Battalion (Mechanized), Armored Division

or

Rifle Company

Infantry Battalion (Mechanized), Infantry Division

or

Rifle Company

Infantry Battalion (Mechanized), Separate Armored Brigade

or

Rifle Company

Infantry Battalion (Mechanized), Separate Infantry Brigade

or

Infantry Battalion (Mechanized), Separate Infantry Brigade (Mechanized)

Weapons Platoon

81mm Mortar Section (3 81mm Squads)

81mm Mortar Squad

Personnel

1 squad leader, F-5
1 gunner, E-4
1 mortar carrier driver, F-4
1 ammunition bearer, E-3
1 assistant gunner, E-3

Total 5

Equipment

1 decontaminating apparatus, portable, 1 $\frac{1}{2}$ -qt.
1 filter unit, gas-particulate, tank, 4-man
5 masks, protective, tank
5 bayonets, knife, w/ scabbard, for 7.62mm rifle
1 compass, mil graduations

Equipment (Concluded)

1 launcher, grenade, 40mm
3 pistols, automatic, caliber .45
2 rifles, 7.62mm, semiautomatic, light barrel
1 flag set, M-238
5 goggles, sun, 2 plastic lens, 1 colorless, 1 polarized green
1 radio set, AN/ GRC 12S, mounted in carrier, personnel, FTA
1 reeling machine, cable, hand, RL-39
1 telephone set, TA-2/ PT
1 wire, WD-1/ TT, on DR-8 $\frac{1}{4}$, M1
1 mortar, self-propelled, full-tracked, 81mm, T257E1
5 life preservers, yoke, oral inflation, trapped air, adult,
26 $\frac{1}{2}$ -in. H

APPENDIX C

DATA ON PRINCIPAL MORTARS IN USE IN EUROPE - WW I

Calibers and Type	Armies in Which Used	Bombs, lb	Explosives, lb	Maximum Range, yards	Wt. to Transport, lb
3-inch Stokes	US GB Italy	9, 35	2, 09	795	108
76mm (Old Md) Light Minenwerfer 2.99-in.	Germany	HF 10, 06 Gas 9, 68	HF 1, 45	HE 1148 Gas 1148	220
76mm (New Md) Light Minenwerfer 2.99-in.	Germany	HF 10, 06 Gas 9, 68	HF 1, 45	HF 1422 Gas 1203 Mag. 1422	312
76mm (New Md) Light Minenwerfer Flat Trjty, Carriage	Germany	HF 10, 06	HF 1, 45	995	550
58mm No. 2 French	US France Belgium	LS 37 DLS 77 ALS 37	LS 12 DLS 22 ALS 12	LS 1360 DLS 490 ALS 1526	1879
58mm Italian	Italy	16kg 36 29kg 63.8 45kg 99	16kg 13.2 29kg 11 45kg 24.2	16kg 720 29kg 817 45kg 485	981
70mm Van Duren	Italy Belgium	19kg 42 35kg 77	19kg 132 35kg 37	19kg 926 35kg 436	761
6-in. Newton	US GB	50	10	1800	829
6-in. Newton (Mobile) Model 1918	US	50	50	1800	With Hard- cart and Equip. 688
150mm Fabry	France	37	12	2180	1500
17.5cm Old Md Medium Minenwerfer 6.69-in.	Germany	HF 121 Incendiary 82 Gas 92.4	HE 23	HF 1295 Gas 1759 Incendiary 1126	1064
17.5cm New Md Medium Minenwerfer	Germany	HF 13 121 HF 16 108 Gas 92.4 Inc 82	HF 13 23 HF 1626	HF 13 1011 HF 16 1268 Gas 1750 Inc 1126	1232
225mm Austrian Trench Mortar	Austria	Short 115 Long 167	Short 26.4 Long 48	Short 1365 Long 708	800 (Estmd)
9.45mm British Trench Mortar	GB	152	75 (Estmd)	2400	3400
240mm French	US France	183	90	2240	7700
240mm Italian	Italy	147	57	4120	
24cm Hvy. Flugol-Minenwerfer Lg. Bl. 9.45-in.	Germany	HF 220	HF 92.6	2625	

DATA ON PRINCIPAL MORTARS IN USE IN EUROPE - WWI (Concluded)

Calibers and Type	Armies in Which Used	Bombs, lb	Explosives, lb	Maximum Range, yards	Wt. to Transport, lb
24.5cm Old Md Hvy. Minenwerfer 9.8-in.	Germany	Short 139 Long 209 Gas 129.8	Short 57.2 Long 101 Gas 50.6	Short 992 Long 612 Gas 1696	1362
24.5cm New Md Hvy. Minenwerfer 9.8-in.	Germany	Short 139 Long 209	Short 57.2 Long 101	1060	1693
292mm Austrian Trench Mortar	Austria	110	28.6	360	264
320mm Samia Trench Mortar	Italy	130	77	1526	1980
390mm Austrian	Austria	213	79	360	319
400mm Italian	Italy	580	220	4470	25,689

Source: Ottosen, Major P. H., Trench Artillery - A. F. F., Boston: Lothrop, Lee and Shepard Co., 1931. By permission.

APPENDIX D

MOBILE MORTAR TO ACCOMPANY INFANTRY

EXTRACT: Remarks of Colonel Forrest E. Williford, Commandant, Trench Artillery Center, American Expeditionary Forces, Treves, France, January 21, 1919.

In our future, one of the most important things is a truly mobile mortar to accompany infantry, one which we class as the light mortar. So far, no nation has produced one which is wholly appropriate, and this has led us to look into the requirements as regards:

1. Range.
2. Weight of weapon.
3. Weight and type of bomb.
4. Features contributing to certainty of action and convenience of service.
5. The best organization for development and tactical use.
6. The coordination of its material with that of other branches.

In the design of any gun it is necessary to strike a balance between the conflicting factors of range, mobility, and power, and the weapon which possesses these three features in the highest degree is the most efficient one. Thus in determining the accompanying mortar it is necessary to provide for sufficient range and power within the weight limit.

As the direct-fire gun is the proper weapon for flat, open country, so is the mortar the weapon for rugged and wooded country, and the original definition and conception of a trench mortar might well be changed to a "weapon designed to throw a bomb containing a large explosive charge from a position with high-angle defilade against a target similarly defiladed."

The tactics of an army are determined by the terrain in which it is operating, and so is the range of the weapons employed. A flat, open country is adaptable for the quick movement of large bodies of troops and gives little aid for resistance, but does not permit large troop movement; and therefore is not the place where decisive battles are fought. The most stubborn resistance of the enemy is to be overcome in country of moderate roughness, where tactical necessity demands that the fighting take place from ridge to ridge, so that the main strength of the armies will be behind opposing ridges. A mortar must then have a minimum range that will permit it to take cover behind one ridge and to fire upon targets on the next ridge. Examination of maps of a number of sections of country which is moderately rugged shows that the average distance between ridges is from one mile to one and one-half miles, and so we see that a range of about 3500 yards is required for our mobile accompanying mortar if it is to take part in the greatest number of actions.

For this accompanying artillery to be of greatest value in support of

infantry, it must be capable of going anywhere that infantry can go and at the same speed as the infantry, and to accomplish this the weight will be limited to the following fundamentals:

1. The maximum weight which the average man can conveniently lift is 100 pounds.
2. The maximum weight a man can conveniently carry over rough country is 75 pounds.
3. The maximum weight a man can haul on a pneumatic tired ball-bearing cart over rough country is about 130 pounds (from experiment at Trench Artillery Center).
4. The maximum number of men that can conveniently carry any one piece on a steep slope is 4.
5. The most convenient unit of men is 8.

It is presumed that the mortar and ammunition will be carried as far forward as possible by motor truck, and from there on by hand-carts, then of course the men must carry the mortar and ammunition. The weight thus becomes limited to about 600 pounds for the mortar and 200 pounds for the cart or means of transportation. The weight of any one piece must not exceed 300 pounds, and the bulkiest piece must be of such shape that it can be carried by four handles. There are few places that the hand-cart cannot be taken, and the total weight could be made as high as 1000 pounds, though it would be far better to limit this weight to 800 pounds.

As a feature of mobility, also, the mortar should be capable of being quickly and easily assembled under conditions of darkness, wet, and mud, and there should be no small or loose parts to become lost.

The power which the mortar must have will depend upon the class of targets against which it is to be used. Those, in the main, will consist of:

1. Concealed machine-gunners, trench artillerymen, or automatic riflemen without shelter.
2. Same in shell-holes or light shelter.
3. Machine-gunners in concrete shelters.

For use against troops in the open, the cast-iron bomb with instantaneous fuse will be most useful.

Targets of the second and third classes, and actual destruction of the shelter would in most cases require too much time. This is not necessary, however, and the advisable course is to make the zone untenable, a condition which is easily obtainable with one or another of the H. E. , gas, or incendiary bombs, according to circumstances. Smoke bombs, too, are needed for cases where the enemy must be blinded, such, for instance, as when knowledge of his location is too indefinite to justify zone fire.

Based upon the statement that a fragment weighing .66 ounce (.024 lb.), with a velocity of 580 ft. per second, will kill a man and the fact that there might be 474 human targets in a circle whose radius is 100 feet (the effective radius of the 6-inch Newton bomb), we see that we need 11,376 pounds of metal.

Based upon thorough analysis, of which the above is the briefest outline, and with a view to ascertaining how to modify our present 6-inch Newton mortar, in order to get the best accompanying mortar, we are led to the following salient conclusion about our light mortar:

1. 3500 yard range.
2. 35 to 40 pound bomb.
3. 10 to 12 pound H. E. capacity in bomb.
4. Smoke, gas, and incendiary fillers also.
5. Total weight of complete mortar, about 800 pounds.
6. No part to weigh more than 300 pounds.
7. Steel bed with spades.
8. Transported on light carts.

We have no other weapon which is in any way suitable for accompanying infantry, so we can inquire into the proper kind of weapon for light trench artillery with little reference to other artillery. By an analysis similar to the above we also ascertain the desirable features for the medium and heavy trench artillery recommended, but they cannot be considered apart from the other artillery which an army should have, and this latter is wholly outside the province of this conference.

ORGANIZATION

Just another word, and that about organization. As you know, we started out with a battery, of what we now term light trench artillery, per division, and a battalion of four batteries, of what we now term medium trench artillery, per corps. This organization was unsuitable from every point of view, and regimental organization was even more necessary than for other arms already well established. My first paper attempting to get a regimental organization was dated February 8, 1918, and it took until November 10, 1918, to convince the proper authorities, for it was on that date that a cable was sent to the U. S. recommending regimental organization. The fact that our own General Staff here was convinced relieves me of the necessity of telling about, and you of the necessity of listening to, the details of why that organization is essential, for I assure you that there was strong opposition, and the General Staff had to be shown.

And then the Germans signed the Armistice the next day.

CONCLUSION

In conclusion let me say that:

1. We need a Center for Trench Artillery.
2. We need regimental organizations.
3. We need a light, truly mobile weapon to accompany infantry.

And we need many other things, for all of which we trench artillerymen bent every effort. These points were important and they are important still, but back of these three are two associated facts which are far more important, not only because they are basic, but also because they affect the whole artillery, the whole army, and even the whole nation. These facts are:

1. We have very fully and ably developed the gun, and have exploited it, at least, as far as we are justified.
2. We have almost wholly neglected the possibilities of the mortar as a field weapon.

Officers of your present rank, perhaps many in this room, will be our higher commanders in our next war and will have the attending responsibilities. Further, it is well within reasonable limits to say that your part of the responsibilities for a proper armament exists even now, all this apart from personal interest in the manner in which the people back home hate a war loser.

We shall feel fully repaid for all our work along this line if our suggestions to you and others ultimately result in a thorough study of the mortar as a field weapon, because we believe that the study will result in field mortars, and therefore in a greatly improved and better-balanced artillery for our army.

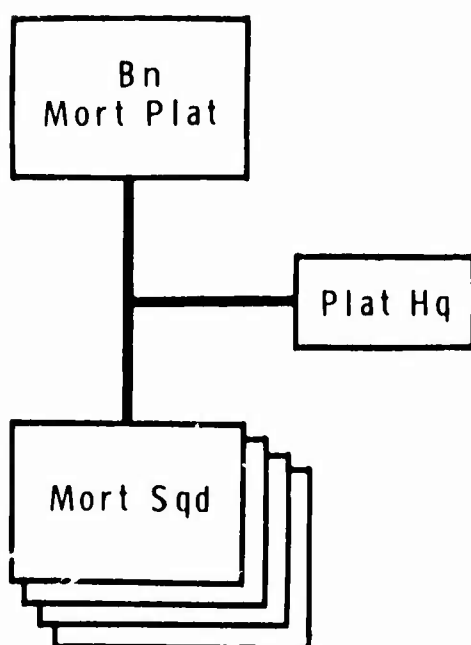
SOURCE: Major P. H. Ottosen, Trench Artillery A. E. F., Boston: Lothrop, Lee and Shepard, 1931. By permission.

APPENDIX E

TABLES OF ORGANIZATION AND EQUIPMENT

TOE 7-36E
Headquarters,
Department of the Army
Washington, D. C.
15 August 1965

Headquarters and Headquarters Company
Infantry Battalion, Airborne Division



Personnel

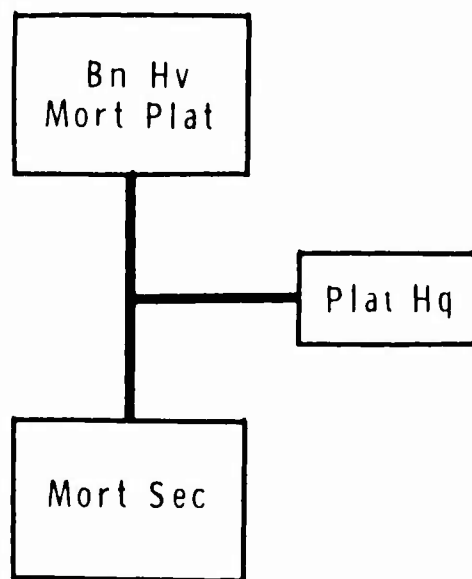
- 1 Squad Leader (E-5)
- 1 Mortar Gunner (E-4)
- 3 Ammunition Bearers (E-3)
- 1 Assistant Mortar Gunner (E-3)
- 1 Light Truck Driver (E-3)

Equipment

- 2 Decontaminating apparatus, portable 1½ -qt.
- 7 Bayonets, knife, w/ scabbard for 7.62mm rifle
- 1 Carrier light weapons, infantry, ½ -ton, 4x4
- 1 Compass, mil graduations
- 1 Launcher, grenade, 40mm
- 1 Mortar, 4.2-inch, on mount
- 4 Rifles, 7.62mm, semiautomatic, light barrel
- 3 Pistols, automatic, caliber 45
- 1 Trailer, amphibious, cargo, ¼ -ton, 2 wheel
- 1 Truck, utility, ¼ -ton, 4x4

TOE 7-16E
 Headquarters,
 Department of the Army
 Washington, D. C.
 15 July 1963

Headquarters and Headquarters Company
Infantry Battalion, Infantry Division



Mortar Section

- 1 Section Leader (E-6)
- 4 Squad Leaders (E-5)
- 4 Mortar Gunners (E-4)
- 12 Ammunition Bearers (E-3)
- 4 Asst Mortar Gunners (E-3)
- 4 Lt Truck Drivers (E-3)

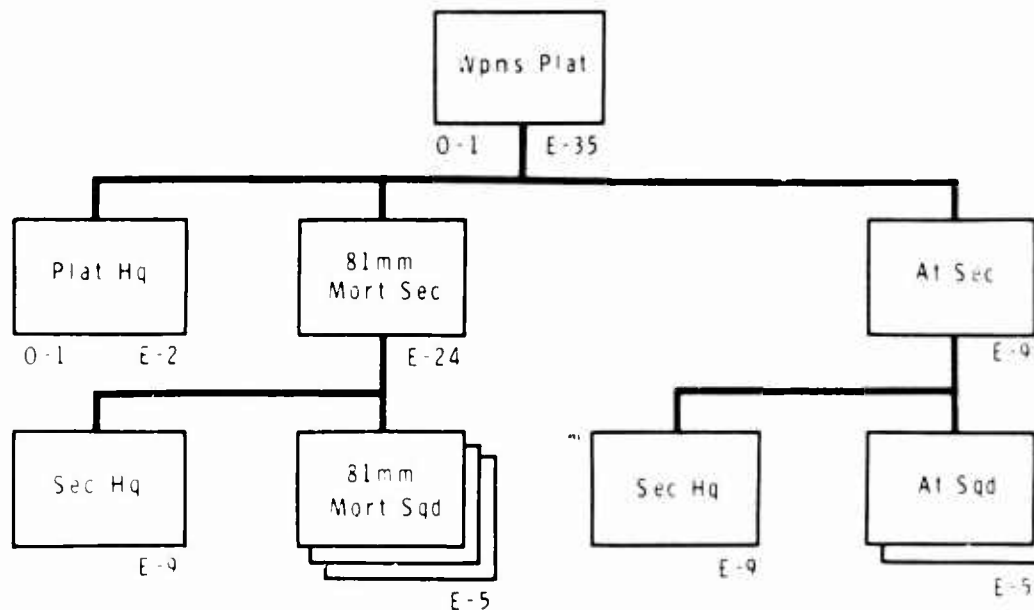
Mortar Squad

- 1 Squad Leader (E-5)
- 1 Mortar Gunner (E-4)
- 3 Ammunition Bearers (E-3)
- 1 Asst Mortar Gunner (E-3)
- 1 Lt Truck Driver (E-3)

Equipment

- | | |
|---|--|
| <ul style="list-style-type: none"> 1 Decontaminating apparatus, portable, 1½ -qt. 7 Bayonets, knife, w/scabbard for 7.62mm rifle 1 Compass, mil graduations 1 Launcher, grenade, 40mm 1 Mortar, 4.2-inch, on mount 3 Pistols, automatic, caliber .45 4 Rifles, 7.62mm, semiautomatic, light barrel 1 Trailer, cargo, 3/4-ton, 2-wheel | <ul style="list-style-type: none"> 1 Truck, cargo, 3/4-ton, 4x4 1 Goggles, sun, 2 plastic lens, 1 colorless, 1 polarized green 5 Packboard, plywood, w/tongueless buckles, shoulder strap, 24 Lg 10 Pouches, shoulder, packboard, felt, w/ctn drill, 113/4 lg 3 W 15 Straps, quick release, packboard 1 Reel, equipment, CE-11 1 Wire, WD-1/TT on DR-8¼ Mi. |
|---|--|

Rifle Company, Infantry Battalion, Infantry Division



81mm Mortar Section Hq

- 1 SSgt, Section Leader
- 3 Sgt, Forward Obsr
- 2 SP5, Fire Dir Cmpt
- 3 Pfc, Rad Tel Op

- 1 Launcher rocket 3.5-inch
- 1 Trl cgo 3/4-T 2 whl
- 1 Trk cgo 3/4-T 4x4
- 4 Radio set AN/PRC-25
- 1 Swbd tel manual SB-993/GT
- 6 Telephone sets TA-312/PT

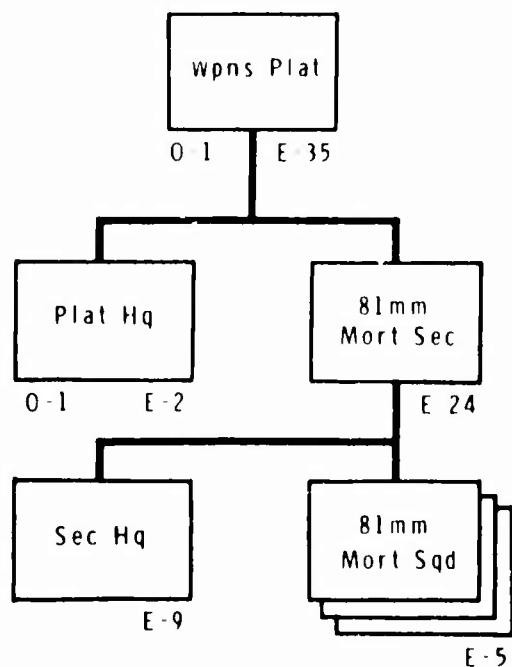
81mm Mortar Squad (3)

- 1 Sgt, Squad Leader
- 1 SP4, Gunner
- 2 Pfc, Ammo Bearer
- 1 Pfc, Asst Gunner

- 1 Mortar 81mm on mount
- 1 Trl cgo 3/4-T 2 whl
- 1 Trk cgo 3/4-T 4x4
- 1 Telephone set TA-1/PT

(Mech) TOE 7-47E

Rifle Company, Infantry Battalion (Mech),
Armored Division or Infantry Division



81mm Mortar Section Hq

- 1 SSgt, Section Leader 11260
- 3 Sgt, Forward Obsvr 11260
- 2 SP5, Fire Dir Cmptr 11220
- 1 SP4, Pers Carr Dvr 11210
- 2 Pfc, Rad Tel Op 11200

- 1 Carr pers full tracked
- 1 Launcher rocket 3.5-inch
- 1 Tlr cgo 1½-T 2 whl
- 1 Radio set AN/GRC-125 mtd in Carr
Pers FTRAC
- 1 Radio set AN/VRC-46 mtd in Carr
Pers FTRAC
- 4 Radio sets AN/PRC-25
- 1 Swbd tel manual SB-993/GT
- 2 Telephone sets TA-312/PT
- 4 Telephone sets TA-1/PT

81mm Mortar Squad

- | | | |
|----------------------|-------|------------------------------------|
| 1 Sgt, Squad Leader | 11260 | 1 Mort SP FTRAC 81mm |
| 1 SP4, Gunner | 11210 | 1 Radio set AN/GRC-125 mtd in Mort |
| 1 SP4, Mort Carr Dvr | 11210 | Carr 81mm FTRAC |
| 1 Pfc, Ammo Bearer | 11200 | 1 Tel set TA-1/PT |
| 1 Pfc, Asst Gunner | 11200 | |

Remarks:

All personnel armed with rifle 7.62mm light barrel unless otherwise indicated. Minimum of one officer per company to be Ranger qualified.

TOE 7-46G
Headquarters,
Department of the Army
Washington, D. C.
31 March 1966

Headquarters and Headquarters Company, Infantry
Battalion (Mechanized) Armored Division

or

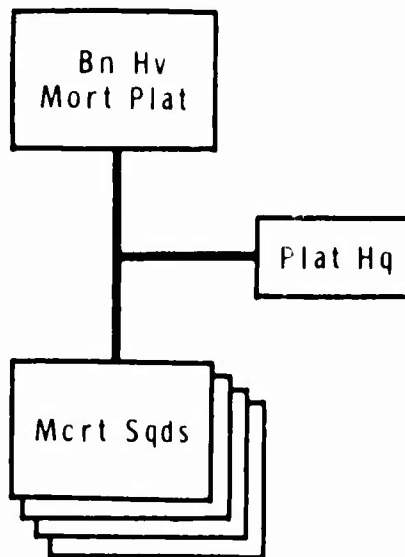
Headquarters and Headquarters Company, Infantry
Battalion (Mechanized) Separate Armored Brigade

or

Headquarters and Headquarters Company, Infantry Battalion
(Mechanized) Separate Infantry Brigade

or

Headquarters and Headquarters Company, Infantry Battalion
(Mechanized) Separate Infantry Brigade (Mechanized)



Personnel

- 1 Squad Leader (E-5)
- 1 Mortar Gunner (E-4)
- 1 Mortar Carrier Driver (E-4)
- 1 Ammunition Bearer (E-3)
- 1 Asst Mortar Gunner (E-3)

Total 5

Equipment

- 5 Bayonets, knife, w/ scabbard for M14 rifle
- 1 Cable, telephone, WD-1/ TT DR-8 1320 ft
- 1 Compass, magnetic, unmounted, mil graduations
- 1 Flag set, M-238
- 5 Goggles, sun, wind, and dust, single aperture, two plastic lenses
- 1 Launcher, grenade, 40mm
- 1 Mortar, 107mm, self propelled, full tracked
- 1 Mortar, 4.2-inch, on mount
- 3 Pistols, caliber .45, automatic
- 1 Radio set, AN/ GRC-125, mounted in carrier, mortar, heavy
- 1 Reel, equipment, portable wire laying unit
- 2 Rifles, 7.62mm
- 1 Weapon sight, infrared

TOE 7-18
Headquarters,
Department of the Army
Washington, D. C.
15 May 1952

Infantry Heavy Weapons Company

Personnel

Mortar Squad

1 Squad Leader, E-5 (Sergeant)
1 Mortar Gunner, E-4 (Corporal)
5 Ammunition Bearers, E-3 (Private, First-class)
1 Asst Mortar Gunner, E-3 (Private, First-class)
1 Light Truck driver, E-3 (Private, First-class)
Total 9

Equipment

9 Masks, protective field - M9A1
1 Compass, lensatic, luminous, damped, 5 deg-20 mil grad, w/ case
2 Bayonets, M1, with scabbard, M7
7 Bayonets, knife, M4, w/ scabbard, M8A1
1 Binocular, M13A1
1 Board, plotting, M10
4 Carbines, caliber .30, M2
2 Launchers, grenade, M7A2
1 Mortar, 81mm on mount, M23A1
3 Pistols, automatic, caliber .45, M1911A1
2 Rifles, caliber .30, M1
1 Trailer, $\frac{1}{4}$ -ton, 2W, cargo, M100
1 Truck, utility, $\frac{1}{4}$ -ton, 4x4, M38A1
16 Attachments, packed, plywood, cargo
1 Axe, chop, single bit, wt 4lb, w/ handle
2 Bags, carrying, ammunition
2 Cans, gasoline, 5 gal capacity
8 Goggles, M1944
8 Packboards, plywood

TR 415-20
War Department,
Washington, D. C.
2 January 1934

Chemical Squad 4.2-inch and 4-inch Chemical Mortar

Mortar Squad

One corporal and eight privates. During firing those men who are with the mortar are known as the mortar crew (Nos. 1, 2, 3, and 4), No. 2 being designated as the gunner. Those men with the ammunition being brought to the mortar are known as the ammunition crew (Nos. 5, 6, 7, and 8).

Ammunition Squad

The ammunition squad consists of one corporal and eight privates.

TR 420-140
22 May 1923

Combat Principles - Howitzer Company Squads

Allocation of duties of 3-inch trench mortar squad during combat.

Sergeant - Squad Leader

Corporal - Gunner

Privates - No. 1 Loads and fires mortar

No. 2 Assists No. 1

No. 3 Prepares ammunition and hands it to No. 2

No. 4 Assists mule leader

TOE 7-18L
1 February 1955

Infantry Heavy Weapons Company

Shows addition of one mortar section to mortar platoon, thus making a total of three mortar sections of two mortar squads each, with the squad reduced to seven members.

1 Squad Leader, E-5 (Sergeant)

1 Mortar Gunner, E-4 (Corporal)

2 Ammunition Bearers, E-3 (Private, First-class)

1 Light Truck Driver, E-3 (Private, First-class)

2 Assistant Mortar Gunners, E-3 (Private First-class)

Total 7

Two ammunition bearers dropped.

TOE 7-19D
Headquarters,
Department of the Army
Washington, D. C.
1 February 1960

Combat Support Company

Infantry Division Battle Group

Heavy Mortar Platoon

Fire Direction Center and Survey Section

3 Forward Observer Teams 1 Officer (Lt)
1 EM (E-5)

2 Firing Section Headquarters

2 Section Comdrs, (Lt)
2 Section Sergeants, (E-7)
2 Lt Truck Drivers, (E-3)
2 Radio Tel Oprs. (E-3)

Mortar Squad

1 Squad Leader, (E-5)
1 Mortar Gunner, (E-4)
3 Ammo Bearers, (E-3)
1 Asst Mortar Gunner, (E-3)
1 Lt Truck Driver
Total 7

1 Mortar, 4.2-inch, on mount
1 First aid kit, general purpose, 12 unit
7 Bayonets, knife, w/ scabbard, carbine
1 Compass, MIL graduations
1 Mortar, 4.2-inch, on mount
2 Pistols, caliber .45, semiautomatic
5 Rifles, 7.62mm, semiautomatic, lt barrel
1 Trailer, cargo, 3/4-ton, 2 wheel
1 Truck, cargo, 3/4-ton, 4x4
1 Axe, single bit
1 Goggles, M1944
1 Mattox pick
1 Shovel
1 Reel, equip, C-11
1 Tool, equip, TE-33

APPENDIX F

EXTRACT FROM CONGRESSIONAL MEDAL OF HONOR CITATION

TECHNICAL SERGEANT CHARLES E. KELLY

" The following morning the enemy attack was resumed. Corporal Kelly took a position at an open window of the storehouse. One machine gunner had been killed at this position and several other soldiers wounded. Corporal Kelly delivered continuous aimed and effective fire upon the enemy with his automatic rifle until the weapon locked from overheating. Finding another automatic rifle, he again directed effective fire upon the enemy until this weapon also locked. At this critical point, with the enemy threatening to overrun the position, Corporal Kelly picked up 60 mm. mortar shells, pulled the safety pins, and used the shells as grenades, killing at least five of the enemy."

BIBLIOGRAPHY

BOOKS

Appleman, Roy E., et al., Okinawa The Last Battle, Rutland, Vermont and Tokyo, Japan: Charles E. Tuttle Company, 1960.

Azan, Lieutenant Colonel Paul, The War of Positions, Cambridge: Harvard University Press, 1917.

Barnes, Major General M. G., Weapons of World War II, New York: Van Nostrand Company, 1947.

Berkhimer, William E., Historical Sketch of the Artillery, United States Army, Washington: Press of Thomas McGill & Company, 1884.

Bertrand, Georges and Solbert, Oscar N., Tactics and Duties For Trench Fighting, New York: G. P. Putnam's Sons, 1918.

Blau, J. S., The Civil War, New York: Thomas Y. Crowell Company, 1958.

Boutell, Charles, Arms and Armour, London: Gibbings and Company, Limited, 1902.

Canby, Courtlandt, A History of Weaponry, New York: Hawthorn Books, Inc., 1963.

Cannon, M. Hamlin, Leyte: The Return to the Philippines, UNITED STATES ARMY IN WORLD WAR II, Office of the Chief of Military History, Department of the Army, Washington, D. C., 1954.

Carman, W. Y., A History of Firearms From Earliest Times to 1914, London: Routledge & Kegan Paul, Ltd., 1955.

Cawston, Lieutenant Colonel H. E. P., Mobile Spigot-Mortar Tactics, London: Practical Press, Ltd., 1944.

Clark, General Mark W., From The Danube to The Yalu, New York: Harper & Brothers, Publishers, 1954.

Cole, Hugh M., The Ardennes: Battle of The Bulge, UNITED STATES ARMY IN WORLD WAR II, Office of the Chief of Military History, Department of the Army, Washington, D. C., 1965.

Cole, Hugh M., The Lorraine Campaign, UNITED STATES ARMY IN WORLD WAR II, Office of the Chief of Military History, Department of the Army, Washington, D. C., 1950.

Courtland, C., A History of Weaponry, New York: Hawthorn Books, Inc., 1963.

Crowell, Benedict, America's Munitions 1917-1918, Washington: The Government Printing Office, 1919.

Crowell & Wilson, The Armies of Industry, New Haven: The Yale University Press, 1921.

BOOKS (continued)

Demmin, A., Weapons of War, London: Bell & Daldy, 1870.

Downey, Fairfax, The Sound of the Guns, New York: D. McKay Company, 1956.

Eisner, W., A Pictorial Arsenal of America's Combat Weapons, New York: Sterling Publishing Company, 1960.

Greenfield, Kent Roberts, et al., The Organization of Ground Combat Troops, UNITED STATES ARMY IN WORLD WAR II, Office of the Chief of Military History, Department of the Army, Washington, D. C., 1947.

Gugeler, Captain Russell A., Combat Actions in Korea, Washington: Combat Forces Press, 1954.

Hicks, Major J. E., Notes on French Ordnance, Published by the Author, Mt. Vernon, N. Y., 1938.

Hicks, Major J. E., Notes on German Ordnance, Published by the Author, Mt. Vernon, N. Y., 1937.

Hicks, Major J. E., Notes on United States Ordnance, Published by the Author, Mt. Vernon, N. Y., 1940.

Hicks, Major James E., Our Arms & Weapons, New York: W. W. Norton Company, 1941.

Hicks, Major J. E., French Military Weapons 1717-1938, New Milford, Connecticut: N. Flayderman Company, 1964.

Higgins, Marguerite, War in Korea, Garden City, New York: Doubleday & Company, Inc., 1951.

Hodges, Major Le Roy, Post-War Ordnance, Richmond: Richmond Press, 1923.

Howe, George F., Northwest Africa: Seizing the Initiative in The West, UNITED STATES ARMY IN WORLD WAR II, Office of the Chief of Military History, Department of the Army, Washington, D. C., 1957.

Kirk, John and Young, Robert, Jr., Great Weapons of World War II, New York: Walker and Company, 1961.

Kleber, Brooks E., and Birdsell, Dale, The Chemical Warfare Service: Chemicals in Combat, UNITED STATES ARMY IN WORLD WAR II, Office of the Chief of Military History, Department of the Army, Washington, D. C., 1966.

Lloyd & Hadcock, Artillery: Its Progress and Present Position, Portslade, England: J. Griffin & Co., 1893.

Lord, Francis A., They Fought for the Union, Harrisburg, Pennsylvania: The Stackpole Company, 1960.

MacDonald, Charles B., and Mathews, Sidney T., Three Battles: Arnaville, Altuzzo, and Schmidt, UNITED STATES ARMY IN WORLD WAR II, Office of the Chief of Military History, Department of the Army, Washington, D. C., 1952.

BOOKS (continued)

Manders, Lieutenant E. W., The 29-mm Spigot-Mortar, London: Practical Press, Ltd., 1944.

Manucy, A., Artillery Through the Ages, Washington; United States Government Printing Office, 1949.

Marshall, S. L. A., Commentary on Infantry Operations and Weapon Usage in Korea, Winter of 1950-51, Johns Hopkins University, 1951.

Marshall, S. L. A., Pork Chop Hill, New York: William Morrow and Company, 1956.

Marshall, S. L. A., The River and The Gauntlet, New York: William Morrow & Company, 1953.

Miller, John Jr., Guadalcanal: The First Offensive, UNITED STATES ARMY IN WORLD WAR II, Office of the Chief of Military History, Department of the Army, Washington, D. C., 1949.

Miller, John, Jr., Korea 1951-1953, Office of the Chief of Military History, Department of the Army, Washington, D. C., 1956.

Milner, Samuel, Victory in Papua, UNITED STATES ARMY IN WORLD WAR II, Office of the Chief of Military History, Department of the Army, Washington D. C., 1957.

Morton, Louis, The Fall of The Philippines, UNITED STATES ARMY IN WORLD WAR II, Office of the Chief of Military History, Department of the Army, Washington, D. C., 1953.

Moss, Major James A. Trench Warfare, Menasha: George Banta Publishing Company, 1917.

Ogburn, Charlton, Jr., The Marauders, New York: Harper & Brothers, Publishers, 1959.

Otosen, Major P. H., Trench Artillery A. E. F., Boston: Lothrop, Lee and Shepard Co., 1931.

Peterson, Harold L., Notes on Ordnance of The American Civil War, Washington D. C., The American Ordnance Association, 1959.

Pope, Dudley, Guns, New York: Delacorte Press, 1965.

Smith, Robert Ross, The Approach to The Philippines, UNITED STATES ARMY IN WORLD WAR II, Office of the Chief of Military History, Department of the Army, Washington, D. C., 1953.

Smith, Robert Ross, Triumph in The Philippines, UNITED STATES ARMY IN WORLD WAR II, Office of the Chief of Military History, Department of the Army, Washington, D. C., 1963.

Tunis, E., Weapons, New York: World Publishing Company, 1954.

BOOKS (concluded)

Westover, J. G., Combat Support in Korea, Washington: Combat Forces Press, 1955.

Worden, William L., General Dean's Story, New York: The Viking Press, 1954.

Worley, Captain Marvin L., Jr., New Developments in Army Weapons, Tactics, Organization and Equipment, Harrisburg: The Military Services Publishing Co., 1958.

OFFICIAL AND SEMI-OFFICIAL PUBLICATIONS

Handbook on Machine Gun Cart Model 1917, Washington, D. C., War Department, March 25, 1918.

Handbook of Light Stokes Trench Mortar, Prepared by the Infantry School of Arms, Fort Sill, Oklahoma, July 1918.

Manual For Trench Artillery U. S. Army (Prov.) Part V, The 58 No. 2 Trench Mortar, US Army A. E. F. 1917-1920, Washington, D. C., Government Printing Office, 1918.

Manual for Trench Artillery, U. S. Army (Prov.) Part III, The Newton 5-inch Trench Mortar, US Army A. E. F. 1917-1920, Washington, D. C., Government Printing Office, 1918.

Stokes Mortar Marksmanship. Prepared at the U. S. Infantry School, Camp Benning, Georgia, The U. S. Government Printing Office, Washington, D. C., 1920.

Training Regulations, No. 420-75, Infantry Drill, The Howitzer Squad, Platoon, and Company, prepared under direction of the Chief of Infantry, War Department, Washington, June 15, 1926.

Basic Field Manual, Volume II, Infantry Drill Regulations, Prepared under the direction of the Chief of Infantry, Washington: The United States Infantry Association, 1931. Contains "Mortar Drill, 3-inch trench mortar squad" p. 100.

Basic Field Manual, Howitzer Company, Basic Weapons, Washington, D. C., War Department, 1932.

Basic Field Manual, Volume III, Basic Weapons, Part Four, Howitzer Company, War Department, United States Government Printing Office, Washington: 1932.

60-mm Mortar Handbook, Washington, D. C., Infantry Journal c. 1941.

Mortars and Mortar Gunnery, Military Service Publishing Company, Harrisburg, n.d.

Japanese Mortars and Grenade Dischargers, Washington: War Department, Military Intelligence Division, 1945.

OFFICIAL AND SEMI-OFFICIAL PUBLICATIONS (concluded)

Basic Heavy Weapons Manual, Harrisburg: Military Service Publishing Company, n. d.

Tactics and Technique of Infantry, Volume III, Infantry Weapons, Harrisburg: The Military Service Publishing Company, 1953.

FM 6-50, January 1956, 4.2-inch MH, M 30.

FM 6-18, May 1957, Mortar Battery Infantry Division Battle Group.

FM 6-18, Mortar Battery, Airborne Division, Battle Group, Washington, D. C., Headquarters, Department of the Army, July 1959.

FM 23-90, Department of the Army Field Manual, 81-mm Mortar, M29, Headquarters, Department of the Army, December 1958.

FM 7-19, Department of the Army Field Manual, Combat Support Company, Infantry Division Battle Group, Headquarters, Department of the Army, February 1960.

FM 23-92, Department of the Army Field Manual, 4.2-Inch Mortar, M30, Headquarters, Department of the Army, February 1961.

Crew-Served Weapons, ROTCM 145-41, July 1964.

FM 7-20, Department of the Army Field Manual, Infantry, Airborne Infantry, and Mechanized Infantry Battalions, Headquarters, Department of the Army, May 1965.

The 6th Infantry Division in World War II, Washington, D. C.: Infantry Journal Press, 1947.

History of the Infantry Mortar, manuscript by Mortar Committee, The Infantry School, not published.

United States Army in The World War 1917-1919, Organization of The American Expeditionary Forces, Washington, D. C.: Historical Division, Department of the Army, 1948.

Korea-1950, Office of the Chief of Military History, Department of the Army, Washington, D. C., 1952.

Operations Report, Lessons Learned Report 3-66, The PLEIKU Campaign, Headquarters, Department of the Army, Office of the Adjutant General, Washington, D. C., 10 May 1966.

ARTICLES

Aplinton, Henry, "Mortars and Smoke", Marine Corps Gazette, September 1944.

Arnhym, Rolfe G., "The Battle Group Heavy Mortar Platoon", Infantry Journal, February-March 1960.

Auspex (Pseudonym), "The Mortar on the Frontier", Journal of the United Services Institute of India, July 1938.

ARTICLES (continued)

Barker, Major, M. E., "A Subcaliber Mortar", Infantry Journal, January-February 1937.

Brandt, "Zugwerfer?" "Platoon Mortars?", English Abstract in Review of Military Literature, March 1936.

Bulawsky, L. H., "Two-Man Punch", The Infantry School Quarterly, April 1956.

Clark, Lyman H., "Get the Most From Your Mortars", The Infantry School Quarterly, July 1953.

Curry, Mike, "Jungle Warfare Weapons" in Chemical Warfare Bulletin October 1934.

Davis, W. J., "Fire For Effect", Marine Corps Gazette, April 1956.

Driver, J. W., "More Punch for the 60mm", Marine Corps Gazette, April 1956.

Erwin, Major James Q., "Notes On the Coehorn Mortar" Military Collector and Historian, Volume XIII, No. 2, Summer, 1961.

Falk, Stanley L., "Artillery for the Land Service: The Development of a System", Military Affairs, Volume XXVIII, No. 3, Fall, 1964.

Finan, W. T. E., "Should the Mortar Go?", Canadian Army Journal, No. 9, 1 January 1955.

French, J. Forrest, "Advantages and Disadvantages of the 4" Stokes Mortar", Chemical Warfare, Volume 16, March 1930.

Goebert, E. C., "An Effective Trench Mortar; Development of the 81-mm Stokes-Brandt Weapon", Army Ordnance, March-April 1933.

Gomez-Jordana, Luis V., "The Mortar in Battle", Military Review, March 1945.

Haslam, C. G., "A Comparison of Our Own and Foreign Heavy Mortars", Marine Corps Gazette, January 1957.

Haydon, F. S., "Grant's Wooden Mortars and Some Incidents of the Siege of Vicksburg", Journal of the American Military Institute, April 1940.

Hill, B. J., "The Marine Corps Has a Mortar", Marine Corps Gazette, March 1956.

Horn, C. E., "A 'Junior Redleg' Speaks", Infantry, January-February 1962.

Izenour, F. M., "ROCID Changes", Infantry, April-June 1959.

Jevenois, Pedro, "Accompanying Artillery- The Use of Trench Artillery as Accompanying Artillery", Memorial De Artillerie, Spain, September 1921.

Kaufer, E. E., "Four Deuce is a Winner", Marine Corps Gazette, December 1952.

Kelman, Manfred, "Bah, Bah, Black Sheep" , Infantry, July-August 1961.

Lehmann, " Employment of Heavy Mortars in Defense" , Military Review, August 1943.

Lloyd, Charles T., " Give It To Them" , Infantry Journal, March 1945.

Lynch, Francis, D., " Weapons Platoon Leader" , Infantry, November-December 1962.

MacKechnie, Colonel A. R., " Notes on Campaign 162d Infantry in New Guinea, 1943" , (Infantry School Library, D 793.58 M199 dv).

Martin, D. J., " Modern Trench Mortars: Infantry Weapons with High Trajectory for Close Support" , Army Ordnance, July-August 1940.

McCaffrey, Colonel W. J., " Some Notes on Korea" , (Infantry School Library, DS 917.12 M 15dv).

McConnell, F. M., " Tracks for the Infantry - PT III: Mortar Mobility" , Infantry, January-March 1959.

McConnell, F. M., and Sears, C. W., " Give Little Tube a Job" , Infantry, October-December 1958.

Melhado, Mark, " Keep Those 81's Pitching" , Infantry Journal, October 1945.

Merritt, Delber T. L., " A Pattern For Jap Busting" , Infantry Journal, January 1944.

Mertel, K. D., " Heavy Mortars Parade of Progress" , The Infantry School Quarterly, October 1955.

Multop, Charles, " A Heavy Weapons Company in Korea" , The Infantry School Quarterly, October 1951.

Moran, E. J., " Employment of the 4.2" Chemical Mortar in Placing Smoke Screens" , Chemical Warfare, Volume 16, February 1930.

Nihart, Brooke, " Necessity - Not Sentiment" , Marine Corps Gazette, January 1954.

Nolan, J. E., " The 30-mm Mortar In Korea" , USMC Gazette, July 1952.

Paciulli, O. C., " Fire Power Plus" , Marine Corps Gazette, March 1955.

Painter, Dean E., " An Artillery Weapon Now - The 4.2-inch Mortar" , Combat Forces Journal, June 1955.

Perret, Captain, " Le Mortier Leger 36" , Revue d'Infanterie, May 1939.

Perry, R. F., " Pack Mortars" in Chemical Warfare, Volume 15, No. 5, May 1929.

ARTICLES (continued)

Poser, Norman S., "The Sunday Punch", The Infantry School Quarterly, January 1954.

Powers, Lieutenant Colonel John L., "81-mm Mortar Platoons in Combat", Infantry Journal, January 1945.

Prentiss, Brigadier General A. M., "The 4.2-inch Mortar", Army Ordnance, July-August 1945.

Rice, Captain John K., "New Infantry Accompanying Weapons", Infantry Journal, Volume 32, No. 4, April 1928.

Ross, R. H., "Give The Battle Group a Punch", Army, January 1958.

Rouguerol, J., "L'Artillerie de Tranchee' enforet d'Apremont Fin 1915", Revue Militaire Suisse, October 1926, Volume 71, No. 10.

Schmidt, Carl T., "Weapons of German and British Infantry Battalions", Infantry Journal, July 1941.

Schmierer, Elmer, "Those Heavy Mortars; What the Heavy Mortar Company Can Do and How It Does It", Infantry Journal, January 1949.

Sobolev, "Mortar Fire by the Red Army", Infantry Journal, April 1943.

Speidel, W. H., "Heavy Mortars-Germany", Military Review, December 1939.

Spring, C. J., "Mortar-Howitzer?", Marine Corps Gazette, September 1955.

Stoehr, Major C. F., "Tank or Light Mortar as a Weapon of Infantry", Journal of the Royal United Service Institution, Volume 67, 1922.

Stogner, H. D., "The Battle Group Commander's Personal Artillery", Infantry, October-December 1958.

Sydenham, Colonel H. G., "The Infantry Mortars", Infantry Journal, May-June 1939.

Thomas C. B., "The 81-mm Mortar Platoon", The Infantry School Quarterly, April 1951.

Torbett, W. C., "Illumination with the 4.2", Infantry, November-December 1961.

Townsend, Earle, J., "First Round on Target", Armed Forces Chemical Journal, January 1953.

Van Orden, George O., "Machine Guns and Mortars in the Jungle", Infantry Journal, August 1944.

Wade, J. J., "Of Mortars and Men", Marine Corps Gazette, January, 1954.

Waite, Alden H., "The 4.2-Chemical Mortar", Infantry Journal, March 1944.

ARTICLES (continued)

" Employment of New Weapons in British Infantry" , The Infantry School Mailing List, Volume 16, 1938.

Wilson, A. W., " Heavy Mortar Digs In" , The Infantry School Quarterly, January 1952.

Willoughby, C. A., " Accompanying Weapons - Italy" , Army and Navy Journal, March 25, 1939.

Willoughby, C. A., " Light Mortar Training - Germany" , Army and Navy Journal, March 25, 1939.

" Trench Guns - French and German Armies" , The Field Artillery Journal, April-June 1917.

" Trench Mortars Against U-Boats" Scientific American, No. 17, 1917.

" Development, Methods, and Desiderata of Trench Artillery, European War" , Revue Militaire Suisse, August 1917.

" With a Trench Mortar Battery on the French Front" , Field Artillery Journal, October-December 1917.

" The Stokes Gun and Shell and Their Development" , Engineering, June 28, 1918.

" The Minenwerfer in the German Army" , Revue D' Artillerie, January-February, 1921.

" New 75-mm Mortar" , Ordnance, Volume 5, No. 28.

" New Ammunition For The 75-mm Mortar" , Ordnance, Volume 10, No. 57.

" Firepower of the Infantry" , Ordnance, Volume 13, No. 73.

" The 4-inch Trench Mortar" , Ordnance, Volume 15, No. 84.

" Infantry Fire Power and Mobility" , Volume 17, No. 98.

" Modern Trench Mortars" , Ordnance, Volume 21, No. 121.

" The Infantry Howitzer Company, 1925" , U. S. General Services Schools, Fort Leavenworth, Kansas.

" 81-mm Stokes - Brandt Mortar" , Infantry Journal, Volume 39, May-June, 1932.

" Howitzer Units in Battle" , U. S. Infantry School, Fort Benning, Georgia, 1933.

" France: The 60-mm Mortar and Accompanying Machine Guns (International Military Survey), Infantry Journal, September-October, 1938.

" Mission and Employment of 50-mm Mortar" , Army and Navy Journal, March 25, 1939.

" Germany: Mission and Action of German Light Mortars" , Infantry Journal, May-June, 1939.

ARTICLES (continued)

- " An 81-mm Mortar Platoon Supports an Attack" , (Infantry School Teaching), The Infantry School Mailing List, Volume 18, July 1939.
- " The Heavy Weapons Company of the Infantry Battalion" , The Infantry School Mailing List, Volume 19, February 1940.
- " Infantry Weapons" , U. S. Infantry Mailing List, Volume 19, Chapter 10, 1940.
- " The Heavy Weapons Company and Its Units" , Infantry Journal, July-August 1940.
- " Infantry Weapons" , The Infantry School Mailing List, Volume 30, April 1947.
- " Combat Tactics of the Weapons Platoon" , The Infantry School Quarterly, October 1947.
- " The Heavy Mortar Company in Defensive Combat" , The Infantry School Quarterly, January 1948.
- " Organization and Principles of Employment of the Heavy Weapons Company in the Attack" , The Infantry School Quarterly, April 1948.
- " Employment of the Heavy Mortar Company in the Attack" , The Infantry School Quarterly, No. 33, 1 July 1948.
- " The Heavy Mortar Company in Support of a Regimental Attack" , The Infantry School Quarterly, No. 33, 2 October 1948.
- " Infantry Mortars, 60-mm and 81-mm" , The Infantry School Mailing List, Volume 19, February 1940.
- " Infantry Artillery-Germany" , Infantry Journal, March-April, 1940.
- " Fighting Equipment of Square and Triangular Infantry Division" , Ordnance, Volume 22, No. 128, 1941.
- " Infantry Equipment - USSR (Mil notes around the world)" , Military Review, October 1942.
- " Chemical Defense - 81-mm Mortar" , Ordnance, Volume 22, No. 313, 1942.
- " Chemical Defense" , Ordnance, Volume 22, No. 121, 1942.
- " Japanese ' Knee Mortar' " , Ordnance, Volume 22, No. 138, 1943.
- " Ordnance For The Infantry - 60-mm Mortar" Ordnance, Volume 25, No. 141, 1943.
- " Mortar Carrier, Half-Track 81-mm" , Ordnance, Volume 25, No. 141, 1943.
- " Ordnance For The Infantry - Mortar 81-mm" , Ordnance, Volume 25, No. 141, 1943.
- " British Armament - 2-inch Mortar" , Ordnance, Volume 25, No. 140, 1943.

ARTICLES (continued)

- " British Armament - 3-inch Mortar, Ordnance, Volume 25, No. 140, 1943.
- " Army Equipment - Italy", Military Review, January 1943.
- " Mortars (USSR)", Military Review, January 1943.
- " The Use of Trench Mortars in Defending Inhabited Places", Marine Corps Gazette, July 1943.
- " Knee Mortar, M-1, G-1, USA (60-mm Mortar Tube without base plate and bipod and fired by one man)", Infantry Journal, July 1943.
- " The Jungle Mortar, T18E6 New Developments", Ordnance, Volume 27, No. 147, 1944.
- " The Jungle Mortar T18E6", Army Ordnance, November-December 1944.
- " One-Man Mortar", Army and Navy Register, October 21, 1944.
- " The 4.2-inch Chemical Mortar", Ordnance, Volume 28, No. 141, 1943.
- " The 4.2-inch Mortar, Rifled Mortar Shell", Ordnance, Volume 28, No. 148, 1945.
- " The 4.2-inch Mortar, Stokes Mortar Shell", Ordnance, Volume 28, No. 148, 1945.
- " Breaking the Shimbu Line", Chemical Warfare Bulletin, June-July-August, 1945.
- " American, German and Japanese Mortar - The 4.2-inch Mortar", Ordnance, Volume 28, No. 148, 1945.
- " New Secret Weapons - 10-inch Mortar", Ordnance, Volume 28, No. 148, 1945.
- " The 4.2-inch Chemical Mortar", Ordnance, No. 148, 1945.
- " 4.2-inch Rifled Mortar", Ordnance, Volume 28, No. 148, 1945.
- " New Developments, German 380-mm Mortar", Ordnance, Volume 28, No. 150.
- " Recoilless Chemical Mortar - New Developments", Ordnance, Volume 28, No. 150, 1945.
- " 4.2-inch Chemical Mortar", Ordnance, Volume 30, No. 154, 1946.
- " Little David", New 36-inch Mortar", Ordnance, Volume 30, No. 154 1946.
- " Ordnancemen at Aberdeen - Mortar, 105-mm", Ordnance, Volume 31, No. 160, 1947.
- " Ordnancemen at Aberdeen - Mortar, 250-mm", Ordnance, Volume 31, No. 160, 1947.

ARTICLES (concluded)

" Ordnancemen at Aberdeen - Mortar, 155-mm" , Ordnance, Volume 31, No. 160, 1947.

" Comparative Data on 4.2-inch and 81mm Mortars" , The Infantry School Quarterly, January 1952.

" Chemical Mortar Battalions Converted to Infantry Heavy Mortar Battalions" , Army-Navy-Air Force Register, 11 October 1952.

" New 81-mm Mortar - New Developments" , Ordnance, Volume 37, No. 194, 1952.

" New Infantry Equipment - Defense Highlights" , Ordnance, Volume 41, No. 217, 1956.

" Self-Propelled Mortar - New Developments" , Ordnance, Volume 43, No. 232, 1959.

" New Infantry Items - New Developments" , Ordnance, Volume 43, No. 232, 1959.

" Spanish Infantry Weapons" , Ordnance, Volume 45, No. 244, 1961.

" The Union Mortar Boats" , Ordnance, Volume 46, No. 251, 1962.

" The ROAD Battalion in Vietnam" , ARMY, Vol 16, No. 9, September 1966.

Dziuban, Colonel S. W. , "Choose Your Weapon" , Military Review, Vol XLVI, No. 10, October 1966.

Arengo-Jones, Brig. A.J.A. , British Army, "An Exchange of Ideas" , Infantry, Vol 56, No. 5, p 10, Sept-Oct 1966.

DISTRIBUTION FOR CORG-M-281

HQ, USACDC

SECRETARY GENERAL STAFF (3)
DCS/PROGRAM (2)
DIRECTORATE OF PLANS (Hist. Div) (30)
DIRECTORATE OF DOCTRINE (2)
DIRECTORATE OF MATERIEL (8)
DIRECTORATE OF ORGANIZATION (2)
DIRECTORATE OF EVALUATION (2)
DIRECTORATE OF PERSONNEL (2)
Library (1)
COMPTROLLER (2)
INSPECTOR GENERAL (1)
CHAPLAIN (1)
INFORMATION OFFICE (1)
JUDGE ADVOCATE (1)

USACDC SUBORDINATE COMMANDS & AGENCIES

INSTITUTE OF ADVANCED STUDIES (2)
COMBAT ARMS GROUP (2)
Infantry Agency (2)
Armor Agency (2)
Artillery Agency (2)
Aviation Agency (2)
Special Warfare Agency (2)
COMBAT SUPPORT GROUP (2)
Engineer Agency (4)
Intelligence Agency (2)
Air Defense Agency (2)
CBR Agency (2)
Comm-Elec Agency (4)
COMBAT SERVICE SUPPORT GROUP (2)
Military Police Agency (2)
Medical Service Agency (2)
Maintenance Agency (2)
Supply Agency (2)
Transportation Agency (2)
Judge Advocate Agency (2)
EXPERIMENTATION COMMAND (10)
AUTOMATIC DATA FIELD SYS COMD (2)
Auto Data Fld Sys Design Agcy (1)
INSTITUTE OF NUCLEAR STUDIES (2)
INSTITUTE OF COMBINED ARMS & SPT (2)
INSTITUTE OF SPECIAL STUDIES (2)

USACDC LIAISON OFFICERS

USA ELEC COMMAND (1)
USA EUROPE (1)
USA MISSILE COMMAND (1)