TACTICS AND TECHNIQUE
OF
FIELD ARTILLERY

A Tentative Text

THE GENERAL SERVICE SCHOOLS PRESS
FORT LEAVENWORTH, KANSAS

1927

Smith

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Preface

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This text is designed to afford a basis for conferences and problems at the General Service Schools, Fort Leavenworth, Kansas, on field artillery. The text is primarily an amplification and explanation of present training regulations, and is subject to change to conform to training regulations now in course of revision.

In the preparation of the text, an attempt has been made to present only so much of purely technical matters as the students should understand in order that they may appreciate the powers and limitations of field artillery, and thereby be prepared to approach the study of the rôle this arm plays in the employment of the combined arms in battle. Stress is placed on the desirability of unity of control of the artillery with the field forces, and on the fact that field artillery is an auxiliary arm whose sole mission is to furnish effective fire support to the other arms, particularly the infantry.

With respect to the methods discussed in this volume as to the use of toxic gases, it should be noted that the Washington Conference on the Limitation of Armament, 1922, adopted the treaty provisions prohibiting the use in war of "asphyxiating, poisonous, or other gases," as between the signatory powers, and other nations which might, from time to time, adhere thereto; however, the fact that not all nations are signatories to that treaty and the possibility of the use of chemical materials by an enemy, make it essential that the employment of chemical warfare materials, both offensively and defensively, be studied.

H. J. BREES,
Colonel, Cavalry (D.O.L.),
Assistant Commandant.

APPROVED:

EDW. L. KING,
Brigadier General, U. S. Army,
Commandant.

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Glossary of Field Artillery Terms

Accompanying batteries.—Batteries of field artillery used in the same manner as accompanying guns.

Accompanying fire.—The artillery fire which accompanies infantry in movement, such as rolling barrages and successive concentrations.

Accompanying guns.—Field artillery guns sometimes attached to the small infantry units for attack. They move forward with the infantry to which attached for the purpose of attacking emergency targets.

Aerial (air) observation.—Observation of fire from airplanes, balloons, or airships.

Agent.—An officer or enlisted man employed to act as the medium of an oral or written communication between a commander and the units under his command. An agent is a member of the lower unit, but, in operations, remains habitually with the higher commander. For example, the agent of Battery B is a member of that battery, but rides habitually with the battalion commander and is designated "B Battery agent."

Aiming point.—The point at which the gunner sights when laying his piece for direction.

Ammunition dump.—A location in the combat zone where ammunition is temporarily stored for immediate use of the artillery to which the dump pertains.

Angle of departure.—The angle from the horizontal to the tangent to the trajectory at the muzzle, diminished algebraically by the angle of site.

Angle of fall.—The angle from the horizontal to the tangent to the trajectory at the point of fall.

Angle of impact.—The angle at the point of impact between the plane of the ground (or other material object) and the tangent to the trajectory.

Angle of site (of a point).—Defined with sufficient accuracy for most purposes as the angle between the hori-

zontal plane through the muzzle and a line from the muzzle to the point. It is positive for points above, and negative for points below the horizontal plane. Frequently called site or angle of position.

Antitank guns.—Field artillery guns to which the specific mission of defense against tanks is assigned. They are preferably posted so as to cover with fire, using direct laying, ground over which tanks are likely to advance.

Artillery information service.—The personnel of army and corps artillery assigned to the duty of obtaining, collating, and distributing information of value to the artillery.

Artillery preparation.—A term applied to a systematic destruction of the enemy's defenses and *matériel* and destruction or neutralization of his personnel, preparatory to an attack.

Atmosphere (meteorological) message.—A statement by the meteorological service of atmospheric conditions for the meteorological datum plane, expressed in a form convenient for the artillery.

Attached artillery.—Artillery temporarily detached from its organic command and placed under orders of another commander. In the division, artillery attached to a subordinate infantry or cavalry unit is under the command of the subordinate infantry or cavalry commander, and, for the time being, is detached from the command of the division artillery commander and intermediate artillery commanders.

Axial observation.—Observation of fire from a point on or near the line of fire. The term is used when the observer displacement does not exceed 100 mils.

Barrage.—A barrier of fire usually delivered close to friendly troops to screen and protect them by inflicting losses on the enemy and by keeping down or preventing his fire. A barrage may be moving or fixed and may be used offensively or defensively.

Barrage chart.—A chart showing graphically the barrage plan. The chart of a rolling barrage is based on the rate of advance of the infantry and shows diagrammatically the lines short of which fire must not be delivered after the time shown on each line.

Barrage plan.—The assignment of barrage and counter-preparation missions to the batteries of a command when on the defensive, and the assignment of rolling barrage missions when on the offensive.

Bilateral observation.—Observation of fire by two observers, one on each side of the line of fire.

Box barrage.—A stationary barrage delivered on the flanks and rear of a limited area occupied by the enemy for the purpose of restricting his movements and preventing the arrival of reinforcements.

Bracket.—The difference between two ranges or elevations, one of which gives a center of impact which is over the target and the other a center of impact which is short of the target. The term is also used in a similar manner with reference to deflection, height of burst, etc.

Bracket adjustment.—The process of determining a bracket, the depth of which depends on circumstances and the character of target, for the purpose of searching it immediately with zone *fire for effect.*

Center of impact.—The mean position of several points of impact of projectiles fired with the same data.

Command post.—The station occupied by the commander of a unit for the purpose of exercising tactical command.

Concentration.—A simultaneous firing by one or more batteries upon a position or area within the enemy's lines for the purpose of destruction, neutralization, or demoralization.

Conduct of fire.—The employment of the technical means necessary to cause fire of the desired nature to be brought to bear upon the target. Fire is ordinarily conducted by battery.

Contingent zones.—Areas within the objective zone, but outside the normal zone, within which an artillery unit may be called upon to fire under certain contingencies.

Continuous fire.—Continuous fire is, in effect, the firing of repeated salvos without further command until stopped by the command to cease firing.

Counterbattery.—The term used to designate the mission of those batteries to which is assigned the duty of firing on hostile artillery in position.

Counterpreparation. — Prearranged fire, delivered while the enemy is forming for attack, with the object of breaking up his formations and preventing the attack from being launched.

Counterslope.—The first slope in rear of a point or position, which descends toward the enemy and is wholly or partially hidden from him by the covering ridge. When used in reference to a hostile position or a point within or near the enemy's lines, it is used in the sense in which the enemy himself would use it.

Couple.—To attach the connecting pole of a carriage directly to the pintle of a tractor.

Covering mass.—Any natural or artificial feature—hills, substantial buildings, etc.—which affords shelter from view and also a certain amount of protection from fire.

Covering ridge.—The ridge or hill which covers or masks a point or position from the enemy. Such point or position may be in rear of the covering ridge or may be on the reverse slope of the covering ridge itself. The slopes which form the covering ridge, descending toward the enemy and toward the rear, are called respectively the forward and reverse slopes.

Curved fire.—Fire delivered at elevations between 360 mils (about 20 degrees) and the elevation for the maximum range.

Danger space.—That part of the range within which a target of a given height would be hit by a projectile.

Day of fire.—An arbitrary unit of measure (in terms of rounds per piece) for ammunition supply, adopted in order to have a measure of equal relative value for the different types of artillery.

Dead space.—An area within the field of fire of a piece which cannot be reached by fire from the piece in the given position.

Defilade.—The defilade of an object from a point is its distance below the plane through the point from which defilade is desired and tangent to the covering mass or mask.

Defiladed.—A battery is said to be defiladed from a given point when an observer at that point cannot see the battery.

Deflection.—The setting on the deflection scale of the sight such that when the line of sighting is on the aiming point the piece is laid for direction.

Detail.—The battery (battalion, regimental) detail consists of the enlisted personnel which assists the battery (battalion, regimental) commander in reconnaissance, preparation of firing data, observation, signal communication, liaison, security, etc.

Direct laying.—Pointing a piece for direction and elevation by directing the line of sighting upon the point indicated as the target.

Dismounted defilade.—A position of dismounted defilade is one which just affords concealment to a dismounted man. It is usually taken as six feet.

Dispersion.—The more or less irregular distribution of the points of impact of projectiles, fired with the same data, about a certain point called the center of impact.

Displacement.—The movement of an artillery unit from one firing position to another.

Distribution in depth.—The posting of artillery units at different distances from the front line so as to insure continuous support of the infantry during advance or withdrawal.

Drift.—The drift (in firing tables) is:

a. The angle between the vertical plane containing the axis of the bore prolonged and the vertical plane containing the point of fall and the muzzle of the piece, under standard conditions.

b. The horizontal distance of the point of fall from the vertical plane containing the axis of the bore prolonged, under standard conditions, due to the same causes as in *a.*

Drop.—The vertical distance at any point on the trajectory from the tangent to the trajectory at the muzzle to that point.

Elevation.—The angle between the horizontal and the axis of the bore prolonged when the piece is laid, diminished algebraically by the angle of site.

Emergency barrage.—A standing barrage for which data have been prepared by a battery for the purpose of reinforcing the normal barrage of some other battery or of covering a part of the front not otherwise covered. These barrages are delivered when called for in the manner prescribed in the barrage plan. They are designated as "Emergency barrage No. 1," "Emergency barrage No. 2," etc.

Executive (battery).—The firing battery in position is under the immediate command of one of the lieutenants of the battery who is called the executive.

Fire control map.—A large scale map showing the terrain in great detail. On it may be shown the enemy's works and occasionally the friendly works. Scale: 1:20,000 (approximately 3 inches equals 1 mile) ; V.I. equals 20 feet.

Fire direction.—The tactical command of one or more fire units, with a view to bringing their fire to bear from a suitable position upon the proper targets at the appropriate time.

Fire discipline.—That condition resulting from training and practice which insures an orderly and efficient working of the personnel in the delivery of fire.

Fire for adjustment.—Fire delivered primarily for the purpose of correcting, by observation, inaccuracies in the firing data.

Fire for destruction.—Accurately adjusted fire delivered with the object of destroying the enemy's works or *matériel.*

Fire for effect.—Fire delivered primarily for the purpose of obtaining effect on the target.

Fire unit.—A unit of which the fire is conducted by a single man. In the field artillery the fire unit normally is the battery.

Firing battery.—That part of a battery so designated in the *Tables of Organization* for the various types. It usually consists of four piece sections and one ammunition section. In a more restricted sense the term is used to designate that part of the battery at the gun position when the battery is in position.

Firing chart.—A fire control map or a grid sheet on which are shown elements used in the computation and preparation of the firing data.

Firing tables.—Collections of data, chiefly in tabular form, intended to furnish the ballistic information necessary for conducting the fire of a specified model of artillery weapon with a specified ammunition; also called range tables.

Flank observation.—Observation of fire from a point on or nearly on the flank of the target. The term is used when the observer displacement is greater than 1,300 mils.

Flash defilade.—A position of flash defilade is one that affords concealment for the flashes of the piece.

Flat fire.—Fire delivered at elevations not greater than 360 mils (about 20 degrees).

Forward slope.—The slope descending toward the enemy which forms the enemy's side of the covering ridge. The term is usually used with reference to some specific point or position but is sometimes used in a more general sense to designate any slope descending toward the enemy. In this sense, the counterslope is a forward slope.

When used in reference to a hostile position or a point within or near the enemy's lines, it is used in the sense in which the enemy himself would use it.

Front.—The front of a piece unlimbered is the direction in which the muzzle points; of a limber or of a carriage limbered, the direction in which the pole points.

Graze burst.—A burst on impact at the ground.

Group.—A tactical unit formed of two or more batteries assembled under a single tactical commander for convenience in carrying out assigned missions. It is normally a battalion, but may be a temporary assemblage of batteries of different battalions. The term is used more generally in reference to the latter, though it may be applied to regularly organized battalions when convenient. Groups, other than normal battalions, are usually designated by the name of the commander, as for example, the "Smith Group."

Groupment.—An improvised tactical unit temporarily formed from two or more battalions (or groups) or larger

tactical units for convenience in carrying out assigned missions. A groupment is usually designated by the name of a prominent feature of the terrain or by its relative position, as, for example, the "Signal Mt. Groupment," the "Taneytown Groupment," the "Left Groupment," the "South Groupment."

Harassing fire.—Fire delivered for the purpose of annoying the enemy, causing casualties, and destroying his morale. It is usually delivered on camps, billets, shelters, front lines, assembly places, roads, and working parties.

Heavy field artillery.—The term used to designate the heavier guns and howitzers of the field artillery. They are the 155-mm. gun, the 6-inch gun, the 8-inch howitzer, the 240-mm. howitzer, and larger calibers.

Height of burst.—The vertical angle between the base of the objective and the point of burst as seen from the piece.

High angle fire.—Fire delivered at an elevation greater than the elevation for the maximum range.

Indirect laying.—Pointing a piece for direction by directing the line of sighting upon the point indicated as the aiming point and for elevation by the use of a quadrant or elevation level.

In position.—An artillery unit is said to be in position when the pieces are in position and ready to fire and the necessary systems of observation and signal communication have been established.

In readiness.—An artillery unit is said to be posted in readiness when the pieces, limbered or coupled, are held under cover near a position for possible immediate action, but ready to move quickly to another locality if the development of the tactical situation should require it.

Interdiction fire.—Fire delivered for the purpose of preventing the use of certain roads or areas by the enemy.

Lateral observation.—Observation of fire from a point considerably displaced from the line of fire. The term is used when the observer displacement is between 100 and 1300 mils.

Laying.—The process of pointing a piece for a given range, for a given direction, or for both.

Liaison.—The linking together of the different arms, or different units of the same arm, so as to secure proper coordination and cooperation in battle. This is accomplished by the interchange of liaison officers and detachments of enlisted men between the different units.

Light field artillery.—The lighter guns and howitzers of the field artillery. They are the 2.95-inch or 75-mm. pack howitzer, the 75-mm. gun, and the 105-mm. howitzer.

Limber.—To limber means to attach the lunette of an artillery carriage to the pintle of another artillery carriage. See paragraph 4 *b* (2) (b) of text.

Limits of fire.—Lines marking the limits of areas on which fire can be delivered.

Map range.—The range from the piece to any point as scaled or calculated from a map.

Mask.—Any actual or artificial feature, such as hills, trees, and buildings, which affords shelter from view.

Maximum ordinate.—The difference in altitude between the piece and the summit of the trajectory.

Medium field artillery.—The medium guns and howitzers of the field artillery. They are the 4.7-inch gun and the 155-mm. howitzer.

Meteorological datum plane.—The level assumed as a basis for the data concerning atmospheric conditions furnished by the meteorological service to the artillery.

Meteorological message.—See *Atmosphere message.*

Mil.—One sixty-four hundredth of a circle. The arc which subtends a mil at the center of a circle is, for practical purposes, equal to one one-thousandth of the radius. The arc and its tangent are nearly equal for angles not greater than 330 mils.

Mounted defilade.—A position of mounted defilade is one which just affords concealment to a mounted man.

Muzzle velocity.—The velocity the projectile is assumed to have at the muzzle of the piece. Also called initial velocity.

Neutralization fire.—Fire delivered for the purpose of prohibiting hostile activity, either partially or completely, within the area covered.

Normal barrage.—The standing barrage on which a battery in position, when not otherwise engaged, is kept constantly laid. It is the barrage which is fired on signal from the rocket post without further orders, and is the barrage fired by the battery in case the enemy makes a general attack.

Normal zone.—The zone within the objective zone for which an artillery unit is normally responsible and within which its normal fire is directed.

Objective zone.—The area beyond the friendly lines included within the lateral limits of fire.

Observation of fire.—Viewing the bursts or impact of projectiles in order to determine their location with respect to the target.

Observation post.—A post selected for the observation and conduct of fire, for the observation of a sector, for the study of objectives, or for the purpose of securing information of the enemy and of his activities. Observation posts are classified as Firing O.P's, Command O.P.'s, and Intelligence O.P's.

Observer displacement.—The angle at the objective between the observer and the battery.

Observing sector.—The sector subtended by the objective as viewed by the observer.

Park.—*a.* The ground occupied by the pieces of a battery in garrison or in camp.

b. The formation taken by artillery carriages and vehicles when in garrison or in camp.

Party.—The battery (battalion, regimental) commander's party is that part of the battery (battalion, regimental) detail and staff which usually accompanies its commander on reconnaissance.

Point of burst.—For a projectile which is designed to burst in the air, the point at which the burst takes place or would take place were it not previously obstructed by the ground or other material object.

Point of fall.—The point on the descending branch of the trajectory at the same altitude as the muzzle of the piece.

Point of impact.—The point at which the projectile first strikes the ground or other material object.

Position.—The area occupied by all the combat elements of an artillery unit, organized for combat. In a narrower sense, it is frequently used in referring to the position of the pieces. (See *In position.*)

Prearranged fire.—Fire for which the need has been foreseen and for which the data have been prepared in advance. It includes such fires as counterpreparation, concentrations, rolling barrages, interdiction, etc.

The data are corrected by adjustment and the fire itself observed whenever possible. When necessity demands, however, such fires may be delivered without either adjustment or observation.

Precision adjustment.—An adjustment executed for the purpose of determining a single elevation which will place the center of impact at or near the objective.

Preparation of fire.—The technical determination of the data necessary for opening fire on a given target.

Probable error.—The error which, in the long run, would be as often exceeded as not. In the artillery it is generally used in reference to errors in range, deflection, or height of burst. The probable errors in range and deflection are used as measures of accuracy of a piece.

Railway artillery.—Artillery which is mounted on, transported by, and fired from, special railway car bodies.

Range.—Defined with sufficient accuracy for most field artillery purposes as the horizontal distance from the piece to the target or point of impact.

Range or elevation setting.—The range or elevation setting, with *matériel* having laying instruments graduated in yards, meters, or mils, is the number at which the laying instruments are set.

Readiness.—See *In readiness.*

Registration of fire.—The adjustment of fire on a number of selected points throughout the objective zone in order that these points may later serve as auxiliary targets.

Reference point.—A prominent point on the terrain by reference to which objectives may be identified.

Retaliation fire.—Fire delivered in retaliation for hostile harassing fire.

Reverse slope.—The slope which descends away from the enemy and forms the masked or sheltered side of the covering ridge. The term is usually used with reference to some specific point or position, but is sometimes employed in a more general sense to designate any slope descending away from the enemy. When used in reference to a hostile position or a point within or near the enemy's lines, it is used in the sense in which the enemy himself would use it.

Ricochet.—A glancing rebound of a projectile after impact.

Rocket board.—A board with graduated arc and pointing arm, set up near each battery for the purpose of identifying signals from rocket posts.

Rocket posts.—Posts established for the purpose of sending rocket signals.

Rolling barrage.—A barrage that precedes the infantry in its advance during an attack.

Roving guns.—Guns withdrawn from the regular positions of their batteries and given the mission of firing from several different positions. They are employed either for the purpose of misleading the enemy as to the artillery strength and positions, or merely for the purpose of delivering certain harassing fire without betraying the battery positions.

Salvo fire.—In fire by salvo, the pieces are fired at the command of their chiefs of section, in order from the right (left) at intervals of two seconds. Fire by salvo may be executed at intervals of other than two seconds by special command.

Sense.—Rounds may be sensed for range, direction, and height of burst. To sense a round for range is to decide positively from observation whether the burst is short or over. To sense a round for direction is to determine the amount of its deflection error; for height of burst, to determine the amount by which the point of burst is above or below the plane of site.

Site.—See *Angle of site.*

Standing barrage.—A stationary barrage delivered for defensive purposes in front of an occupied line or position.

Successive concentrations.—Accompanying fire in the form of concentrations, usually zone fire, changing from one target to another ahead of the advancing infantry.

Supporting artillery.—The artillery to which has been given as a primary mission the duty of supporting a specific infantry or cavalry unit.

Terminal velocity.—The velocity of the projectile at the point of fall. The velocity at the point of impact may be called the striking velocity.

Terrestrial (ground) observation.—Observation of fire from the ground or from any natural object or artificial structure based on the ground.

Time fire.—In time fire, the projectile bursts, or is intended to burst, in air.

Time of flight.—The time in seconds required for the projectile to travel from the muzzle of the piece to the point of impact or of burst. The firing tables give the time of flight corresponding to the point of fall.

Trajectory.—The curve described by the center of gravity of a projectile in flight.

Transient target.—A target that affords a very limited time for adjustment and fire for effect.

Trench artillery.—Artillery of 6-inch or greater caliber which is capable of being emplaced in forward trench systems and of delivering large charges of high explosives at short ranges and with large angles of fall.

Volley fire.—In volley fire, each piece included in the command fires the specified number of rounds without regard to the other pieces and as rapidly as is consistent with accuracy.

Volley-fire sweeping.—The execution of volley-fire sweeping is the same as that of volley fire, except that after the first and each succeeding round of the sweep, the gunner traverses the piece to the left by the number of turns of the hand-wheel or by the number of mils specified in the command.

Zone fire.—Fire delivered at successive ranges, and sometimes with varying deflections, in order surely to cover the area in which the target lies.

CHAPTER I

Weapons and Transport

SECTION I

Classification

1. GENERAL CLASSIFICATION OF FIELD ARTILLERY.*—*a.* Field artillery, the artillery used with the armies in the field, is classified according to the weight or caliber of its *matériel* as light field, medium field, and heavy field artillery. See Appendix A, for table of characteristics of field artillery.

b. Field artillery may be classified according to the means of transport employed as horse-drawn, horse, tractor-drawn, *portée,* and pack artillery. Railway artillery is a special type of coast artillery which may be employed with armies in the field.

2. CLASSES OF CANNON.—*a.* Artillery cannon are also classified as guns, howitzers, and mortars. The general term *piece* is applied to a weapon of any of these classes.

b. A gun is a piece of comparatively flat trajectory and high muzzle velocity.

*In the United States Army, the Coast Artillery Corps furnishes all antiaircraft, trench, and railway artillery for use in connection with the armies in the field. Furthermore, certain types of cannon designed primarily for service with field forces have, for reasons of economy, been authorized for use by the coast artillery for fire on naval targets both in harbor defense and general coast defense.

c. A howitzer in general has a shorter tube than a gun of the same caliber, a more curved trajectory, and lower muzzle velocity. It is able, therefore, to reach targets defiladed behind cover which cannot be reached by a gun, and, correspondingly, to occupy positions with deep defilade, impracticable for a weapon of flatter trajectory. Due to its shorter tube and the fact that its lower muzzle velocity permits a lighter construction of the tube, a howitzer can be made considerably more mobile than a gun of equal caliber. Formerly, a weapon which had a maximum elevation of less than 15 degrees was called a *gun*; one with a maximum elevation greater than 15 degrees, a *howitzer* or *mortar*. Due to the development of long range guns requiring a high angle of elevation for extreme ranges, there is no longer a definite line of demarcation between guns and howitzers based on elevation alone.

d. A mortar is a piece with a still shorter tube, lower muzzle velocity, and more curved trajectory than a howitzer of the same caliber. It is designed for high angle fire at angles of elevation greater than 45 degrees, thus permitting fire with very steep angles of fall, the range decreasing as the angle of elevation increases.

Section II

Light Field Artillery

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3. General.—The light field artillery (usually referred to as light artillery) of the United States Army consists of the 75-mm. gun, the 105-mm. howitzer, the 2.95-inch pack howitzer, and the 3-inch field gun.

4. 75-MM. GUNS.—*a. Types.*—There are three types of 75-mm. guns available for use in our service. These are the French, model 1897; the British; and the American, model 1916. There is in process of development a new American 75-mm. gun which is expected eventually to supersede the other three types. At present, however, this is merely a development program and the gun is not expected to be manufactured in quantity except in the event of war.

b. 75-mm. gun, model 1897, French.—(1) The 75-mm. gun, model 1897, is the service type of the French army, introduced in 1898. It was the forerunner of all modern light field artillery and has held its own for more than twenty-five years in spite of the progress in gun design and gun making. It is simple, rugged, and efficient. It was adopted by the United States in 1917, due to the great facilities for its manufacture available in France and in the United States, and to certain difficulties which had arisen in the manufacture of the American 75-mm. gun, model 1916. Some of these guns were purchased from the French, while others are of American manufacture, built from French plans. It is now our service type, although other types are still in use, and, pending the adoption of a new gun of American design, is the type we are prepared to manufacture in the event of war.

(2) (a) Compared to other types of approximately the same caliber in use by all nations, it is light in weight. The weight of gun and limber completely equipped with ammunition and tools is 4586 pounds. The sight is simple and rugged but without the telescopic and panoramic features of the American sight. Eventually this gun will be equipped with the American panoramic sight. The recoil system is of the type known as hydropneumatic. The recoil is checked by an hydraulic brake (oil), and the counter-recoil is effected by compressed air. The details of the system in use in this gun were jealously guarded as a secret by the French Government before and during the war, and when its manufacture was commenced by the United States Ordnance Department, an agreement was made to continue the secrecy. Due to this and to the very fine adjustments

required between parts, no repairs or adjustments of the interior of the recoil mechanism are permitted to be made in the field. The complete recoil mechanism must be sent to special repair depots. The gun carriage traverses on the axle by means of a geared nut. This system limits the traverse to about 3 degrees on each side of the center. A shield is provided for the protection of the cannoneers. The ammunition is fixed. The projectiles consist of a shrapnel of about 16 pounds, a high explosive shell (Mark I) of about 12 pounds, gas shell and smoke shell. A shell (Mark IV)

PLATE I—75-mm. Gun (French, Model 1897) in Action

(The trail handspike shown in this picture was attached at the Field Artillery School, for test.)

of about 13.5 pounds, of longer range, will supersede the 12-pound shell as soon as the supply of the latter is exhausted. The extreme range of the present shell is 8,800 yards. The extreme range with the new shell (Mark IV) is about 12,700 yards. The muzzle velocity with the Mark I shell is 1805 feet per second, and with the Mark IV shell, 1955 feet per second. A reduced charge is also provided, giving a muzzle velocity of 1130 feet per second and an extreme range with the Mark I shell of 7000 yards. This

charge gives angles of fall approximately twice as great as those obtained with the normal charge, thus permitting fire on steep reverse slopes and other ground which cannot be reached with the normal charge. Production plans at present do not provide for the manufacture of a reduced charge.

(b) The limber is the two-wheeled vehicle which supports the trail of the gun carriage or caisson body in transport, making therewith in each case, a four-wheeled vehicle. Mounted on the axle of the limber is a steel chest which carries 36 rounds of ammunition. The caisson body has a large steel chest carrying 70 rounds of ammunition, and a hinged shield which can be dropped to the ground to give protection to the cannoneers. Like the gun carriage, the caisson body is connected to its limber by a pintle and lunette. The limber and caisson body used with this *matériel* are of American design, entirely replacing those of French design. The caisson body with limber is referred to as the caisson, which weighs 4960 pounds when filled with ammunition.

c. 75-mm. gun, British.—(1) The 75-mm. gun (British) was originally the 18-pounder gun of the British service, caliber 3.3-inch. At the time of our entry into the World War this piece was in production in the United States for the British Government. On this account it was adopted by our service to supplement the French gun, with the caliber changed, however, to 75-mm. It proved to be a very satisfactory weapon.

(2) It is somewhat heavier than the French gun. The recoil system is hydrospring, that is, the recoil is checked by an oil brake as in the French model, but the counterrecoil is effected by steel springs instead of compressed air. Contrary to the general practice, the gun tube is mounted below the cradle instead of above it. The gun is traversed on a pivot and has a maximum traverse of about 4 degrees on each side of the center. The American panoramic sight is used. The ammunition is identical with that of the French 75-mm. gun, and ranges are approximately the same. Other characteristics of the gun are very similar

to the French gun. There are about eight hundred complete guns of the British type on hand. While these might be used in the event of war, they are no longer standard equipment for our service.

d. 75-mm. gun, model 1916.—(1) The 75-mm. gun, model 1916, is of American design and manufacture. It was just being put into production on our entry into the World War, to replace the 3-inch field gun, model 1902. As stated above, the question of production led to the abandonment of this piece in favor of the French and British models.

(2) A new feature was introduced in the design of the American gun—that of the split trail. The trail consists of two parts which are closed and locked together in the traveling position. When the gun is in the firing position, the two parts on the trail are spread apart, forming, with the two wheels, four points of support instead of the three points available with the single (box) trail. This has several advantages. It adds to the stability of the piece, it permits a very wide traverse without getting the thrust of the recoil too far out of line with its supporting point, and it permits a high angle of elevation, since the gun recoils between the two parts of the trail. On the other hand, the split trail increases the weight of the carriage and requires more time and labor to place in firing position than does the box trail. Also, when it becomes necessary to change the direction of the piece beyond the limits of traverse on the carriage, it adds greatly to the time required to perform the operation. There is more lost motion in the elevating and traversing mechanisms, necessitating better trained gun squads for equal accuracy of fire in comparison with the French gun carriage. The gun is traversed on a pintle and has a maximum traverse of about $22\frac{1}{2}$ degrees on each side of the center. It has a maximum elevation of about 53 degrees, compared to about 19 degrees obtainable with the French gun. The recoil system is hydrospring. The same projectiles are used as with the French gun and maximum ranges are approximately the same. With box trail types, such as the French and British, it is necessary to sink the trail in the ground to

obtain the elevation necessary for the maximum range. Other characteristics are similar to those of the other two models discussed. There are about 300 complete guns and carriages of this type on hand, and while some are still in service, it is no longer standard equipment.

e. Transport.—The transport of these three models of the 75-mm. gun is identical. Units of these guns assigned to divisions are horse-drawn, while units assigned to the general headquarters reserve artillery are either tractor-drawn or carried in trucks (*portée*).

f. Development.—Several experimental models of a new 75-mm. gun and carriage have been produced, and are undergoing development. The gun desired is to have a maximum range of about 15,000 yards and permissible elevation on the carriage of about 45 degrees. The traverse and the weight of the carriage will depend somewhat upon whether the box or the split-trail type of carriage is adopted.

5. 105-MM. HOWITZER.—*a.* The 105-mm. howitzer is contemplated as a companion piece to the 75-mm. gun in the division artillery. There is no weapon of this type now in service in the United States Army, though one is in process of development.

b. The 105-mm. howitzer under development is a horse-drawn weapon with a maximum range of about 12,000 yards, firing a 33-lb. projectile. The weight in firing position will probably be about 3300 pounds.

6. 2.95-INCH PACK HOWITZER.—*a.* The 2.95-inch pack howitzer is a light weapon designed for pack transport for use in mountainous or close country where it is impracticable or difficult to operate horse-drawn artillery. The original howitzers in use in our service were purchased from the Vickers Company of England in 1902. The howitzer has subsequently been built by our Ordnance Department from the same design, and has been used extensively in the Philippine Islands as well as in the United States and Mexico.

b. The howitzer is extremely rugged and simple. It can stand an almost indefinite amount of the knocking about to which such a weapon is subjected, and there is little that

can get out of order. It can be unpacked, assembled, and placed in firing position in about one minute, and can be dismounted and packed in the same time. It is not, however, a modern type of artillery. The tube is 36 inches long, and the wheels are 36 inches in diameter. The recoil mechanism is hydrospring, of the type known as short recoil. The length of recoil (14 inches) is sufficient to diminish the movement of the carriage when firing but not sufficient to render it stable, so that the piece must be relaid for each shot. No shield is provided. There is no method of traverse on the carriage, so that the only way of

PLATE II—2.95-inch Pack Howitzer in Action

pointing is by moving the trail. It has been adapted to use the standard panoramic sight. Fixed ammunition is used, carrying a $12\frac{1}{2}$-lb. shrapnel, or the same weight shell. Its maximum range is about 4800 yards. The ammunition is carried in special containers packed on mules, 10 rounds to a mule. Due to the necessity of relaying for each shot, the rate of fire is comparatively slow.

c. The total weight of howitzer and carriage is 830 pounds. For transport it is divided into four loads; howitzer, cradle, trail, and wheels and axle, each packed on the back of a mule. The heaviest load is 235 pounds. A more modern 75-mm. pack howitzer to replace this piece is under development.

7. 3-INCH FIELD GUN, MODEL 1902.—The 3-inch field gun was our standard equipment before the World War. It is a modern and efficient weapon and compares favorably in most of its characteristics with the French 75-mm. gun. It is now in use for limited training at schools and colleges; otherwise, it is out of service. With its aiming devices, float and trail handspike, this weapon is much more efficient against targets of opportunity than the French 75-mm. gun, as at present equipped. A considerable amount of ammunition is on hand but no more is being manufactured.

8. TRANSPORT.—*a. Types.*—As mentioned in the preceding paragraphs, light artillery transport is of five classes: horse-drawn, horse, tractor-drawn, *portée,* and pack. The method of transport depends upon the type of weapon and the tactical purpose for which the unit is to be used.

b. Horse-drawn.—The 75-mm. guns assigned to divisions and the 105-mm. howitzers are drawn by teams of six horses, attached to a limber. The team is arranged in pairs, each pair being driven by a man mounted on the near horse. The weight behind the team is such that the carriage can be drawn at a walk or trot over roads or across country. Training regulations prohibit the use of the gallop for horses in draft. The rear of the limber is equipped with a large, upright stud called a pintle. The end of the trail of the gun or howitzer carriage and of the caisson body carries a heavy rigid ring called a lunette which slips over the pintle when the carriage is limbered and is prevented from jumping off by a latch on the pintle. This type of coupling allows considerable play in all directions between the limber and rear carriage, and permits the negotiation of rough ground impossible for an ordinary four-wheeled vehicle. The vehicle can be driven over practically any ground over which a mounted man can pass, provided the available track is not too narrow for the width of a carriage. The cannoneers ride on the caisson body and limber chests. They dismount and walk when it is necessary to lighten the load behind the team.

c. Horse.—The artillery assigned to a cavalry division is known as horse artillery. The *matériel* and transport is

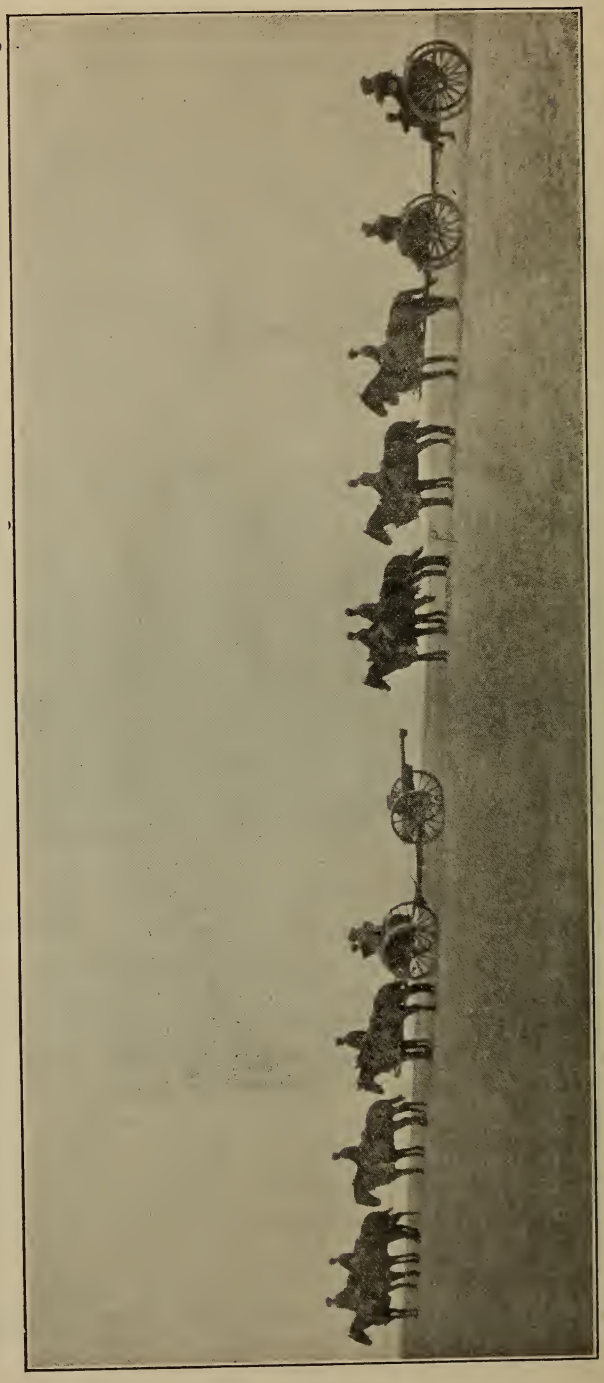

PLATE III—75-mm. Gun Section, Horse-drawn

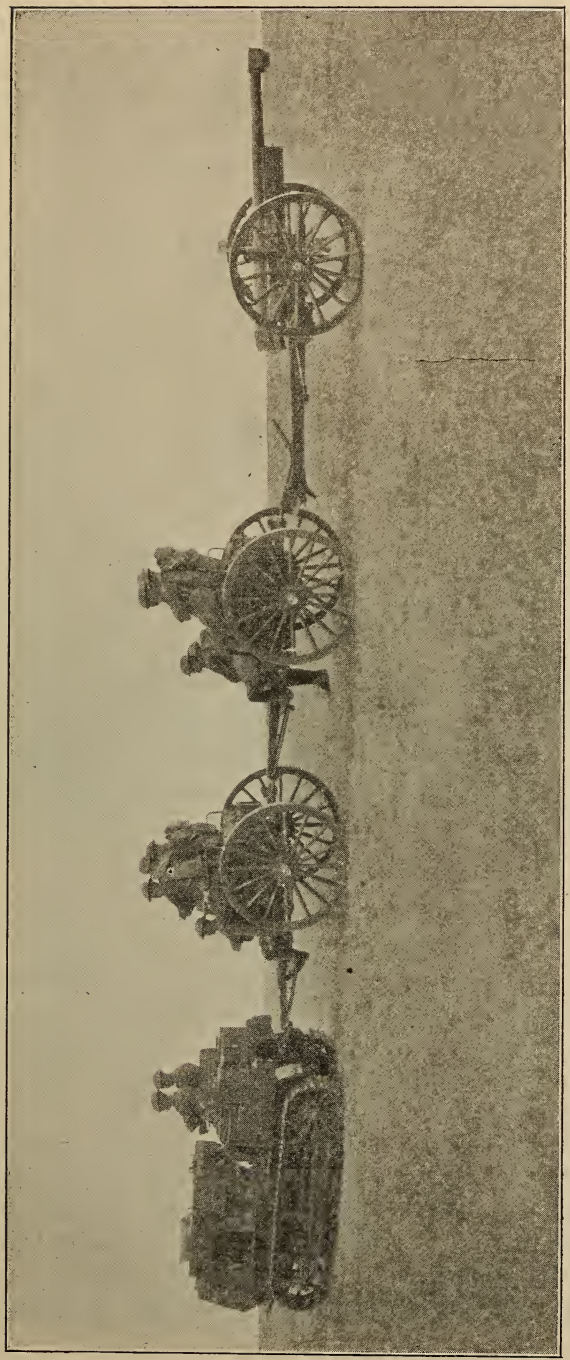

PLATE IV—75-mm. Gun Section, Tractor-drawn

the same as that of the artillery of an infantry division except that an individual mount is provided for each cannoneer. By thus lightening the load behind the team the mobility of the artillery is increased, and it is enabled to keep up with the cavalry when on the march.

d. Tractor-drawn.—Some of the 75-mm. guns in the general headquarters reserve artillery are tractor-drawn. A 5-ton tractor takes the place of the six-horse team. One tractor draws two caisson bodies and the gun coupled in tandem, or three caisson bodies coupled in tandem. (See foot-note page 41.) The limber is not used with tractor-drawn *matériel.* The mobility and rate of march of tractor-drawn 75-mm. guns are about the same as that of horse-drawn units, but their possibilities for sustained marches of great length are somewhat greater.

e. Portée.—Other 75-mm. guns in the general headquarters reserve artillery are carried in trucks and are known as *portée* artillery. The gun is loaded on the standard type of truck. Caissons and limbers are not used. Ammunition is carried in the trucks with the guns, 60 rounds with each gun. Each battery includes one light tractor carried on a truck for the purpose of moving the guns after they are unloaded from the trucks. These units have great strategic mobility where good roads exist, since they travel at ordinary truck speeds and can be moved rapidly for considerable distances. Their tactical mobility is small, as there is no means of transportation for the guns after they are unloaded from the trucks except the one tractor per battery, or teams or tractors borrowed from other nearby organizations. They are used for the rapid reinforcement of a front, generally for an attack, to fire from the positions in which they are initially installed, and are then usually withdrawn.

f. Pack.—Pack transportation is used only for the 2.95-inch pack howitzer. It is separated into four loads, each of which is carried by one mule. A special pack saddle or aparejo is used. Ammunition is carried similarly at the rate of 10 rounds per mule. Packs of pioneer tools, kits, and miscellaneous stores are also carried. The ammunition

and equipment mules are led by their drivers. The drivers and cannoneers walk. Officers and noncommissioned officers are mounted. These units are very mobile. The pack mule can go anywhere that a man can go without using his hands. While the greater part of the personnel marches on foot, the rate and length of march are considerably greater than those of infantry. The pack mule normally walks at a gait of 4 miles per hour or faster. The pace of the men is thus kept up to a faster rate than that of other foot troops, without undue fatigue.

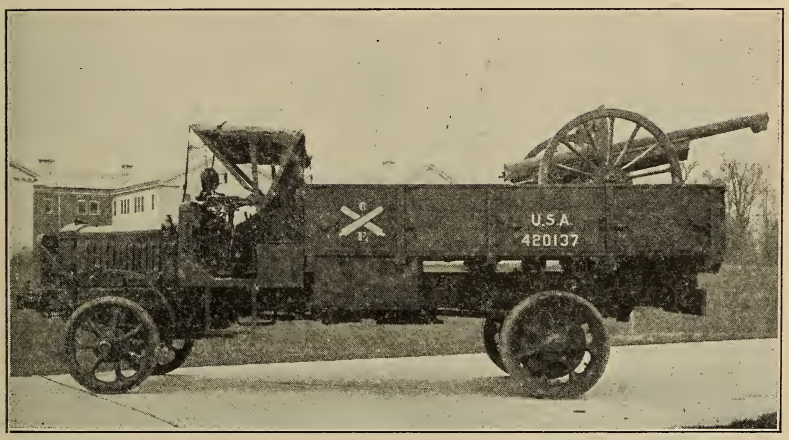

PLATE V—75-mm. Gun Section, *Portée*

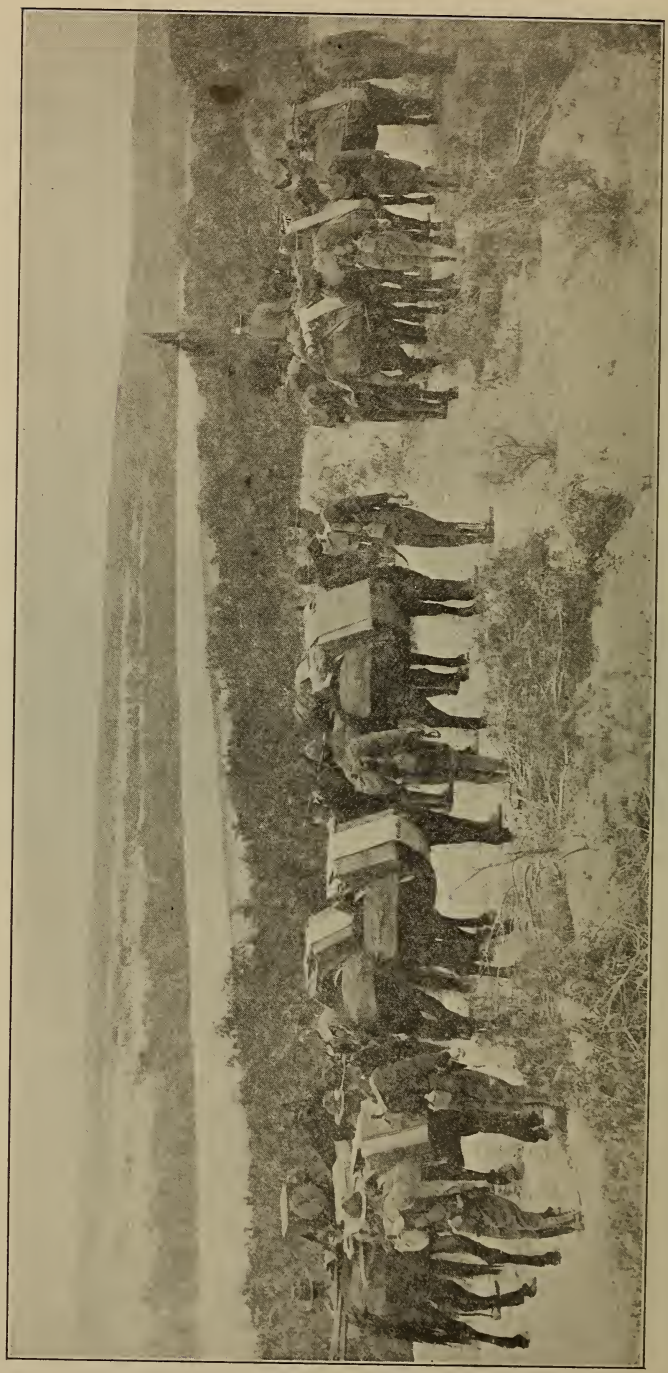

PLATE VI—2.95-inch Pack Howitzer Section

SECTION III

Medium Field Artillery

9. TYPES.—The medium field artillery (usually referred to as medium artillery) consists of the 155-mm. howitzer and the 4.7-inch gun.

10. 155-MM. HOWITZER, MODEL 1918 (SCHNEIDER).—*a.* The 155-mm. howitzer is of French design and dates back prior to 1900. It had been improved in many particulars, however, so that early in the World War it was an entirely modern and very efficient weapon. In 1917 the United States Government purchased the plans from the French firm of Schneider and Company, and commenced the manufacture of the howitzers to replace the 6-inch howitzer in service at the time. The howitzers manufactured in the United States are distinguished from those purchased in France by the designation "model 1918." It is now our service type, pending the development of a more modern and more powerful howitzer of American design.

b. The weight of the howitzer and limber, completely equipped, is 8926 pounds, and of the howitzer in firing position about 7600 pounds. A panoramic sight is used. The recoil system is hydropneumatic. The length of recoil is constant, as distinguished from variable recoil which automatically shortens the length of recoil as the elevation is increased. The piece is traversed on the axle, 3 degrees on each side of the center, and has a maximum elevation on the carriage of about 42 degrees. It is shielded, like all modern field artillery weapons. It has a box trail, cut away to enable the howitzer to recoil through it at high elevations. The ammunition consists of high explosive shell weighing 95 pounds, gas shell, and smoke shell. The propelling charge, contained in cloth bags, is loaded separately from the projectile. It is divided into seven sections, any

of which, except the base charge, are removable, thus giving seven different zones of fire. This enables greater angles of fall to be obtained at short ranges and reduces the wear on the piece. The maximum range obtainable is 12,400 yards. The muzzle velocity varies from 680 feet per second for zone I to 1479 feet per second for zone VII.

c. In the traveling position the howitzer is retracted on the carriage and locked in place so that a part of the weight is taken off the piece wheels and borne by the lim-

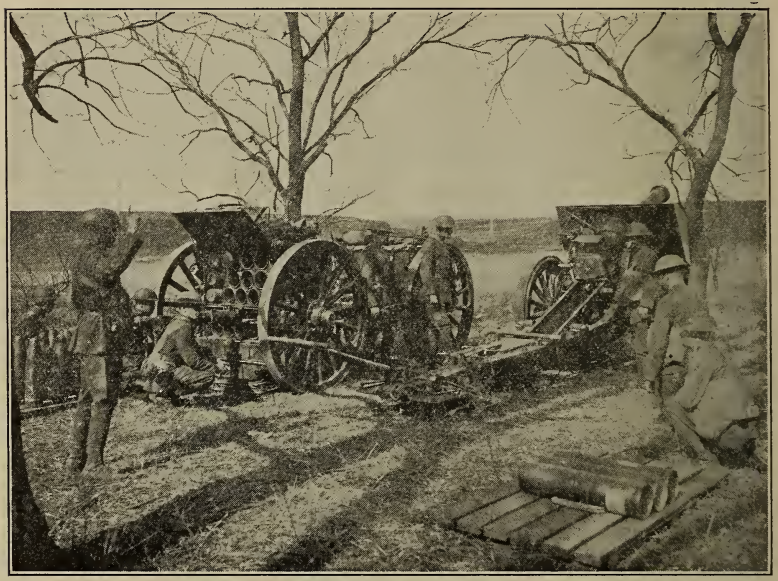

PLATE VII—155-mm. Howitzer in Action

ber. The limber, which is of French design, is used to support the trail of the howitzer when traveling. It consists of only a steel frame mounted on two wheels and an axle without an ammunition chest. A short coupling pole connects it with the tractor. The caisson is of American design. It is a two-wheeled vehicle provided with a short coupling pole. The steel body is an ammunition chest which carries 14 complete rounds of ammunition and two extra powder charges. A 5-ton tractor is used to draw either the howitzer limbered, or two caissons coupled in tandem.

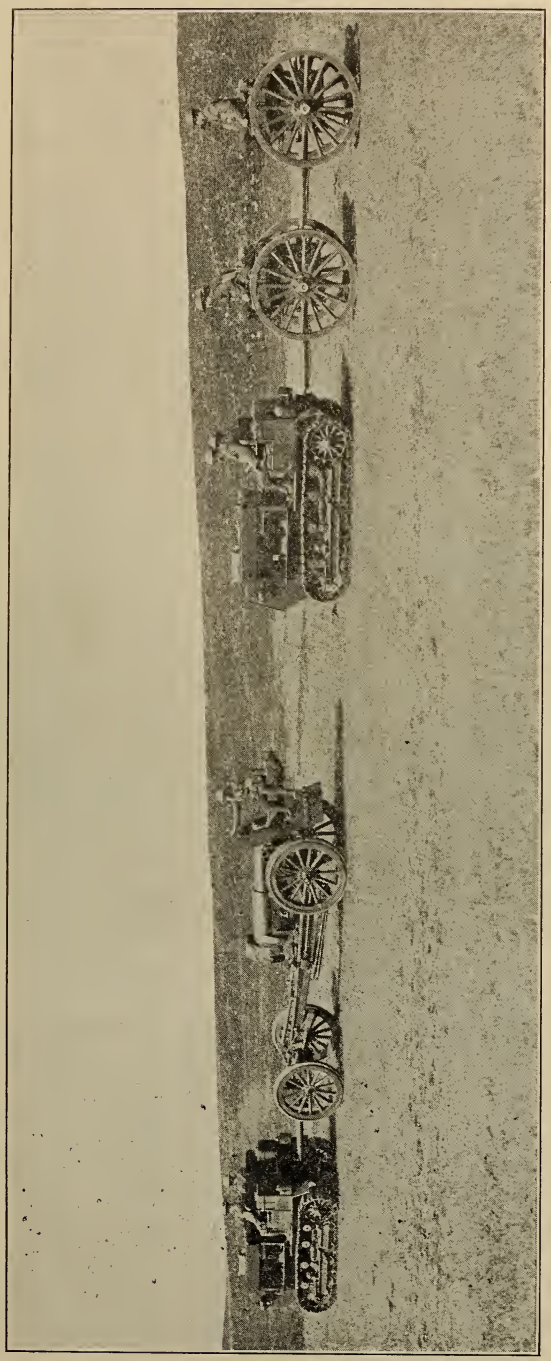

PLATE VIII—155-mm. Howitzer Section

d. The new 155-mm. howitzer (Model 1920 E), now under development will fire a 95-lb. projectile to a range of about 16,000 yards and will weigh about 13,000 pounds in the firing position.

11. 4.7-INCH GUN, MODEL 1906.—*a.* The 4.7-inch gun is of American design and was a standard part of our equipment before the World War. There were only 60 complete guns on hand in 1917, but manufacture was started immediately upon our entry into the World War, and some 380 were delivered by December, 1918. At present this gun is not included in our organization.

PLATE IX—4.7-inch Gun in Action

b. It is a box trail gun, with hydrospring recoil system. The traverse is about 4 degrees on each side of the center and the maximum range with an elevation of 43 degrees is 14,000 yards. The possible elevation on the carriage is only 15 degrees and as the trail is large and heavy it is difficult to sink it in the ground sufficiently to get a much greater elevation. The range with an elevation of 15 degrees is 8860 yards. The weight of gun, carriage, and limber is 10,015 pounds, and of the gun in firing position 8069 pounds. The ammunition is of the fixed type and

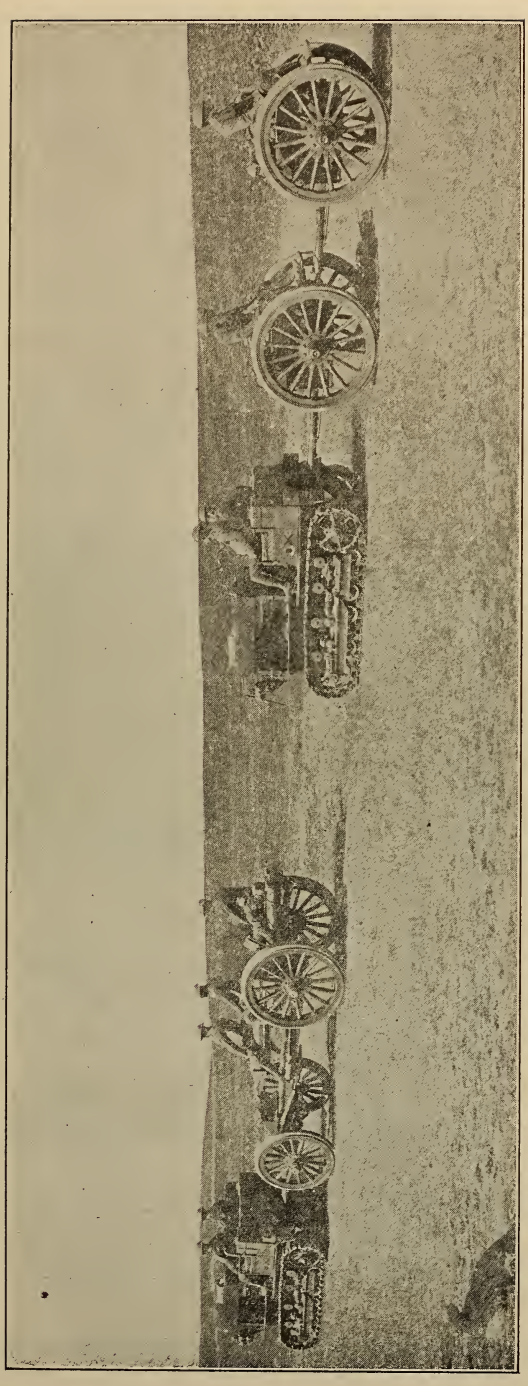

PLATE X—4.7-inch Gun Section

consists of a 60-lb. shrapnel and a 45-lb. high explosive shell. The muzzle velocity with the 60-lb. projectile is 1700 feet per second, and with the 45-lb. projectile, 2050 feet per second.

c. The gun limber has no ammunition chest. It is used for support of the trail of the gun carriage in traveling. The caisson is somewhat similar to that of the 155-mm. howitzer and carries 28 rounds of ammunition. The 5-ton tractor is used for transportation and draws the gun and limber or two caissons.

d. The 4.7-inch gun (Model 1921), now being developed, will have a maximum range of about 20,200 yards, firing a 50-lb. projectile. The weight in firing position will be about 11,000 pounds.

12. TRANSPORT.—*a.* All medium artillery now in the United States service is tractor-drawn. The tractor used for this purpose is the 5-ton. The term 5-ton refers to the weight of the tractor and not to its hauling capacity. Due to the great weights involved, medium artillery can be more efficiently handled by motor transport than by horse. It can, however, be handled by eight-horse teams.

b. In many ways the present tractor is not satisfactory and constant experimentation is under way to produce a more satisfactory vehicle. In addition to mechanical difficulties and difficulties of production, its principal defects from a tactical viewpoint are its excessive noise and the flame from the exhaust. These factors make it difficult to move tractor-drawn artillery at night with any degree of secrecy.

SECTION IV

Heavy Field Artillery

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13. TYPES.—The heavy field artillery (usually referred to as heavy artillery and formerly called siege ar-

tillery) at present available for use consists of the 155-mm. gun, the 6-inch gun, the 8-inch howitzer, and the 240-mm. howitzer. The 8-inch howitzer, however, is of considerably less power than is desired for a weapon of this type.

14. 155-MM. GUN, MODEL 1918.—*a.* The 155-mm. gun is a highly efficient modern gun of French design. Plans were purchased from the French in 1917 and the gun was manufactured in the United States. Some guns of French manufacture were purchased and delivered in France.

PLATE XI—155-mm. Gun in Action

b. (1) The gun carriage has a split trail which is spread out when in firing position, the ends of the trail being firmly anchored by spades in the ground. This permits an elevation on the carriage of 35 degrees. The traverse is very wide, 30 degrees on each side of center. The recoil system is hydropneumatic. The length of recoil is variable, being automatically shortened for high elevations. The sight is panoramic, of similar type to that used with the 155-mm. howitzer. The ammunition is separate loading and consists of high explosive shell weighing 95 pounds, and gas shell, and a powder charge consisting of

two parts, base charge and increment. For all except long range fire, the increment is removed and the base charge alone used. Smoke shell is not used with this gun. The extreme range is 18,000 yards, with a muzzle velocity of 2410 feet per second.

(2) For transport the gun is retracted on its carriage, the two parts of the trail closed and locked, and the trail supported on a limber. The weight of gun and limber in traveling position is 29,400 pounds. No caisson is provided, the ammunition being carried in trucks.

(3) The gun is drawn by a 10-ton tractor. Considering its weight and power this piece is comparatively mobile.

c. A new design of 155-mm. gun (Model 1920 E) is under development which will have a range of about 25,850 yards, will fire a 95-lb. projectile, and will weigh about 24,000 pounds in firing position.

15. 6-INCH GUN.—The 6-inch gun is of British design and manufacture. Its ballistic qualities, weight, and mobility are similar to those of the 155-mm. gun. It is mounted on the 8-inch howitzer carriage. While this gun is shown in our organization as in the general headquarters reserve artillery, there are only a few of the guns and no ammunition on hand, and it is not probable that it will ever be used in action.

16. 8-INCH HOWITZER.—*a.* The 8-inch howitzer is of British design, and of British and American manufacture. Several types have been manufactured and are on hand. The principal modification is between the Mark VI and Mark VII howitzers, the Mark VII having a higher muzzle velocity and 1840 yards greater range than the Mark VI. Both types are on hand but as the greater part are Mark VI, this type alone will be described.

b. (1) The howitzer is mounted on a wheeled carriage and does not have to be disassembled for transportation. When in firing position the wheels rest on a firing platform sunk flush with the ground. It has a box trail, but this trail is cut away so that it does not block the recoil of the howitzer at high elevations. An elevation of 50 degrees on the carriage can be obtained. The traverse is 4 degrees on each side of the center. The recoil system is of variable

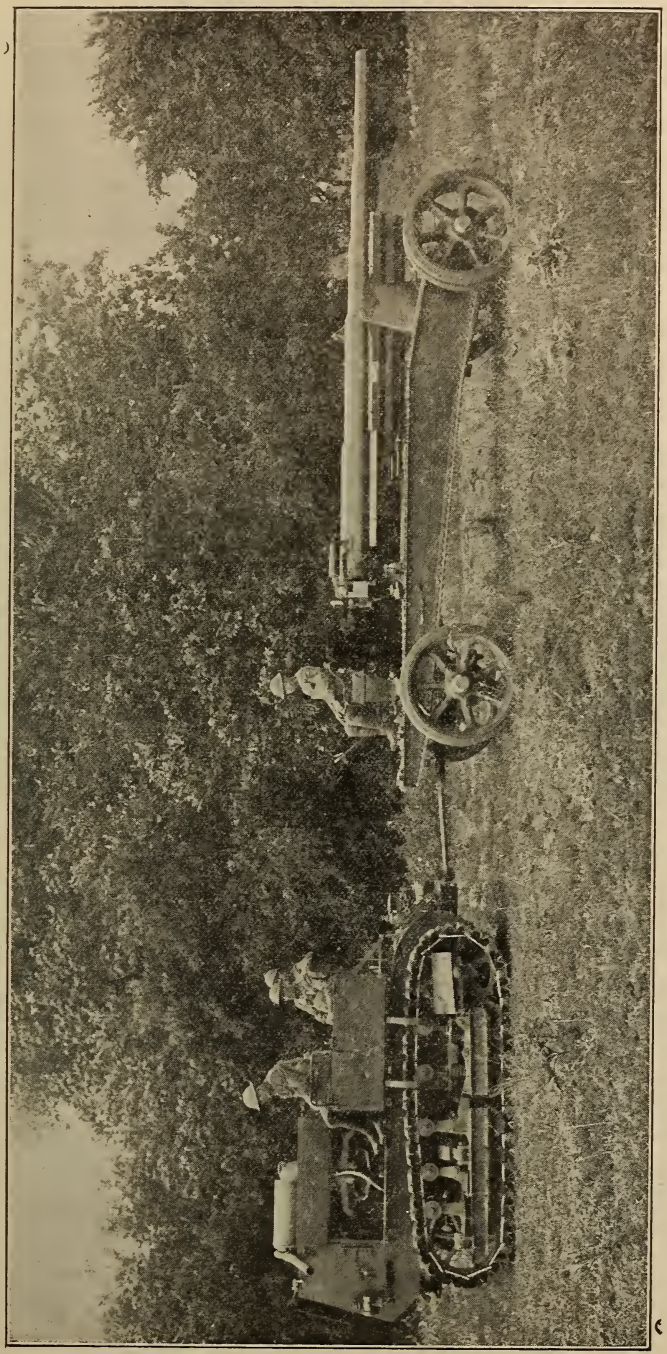

PLATE XII—155-mm. Gun Section

hydropneumatic type. A panoramic sight is used. The weight of the piece in firing position is 19,100 pounds. The projectile is a 200-lb. high explosive shell. The powder charge consists of four sections corresponding to four range zones. The muzzle velocity varies from 777 feet per second in zone I to 1303 feet per second in zone IV. The maximum range is 10,700 yards.

PLATE XIII—8-inch Howitzer in Action

(2) A limber is provided to support the end of the trail in traveling. This limber carries tools and accessories, but no ammunition. The howitzer, the limber, and the firing platform mounted on a two-wheeled transport wagon, form the load for one 10-ton tractor. The weight of the howitzer and limber is 21,700 pounds, and the weight of the wooden platform and transport wagon is 7840 pounds. The ammunition is carried in trucks.

c. The new 8-inch howitzer (Model 1920 E), under development, will be a considerably more powerful weapon than the type described above. It will fire a 200-lb. projectile with a muzzle velocity of 1950 feet per second and a maximum range of about 18,000 yards. The carriage will probably be of the split-trail type, permitting a maximum

elevation of 65 degrees and a total traverse of 60 degrees. The weight in firing position will be about 24,000 pounds.

17. 240-MM. HOWITZER, MODEL 1918 (SCHNEIDER).—*a.* The 240-mm. howitzer is of French design and American manufacture. Like the other pieces, described above, it was adopted by the United States Army during the World War.

b. (1) Unlike the weapons previously described, this piece is not mounted on wheels but fires from a fixed platform of steel. This platform is sunk in a pit and requires considerable labor to install. The piece is bolted to the platform and therefore cannot be shifted. It has a maximum elevation of 60 degrees and a traverse of 10 degrees on each side of the center. The recoil system is hydropneumatic with constant length of recoil. A panoramic sight is used. The weight of the complete unit in firing position is 58,600 pounds. The powder charge consists of five sections, corresponding to five range zones. It fires a 345-lb. shell with a muzzle velocity varying from 630 feet per second in zone I to 1700 feet per second in zone V. The maximum range is 16,400 yards.

(2) For transport, the complete howitzer unit is divided into four loads; platform, top carriage, cradle, and howitzer. Each load is carried on a special transport wagon. The wagons differ slightly in detail to fit the different loads, but in general, consist of a two-wheeled limber, a two-wheeled rear carriage, and a false trail which is attached to the limber and to the load. When the wagon is unloaded the false trail is attached to the rear carriage and couples it up to the limber. The weights of the loads on their transport wagons vary from 12,545 pounds for the top carriage to 16,230 pounds for the platform load. Each load is drawn by a 10-ton tractor. A structural steel erecting frame operated by hydraulic jacks is required to dismount the loads from their wagons and place them in position. A number of other tools and accessories are required for the erection, operation, and maintenance of the piece. This material for each howitzer is carried on two 4-ton trailers which are drawn in tandem by one 10-ton tractor.

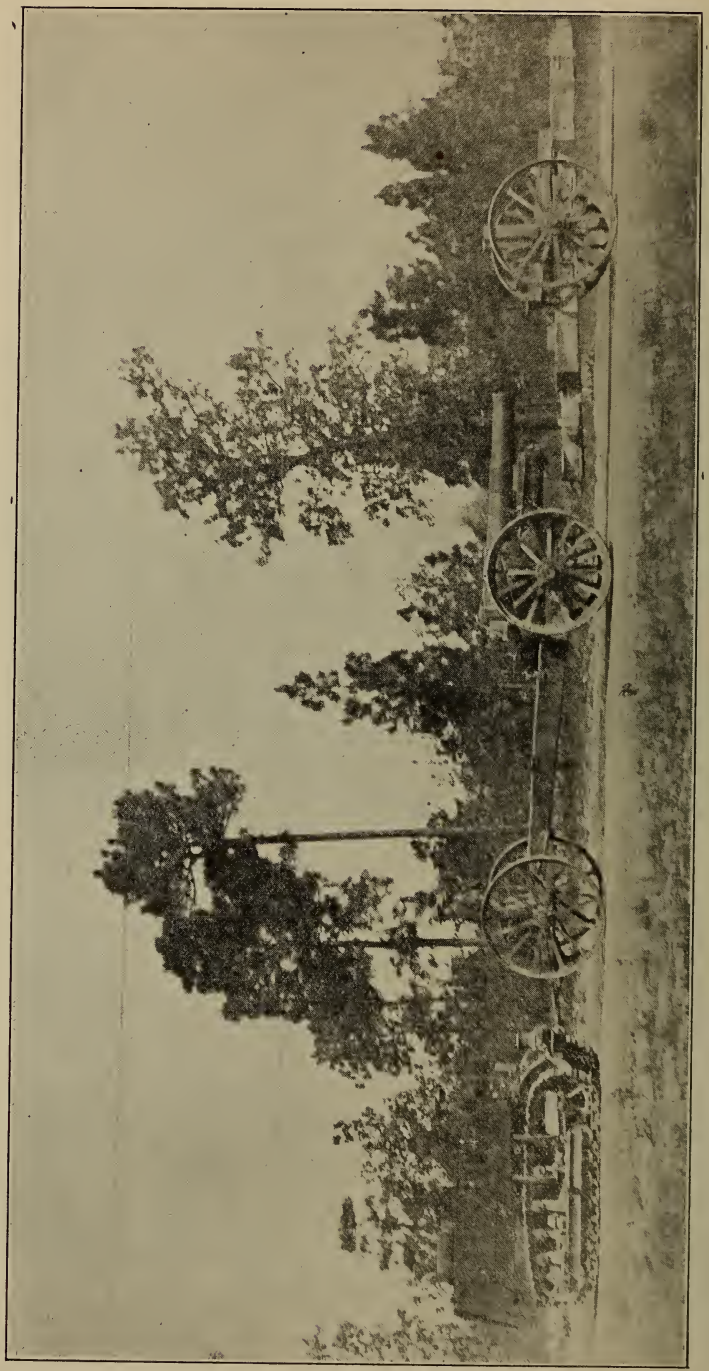

PLATE XIV—8-inch Howitzer Section

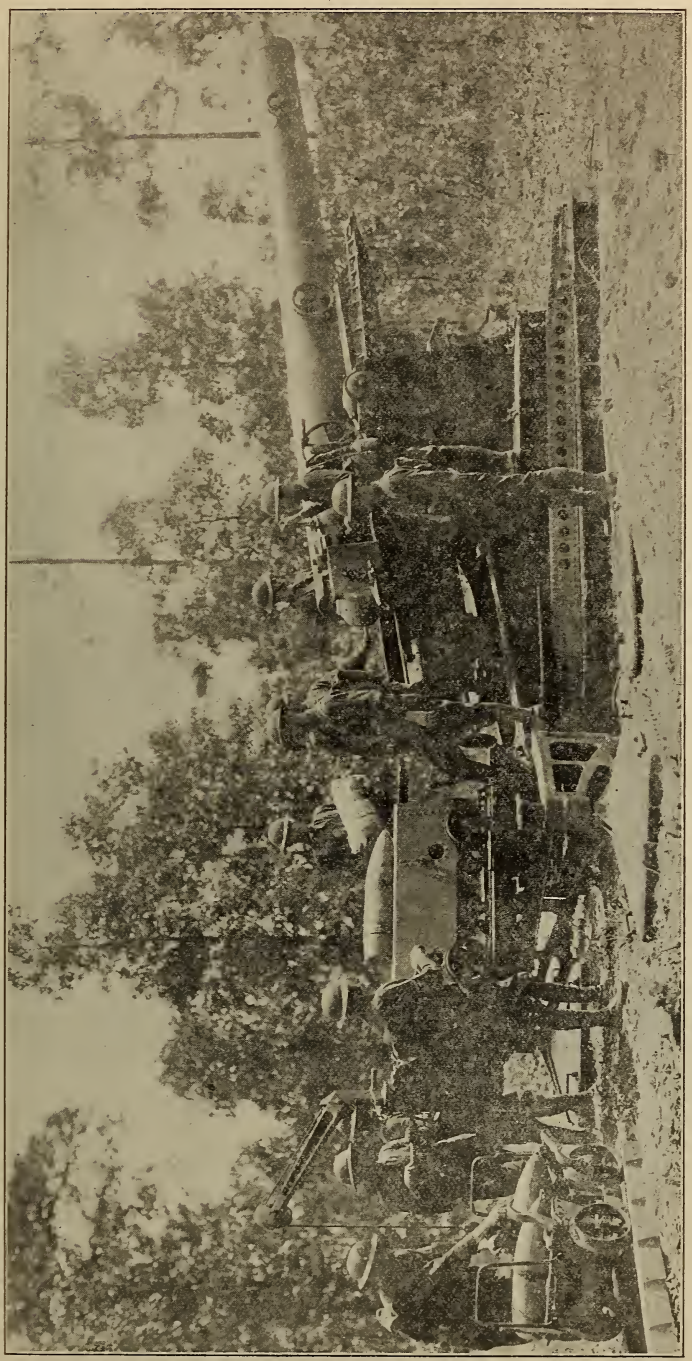

PLATE XV—240-mm. Howitzer in Action

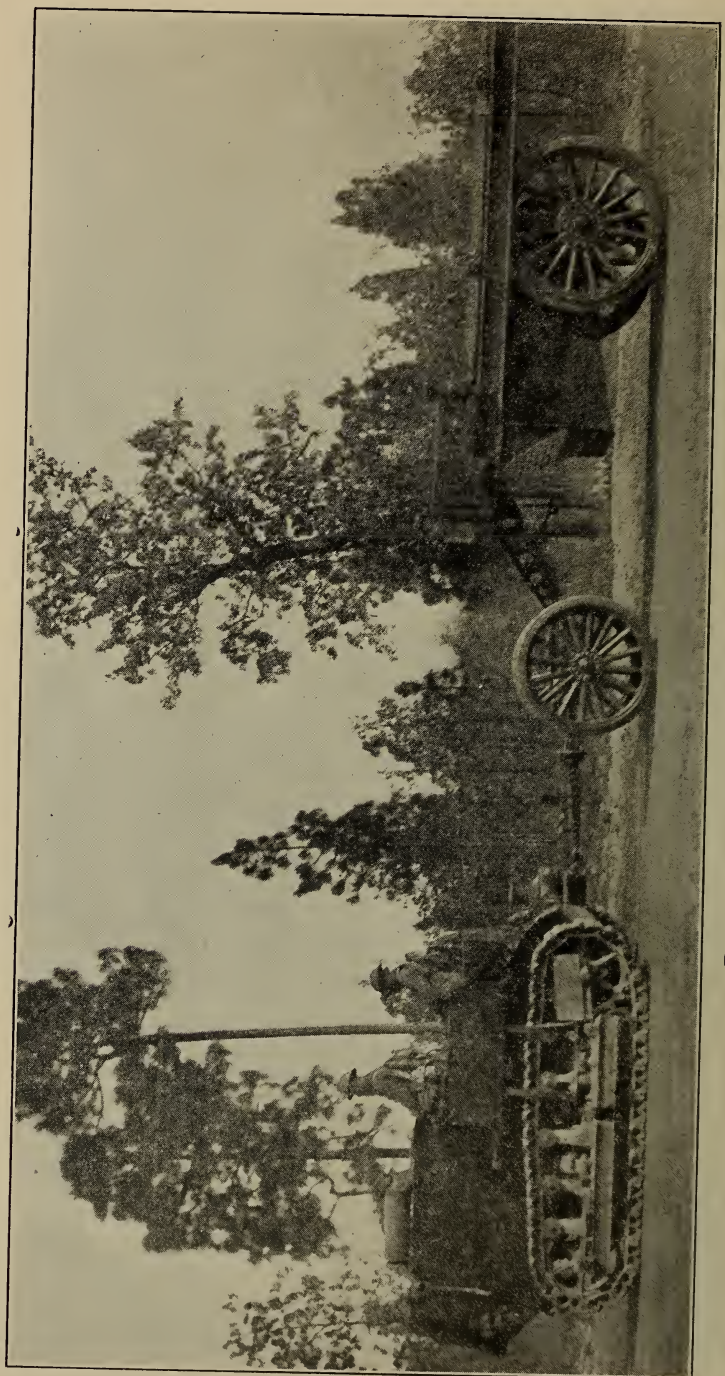

PLATE XVI—240-mm. Howitzer, Platform Load

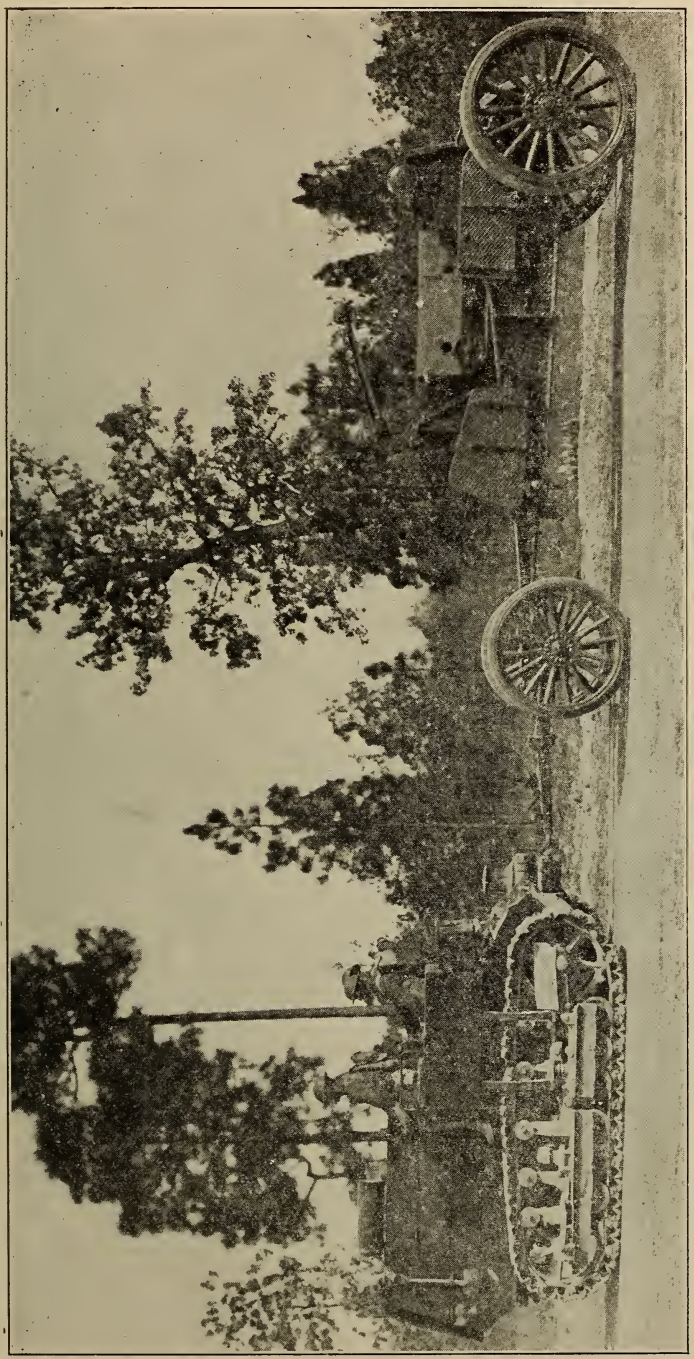

PLATE XVII—240-mm. Howitzer, Top Carriage Load

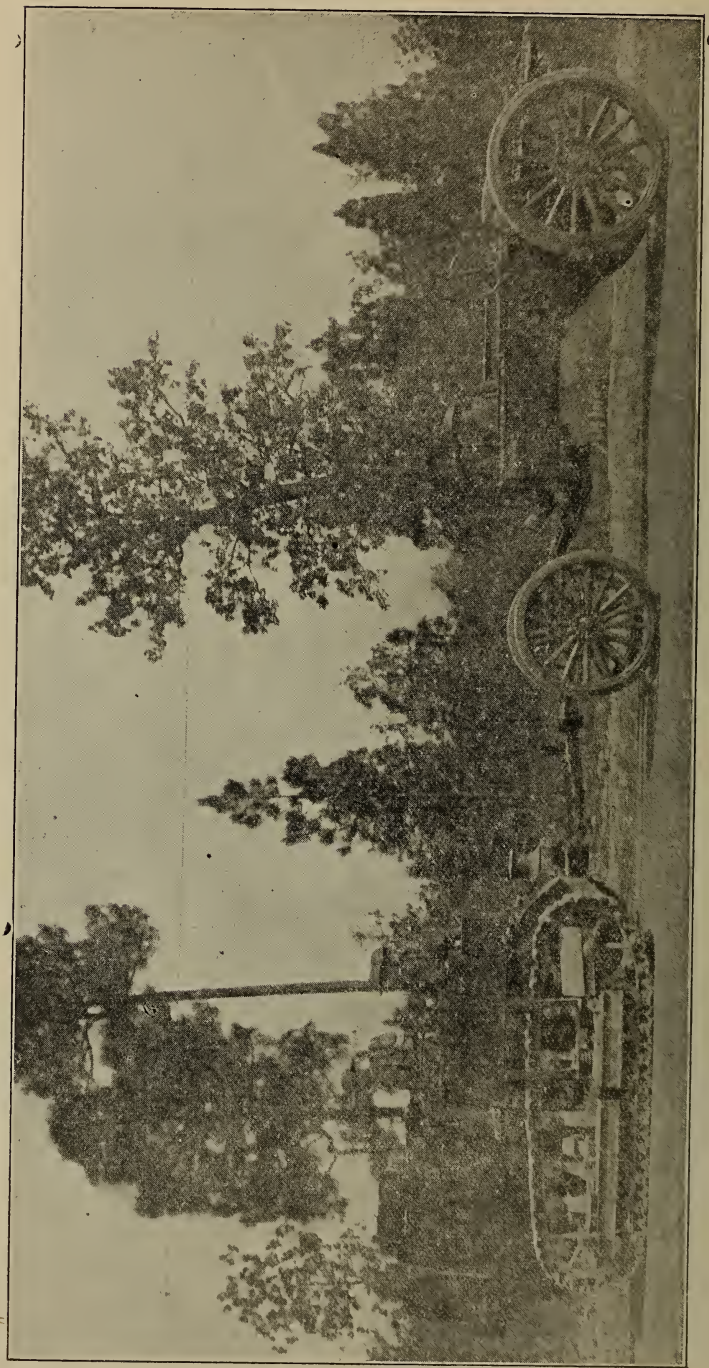

PLATE XVIII—240-mm. Howitzer, Cradle Load

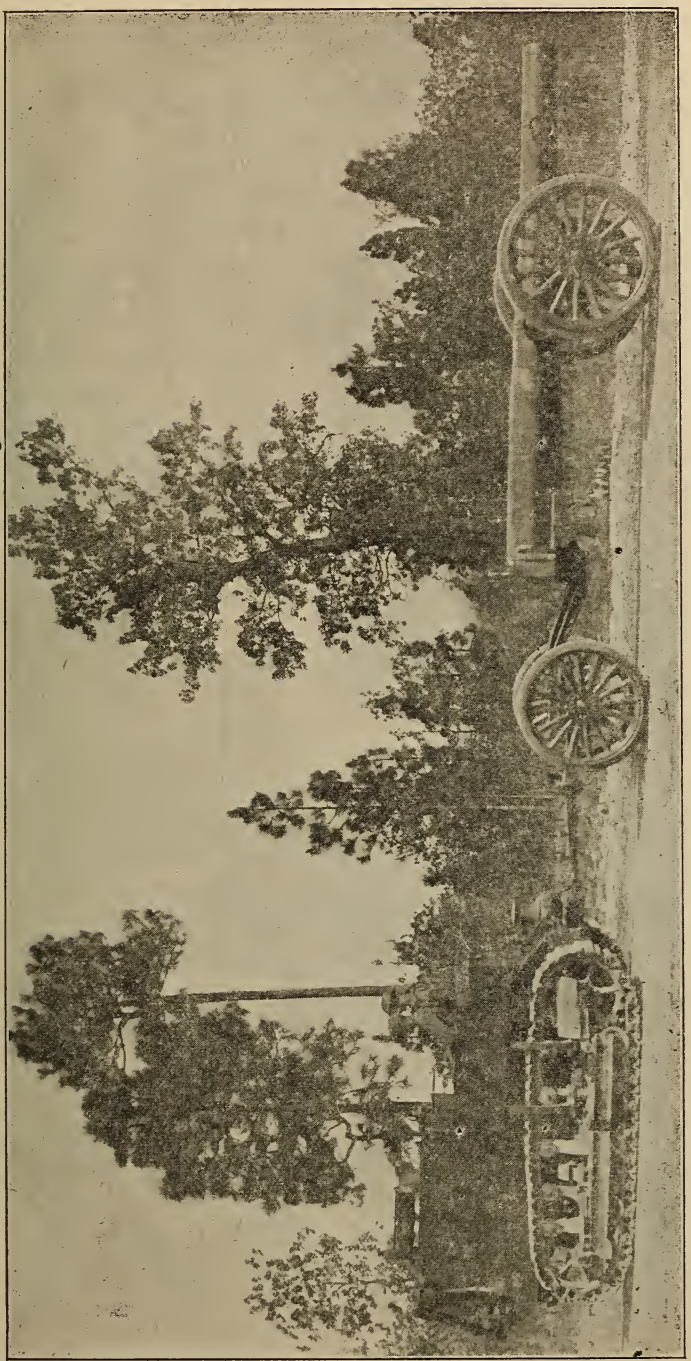

PLATE XIX—240-mm. Howitzer, Howitzer Load

c. Upon the development and manufacture of the new 8-inch howitzer, it is expected to take the place of the 240-mm. howitzer in our present organization. A still more powerful howitzer of 240-mm. caliber and a gun of 8-inch caliber are desired, however, and tentative designs are under consideration by the Ordnance Department. A range of 25,000 yards with a 400-lb. projectile is desired for the 240-mm. howitzer and a range of 35,000 yards with a 220-lb. projectile for the 8-inch gun.

NOTE

Of the weapons and ammunition mentioned above, as on hand, the following, for various reasons stated in the text, are considered as not available in the work at the General Service Schools:

3-inch gun
105-mm. howitzer
4.7-inch gun
6-inch gun
8-inch howitzer
Mark IV (long range) shell for the 75-mm. gun
Reduced charge for the 75-mm. gun.

CHAPTER II

Ammunition

18. CLASSIFICATION.—*a.* A round of artillery ammunition consists of a projectile, a fuze, and a propelling charge, with the necessary primer, igniter, and container for the powder charge. Artillery ammunition is classified as *fixed*, *semi-fixed*, and *separate loading*, according to the method of assembling the round for transportation and loading.

b. (1) Fixed ammunition.—The complete round of fixed ammunition is assembled in one unit for handling and loading, except that the fuze may be separate from the projectile until the round is prepared for firing. A brass cartridge case contains the primer and propelling charge; the projectile is fixed in the mouth of the cartridge case just as in small arms ammunition. When the fuze is not included in the assembly, it is screwed into the point of the projectile just before the latter is loaded into the gun. Fixed ammunition is used in our service in the 75-mm. gun, 2.95-inch pack howitzer, 3-inch gun, and 4.7-inch gun.

(2) Semi-fixed ammunition.—The propelling charge and primer of semi-fixed ammunition are contained in a metal cartridge case just as in fixed ammunition. In some types the projectile is issued, handled, and loaded separately from the charge and case. The 105-mm. howitzer ammunition is of this kind. In other types, as in the ammunition for the 75-mm. pack howitzer now under development, the projectile is merely removable from the cartridge case by hand for the purpose of varying the charge, and is replaced in the case before loading.

(3) Separate loading ammunition.—The propelling charge of separate loading ammunition is contained in a

cloth bag or bags issued and loaded separately from the projectile. The primer is also separate and is inserted in the breechblock of the piece. The 155-mm. howitzer and gun and all weapons of larger caliber in our service use this type of ammunition.

19. PROPELLING CHARGES.—*a.* The propellant used for all artillery ammunition in our service is a nitrocellulose powder. The size and type of grain varies for different calibers. The charge for howitzers is divided into sections. These sections are removable, giving a variable charge, thus permitting a variable muzzle velocity and consequently a greater angle of fall at short ranges and less wear on the bore. Guns of the heavier calibers are provided with a charge divided into two unequal parts giving a normal charge and a super charge, the latter being used only for extreme ranges.

b. The igniter is a small packet of black powder used to insure a thorough ignition of the propellant. In fixed ammunition, the ignition is accomplished by the black powder in the primer.

c. The charge gives a small amount of smoke and considerable flash. Experimental powders have been developed which almost entirely eliminate the flash and smoke. When these are perfected they will undoubtedly replace our present powders. The charge for the 75-mm. gun weighs about $1\frac{1}{2}$ pounds, for the 155-mm. howitzer 8 pounds, for the 155-mm. gun 25 pounds, and for the 240-mm. howitzer 36 pounds.

20. FUZES.—*a. General.*—A fuze performs the function of igniting the bursting charge and initiating the explosion, either upon impact of the projectile or after a certain time of flight and before the projectile strikes. Fuzes are generally classified as percussion, time, and combination fuzes. All fuzes are provided with safety devices which prevent them from operating until after they are fired from the piece.

b. Percussion fuzes.—(1) Percussion fuzes are arranged to detonate on impact only, by means of a plunger operated by the shock of impact. They are classed as super-

quick or instantaneous, short delay, and delay fuzes, according to the length of time required for the fuze to act after impact. A super-quick fuze operates the instant it touches the ground, detonating the projectile above the surface; a short delay fuze operates a fraction of a second after striking so that the projectile detonates just under the surface or on ricochet; a delay fuze is used to obtain a mining effect by detonation after the projectile has buried itself. Delay fuzes are used only for large calibers; super-quick and short delay fuzes are used for all calibers. Gas and smoke shell require super-quick fuzes.

(2) It is obviously very desirable to limit the number of types of fuzes, and progress is now being made along this line. One type of fuze which has recently been developed can be set for either super-quick or short delay action.

c. Time fuzes.—Time fuzes are so arranged that they may be set to function at any given time after the projectile is fired, up to the maximum for which the fuze is designed. There are two general types, one operated by clock work, the other by a time train of compressed powder. They may be set by hand or otherwise for a given number of seconds, or, by an automatic fuze setter, for a given range and height of burst. They do not operate on impact. The time fuze is used for shell and shrapnel in antiaircraft guns, and in some foreign armies, it is used with high explosive shell for other artillery. In the United States Army, however, no time shell for artillery other than antiaircraft is at present supplied.

d. Combination fuzes.—A fuze designed to function as both time and percussion is called a combination fuze. The type in use in our service consists of a time element of the powder train type, and a percussion element. The length of the train of compressed black powder is altered by turning a disc, thus determining the time of burning. The time train is ignited by a primer, fired by the shock of discharge of the piece. The percussion element operates if the projectile reaches the ground without being exploded by the time element. This fuze is made in two sizes, one giving a maximum

time of burning of 21 seconds and the other a maximum of 45 seconds. The fuze is used for shrapnel only. The 21-second fuze is used for 75-mm. and 2.95-inch shrapnel, the 45-second fuze for larger calibers. This time of burning limits the useful range of the 75-mm. shrapnel to about 6700 yards although the range of the projectile itself is about 9700 yards. This fuze is not adaptable to high explosive shell.

21. PROJECTILES.—*a. General.*—The design of projectiles has been a subject of constant study and experiment. Numerous improvements were made during and subsequent to the World War, resulting in increased ranges and increased accuracy. The newer projectiles used with all calibers of field artillery are of substantially the same design. This is a cylindrical body with a long curved tapering nose and slightly tapering base. The tapered part, forward of the cylindrical body, is called the *ogive.* The tapering of the base is called *boat-tailing.* The modern modifications in form have been the introduction of boat-tailing and the lengthening of the ogive. Both of these tend to increase the range, but there is a limit to their application beyond which an increase in boat-tailing or length of ogive renders the projectile unstable and inaccurate. Some modern projectiles are fitted with a false cap, a long hollow steel cone fitted over the nose of the projectile, to decrease the air resistance without destroying the balance. One or more copper bands are fitted around the projectile near the base. Upon discharge, the soft metal of these rotating bands is cut through by the rifling of the bore and serves to give the projectile rotation about its longitudinal axis. The fuze is screwed into a seat in the nose of the projectile.

b. High explosive shell.—(1) The high explosive shell consists of a hollow forged or cast steel case filled with a high explosive. Several substances are used as shell fillers or bursting charges of which the principal ones in use in our service are TNT (Trinitrotoluol), Amatol (a mixture of ammonium nitrate and TNT), Explosive D (ammonium picrate), and Sodatol (sodium nitrate and TNT). The bursting charge is from ten to fifteen per cent of the weight of the shell. It is detonated by the action of the fuze on

impact and bursts the steel case into jagged fragments which are propelled for a short distance in all directions with a very high velocity. The explosive in the fuze itself is not sufficient to detonate the bursting charge, and an intermediate exploder, called a booster, is inserted between the fuze and bursting charge when the shell is charged. With the light and medium calibers, effect is produced principally by the fragments of the case; with the heavier calibers, the impact of the shell and the shock of detonation account for a considerable part of the destructive effect.

(2) The area effectively covered by the burst of one shell is about 5 yards in depth by 15 yards in width for the 75-mm. shell, and 15 yards in depth by 70 yards in width for the 155-mm. shell. Some large fragments of the former may fly as far as 150 yards, and those of the latter as far as 500 yards.

(3) The high explosive shell is used for destruction or neutralization of personnel as well as for destruction of *matériel*, trenches, woods, etc. It forms the bulk of the ammunition supply of all calibers.

c. Special shell.—(1) Smoke and chemical shell of all kinds are known as special shell. The projectile is the same type as the high explosive shell except for the filler. The shell is burst by the booster alone, thus releasing the contents.

(2) Smoke shell contains a smoke producing substance, generally white phosphorus. This shell is used in the 75-mm. gun, 105-mm. howitzer, 4.7-inch gun, and 155-mm. howitzer.

(3) Gas shell is loaded with several different types of asphyxiating or poisonous chemical agents. The chemical agent is loaded into the shell in solid or liquid form. Gas shell is provided for the 75-mm. gun, 105-mm. howitzer, 4.7-inch gun, 155-mm. howitzer, and 155-mm. gun.

(4) The term special shell also includes illuminating, incendiary, and tracer shell. The names of the first two are self-explanatory. Tracer shell is designed to leave a trail of smoke during flight so that its trajectory can be traced. None of these three types is at present provided in

our service, except that some tracer shell is used by anti-aircraft artillery.

d. Shrapnel.—(1) Shrapnel consists of a steel case similar to that of the high explosive shell, filled with lead balls of about one-half inch diameter, the interstices between the balls being filled with resin. Below the shrapnel balls at the base of the case is a small quantity of black powder, separated from the balls by a steel diaphragm. A brass tube connects this powder charge with the fuze. The fuze is assembled to the nose of the projectile before issue. It is generally impossible to make the shape of the shrapnel as ballistically efficient as that of the shell since boat-tailing and a long ogive restrict too much the space available for shrapnel balls.

(2) Before loading into the piece, the time train is set so that the fuze will explode just before reaching the target. When the fuze explodes, the flame passes through the central tube igniting the black powder in the base of the projectile. The explosion of this powder forces the balls out of the case like shot from a shotgun cartridge. They carry with them the fuze and a part of the ogive. At the same time the resin is ignited, forming a ball of white smoke. This ball of smoke enables the battery commander to adjust the fire for range, height of burst, and deflection. The balls leave the case with an additional velocity of some two or three hundred feet per second in the form of a cone, thus covering a considerably larger space than that effectively covered by a shell burst. The effectiveness of a shrapnel burst depends upon the correct adjustment of the height of burst, and range. As the velocity of the shrapnel balls falls off very rapidly, the balls from a burst too high in air lack sufficient velocity. On the other hand, if the burst is too low the area covered is too small to be effective.

(3) Shrapnel is the ideal artillery weapon against personnel in the open. It is comparatively ineffective against personnel behind cover or in woods, and has no effect against *matériel.* The conduct of fire with shrapnel is more difficult than with shell on account of the greater number of elements to be adjusted, and requires a high de-

gree of training on the part of the battery commander. Shrapnel is provided only for the 75-mm. gun, 2.95-inch pack howitzer, 105-mm. howitzer, and 4.7-inch gun.

NOTE

For the purpose of the solution of problems at the General Service Schools, it is assumed that smoke shell comprises ten per cent of the ammunition supply of all units for which smoke shell is provided (see Characteristics of Field Artillery, *Appendix A*), and that no gas shell is available unless specifically indicated in the problem.

CHAPTER III

Organization and Command

SECTION I

Organization

22. TYPES OF FIELD ARTILLERY UNITS.—For the purpose of command and administration, the field artillery is organized into units containing artillery weapons—batteries, battalions, regiments, and brigades—and certain other units including battalion combat trains, ammunition trains, and observation battalions. The details of organization of these units are given in *Tables of Organization.* This text deals with war strength organizations only.

23. FIELD ARTILLERY UNITS.—*a. The battery.*—(1) In the field artillery, a battery consists of four pieces of like type and caliber, with the personnel and equipment necessary for their maneuver and for the delivery of fire. It is the smallest administrative unit. Ordinarily, the battery has no independent tactical rôle but operates as part of a battalion. It is primarily the unit for the technical conduct of fire.

(2) The principle subdivisions of the battery are:

(a) The battery headquarters, organized for command, administration, supply, reconnaissance, observation of fire, preparation of fire, signal communication, and conduct of fire.

(b) The firing battery, which consists of gun or howitzer sections, and usually of one ammunition section.

(c) The maintenance section, which consists of the kitchen, the ration and water carts, and the repair vehicles.

(3) In a 75-mm. gun battery, horse-drawn, the first four sections are gun sections. A gun section consists of a gun with limber, and a caisson body with limber, manned and equipped. The ammunition or fifth section consists of two complete caissons. Each carriage is drawn by a six-horse team. The cannoneers march on foot or are mounted on the carriages, at the discretion of the battery commander.

(4) In a horse battery, the organization is the same as in the horse-drawn, except that the cannoneers are mounted individually on horses.

(5) The organization of each of the following batteries is, in general, similar to that of the 75-mm. gun battery, horse-drawn, except as mentioned:

(a) In a 75-mm. gun battery, tractor-drawn, a gun section consists of a gun and two caisson bodies drawn by one 5-ton tractor. The fifth section consists of two units, each of three caisson bodies and one 5-ton tractor.* All cannoneers ride on the carriages.

(b) In a 75-mm. gun battery, *portée*, a gun section consists of a gun and a truck. There is no fifth or ammunition section. All cannoneers ride in trucks.

(c) In a 2.95-inch pack howitzer battery, a howitzer section consists of a howitzer transported in four packs, five ammunition packs, and one pioneer pack, each pack being carried by a mule. There is no fifth or ammunition section. All cannoneers march on foot.

(d) In a 155-mm. howitzer battery, a howitzer section consists of a howitzer drawn by a 5-ton tractor, and two caisson bodies similarly drawn. The fifth section consists of two units, each of two caisson bodies and one 5-ton tractor, and of a trailer for antiaircraft machine guns and personnel, drawn by a 5-ton tractor. All cannoneers ride on the vehicles.

(e) In a 155-mm. gun battery, a gun section consists of a gun and a 10-ton tractor. The fifth section consists of four trucks for ammunition, two trucks for personnel, and a trailer for antiaircraft machine guns, supplies, and personnel, drawn by a 10-ton tractor. All cannoneers ride in trucks or in the trailer.

(f) In a 240-mm. howitzer battery, a howitzer section consists of a howitzer transported in four loads and two 4-ton trailers, each load and the trailers being drawn by one 10-ton tractor. The fifth section contains eight trucks for ammunition and personnel, four for personnel, and one 4-ton trailer for antiaircraft machine guns and personnel, drawn by a 10-ton tractor. All cannoneers ride in trucks or in the trailer.

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*Experiments are in progress to determine whether the 5-ton tractor should pull a two or three-axle load when used as the motive power for 75-mm. gun *matériel*. In this connection, the present (1925) tendency is toward a lighter tractor—approximately 2½-ton—pulling either a one or a two-axle load.

(6) A platoon consists usually of two sections. It is a convenient, but relatively unimportant command subdivision of the battery.

(7) The word "battery" is also used to designate certain artillery units other than those containing artillery weapons, but when so used the name of the unit contains also a descriptive word, for example, "headquarters battery."

b. The battalion combat train.—(1) A battalion combat train is a unit used for the purpose of furnishing a mobile reserve of ammunition for the batteries, and a means of transporting ammunition from the distributing point to the batteries. When occasion demands, an appropriate part of the battalion combat train can be detached readily for service with a detached battery, in which case, the part of the battalion combat train attached to the battery is joined with the maintenance section thereof to form the battery combat train.

(2) The principal subdivisions of the battalion combat train are:

(a) The train headquarters.
(b) Ammunition sections, organized usually into platoons.
(c) The maintenance section.

(3) The organization of the battalion combat train differs for the several calibers, but the number of its major subdivisions agrees in each case with the number of batteries in the battalion. The various battalion combat trains are organized, in general, as follows:

(a) The 75-mm. gun, horse-drawn or horse—nine ammunition sections, each of two caissons, organized into three platoons.
(b) The 2.95-inch pack howitzer—three ammunition sections, each of forty ammunition packs, twelve kit packs, and two packs of miscellaneous stores.
(c) The 155-mm. howitzer—six ammunition sections, each of four trucks, organized into two platoons.
(d) The 155-mm. gun—two ammunition sections, each of six trucks.
(e) The 240-mm. howitzer—four ammunition sections, each of four trucks, organized into two platoons.

(4) The battalion combat train of a separate battalion of horse artillery includes also a service platoon. (See service battery, subparagraph *e* (2), below.)

c. The battalion.—(1) A battalion consists of two or three batteries, a battalion combat train in most cases, and the necessary elements for tactical control and ammunition supply. The battalion is primarily a tactical unit and is ordinarily the smallest tactical unit of artillery. The functions of its commander are purely tactical and not administrative or technical. He directs but does not conduct fire. The *group* may be considered for all tactical purposes as corresponding to a battalion. It may include a greater or less number of batteries than the normal battalion.

(2) The principal subdivisions of the battalion are:

(a) The headquarters and headquarters battery, organized for command, reconnaissance, observation, signal communication, liaison, fire direction, and supervision of the supply of ammunition.

(b) Three batteries of light artillery, or two batteries of medium or heavy artillery.

(c) The battalion combat train, except that 75-mm. gun battalions of regiments of the general headquarters reserve have no battalion combat trains.

(3) The term "battalion" is used also in the designation of the observation battalion (see subparagraph *d*, below).

d. The observation battalion.—(1) An observation battalion consists of two observation batteries and the necessary elements for carrying on its functions of locating the positions of hostile batteries by observation of the flashes of their pieces, and of assisting friendly batteries in the adjustment of fire. (See Chapter X, Section VII.)

(2) The principal subdivisions of the observation battalion are:

(a) The headquarters and headquarters detachment.
(b) Two observation batteries.

(3) The observation battalion is motorized, its transport consisting of motor cars, motorcycles, and trucks.

e. The regiment.—(1) A regiment consists of two or three battalions and the necessary elements for administration, supply, and tactical control. It is both an administrative and a tactical unit. The *goupment* may ordinarily be considered for all tactical purposes as corresponding to

a regiment. In certain cases, the groupment may be so large that it will be convenient to break it into subgroupments, or it may have been formed of regiments of different brigades. In these cases the subgroupments correspond to regiments and the groupment itself to a brigade.

(2) The principal subdivisions of the regiment are:

(a) The headquarters and headquarters battery, organized for command, administration, supply, reconnaissance, observation, signal communication, liaison, and fire direction.

(b) The service battery, organized for the supply and baggage transport of the regiment, and for the ready detachment, when the occasion demands, of an appropriate part of the battery for service with a detached battalion.

(c) Two three-battery battalions of light artillery, or three two-battery battalions of medium or heavy artillery, the batteries being lettered in either case from A to F, inclusive.

f. The ammunition train.—(1) An ammunition train is a unit used to provide a mobile reserve of ammunition for the regiments and a means of transporting ammunition from refilling points to distributing points.

(2) The principal subdivisions of the ammunition train are:

(a) The train headquarters.

(b) The transport batteries—one (Battery A) in the division, and six (Batteries A to F, inclusive) in both the corps and the army artillery—organized to function under any circumstances in which the transport of the regiments which they serve, can function.

(c) Ammunition batteries—one (Battery G) in the division, three (Batteries G to I, inclusive) in the corps, and none in the army artillery—organized to provide the labor necessary for the handling of ammunition and the operation of distributing points.

g. The brigade.—(1) The brigade consists of two or more regiments, an ammunition train in most cases, and the necessary elements for tactical control. The functions of the brigade are primarily tactical except in the matter of ammunition supply. In matters of administration and of supply, other than that of ammunition, the supervision of the brigade commander is limited to the minimum necessary to insure the proper functioning of the regiments and to take advantage of every opportunity of assisting the regiments in this work.

(2) The principal subdivisions of the brigade are:

(a) The headquarters and headquarters battery, organized for functions corresponding to those of the similar unit in the battalion.
(b) Two or more regiments.
(c) The ammunition train, except that brigades of the general headquarters reserve artillery have no ammunition trains.

(3) A corps artillery brigade contains also an observation battalion, and has attached to it an ordnance company (maintenance).

(4) A heavy artillery brigade of the general headquarters reserve has attached to it an ordnance company (heavy maintenance).

24. SMALL ARMS EQUIPMENT.—*a.* Field artillery units are equipped with small arms to provide for local protection and for antiaircraft defense. All artillery personnel, officers and enlisted men, are armed with the pistol.

b. Machine guns with antiaircraft sights and mounts are distributed to field artillery units as follows:

(1) Division artillery (organic):

Two to each battery,
Two to each service battery,
Three to each battalion combat train,
Two to the ammunition battery of the brigade ammunition train.

(2) Corps artillery (organic):

Two to each battery,
Four to each ammunition battery of the brigade ammunition train.

(3) General headquarters reserve artillery:

Two to each battery.

25. TACTICAL DIVISION OF ARTILLERY.—*a. Subdivisions.*—For the purpose of tactical employment, the artillery with the field forces is divided into:

(1) Division artillery.
(2) Corps artillery.
(3) Army artillery.
(4) General headquarters reserve artillery.

Each of these is separate and distinct from the other. The term "army artillery" or "corps artillery" does not in-

clude the organic artillery of subordinate units. In referring to all the artillery in an army or in a corps, the expression, "the artillery with the —— Army" or "with the —— Corps" is used.

b. Division artillery.—(1) The division artillery comprises all the artillery placed under command of the division commander. It includes the organic artillery of the division, if present, and such units from other divisions, from the corps artillery, or from the general headquarters reserve artillery as may be attached to it.

(2) The organic artillery of an infantry division is a brigade of two regiments of 75-mm. guns and an ammunition train. In situations where the corps artillery, as such, is unable to furnish necessary fire support, the division artillery, is frequently reinforced by attaching a regiment of 155-mm. howitzers from the corps artillery.*

(3) The artillery of an infantry division, then, consists of the following:

(a) Organic division artillery:
One brigade of:
Brigade headquarters and headquarters battery;
Two regiments of 75-mm. guns, horse-drawn;
One ammunition train, animal-drawn and motorized, of:
One transport battery,
One ammunition battery.

(b) Attached artillery units, if any.

(4) The organic artillery of a cavalry division consists of one separate horse artillery battalion of 75-mm. guns.

(5) The artillery of a cavalry division, then, consists of the following:

(a) Organic cavalry division artillery:
One separate battalion of 75-mm. guns, horse.
(b) Attached artillery units, if any.

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*The memorandum of the Chief of Staff, approving the report of the Special Committee convened to recommend a scheme for the reorganization of the Army in conformity with the *Act of June 4, 1920*, contains the following statement:

"The development of the field howitzer as recommended by the Caliber Board of substantially the same mobility as the 75's will be continued by the Ordnance Department, and when such weapon has been developed the organization of the field artillery brigades with the infantry divisions will be fixed at three regiments, one to be armed with the new howitzer."

c. Corps artillery.—(1) The corps artillery consists of a corps artillery headquarters, a corps artillery brigade, a regiment of antiaircraft artillery, and such units from the general headquarters reserve artillery as may be attached to the corps by the army, and not attached to divisions by the corps.

(2) The corps artillery headquarters consists of the corps chief of artillery, his staff, and the additional personnel connected therewith.

(3) The corps artillery brigade includes a brigade headquarters and headquarters battery, three regiments of 155-mm. howitzers, a regiment of 155-mm. guns, an observation battalion, and an ammunition train. An ordnance company (maintenance) is attached to the brigade to facilitate the upkeep and repair of the *matériel.*

(4) When the corps is actively engaged, some artillery from the general headquarters reserve frequently is attached to it. Such of this artillery as is not attached to divisions by the corps, forms a part of the corps artillery. It may be attached to the corps artillery brigade or it may function under the corps chief of artillery as one or more distinct tactical units.

(5) The corps artillery for one army corps, then, consists of the following:

(a) Organic corps artillery:
Corps artillery headquarters.
One brigade of:
Brigade headquarters and headquarters battery;
Three regiments of 155-mm. howitzers, tractor-drawn;
One regiment of 155-mm. guns, tractor-drawn;
One observation battalion;
One ammunition train, motorized, of:
Six transport batteries, and
Three ammunition batteries;
One ordnance company (maintenance), attached.
One antiaircraft artillery regiment, motorized.*

(b) Attached artillery units, if any.

d. Army artillery.—(1) The army artillery consists of an army artillery headquarters, an ammunition train, a bri-

*See footnote, page 1.

gade of antiaircraft artillery, and such units from the general headquarters reserve artillery as may be attached to the army by general headquarters, and not attached to corps by the army.

(2) The army artillery headquarters consists of the army chief of artillery, his staff, and the additional personnel connected therewith.

(3) When the army is actively engaged, some artillery from the general headquarters reserve usually is attached to it by general headquarters. Such of this artillery as is not attached to corps by the army is a part of the army artillery.

(4) The army artillery for one army, then, consists of the following:

(a) Organic army artillery:
Army artillery headquarters;
One ammunition train, motorized, of six transport batteries;
One antiaircraft brigade of:
Brigade headquarters and headquarters battery;
Three antiaircraft artillery regiments, motorized.*
(b) Attached artillery units, if any.

e. General headquarters reserve artillery.—(1) The general headquarters reserve artillery includes all artillery not an organic part of divisions, corps, and armies, which comes under the control of the commander of the field forces.

(2) For purposes of mobilization under the *War Department General Mobilization Plan,* the artillery of the general headquarters reserve has been fixed as follows:

(a) Six brigades of 75-mm. guns, tractor-drawn, each of a brigade headquarters and headquarters battery, and three regiments.
(b) Six brigades of 75-mm. guns, *portée,* each of a brigade headquarters and headquarters battery, and three regiments.
(c) Six brigades, tractor-drawn, each of:
Brigade headquarters and headquarters battery,
Two regiments of 155-mm. guns,
Two regiments of 240-mm. howitzers.
One regiment of 6-inch guns;
(d) Four brigades, motorized, comprising eighteen regiments of antiaircraft artillery.*
(e) A sound ranging service including ten sound ranging batteries.*
(f) One regiment of 6-inch trench mortars.*

*See footnote, page 1.

(3) In time of war the artillery units comprised in the general headquarters reserve is determined in accordance with the requirements of the situation. Consequently, artillery other than that listed above, such as pack, railway, and obsolescent types, will be included in the general headquarters reserve when needed.

26. FIELD ARTILLERY STAFFS.—*a.* The commander (major) of a battalion, the commander (colonel) of a regiment, and the commander (brigadier general) of a brigade of light, medium, or heavy field artillery are assisted in the performance of their duties by staffs composed of officers whose grades, number, and designations are as follows:

Staff Officer	*Battalion*	*Regiment*	*Brigade*
Executive	Captain	Lieutenant Colonel	Major
Aids			Lieutenants (2) (f)
Adjutant	Lieutenant (Bn-1)	Captain (R-1)	Captain (B-1)
Assistant adjutant		Lieutenant (c)	
Intelligence officer	Lieutenant (Bn-2)	Captain (R-2)	Captain (B-2)
Assistant intelligence officer			Lieutenant
Plans and training officer	Lieutenant (Bn-3)	Captain (R-3)	Captain (B-3)
Assistant plans and training officer		Lieutenant	Lieutenant
Supply and munitions officer			Lieutenant (B-4)
Supply officer	Lieutenant (Bn-4) (a)	Captain (R-4) (d)	
Munitions officer		Lieutenant	
Reconnaissance officer	Lieutenant	Lieutenant	
Communications officer	Lieutenant (b)	Captain (b)	Lieutenant
Assistant communications officer		Lieutenant (e)	Lieutenant
Liaison officers	Lieutenant	Lieutenants (2)	

(a) Commands battalion section of service battery, and performs the duties of munitions officer. Frequently an officer of the battalion combat train is detailed to act as munitions officer.
(b) Commands headquarters battery.
(c) An officer of the service battery.
(d) Commands service battery.
(e) An officer of the headquarters battery.
(f) One commands headquarters battery.

b. In the division, the brigade staff of the division artillery commander acts as his staff to assist him in the performance of his duties as division artillery commander (see paragraph 29 *b*).

c. The corps chief of artillery (major general) has a staff consisting of an executive (colonel) who acts as chief of staff, two aids, and nine other officers (lieutenant colonels, majors, and captains). This staff usually is divided into four divisions (personnel, intelligence, operations and training, and supply) in a manner similar to the general staff

of a large unit, and the functions of the officers assigned to these divisions are similar to those of correspondingly assigned general staff officers.

d. The army chief of artillery (major general) has a staff consisting of an executive (colonel) who acts as chief of staff, three aids, and thirty other officers (colonels to lieutenants, inclusive). This staff is organized similarly into four divisions, and the functions of its members are similar to those of the general staff officers of a large unit.

e. The details of organization of artillery staffs are given in *Tables of Organization.*

SECTION II

Command

27. COMMAND WITHIN THE BRIGADE.—The chain of artillery command within an artillery brigade extends down from the brigade commander through the regimental commander, the battalion commander, and the battery commander. The functions and duties of these commanders are mentioned hereinafter in connection with various subjects.

28. COMMAND BY HIGHER COMMANDERS.—There is no chain of artillery command between an army and a division. Control by the higher artillery commanders is exercised through the normal chain of command. The senior artillery commander on duty with a unit commands all the artillery belonging to the unit or attached thereto, but does not command the artillery of subordinate units. For example, the corps chief of artillery exercises command of the corps artillery, but does *not* command the division artillery of the divisions of the corps.

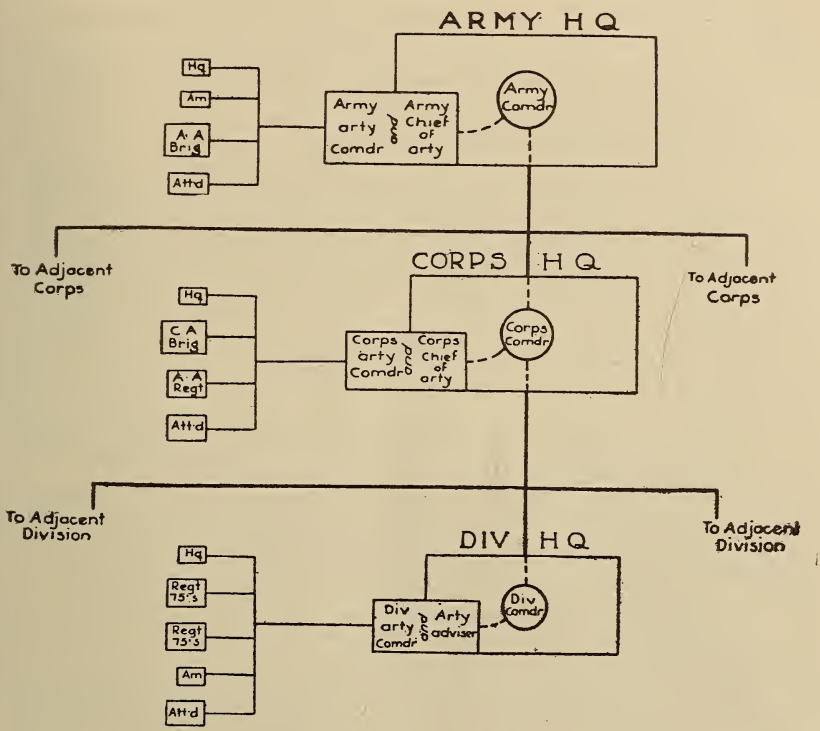

FIGURE 1—Chart Showing Chain of Command as Applied to Artillery

29. THE DIVISION ARTILLERY COMMANDER.—*a.* The division artillery commander commands the division artillery. Though not officially designated as a member of the staff of the division commander, he acts as his adviser on artillery matters.

b. When the division is supported by its organic artillery only, the commander of this artillery is the division artillery commander. When other artillery is attached, the senior officer of the division artillery (organic or attached) by virtue of his rank, is the division artillery commander. For many reasons, it may be desirable to have the commander of the organic division artillery, commander of all the division artillery. Special arrangements to accomplish this without violating the rights of seniority must be made by the division commander.

c. The functions of the division artillery commander are:

(1) To act as adviser to the division commander on artillery matters.

(2) To exercise tactical command over all units of division artillery, whether organic or attached.

(3) To prepare the general and detailed plans for the employment of the division artillery, to prepare the necessary field orders or annexes for artillery, and to supervise their execution.

(4) To make the necessary reconnaissances for the disposition of the units under his command, and for the supervision of the execution of his orders.

(5) To insure cooperation with the artillery of adjacent divisions.

(6) To supervise and coordinate the work of the intelligence service of all units of the division artillery.

(7) To supervise the observation system of the division artillery.

(8) To allot the ammunition placed at the disposal of the division artillery to the various units, and to provide for and supervise its distribution.

(9) To prepare plans for the employment of air observation for the division artillery, and for the cooperation of the division artillery with air corps units assigned attack or bombardment missions within the area covered by the division artillery.

(10) To be responsible for the training, fighting efficiency, and morale of the division artillery.

(11) To insure cooperation with the corps artillery and the corps artillery information service.

(12) To exercise a strict control over artillery means of signal communication in order to insure their efficiency and to prevent waste of equipment and duplication of effort.

(13) To exercise a strict supervision over the liaison system between the units of his command and the supported infantry units.

30. THE CORPS CHIEF OF ARTILLERY.—*a.* The corps chief of artillery is assigned to the corps to insure the most efficient use of all the artillery with the corps. He has a dual rôle. He is a member of the staff of the corps commander and his adviser in all matters pertaining to artillery, and, in addition, is the tactical commander of the corps artillery. The degree of control exercised by the corps chief of artillery over the artillery of the divisions of the corps varies with the tactical situation and the nature of the decisions of the corps commander. This control is exercised through the normal chain of command and consists mainly of the assignment of zones and missions and of coordination. At no time does the corps chief of artillery exercise either administrative or tactical command over any divi-

sion artillery. In all his relations therewith he acts as a staff officer of the corps commander. With respect to his relation to the organic corps artillery brigade, he is not the commander of this unit which has its brigade commander, but he exercises command over the entire corps artillery, both organic and attached.

b. The staff of the corps chief of artillery is organized primarily to assist him in the performance of his duties as a member of the staff of the corps commander, and as the latter's adviser in matters pertaining to artillery.

c. The functions of the corps chief of artillery are:

(1) To act as adviser to the corps commander on artillery matters.

(2) To exercise tactical command over all units of corps artillery, whether organic or attached.

(3) To prepare the plan for the employment of all the artillery with the corps. This plan is a general one, going no further into details than is necessary to give a thorough understanding to all concerned of the rôle to be played by the artillery with the corps, and by the component elements of this artillery. So much of this plan as is desirable is published in the artillery subparagraph of the corps field order. It is amplified to the necessary extent in the artillery annex when one is issued.

(4) To insure coordination between the units of all the artillery with the corps, and cooperation of the artillery with the corps with that of adjacent corps, and with the army artillery.

(5) To direct and supervise the work of the corps artillery information service.

(6) To supervise and coordinate the observation system of all the artillery with the corps.

(7) To make inspections of the artillery with the corps.

(8) To submit recommendations as to artillery personnel, *matériel*, and methods.

(9) To determine the needs of the corps in artillery ammunition, and to allot artillery ammunition to the corps artillery and to divisions; to supervise its distribution; and when necessary to assist in its distribution. Normally, the division and corps artillery draw ammunition directly from the army.

(10) To supervise the counterbattery work of the entire corps.

(11) To prepare plans for the employment of air observation for the corps artillery, and for the cooperation of the corps artillery with air corps units assigned attack or bombardment missions within the area covered by the corps artillery.

(12) To prepare plans for the employment of the antiaircraft artillery in cooperation with the air corps in antiaircraft defense, and to supervise the execution of the orders promulgating these plans.

31. THE ARMY CHIEF OF ARTILLERY.—*a.* The army chief of artillery is assigned to the army for the same rea-

sons that the corps chief of artillery is assigned to the corps. The degree of control exercised by the army chief of artillery over the corps and division artillery varies with the tactical situation and the nature of the decisions of the army commander. This control is exercised through the normal chain of command and consists mainly of the assignment of zones to corps artillery and of missions to corps and division artillery, and of coordination. At no time does the army chief of artillery exercise command over corps or division artillery. In all his relations therewith he acts as a staff officer of the army commander.

b. While there is no organic army artillery, other than antiaircraft, it may be advisable at times to retain certain of the units of the general headquarters reserve artillery assigned to the army, as army artillery, usually the long-range heavy artillery. Groupment commanders and staffs for artillery retained as army artillery are obtained from the general headquarters reserve. Command over army artillery by the army chief of artillery is exercised in a manner similar to command of corps artillery by the corps chief of artillery.

c. The staff of the army chief of artillery is organized primarily to assist him in the performance of his duties as a member of the staff of the army commander, and as the latter's adviser in matters pertaining to artillery.

d. The functions of the army chief of artillery are:

(1) To act as adviser to the army commander on artillery matters.

(2) To exercise tactical command over all units of army artillery, whether organic or attached. In this exercise of command, the army chief of artillery and his staff function as prescribed for the corps chief of artillery.

(3) To prepare the plan for the employment of all the artillery with the army. This plan is a general one, going no further into details than is necessary to give a thorough understanding to all concerned of the rôle to be played by the artillery with the army, and by the component elements of this artillery. So much of this plan as is desirable is published in the artillery subparagraph to the army field order. It is amplified to the necessary extent in the artillery annex when one is issued.

(4) To make recommendations as to the amount of general headquarters reserve, or other artillery needed for the success of the mission, and to recommend for allotment to the different corps such of this artillery as is not retained as army artillery.

(5) To insure coordination between the units of all artillery with the army, and cooperation of the artillery with the army with that of adjacent armies.

(6) To direct and supervise the work of the army artillery information service.

(7) To supervise and coordinate the observation system of all the artillery with the army.

(8) To make such inspections of the artillery with the army as may be required.

(9) To submit recommendations as to artillery personnel, *matériel*, and methods.

(10) To determine the needs of the army in artillery ammunition, and to recommend the allotment of artillery ammunition to the army artillery, to corps, and to reserve divisions.

(11) To prepare plans for the employment of air observation for the army artillery, and for the cooperation of the army artillery with air corps units assigned attack or bombardment missions within the area covered by the army artillery.

(12) To prepare plans for the employment of the antiaircraft artillery in cooperation with the air corps in antiaircraft defense, and to supervise the execution of the orders promulgating these plans.

32. THE CHIEF OF ARTILLERY, GENERAL HEADQUARTERS. —*a.* The staff of the commander of the field forces includes a chief of artillery. He exercises no tactical command.

b. The functions of the chief of artillery, general headquarters, are:

(1) To submit recommendations on all artillery matters relating to tactics, training of artillery, and the employment of the general headquarters reserve artillery.

(2) To determine the amount and types of artillery needed, the quantity of munitions, and the number of replacements to be provided for the artillery, and to recommend their disposition when they become available.

(3) To weigh the relative needs and demands of the various armies and to recommend the allotment or withdrawal of units of the general headquarters reserve artillery, in accordance with such needs.

(4) To supervise such artillery schools as are under control of the commander of the field forces.

(5) To make such inspections as may be necessary.

(6) To recommend the transfer of artillery from one army to another or to the general headquarters reserve.

(7) To supervise the assignment of artillery personnel.

(8) To make recommendations for promotion.

(9) To make studies of artillery tactics and *matériel*.

(10) To supervise the training of artillery personnel.

(11) To distribute artillery information.

(12) To prepare from time to time, for the use of other arms of the service, bulletins explaining artillery methods.

CHAPTER IV

Ammunition Supply

33. GENERAL.—*a.* In war the supply of artillery ammunition is seldom equal to the demand. The amount that could be utilized to good purpose is limited only by the capacity of the available weapons to fire it, and this is far beyond any manufacturing and transportation facilities yet devised. Ammunition expenditure must be based ultimately, not on the amount that can be fired, but on the amount that can be manufactured and transported to the front. It is necessary to balance proposed expenditures against expected benefits; hence, artillery ammunition is allocated by the headquarters of all units from general headquarters down to include battalions, in accordance with the situation. The authorized consumption is severely limited at certain times and places in order to provide sufficient ammunition for important operations at other times and places.

b. General headquarters, from a knowledge of the amount of ammunition available and the plan of future operations, allots to each army in active operations a certain credit against which the army may draw for a given operation or for a given period of time. The ammunition which these credits represent is stored in ammunition depots of the communications zone or in other depots farther to the rear. The army allocates ammunition to the army artillery and to each of its corps from the army credit. On demand from the army this ammunition is shipped to the

front and delivered to railheads or army ammunition depots in the amounts desired. Similarly the corps allocates ammunition to the corps artillery and to the divisions, in the form of credits against the corps allotment. The army artillery, the corps artillery, and the division artillery then draw ammunition against their respective credits as they require it, direct from the railheads, army ammunition depots, or other points specified by the army.

c. In addition to the supply thus provided for artillery units, a reserve supply of ammunition for all the artillery with the corps, both corps and division artillery, is carried in the corps quartermaster train. This is used only in emergency or when necessary to supplement other supply. Normally, the corps quartermaster train is not a link in the chain of ammunition supply.

d. Army ammunition depots and other ammunition depots farther to the rear are operated by ordnance personnel. The reserve artillery ammunition in the corps quartermaster train is also handled by an ordnance company. All other agencies of artillery ammunition supply, forward of the railheads or army ammunition depots, are operated by artillery personnel.

e. During active operations, the commanding officer of each artillery unit, from battery to brigade inclusive, the division artillery commanders, corps chiefs of artillery, and army chiefs of artillery are required to submit periodical reports of expenditure of artillery ammunition to the next higher artillery headquarters. These reports are usually rendered daily and form a basis for ammunition allocations.

f. The day of fire is an arbitrary unit of measure for ammunition supply, adopted in order to have a measure of equal relative value for all types of artillery. The actual number of rounds per piece indicated by the term, varies according to the type and caliber of the weapon. Its value is such that it rarely is exceeded by the average expenditure throughout a large command in one day's combat. It is not an average daily expenditure. Experience during the World War indicated that an average daily expenditure for

a considerable period over a large front was very much less than the day of fire then prescribed. Values of a day of fire for the several calibers of artillery are fixed by the War Department at the beginning of a war or campaign based on the type of warfare expected. These values may be changed from time to time according to experience. No values are fixed in time of peace. The values of a day of fire in force at the end of the World War are given in the table, *Characteristics of Field Artillery, Appendix A.**

34. AMMUNITION SUPPLY IN THE INFANTRY DIVISION. —*a.* Within the infantry division, the division artillery commander is responsible for the supply of artillery ammunition. He is assisted in this function by an officer (lieutenant) of the artillery brigade staff, called the brigade munitions and supply officer. The regimental commander also has a munitions officer (lieutenant) on his staff. The battalion staff does not include a munitions officer but the battalion supply officer or an officer of the battalion combat train is usually assigned corresponding duties, and is then referred to as the battalion munitions officer. It is the duty of brigade, regimental, and battalion munitions officers to assist their respective commanders in planning and supervising the supply, distribution, and care of ammunition within their units; to receive, consolidate, and forward, reports of ammunition expenditures, and to keep their commanders informed of the status of ammunition supply within their respective organizations.

b. The corps chief of artillery allocates ammunition to the division artillery, and notifies the division artillery commander of the amount and location of his credit. Usually the credit for a division consists of not more than two or three days of fire at a time, in order that ammunition expenditures may be closely controlled by the corps and higher units. The division artillery commander obtains this ammunition, as it is needed, from an *ammunition refilling point* established by the army. The refilling point may be a railhead to which ammunition is shipped, as required, on de-

*These values are used in work at the General Service Schools.

mand of the army, or an army ammunition depot. In exceptional cases, when distances become too great, the army may establish the refilling point in advance of the railhead or the army ammunition depot, supplying it by army transportation. When the corps is acting alone, it takes over many of the supply functions of the army, and a refilling point may then be established by the corps. In this case the location of the dumped load of artillery ammunition of the corps quartermaster train, known as the corps ammunition park, is frequently used as a refilling point.

c. When the division is on the march, the brigade ammunition train usually marches with the other service trains of the division in rear of all combat troops under the direct control of the division commander. When combat is imminent, the ammunition train is released for operation.

d. Within the division area, in combat, one or more *ammunition distributing points* are established, at which the ammunition is transferred from the brigade ammunition train to the battalion combat trains. A distributing point is established at a convenient sheltered point on a road, usually within two to four miles in rear of the bulk of the positions of the artillery which it serves. The distance depends upon the terrain and the road net. It must be far enough forward to permit the battalion combat trains to keep up the necessary supply to the batteries, and it must be far enough to the rear to be reasonably safe from hostile artillery fire. The road circulation should be such as to permit the ammunition train to come in, unload, and return to the rear, and the battalion combat trains to come in, load, and return to the front, without confusion or congestion of traffic. The location is recommended by the division artillery commander but must be approved by the division commander, through G-4, in order to prevent conflict with other establishments. Upon approval of the location by the division commander, the division artillery commander directs the ammunition train commander to establish and maintain the distributing point. It is operated by a detachment from the ammunition battery of the ammunition train, the checking of ammunition issued to the

regiments and the records of these transactions being performed under the supervision of the brigade munitions officer. Ammunition for the 75-mm. guns is brought up by the ammunition train in boxes, containing nine rounds each. These boxes are unloaded from the vehicles, and opened, and the contents are checked. The ammunition is then issued to battalion combat trains and debited against the regimental allocations. The personnel of the combat trains complete the unpacking, and load the ammunition into their caissons. Effort should be made to avoid an accumulation of ammunition at the distributing point in excess of the amount which will probably be required before the position is changed, since ammunition left behind at a distributing point can seldom be recovered. The question as to whether the establishment of one, or more than one distributing point is advisable, depends primarily on the locations of the batteries and on the road net. It is more economical in personnel to establish but one distributing point, and this results in the supply of ammunition being better centralized. Usually one distributing point is sufficient. However, when artillery positions are widely separated, and the road net or terrain is unfavorable, two or more distributing points may be necessary in order to avoid excessively long hauls by the battalion combat trains. In a stabilized situation, particularly in preparation for an attack, ammunition is sometimes accumulated in division ammunition dumps within the division area.

e. (1) The functions of the ammunition train of the division artillery brigade are to transport ammunition from the refilling point to the ammunition distributing points and to operate the ammunition distributing point. This train consists of a train headquarters, one transport battery and one ammunition battery. The transport battery is organized with a truck section of 27 cargo trucks (25 available for artillery ammunition), and a wagon section of 27 escort wagons (25 available for artillery ammunition). The truck section carries about 5000 rounds of 75-mm. ammunition or one-third of a day of fire for the brigade, while the wagon section carries about one-half this amount. Thus

the transport battery has a capacity of about one-half of a day of fire for the brigade. The ammunition battery consists of personnel for loading and unloading the vehicles and for operating the distributing points. The combination of animal-drawn and motor transport gives considerable flexibility in handling ammunition supply over varied terrain. There is no standard method of utilizing the two sections; each situation calls for its own particular solution of the problem. The division artillery commander makes the plan and the ammunition train commander (major) carries it out. The normal load of the ammunition train constitutes a rolling reserve for the brigade, and this load is kept intact at all times as far as practicable. This is usually done by dumping the load at the ammunition train bivouac before going back to the refilling point for another load for delivery to the distributing point. When the ammunition is to be required for use before a new supply can be brought forward, it will be necessary to deliver a part or all of the normal load to the distributing point before returning to the refilling point for a new load. In this case the normal load is replaced at the earliest opportunity so that the ammunition train can move forward at any time with its complete load. Among the various possible plans of supply are the following:

(a) The truck section after dumping its load at its bivouac hauls ammunition from the refilling point to the distributing point; the wagon section remains at its bivouac with its wagons loaded, as a rolling reserve available in an emergency. This reserve may be used in case there is a breakdown in the supply by truck, when a forward displacement of the artillery takes it temporarily out of reach of the truck supply, or to accompany a detached unit, as for instance, a pursuing column.

(b) The truck section after dumping its normal load at its bivouac, makes the haul from the refilling point to some point short of the distributing point. The wagon section, having dumped its load at its bivouac, receives the ammunition delivered by the truck section and delivers it to the distributing point. This method might be used where the roads in the vicinity of the distributing point are unfit for motor traffic. It is open to the objection of an additional transfer of ammunition from one vehicle to another.

(c) The wagon section, or a part of it, may be used to assist the battalion combat trains when the latter cannot keep up the supply.

(d) Where the terrain is favorable, ammunition train vehicles can haul direct to the batteries, thus avoiding a transfer at the distributing point.

(2) Variations of these methods will suggest themselves in any given situation. The only invariable rule is that the required amount of ammunition must reach the batteries and that the process must be made as simple as possible.

(3) The location of the bivouac of the ammunition train is designated, on recommendation of the division artillery commander, by the division commander, through G-4. It is frequently necessary to separate the truck and wagon sections, since the former requires good roads and hard standings for its trucks, while the latter is not so dependent on good roads but requires a water supply for its animals. Bivouacs should be near the route from the refilling point to the distributing point, and if possible in advance of the division rear boundary in order to avoid interference with corps and army units.

f. The organic artillery of the division may be reinforced by a brigade, regiment, or other unit from another division; by units of 75-mm. guns, tractor-drawn or *portée*, or by trench artillery from the general headquarters reserve; and by 155-mm. howitzers from the corps artillery. These units, when attached, are supplied with ammunition under the direction of the division artillery commander. When a brigade from another division is attached it usually includes its ammunition train. The attached ammunition train may be combined with the ammunition train of the organic artillery brigade, the two trains being used as a whole to supply all units; they may be operated separately but both under the immediate direction of the division artillery commander, or each may serve its own brigade under the direction of its brigade commander. The last method may be adopted when the reinforcing brigade is attached for the initial stage of an attack only. In other cases, both trains usually operate under direct control of the division artillery commander. If one regiment only is attached, it may bring with it a part of the ammunition train, which is handled in the same way as the train with a complete brigade. If no ammunition train vehicles come with it, the regiment becomes simply another unit to be supplied by the organic ammunition train of the division.

Units attached from the general headquarters reserve, either 75-mm. guns or trench artillery, have no ammunition trains and must, therefore, be supplied by the organic ammunition train of the division, or additional trucks may be supplied from the army or corps for the purpose of reinforcing the ammunition train.

A regiment of 155-mm. howitzers attached to the division is usually accompanied by a detachment of the corps artillery brigade ammunition train. This detachment may be combined with the division artillery brigade ammunition train to supply all units, or it may serve only the howitzer regiment, under the direct control of the division artillery commander.

g. (1) The combat train of a battalion of 75-mm. guns, horse-drawn, consisting of 18 caissons, has a capacity of 1908 rounds, or about one-half of a day of fire for the battalion. Its function is to maintain a rolling reserve of ammunition for its battalion and to haul ammunition from the distributing point to the firing batteries. In action, the battalion combat train is posted in a covered position in rear of the batteries. The position should be not more than about twelve hundred yards from the firing batteries, and should have ample space for parking carriages at considerable intervals, and practicable covered routes from the position to the firing batteries and to the distributing point. When positions are occupied for long periods, the position of the combat train may be considerably farther to the rear, and combined with that of the limbers of the battalion, in order to facilitate administration and supply.

(2) When ammunition is available at the distributing point, part or all of the normal load of the battalion combat train is usually dumped at the combat train position, the emptied caissons immediately sent to the distributing point for refilling, and returned to the position ready to deliver to the firing batteries as ammunition is required there. The dumped load enables the combat train to move forward on short notice completely loaded. It is also used as a reservoir to permit a smooth and continuous flow of ammunition to the batteries, that is, if the supply to the distributing point

be delayed, the combat train draws on its normal load, replacing it from the distributing point as soon as possible. The accumulation of a greater amount of ammunition than can be consumed or carried forward should be carefully guarded against.

(3) It should not be necessary for the battery commanders to call for ammunition. Their needs should be foreseen by the battalion commander and automatically supplied. The usual method of handling the battalion combat train during action is as follows. Caissons are sent from the combat train position to the firing batteries as ammunition is needed, unloaded as close to the batteries as practicable, and then returned to the combat train position. Empty caissons are sent from the combat train position to the distributing point to refill, usually in groups of a platoon (6 caissons) or more, returning when filled to the combat train position. When practicable, the battalion munitions officer is present at the distributing point to supervise the drawing. If he cannot be present whenever ammunition is drawn, he visits the distributing point frequently and keeps a close check on the ammunition drawn therefrom. He also keeps in close touch with the firing batteries in regard to their supply.

(4) Under stabilized conditions the method of supply is sometimes modified by the establishment of regimental or battalion ammunition dumps, thus forming intermediate supply points between the ammunition distributing point and the batteries. The establishment of such dumps should be avoided, if possible, since it usually results in waste through ammunition left behind at these points.

(5) *Portée* and tractor-drawn 75-mm. gun battalions and trench artillery battalions have no combat trains. Therefore, when these are attached to divisions, their means of supply must be improvised. In the case of *portée* and trench artillery, the trucks which carry the pieces may be used as combat trains after the latter are in position. The tractor-drawn 75-mm. gun units may use their battery caissons and tractors, or have additional transportation assigned to them by the division.

(6) Each battery of 75-mm. guns, horse-drawn, has six caissons, each carrying 70 rounds of ammunition in the caisson body and 36 rounds in the limber, and in addition, each of the four limbers with the guns carries 36 rounds, making a total of 195 rounds per gun in the battery. The caisson bodies are normally placed in position beside the guns and furnish the first supply of ammunition. The ammunition in the limbers is considered as the last reserve of the battery and is not used until other supply fails. The battery caisson bodies are refilled from the battalion combat train. In stabilized situations, where the guns are in position for a long time, ammunition is frequently stored at the gun positions and the caissons withdrawn to the rear.

h. The first echelon of ammunition supply is the battery caisson bodies. The 105 rounds per gun thus provided will suffice for from one to three hours firing, depending upon the type of action. Before this supply is exhausted, it is replaced by the battalion combat train, the normal load of which will supply from one and one-half to five hours additional firing. The battalion combat trains in turn get their resupply from the ammunition distributing point, which is supplied by the brigade ammunition train hauling from the ammunition refilling point established by the army. In principle, all ammunition-carrying vehicles within the division (battery caissons, battalion combat trains, and brigade ammunition train) are kept filled or have their normal loads quickly available. Consequently, as soon as, or frequently before, the division goes into action, the regular flow of ammunition supply from the refilling point forward is started.

35. AMMUNITION SUPPLY IN THE CAVALRY DIVISION.—The cavalry division having only one battalion of field artillery, has no ammunition train. The division quartermaster train, however, includes in its normal load, 150 rounds of artillery ammunition for each gun in the battalion—a total of 1800 rounds. The method of supply is, in general, the same as that of the infantry division, substituting the ammunition section of the division quartermaster train for the brigade ammunition train. The different methods of

employment of the cavalry division and its organic artillery make some difference in the practical working of ammunition supply. Since the batteries of the battalion are frequently widely separated, more flexibility in the handling of the battalion combat train may be necessary. It may be necessary to separate a platoon from the remainder of the combat train to serve a battery located some distance from the other two, or even to divide the combat train into three parts, if the three batteries be widely separated. The ammunition distributing point usually is closer to the front and more frequently changed than is the case in the infantry division. The refilling point has to be much closer to the front since no motor transportation is available forward of that point. The army is responsible for keeping the refilling point pushed up sufficiently close to the front to permit regular supply.

36. Ammunition Supply of Corps Artillery.—*a.* (1) The general principles of ammunition supply for corps artillery are the same as for division artillery. The corps artillery brigade ammunition train, consisting of a train headquarters, six transport batteries, and three ammunition batteries has a capacity of about one-half of a day of fire for the corps artillery brigade. Each transport battery consists of 28 cargo trucks (24 available for artillery ammunition). Projectiles for the 155-mm. howitzer or gun are issued separately, while powder charges and fuzes are packed in boxes. Regulations require these three components to be stored separately in ammunition depots and dumps. Each truck of the ammunition train, however, should be loaded, as nearly as practicable, with complete rounds; otherwise, the loss of a few trucks containing fuzes or powder charges may render the load of the entire train useless. Due to the wide front over which the corps artillery is usually distributed and the number of battalion combat trains in the brigade, it is frequently necessary to establish two or more distributing points for the corps artillery. Since the battalion combat trains are motorized, distributing points may be located farther from the batteries than can be done with division artillery, but, ordinarily, as in

the division artillery, it is advisable to utilize as much as practicable the ammunition-carrying vehicles of the ammunition train, and thus spare those of the battalion combat trains in order that the latter may be better prepared to move at any time with the firing batteries. Under some circumstances, the brigade ammunition train may deliver ammunition direct to the firing batteries, but this usually is open to the objection of so dispersing the train as to make its control very difficult. In general, the normal method of supply, by the brigade ammunition train from refilling point to distributing points, and by battalion combat trains from distributing points to batteries, is probably most frequently used, although this method is open to the objection of requiring a transfer of ammunition from one truck to another at the distributing point. The locations of the ammunition distributing points are recommnded by the corps artillery brigade commander through the corps chief of artillery and G-4 of the corps to the corps commander.

(2) The 155-mm. howitzer battery has twelve caisson bodies, each carrying 14 rounds, giving 42 rounds per piece as an initial supply. The battalion combat train of twenty-four 3-ton trucks has a capacity of 120 rounds per piece within the battalion.

(3) The 155-mm. gun battery has four 3-ton trucks carrying 40 rounds of ammunition each. The battalion combat train consisting of twelve 3-ton trucks has a capacity of 60 rounds per piece within the battalion.

b. When the corps artillery is reinforced by attached units, the ammunition supply becomes a more complicated matter. If hauls be short and the amount of attached artillery small, the corps artillery brigade ammunition train may be able to handle it without assistance, but usually additional transport for this purpose has to be furnished from the army ammunition train or from the corps quartermaster train. The responsibility for the ammunition supply of the corps artillery rests upon the corps chief of artillery. He is assisted by a munitions officer (lieutenant colonel or major). The corps artillery brigade ammunition train is an organic part of the brigade and is normally operated

under direction of the corps artillery brigade commander. However, when it is necessary to use it in the supply of attached units in addition to the corps artillery brigade, it may be operated under the direct control of the corps chief of artillery.

c. The antiaircraft artillery regiment forming a part of the corps artillery, is supplied by its own transportation, independently of the corps artillery brigade, but its ammunition supply, as well as that of the corps artillery brigade, is under the supervision of the corps chief of artillery.

37. AMMUNITION SUPPLY OF ARMY ARTILLERY.—*a.* Since the army has no organic artillery other than an ammunition train, and a brigade of antiaircraft artillery, no one method of supplying ammunition for such artillery units as may be attached from the general headquarters reserve and retained by the army as army artillery can be followed in all situations. The army artillery is usually dispersed over a wide front and echeloned in considerable depth. The ammunition supply for each regiment then becomes a more or less independent problem. In general it may be said that the organic ammunition train of the army supplies the army artillery, except antiaircraft and railway artillery, but that the method of organizing the ammunition supply varies widely, depending upon the amount of artillery present, its location and the location of available refilling points. It may be possible at times to operate the ammunition train as a unit under the direct control of the army chief of artillery. Frequently, however, it has to be split up among the different organizations to be supplied and operated under the control of the commanders of these units.

b. All units of heavy artillery of the general headquarters reserve are provided with battalion combat trains. The use of these trains in supplying their battalions when attached to an army, depends entirely upon the method of operation of the army ammunition train.

c. Railway artillery is supplied by rail, usually direct from ammunition depots of the communications zone to batteries.

d. The antiaircraft artillery brigade of the army handles its own ammunition supply by means of its battalion combat trains. Its supply, like that of all other army artillery is under the general supervision of the army chief of artillery.

38. AMMUNITION FOR SMALL ARMS.—The relatively small amounts of ammunition for pistols and machine guns of field artillery units are obtained by the artillery brigade commander by arrangement with the ordnance officer of the unit to which the artillery pertains. In case of emergency during combat, small arms ammunition may be procured at the most convenient infantry ammunition distributing point.

39. AMMUNITION CARRIED.—The following amounts of artillery ammunition are normally carried in artillery units, and in the division and corps quartermaster trains:

ROUNDS PER PIECE

(Approximate days of fire)

	Firing battery	*Battalion combat train*	*Brigade ammunition train*	*Corps quartermaster train*	*Total within corps*
75-mm. guns, infantry division	195 (½)	159 (½)	156 (½)	150 (½)	660 (2)
75-mm. guns, cavalry division	195 (½)	159 (½)	Cavalry division quartermaster train 150 (½)	.....	(Total within cavalry division) 504 (1⅔)
75-mm. guns, tractor-drawn, GHQ Reserve	245 (⅘)	No battalion combat train	No brigade ammunition train	.....	.....
75-mm. guns, *portée*, GHQ Reserve	60 (⅕)	No battalion combat train	No brigade ammunition train	.....	.....
155-mm. howitzers, corps	42 (¼)	120 (⅘)	60 (⅖)	75 (½)	297 (2)
155-mm. guns, corps	40 (⅖)	60 (⅗)	60 (⅗)	50 (½)	210 (2)
155-mm. guns, GHQ Reserve	40 (⅖)	60 (⅗)	.....	.....	.....
240-mm. howitzers, GHQ Reserve	20* (⅛)	22† (⅛)	.....	.....	.....
2.95-inch pack howitzer	50 (⅙)	100 (⅓)	.....	.....	.....
3-inch antiaircraft guns, corps	.....	300 (1)	.....	150 (½)	450 (1½)

*8 trucks, each for 10 rounds and personnel.
†16 trucks, each for 11 rounds and personnel.

CHAPTER V

Reconnaissance and Occupation of Positions

SECTION I

Reconnaissance

40. INFORMATION.—*a. Importance.* — Information of the enemy, of the terrain, and of the supported troops is essential to the intelligent and coordinated employment of artillery. The success of the artillery support depends in a great measure upon the accuracy and completeness of this information and upon the promptness with which it is transmitted to the artillery.

b. Sources of information.—Each artillery unit is furnished by higher authority and by the other arms with all available pertinent information of the enemy and of the tactical situation. This information, while as complete as the situation permits, is not always furnished to the artillery in sufficient detail nor with sufficient promptness to meet all the requirements of combat. It, therefore, must

be supplemented by information collected through the activities of the artillery itself. The principal means of obtaining this additional information are by liaison with the supported troops, by observation, and by reconnaissance.

41. DEFINITION.—Reconnaissance is the operation carried out by the troops in the field for the purpose of gaining information of the tactical situation and of the terrain. In general, reconnaissance which is made primarily to obtain information of the tactical situation is a distinct and separate operation, carried out independently from that which is made of the terrain for the purpose of selecting artillery positions. The distinction lies, however, only in the primary object for which the reconnaissance is made, and in no way operates to preclude a reconnaissance party from obtaining all the information possible, both of the tactical situation and of the terrain, which may be of value to the artillery commander.

42. RECONNAISSANCE FOR INFORMATION.—*a.* It is a principle that artillery commanders can not rely entirely upon the other arms to keep them informed of the tactical situation nor to tell them when, where, and how to employ the fire of their units. Artillery commanders must employ all the means available to keep themselves informed of the tactical situation and, through their own initiative, must be prepared at all times to deliver effective fire in support of the other arms.

b. Artillery liaison officers, accompanied by liaison detachments, are sent to the commanders of the supported troops in order to keep the artillery commanders informed as to the changes in the situation and as to the cooperation desired of the artillery by the other arms. Others are sent to accompany assault battalions in an attack and to front line units in the defensive to keep the artillery commander informed of the artillery support required by these elements, and frequently, to observe and conduct fire, while still others are sent out on special reconnaissance missions, such as accompanying raiding parties to gain information within the hostile lines.

c. Reconnaissance detachments habitually accompany the advance and rear guards, and occasionally flank guards, to obtain and transmit early information of the tactical situation and to reconnoiter routes and possible artillery positions.

43. RECONNAISSANCE FOR POSITIONS.—*a.* The tactical situation, the plan of action decided upon by the commander of the troops, and the character of the terrain determine the manner in which the artillery is to be employed and the areas within which it is to take positions. The suitability of the terrain for the location of artillery is an important factor and must be determined in each instance before the final selection of areas or localities is made. Whenever possible, a reconnaissance on the ground should be made by all commanders concerned, preceded, preferably, by a detailed study of the map. When, however, there is insufficient time for the higher commanders to make a complete reconnaissance on the ground, the map is utilized to obtain the required information and to designate the general areas for the artillery. The use of the map alone as a means of designating areas or localities for artillery is avoided whenever possible. Unless a reconnaissance is made on the ground, the artillery may and frequently will find itself located within an area where it is impossible to carry out its mission effectively.

b. A reconnaissance involves a consideration of the terrain, not only for the location of the pieces from a tactical and technical viewpoint, but the locations of the other subdivisions of the command so that the unit as a whole will function smoothly and efficiently. This necessitates a reconnaissance for suitable locations for battalion combat trains, limbers or tractors, command posts, observation posts, routes of approach, routes for lines of signal communication, and routes for ammunition supply. An artillery commander in making his reconnaissance must examine the terrain somewhat from the viewpoint of his subordinate commanders. He must assure himself that the area or locality assigned to a subordinate unit provides suitable positions for each of the subdivisions of the subordinate unit.

For example, a regimental commander, in selecting locations for his battalions, must assure himself, by examination of the terrain, that the areas assigned to his battalion contain suitable locations for the batteries thereof.

44. RECONNAISSANCE BY THE COMMANDER OF TROOPS. —The location and distribution of the artillery of a force is the responsibility of the commander of the force. The commander of troops designates the area within which, or the points near which, the artillery is to take positions and assigns the missions to be performed. The artillery is therefore not usually free to select its own positions, but must utilize the terrain within the limits imposed. These locations, however, should be decided upon by the commander of troops only after consultation with, and after having received the recommendations of, the senior artillery commander. Whenever practicable, the commander of troops, accompanied by the artillery commander, makes a reconnaissance of the terrain before arriving at his decision as to the employment of the artillery and the areas it is to occupy. Where it is impracticable for him to make this reconnaissance in person, he may direct the artillery commander to perform this duty and submit recommendations for the locations of the artillery, or he may designate the locations from the map.

45. RECONNAISSANCE BY ARTILLERY COMMANDERS.—*a.* All artillery commanders make a reconnaissance of the terrain for the purpose of selecting locations for their units. They habitually precede their commands to the area within which their units are to take position, and, by examination of the ground, determine for the various tactical subdivisions of the command, the locations from which they can carry out their missions satisfactorily.

b. The senior artillery commander keeps in close touch with the commander of the troops and accompanies him on his preliminary reconnaissance. In this way the artillery commander is kept informed as to the tactical situation and plan of action, and receives early instructions as to the special missions of the artillery. During this reconnaissance, he formulates a plan for the disposition and employment of the artillery in accordance with the instructions he receives.

At the earliest opportunity he communicates this plan to the next subordinate artillery commanders, who either accompany him on reconnaissance or meet him at a designated rendezvous point. Thus commences a progressive reconnaissance that is taken up successively by each artillery commander of the various grades down to the battery commanders.

46. TIME AVAILABLE FOR RECONNAISSANCE.—*a.* The time available for reconnaissance varies with each particular situation. Under some circumstances a reconnaissance may be carried on for days, as in the preparation for an offensive on a large scale. Under other circumstances the reconnaissance must be completed within a few hours (or even a few minutes) while artillery units are marching toward the positions they are to occupy. As a rule, the necessity for the employment of artillery can be foreseen, and opportunity may be gained for adequate reconnaissance. When, however, it is necessary to bring artillery into action quickly for the support of other troops and there is insufficient time for all commanders to make a thorough reconnaissance, the progressive system of reconnaissance outlined in the following paragraphs, must be curtailed, and brigade and regimental commanders must exercise the greatest care to see that as much time as possible is allowed battalion and battery commanders in which to make their reconnaissance. Situations will, therefore, arise in which brigade commanders will not have sufficient time to make a complete reconnaissance of the ground and will have to resort to the map to indicate positions to regiments.

b. Whenever it is necessary to get artillery into action quickly, delays occasioned by protracted search for technical and tactical advantages are inadvisable. The main consideration is to place the pieces promptly in positions from which they can render effective support.

47. RECONNAISSANCE BY LIGHT ARTILLERY.—*a. Brigade commanders.*—Reconnaissance by the artillery brigade commander is made to determine the general conditions of the entry into action of the large units. In the division this reconnaissance is made by the artillery brigade commander, as division artillery commander, conjointly with that of the

division commander. The division artillery commander must be well informed as to the nature of the terrain, the roads, and defilade, in order to be able to direct the march, deployment, entry into action, and the supply of his command. Reconnaissance of the terrain as a whole and of the target area is made by each artillery commander with the assistance of his staff immediately upon receipt of orders for the engagement of his unit. Reconnaissance is made as soon as the situation permits. Reconnaissance by the brigade commander begins with a study of the map of the area to be reconnoitered. This study coordinates subsequent work and saves time. All possible use is made of information obtainable from troops already on the ground. These steps, however, do not ordinarily obviate the necessity for his going over the ground himself and personally supervising the units under his command. The situation frequently makes it necessary for the brigade commander to make a preliminary assignment of areas to the regiments from the map. This is followed by personal reconnaissance for the purpose of verifying the suitability of the areas assigned.

b. Regimental commanders.—Reconnaissance by the artillery regimental commander is conducted along the same general lines as the reconnaissance by the brigade commander. He rarely is accompanied by the battalion commanders on his first reconnaissance of the ground, which, as a rule, he makes with the brigade commander, but, after making a rough assignment of areas to the battalions, it is often possible for him to make a more detailed reconnaissance of each area, accompanied by the battalion commanders.

c. Battalion commanders.—(1) Reconnaissance is one of the most important duties of the battalion commander, and enters into most of the functions of the battalion in a tactical situation. Reconnaissance is necessary for selecting routes, for the selection of a position, for occupying or changing position, and for the immediate security of the battalion in action or on the march. The battalion headquarters personnel is reasonably complete for this purpose. Although exceptional cases may necessitate reinforcing the

battalion headquarters personnel from the battery details, this practice is to be avoided; battery details should be left for the exclusive use of battery commanders. The basic object of reconnaissance is to insure the prompt and orderly carrying out of assigned missions by the pieces themselves; it follows that reconnaissance must be timely, and must be made sufficiently in advance to insure that the pieces are not delayed or hampered.

(2) In the reconnaissance of positions, the battalion commander examines the terrain, keeping in view his mission, and using his staff and detail to the best advantage. He selects positions for the batteries with an exactness depending upon the time available. He selects a post for the battalion combat train, or merely indicates its general location and leaves the selection of the exact position to the commander of the combat train. The battalion commander selects his own command post early and takes prompt measures to observe the dispositions and movements of the enemy. He may be accompanied on his reconnaissance by the battery commanders, in which case he assigns them positions for their batteries as soon as selected. When the battery commanders or battery reconnaissance officers are not present, he communicates by means of the battery agents the necessary orders for the occupation of the positions selected, or he may send for the battery commanders and communicate his orders in person, either during or upon the completion of his reconnaissance. The battalion commander's reconnaissance should be completed sufficiently early to enable the battery commanders to make the necessary reconnaissance without delaying the batteries.

d. Battery commanders.—(1) Reconnaissance by the battery commander follows the same general lines as the reconnaissance by other artillery commanders. The terrain is examined in more detail and the locations of each subdivision of the battery are more carefully and accurately selected. Generally, more consideration is given to the technical location of the various establishments than in the case of the larger units.

(2) The battalion commander, after giving the battery commander the necessary information concerning the situation, either assigns a target or a normal zone to the battery, or directs the battery commander to accompany him on reconnaissance. He may give the battery commander a detached mission requiring the latter to make a separate reconnaissance. In any case the battery commander then makes a detailed reconnaissance of the position or area assigned to his unit as soon as practicable.

e. Employment detached.—When a regiment, battalion, or battery is employed separately, the reconnaissance and occupation of position are conducted in accordance with the same principles as when a part of the next higher unit. The commander assumes the functions of the senior artillery commander in addition to those properly his own. Under certain circumstances, he may be forced to delegate a part of his duties to the executive or the reconnaissance officer. This is avoided when practicable, but the necessity for an intimate understanding between the commander of troops and the artillery commander may compel him to remain with the former when his duties normally would call him elsewhere. No definite rules can be prescribed.

48. RECONNAISSANCE BY MEDIUM AND HEAVY ARTILLERY.—*a.* Reconnaissance by medium and heavy artillery follows the same principles and is conducted along the same general lines as prescribed for light artillery. Usually the necessity for medium and heavy artillery support can be anticipated and sufficient time gained to make a thorough and adequate reconnaissance for units of these classes of artillery. The location of these units on the march is, ordinarily, sufficiently far to the rear to allow ample time for the various commanders to precede their units and make a reconnaissance, and complete all necessary preparations of the positions during the time their organizations are moving forward.

b. Corps and army chiefs of artillery accompany their respective corps and army commanders upon reconnaissance. This reconnaissance is, generally, followed by a more thorough and detailed reconnaissance in which the corps

and army chiefs of artillery are accompanied by their next subordinate artillery commanders.

c. The reconnaissance of positions by corps and army chiefs of artillery usually commences with a reconnaissance of roads and an examination of bridges to determine their suitability for the movement forward of the artillery of their commands. This is followed by a reconnaissance for general areas for the location of the major units of the commands. The selection of positions for units of medium and heavy artillery, particularly the latter, is largely determined by the suitability of roads for advance and supply, and in the case of heavy artillery, upon the availability of narrow or standard guage railroads for the supply of ammunition. Due to the broad fronts upon which corps and armies operate and the distances necessary to be covered in reconnaissance by corps and army chiefs of artillery, a thorough study of the map before going on reconnaissance is always necessary. For this same reason it is often necessary for corps and army chiefs of artillery to employ the members of their staffs in making a part, at least, of this reconnaissance.

SECTION II

Selection of Positions

49. GENERAL.—*a.* In the selection of artillery positions, there are a number of important factors, both tactical and

technical, that must be considered in each situation. Whenever there is a conflict between the tactical and technical considerations the former, as a rule, govern. The only invariable rule that can be laid down is that the position selected permit the unit to carry out effectively its assigned tactical mission.

b. In general, the considerations affecting the selection of battery positions are as follows:

(1) Effective range.
(2) Field of fire and dead spaces.
(3) Means of signal communication.
(4) Observation.
(5) Concealment of both the position and the approaches.
(6) Facility of movement to the front, flanks, and rear.
(7) Favorable conditions for supply of ammunition.
(8) Proximity of good cover for limbers or tractors.
(9) Suitability of the soil and the slope of the ground for platforms, especially for heavy artillery.
(10) Noninterference with the operations of other troops in the same vicinity.
(11) Security, by the proximity of troops of other arms.
(12) Facilities for providing protection and comfort for the personnel and animals, especially if the position is to be occupied during an extended period.

50. RANGE.—*a.* At long ranges there is a material decrease in the accuracy of artillery fire and, consequently, in its effect. Shell may be employed effectively at greater ranges than shrapnel. The continued use of the maximum charge is very wearing on the pieces, recoil mechanisms, and carriages. Consequently, very long ranges should be avoided.

b. Short ranges, though in most cases advantageous to howitzers, result in increased dead spaces to guns due to their flat trajectories. Within the limits imposed by the tactical situation, however, a short range is always desirable on account of the increased accuracy of fire.

c. Considerations of range are not only technical, but tactical as well, when considered in relation to the field of fire discussed in the next paragraph.

51. FIELD OF FIRE AND DEAD SPACES.—*a.* Technically speaking, the field of fire of a battery includes all the ground in the direction of the enemy that can be covered effectively with fire from the emplacements of the pieces. Usually,

when the field of fire of a battery is spoken of, it includes only that part of the battery's possible field of fire within which the orders of the higher artillery commander indicate that it is expected to employ its fire power. This tactical field of fire usually includes a normal zone and one or more contingent zones. (See Chapter VIII, paragraph 120.)

b. In selecting a battery position, due consideration must be given to the zones assigned, in depth as well as width. When no definite zones have been designated, the possible field of fire must be such as to include all zones likely to be assigned.

c. Due to deep depressions in the terrain, or to obstructions to the trajectories within the possible azimuth of the pieces, there are usually parts of the ground within the field of fire of a battery that can not be reached. These are called dead spaces and, because of the flat trajectory of guns at the shorter ranges, they are usually found comparatively close to the battery position. Dead spaces for howitzers seldom exist.

d. By the skillful selection of gun positions, dead spaces may be reduced to a minimum. Except in very open and flat country they can not be avoided entirely.

e. So far, the discussion of the field of fire and of dead spaces pertains to a single battery. In an artillery command the extent of dead spaces may be greatly reduced and the field of fire enlarged, by disposing the batteries so that a dead space for one battery is within the field of fire of another.

52. DETERMINATION OF POSSIBILITY OF CLEARING MASK. —*a.* The battery position in rear of the mask must be such that the projectile, in firing on a given objective, will pass above the summit of the mask and reach the objective without encountering intermediate obstacles.

b. In the general case, clearance of the mask is assured before the pieces arrive, so as to preclude indecision and delay in posting them. It is necessary to decide what is the shortest range and the minimum site to be used. It can then be decided whether, from the contemplated position of the pieces, the projectiles will clear the mask and reach

the desired targets. If they will not, a place must be found from which they will. With a little care this position may be accurately determined so as to obtain the greatest defilade consistent with the terrain and the range to be used. In the case of howitzers, due to their high angle of fire, little, if any, difficulty is ever encountered in the clearance of the mask.

53. MEANS OF SIGNAL COMMUNICATION.—In the reconnaissance and selection of artillery positions, due consideration must be given to the possibility of the successful establishment and maintenance of a suitable system of signal communication. Points to be considered are:

a. Desirability of short lines.
b. Simplicity of system.
c. Utilization of existing lines.
d. Roads and trails for battery reels, runners, etc.
e. Ease of maintenance, especially at night.
f. Concealment of telephone lines.
g. Interference by traffic and troops.
h. Possibility of getting telephone lines off the ground.
i. Possibility of using visual signals.

54. OBSERVATION.—The proximity of good observation posts usually has a decided influence upon the selection of artillery positions. This is especially true when quick action is required, but terrestrial observation is of the utmost importance under any circumstances. The most effective and dependable means of adjusting artillery fire is from terrestrial observation posts. Airplane and balloon observation and flash and sound ranging systems are important auxiliary means to aid the artillery observer on the ground, but they by no means replace him. A careful topographic preparation of fire often enables an effective fire to be delivered when observation is impossible due to terrain, darkness, fog, rain, etc. This is one of the principal advantages of topographic preparation of fire, since the supported troops often demand artillery fire when observation of any kind is impossible. However, whether the preparation of fire has been made by topographic or other means, observation is always desirable. For this reason the possibilities of obtaining good terrestrial observation posts are always considered during the reconnaissance for artillery positions.

55. CONCEALMENT.—*a.* Due to the ease with which an exposed battery may be neutralized by hostile fire, positions for direct laying have become exceptional, and are used only when absolutely necessary, or when there can be little or no danger of neutralization by hostile artillery fire. The sustained service of an artillery command can be insured, in the face of an active enemy, only by rendering the pieces inconspicuous or by entirely concealing them. Concealment from terrestrial observation is, as a rule, more important than concealment from aerial observation.

b. The principal means of concealment is the defilade of the pieces from all points within the enemy's position. Complete concealment requires that the flashes of the pieces be invisible from the enemy's position. Such concealment requires in daylight a defilade of four yards for the 75-mm. gun and eight yards for the 155-mm. howitzer. To obtain dust defilade, positions with moist ground, pools, or a water course immediately in front of the pieces are desirable.

c. Concealment from aerial observation, including aerial photography, is also of very great importance, especially if the position is to be occupied for a considerable period of time. Concealment from aerial observation is very difficult to obtain. Every advantage must be taken of the natural means available, but these, while making hostile observation more difficult, do not always afford the necessary concealment. It sometimes is necessary to supplement the natural means available by camouflage nets or other artificial means.

56. DEFILADE.—In selecting a position, defilade from terrestrial observation, and sometimes from balloon observation, must be considered. The maximum defilade compatible with the mission is most important for flat trajectory guns. If a study of the map, especially of the contours, is made previous to reconnaissance of the terrain itself, useful indications are obtained. When indirect laying is to be employed, a position on a gentle slope just far enough behind the crest to insure the concealment of the flashes best facilitates running the pieces up to the crest, should direct laying be necessary. If the position is discovered by the enemy,

and the crest is plainly seen by him, the pieces are in a very vulnerable position, as the reverse slope may be searched by fire very effectively. Gas does not accumulate in a crest position, and drainage of the position is simplified, but evidences of occupancy and routes of access are difficult to conceal. In general, the security of a position increases with its defilade. Positions of deep defilade are sought when consistent with the mission of the battery. In addition to the protection afforded, they are as a rule comparatively easy of access. Positions of deep defilade may have disadvantages beside the tactical disadvantages of increased dead space. Low ground is subject to accumulations of gas, and drainage and the digging of shelters may be impossible.

57. FACILITY OF MOVEMENT AND SUPPLY.—*a.* When a position is selected for a battery, due consideration must be given to the feasibility of moving the battery quickly, in daylight or darkness, to some other position.

b. A position to which pieces are moved with difficulty usually opposes even greater difficulties to their removal. The possible effect of changed weather conditions must also be considered. A few hours of heavy rain may render impossible the removal of pieces from a position in which they have been placed without difficulty.

c. An ideal battery position insures quick movement under cover to both front and rear, as well as to one or both flanks.

d. Covered approaches from the rear are essential to the resupply of ammunition in the daytime. Otherwise the flow of ammunition may be interrupted by hostile fire, or the battery position disclosed by the movement of caissons or trucks bringing up ammunition.

58. CHARACTER OF GROUND AT THE EMPLACMENTS.—*a.* Most heavy pieces require the installation of a special platform. A light piece may usually be fired without any work on its emplacement, but if the soil is too hard for the trail spade to engage when the piece is fired, a narrow trench about one foot deep is dug in the shape of an arc to provide a bearing surface for the trail spade. The length of the arc must be sufficient to permit laying the piece in any

direction within its possible field of fire. If the soil is very soft, a similar trench should be dug, and the rear wall of the trench revetted with fascines, logs, or other material, preferably of an elastic nature, to serve as a bearing surface for the trail spade.

b. In selecting a battery position, sandy soil is avoided. Dust is almost as bad. Sand and dust blowing into the mechanism and adhering to the surface of the projectiles cause abnormal wear, and may result in putting pieces out of action. Soft, muddy ground is also avoided.

c. Flat horizontal ground is preferable to sloping ground for an emplacement. If the ground slopes to one flank, the pieces can not be elevated in a vertical plane and corrections for cant must be made. With light pieces this condition may be corrected by digging a trench for the higher wheel, provided the slope is not too great. A steep slope to the rear causes an abnormal recoil of a light carriage, and consequently considerable manhandling and delay in moving the piece back up the slope. A forward slope greatly assists in checking the recoil of the carriages, but, to fire at long range, it may be necessary to dig deep holes for the trails in order to give the pieces sufficient elevation.

59. INTERFERENCE WITH OTHER TROOPS.—*a.* Sites selected for battery positions are usually far enough in rear of the front line to avoid interference with the operations of other arms. It may be necessary, however, to select battery positions close to command posts, supports, or reserves, or even on the ground which they actually occupy. In a case of this kind the ground is made available for the artillery unless it has some other tactical use of greater importance, such as forming part of an organized defensive position. All troops in the same sector must work in harmony to carry out their common mission or plan of action. Due to the noise and the possibility of drawing hostile artillery fire, it is not pleasant for other troops to have a battery in close proximity. This condition can not always be avoided and must be cheerfully tolerated. Placing pieces along the rear edge of a lateral road is avoided, when interference with traffic may result. It is well not to place batteries close to

and on the leeward side of dusty roads, or too close to roads that are subject to heavy interdiction and harassing fire.

b. The batteries of a battalion or regiment are usually placed in position within the sectors or zones of action assigned to the troops they support, but where better positions are available in an adjacent sector or zone, arrangements usually can be made to occupy such positions provided there will be no interference with the troops pertaining to the sector or front.

c. Care is taken to avoid placing a battery so close in rear of another that the blast will interfere with the service of the latter's pieces.

60. SELECTION OF GUN OR HOWITZER POSITIONS.—*a.* Good positions may be found:

(1) On the edge of a road or trail.
(2) In woods, preferably of small trees or brush, where the cutting down of trees will not be necessary.
(3) In old infantry positions.
(4) In ruined settlements.
(5) In quarries.
(6) Sheltered under roofs in a village.
(7) Under a line of trees, with camouflage nets placed overhead.
(8) Irregularly placed over open ground.
(9) In isolated open places in a large wood.

b. Positions along roads are accessible and offer no evidence of occupancy, but if the road is much used, the firing and the resupply of ammunition may obstruct traffic.

c. Thin woods or brush and openings in woods generally afford excellent positions. The emplacements are difficult to discover and locate by aerial observation, the indications of occupancy are easily concealed, the adjustment of fire on them is very difficult, and material for construction is readily obtainable. Positions at the edge of woods are easy to locate accurately, and the same is true of positions in a small clump of woods. Such positions facilitate the adjustment of fire by the enemy.

d. Old infantry works afford good positions for artillery of light and medium calibers. The construction may be effected without attracting attention. The rear trench systems of defensive positions are favorable for positions. If is difficult to locate batteries so emplaced.

e. For similar reasons, the ruins of a village afford excellent positions. Concealment is facilitated, especially if the pieces are irregularly distributed. It is easy to avoid evidences of occupancy.

f. Orchards are suitable places for guns of small caliber.

g. On open ground it is very difficult to conceal positions, especially from aerial photography. This difficulty is increased if there are visible routes of supply or evidences of occupancy. Under such conditions the dispositions should conform to the general lines of cultivation or other natural features. Proximity to prominent points is avoided, since they facilitate both locating the battery originally and picking it up subsequently. This precaution is particularly important in case the position is visible from hostile balloons. Adjustment by balloon observation is much hampered by the absence of a prominent point near the objective. A position on open ground, far from any natural or artificial feature, is often an excellent one for a light battery and far safer than others that furnish excellent concealment. With good camouflage discipline and the nets in place, a battery will often remain undiscovered for a surprising length of time. When discovered, it is still reasonably safe from anything but an actual airplane adjustment.

61. SELECTION OF OBSERVATION POST.—*a.* In selecting an observation post the primary consideration is that observation must be reliable and continuous. Other desirable qualities, such as command, facility of construction, and signal communication, also are sought. The amount of construction work to be performed in establishing an observation post depends upon the time available. Observation posts vary from a tree top, shell-hole, or bare crest to a well-equipped concrete dugout. Ruins, steel towers, windmills, chimneys, church steeples, or any object affording a good view of the desired terrain are employed for this purpose. The more inconspicuous and permanent a structure is, the more desirable it is as an observation post. The general requirements of observation posts are:

(1) A good view of the normal zone.
(2) As close proximity to the first line as conditions warrant.
(3) Sufficient elevation.

(4) Easy communication with the unit it serves.
(5) Close proximity to the line of fire.
(6) Facilities for observing in comfort and for concealment.

b. Observation posts are selected so as to afford an extended view of the objective zone, and not merely of the zones assigned specifically to the unit. The fields of view of the several observation posts overlap, when practicable, so that the observation posts of an artillery unit form an observation system, which assures to that unit as complete a view of the terrain as is possible. This system is interlaced with, and forms an integral part of, the observation system of the next higher unit. Such a system is particularly important to the heavy artillery because of its long range and the large areas covered.

c. In order to provide a complete observation system, artillery commanders frequently establish, or direct the commanders of subordinate units to establish observation posts at particular points for command or intelligence purposes. These observation posts are, as a rule, in addition to those that may be established by the subordinate units for the conduct of fire.

62. SELECTION OF COMMAND POST.—*a.* (1) The requirements of a command post and of an observation post are entirely different. A command post is, if possible, a well-protected place, located under cover, to facilitate the transmission of orders and the conduct of official business. It is the field headquarters of the unit and is centrally located with respect to the command posts of the superior and subordinate commanders. The amount of construction depends upon the time and means available. It varies from a small shelter trench with a shelter tent stretched over it (with a similar one near by for the telephone central) to an elaborate, well equipped concrete dugout. A command post is a place of more or less activity. It includes the commander's station, telephone central, and message center, and there is a constant movement of runners, messengers, agents, etc., in its vicinity. For this reason it must be well protected from fire and observation.

(2) An observation post, on the other hand, is located to facilitate observation of the front assigned to the unit. It is not a command post in the true sense of the word, although it may be temporarily so used in a fast-moving situation, as, for example, an advance or rear guard action. Even when the observation post is used temporarily as a command post, the telephone central, message center, and the personnel pertaining to them are a short distance away under cover. A unit has only one command post but it may have several observation posts. One observation post may be used in common by several commands.

b. Artillery command posts must afford:

(1) Facilities for exercising command.
(2) Constant touch with the situation.
(3) Ready liaison with the commander of the supported unit.

c. Command posts of division artillery commanders and corps chiefs of artillery are near those of division and corps commanders, respectively. The command post of the corps artillery brigade commander is located so as to facilitate command of the brigade.

d. Regimental command posts usually are near roads and located so as to insure rapid and reliable communication by orderlies or messengers with the battalions of the regiment, the supported unit, and with the artillery brigade.

e. Battalion command posts are chosen so as to insure rapid and reliable communication with the batteries of the battalion, the supported unit, and with the regiment.

f. Battery command posts are selected in the immediate vicinity of the firing battery in order to facilitate vocal and visual communication with the firing battery, and to facilitate the exercise of command over the personnel, the supply of ammunition, the care of transport, etc.

63. SELECTION OF POSITION FOR LIMBERS AND BATTALION COMBAT TRAINS.—*a. Limbers.*—The preservation of the mobility of artillery depends upon the protection from hostile fire of the limbers (or other means of transportation of the firing battery). The position to be occupied and the formation to be taken by the limbers depend upon the nature of the cover available. To secure the maximum pro-

tection and to have free and prompt access to the pieces are the objects in view in the choice of position for the limbers. Concealment from view and also protection from fire are best secured by placing the limbers behind vertical cover. Ridges having easy slopes afford concealment from view. They do not, however, afford protection from searching fire. The effect of searching fire in such cases may be avoided or greatly reduced by placing the limbers more than 400 yards in rear of the covering crest. If the limbers can not be echeloned with respect to the firing batteries, they are at least 500 yards in rear of the pieces. When it is impracticable to conceal the limbers from the view of the enemy, they are posted as far from the pieces as the conditions of the case warrant, and formed in line, faced toward the enemy, with as wide intervals between carriages as the ground permits.

b. Battalion combat train.—The battalion combat train is posted as a unit in accordance with instructions of the battalion commander. The first considerations in selecting a position for the combat train are protection from hostile fire, and covered approaches to the firing positions of all the batteries. Other considerations are ample space to permit parking the carriages with considerable intervals, ease of access to roads running both toward the ammunition distributing point established by the ammunition train and toward the batteries, facilities for signal communication with the battalion command post, and concealment from aerial observation. It is desirable that the greatest distance to the firing batteries does not exceed 1200 yards, but this distance may be somewhat increased when good cover is not available. When positions are occupied for long periods and when there are no prospects of a movement, both limbers and combat trains may be established farther to the rear, and if possible together, in order to facilitate administration and the supply of rations to both men and animals.

64. Selection of Positions for Rear Echelons.—The selection of positions for rear echelons, which include the maintenance sections and the administrative and supply per-

sonnel, is made with a view to obtaining the maximum concealment and protection consistent with the exercise of their proper functions. These elements of batteries and battalions usually march with the battalion combat train when the command is about to occupy positions for combat, and, in the absence of instructions to the contrary, are stationed at the post of the battalion combat train. The rear echelons of regiments are usually stationed so as to be convenient to the Class I supply distributing point. Concealment and good roads are the principal considerations.

Section III

Procedure in the Reconnaissance and Occupation of Positions

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65. General.—The procedure in the reconnaissance and occupation of positions, outlined in this section, apply primarily to horse-drawn light artillery, but the principles apply equally to motorized light, medium, and heavy artillery.

66. Artillery Details.—*a*. Each artillery unit is provided with a headquarters, organized to assist the commander in the exercise of the functions of command and administration. Eliminating from these headquarters the commander, and the personnel whose duties are purely administrative, there remain the brigade, regimental, battalion, and battery details. These include the personnel necessary for reconnaissance; for the establishment, maintenance, and operation of the means of signal communica-

tion; for the establishment of command and observation posts and the operation of the fire control instruments; for liaison; and for duty as horseholders, drivers, chauffeurs, buglers, and agents. The organization of regimental, battalion, and battery details is fundamentally the same, differing only in the number of officers and men and in the transport and equipment. The tactical personnel of the brigade headquarters is largely signal; otherwise, its organization is similar to that of the others.

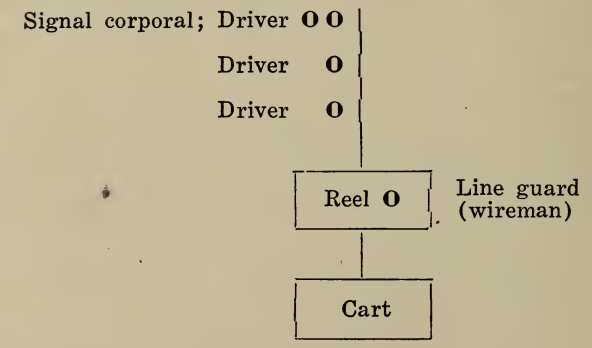
b. The detail is, as a rule, divided into two parts or subdivisions. The smaller of these groups, the commander's party, forms a convenient subdivision of the detail to take forward on a reconnaissance for positions when conditions are such that it is inadvisable to take forward the entire detail. The commander's party includes such personnel as is necessary to assist the commander in making his reconnaissance and in transmitting his orders. In the battalion and in the regiment, the commander's party usually consists of the executive officer, the communications officer, the reconnaissance officer and two scout corporals from the reconnaissance section, a liaison officer, an agent from each of the subordinate units, and a bugler. The regimental commander's party, in addition, usually includes the plans and training officer. The organization of the battery commander's party is similar to that of the battalion and regiment, except that it does not contain the agents, the liaison officers, and the communications officer. A signal sergeant, is, however, substituted for the communications officer. In the brigade, the commander's party is not definitely prescribed, but contains whatever personnel the brigade commander may elect to accompany him.

67. FORMATION OF THE DETAIL.—*a*. In the practical use of the various details, the duties and formations are flexible and must conform to the tactical situation, and to the personnel and equipment available. This is particularly true of the details of tractor-drawn units, since several types of transportation, motorcycles, reconnaissance cars, etc., are found in the column. To meet the requirements of the average case, the members of the detail are assigned normal duties

and positions, but each individual may be called upon to perform the duties of another and to go wherever it is necessary.

b. The following shows the composition and march formation of the battalion detail (horse-drawn), war strength. Those of the battery, regiment, and brigade details are similar.

Battalion commander's party	Battalion executive	O O	Battalion commander
	Communications officer	O O	Reconnaissance officer
	Liaison officer	O O	Bugler
	Battery agent	O O	Combat train agent
	Battery agent	O O	Battery agent
	Scout corporal	O O	Scout corporal
	Intelligence officer	O O	Plans and training officer
	Scout sergeant	O O	Sergeant major
	Scout private	O O	Scout private
	Scout corporal	O O	Scout private
	Instrument corporal	O O	Instrument corporal
	Range finder corporal	O O	Instrument operator
	Orderly	O O	Orderly
	Telephone operator	O O	Telephone operator
	Telephone operator	O O	Telephone operator
	Telephone operator	O O	Telephone operator
	Telephone operator	O O	Telephone operator
	Line guard	O O	Line guard
	Signal corporal	O O	Line guard



68. Location of the Detail on the March.—*a.* The location of the brigade, regimental, battalion, and battery details on the march, when contact with the enemy is expected, cannot be prescribed. They vary according to the situation. The artillery commander must give the necessary instructions in each case.

b. Brigade headquarters usually is at the head of the column. In the division, the brigade commander, as division artillery commander, usually accompanies the division commander, taking with him a part of his staff and leaving the executive to conduct the march of the brigade.

c. Ordinarily, the regimental headquarters and detail marches at the head of the regiment. In certain cases the regimental commander, with his party, may be with the brigade commander; if no other artillery is present, he, as artillery commander, is with the commander of troops. The regimental commander rarely has the battalion commanders, with their parties, march with him, but frequently has with him the battalion reconnaissance officers with certain of the battalion scouts.

d. The battalion headquarters and detail, as a rule, march at the head of the battalion. When no other artillery is present the battalion commander, with his party, is with the commander of troops.

e. In the battery, the battery commander with his party is at the head of his battery, or accompanies the battalion commander, as the latter may direct. The battery detail, less the battery commander's party, usually marches at the head of the battery. Under certain circumstances the details of the batteries of a battalion may be assembled at the head of the leading battery.

69. PROCEDURE IN THE RECONNAISSANCE FOR POSITIONS. —*a.* No fixed rules can be laid down for the employment of the detail in the reconnaissance, preparation, and occupation of positions. The method of employing the detail must be sufficiently flexible to be adapted to varied conditions and circumstances. A suitable system for the employment of the detail as a whole is outlined below. Its application to concrete problems varies greatly.

b. When practicable the artillery commander reaches a position in ample time for complete and careful reconnaissance, for the formulation of a definite plan, and for issuing the necessary orders so that the position may be occupied and effective fire opened without confusion or delay. In the case of a subordinate artillery commander,

this is usually provided for by instructions from the next higher commander which direct the subordinate to proceed forward in time to accompany the higher commander upon his reconnaissance, or to be at hand to receive orders from the latter upon the completion of his reconnaissance.

c. When an artillery commander goes forward on reconnaissance for the selection of positions, he is accompanied by his party or by some part of it. The remainder of the detail follows at such distance in rear as the commander may direct. When reporting to a superior for reconnaissance, artillery commanders rarely take with them the entire commander's party, but are accompanied by a few selected members. Those members of the party who do not accompany the commander are left close at hand where they will be immediately available to assist the commander when he begins his own detailed reconnaissance. The remainder of the detail proceeds to a rendezvous point agreed upon, or remains with the organization until sent for. Arrangements are made so that the detail will be close at hand when the reconnaissance is completed in order that it can commence at once to organize the position selected, establish observation and means of signal communication, compute firing data, and carry messages.

d. (1) As previously stated, subordinate artillery commanders, whenever practicable, accompany their immediate superior on his reconnaissance and receive orders, either during this reconnaissance or upon its completion, assigning missions and locations to the subordinate unit. When not practicable to join the higher commander on the reconnaissance, the subordinate is given the necessary instruction upon his arrival. In either case the subordinate then begins a detailed reconnaissance of the locality or area assigned to his organization.

(2) If not already done, the commander immediately issues orders for the remainder of his detail and his subordinate commanders to proceed forward and report at a designated point. He also sends instructions to the officer left in command of the unit, informing him of the tactical situation, and directing the disposition of the organization,

that is, whether or not the command is to move forward at once, and if so, the route to be followed and the rate of march. Generally, however, these instructions, so far as may be desirable or practicable, are issued when the commander leaves his organization and goes forward on reconnaissance.

(3) Accompanied by his subordinate commanders, if present, the artillery commander then makes a careful examination of the terrain assigned to his unit, utilizing, wherever possible, the members of his party to assist in this reconnaissance, and comes to a decision, so far as they are applicable to the particular command, on the following:

(a) Positions to be occupied.
(b) Routes of access, and concealment for the unit or units in approaching the position.
(c) Missions (including normal and contingent zones and special fires).
(d) Time of occupation and of opening fire.
(e) Location of observation and command posts.
(f) Means of signal communication to be established.
(g) Liaison with other arms.
(h) Instructions as to the limbers, battalion combat trains, ammunition, aid stations, supply, etc.
(i) Construction of camouflage and protection of position, including disposition of machine guns.
(k) Other necessary instructions to insure a prompt opening of fire.

e. After completing his detailed reconnaissance, the artillery commander issues his order for the occupation and organization of the position, embodying therein the decisions made upon the above points. This order, whenever practicable, is complete and in the prescribed form, and issued in the presence of the assembled party and subordinate commanders. When practicable the order is issued at some point from which the terrain in the direction of the enemy and the positions to be occupied can both be seen. When impracticable to select such a point, it is preferable to issue the order where the locations or positions referred to can be observed.

70. Occupation and Organization of the Position. —*a.* As soon as the orders and instructions of the commander are understood, the organization of the position

proceeds without delay. The remainder of the detail comes up and work is started at once to establish observation and signal communication. Firing data are computed by the battery details and every effort is made to complete all arrangements for action prior to the arrival of the firing batteries. In the meantime, the various artillery commanders usually send back guides to meet the organizations to conduct them forward and to transmit instructions to the officers in command relative to the occupation of the position. The approach to and occupation of positions under cover of darkness is of frequent occurrence. In such cases the route and all details of the movement must be determined in advance by reconnaissance during the day. It is usually desirable to post markers before nightfall along the route to be followed. Frequently the commanders go back and lead the units into position when the movement is to be made at night. In the movement forward to the general area to be occupied, battalions, and, in most cases, regiments are kept intact and marched as a single unit. The movement into and the occupation of the position itself is, however, conducted by the batteries in accordance with the battalion commander's order and under his supervision.

b. After the position has been occupied for firing, the work of organization is continued with a view to perfecting the system of observation and command, and furnishing the maximum amount of concealment and protection for the personnel and *matériel*. Reconnaissance is continued for the purpose of locating routes of advance, observation and command posts, and for gaining additional information concerning the enemy and the location of our own troops. Steps are taken to improve the system of signal communication. Alternative means (visual or runners) are established, telephone lines are put on poles or trees where possible, concealment and cover are provided for telephones and switchboards and for their operators, lateral lines are established, and, in general, all steps are taken to insure, as far as possible, rapid and uninterrupted communication within the unit. Measures are taken to develop and improve the system of observation. Auxiliary observation posts are established

when needed and arrangements made with adjacent units with a view to using their observation posts. Concealment and cover are provided for the observers and arrangements made for their relief and messing in case the position is to be occupied for some time. The command post, including message center and switchboard, is more permanently established, and concealment and protection from fire provided for the personnel. Camouflage for the pieces is constructed. Paths and roads are marked out and a system of circulation established. Cover for the personnel is provided wherever possible. In general, the organization of the position is as highly developed as time and material permit. The execution of this work, however, must not interfere with the delivery of fire but must be done before firing, during lulls in firing, or by personnel not otherwise engaged.

71. CHANGE OF POSITIONS.—*a*. The procedure in the reconnaissance, when a change of position is necessary, is in general, the same as in any other situation. If the displacement is to the rear the artillery commander, as a rule, designates a member of his staff, preferably the reconnaissance officer, to make the necessary reconnaissance while he himself remains at the position and supervises the withdrawal of his unit. In an advance the commander ordinarily precedes his command to select and reconnoiter the new position, leaving the reconnaissance officer to close station and bring up the main part of the detail. In principle, the commander goes where his presence is most needed to maintain discipline and morale.

b. (1) Within the brigade, a change of positions may be made by moving the regiments simultaneously, or a single regiment may be moved as the tactical situation of the unit it is supporting may demand. The movements of the individual regiments are usually by battalion. A change of position by one or more regiments does not, in itself, ordinarily make necessary any redistribution of missions by the brigade commander, since each regiment carries on the work called for by its mission throughout the move.

(2) Within the regiment, the battalions very rarely are moved simultaneously, but each battalion in turn is moved as a unit, while the other battalion or battalions remain in action. If practicable, the movement is so timed that not more than one battalion is out of action at any time.

(3) A change of position by a battalion operating with other artillery is normally conducted as nearly simultaneously as the available roads permit. When other artillery is not present, the necessity for maintaining continuity of fire usually makes it necessary to make the change by battery. The reconnaissance is made by the battalion commander or the executive before or during the move of the first battery. The move usually is so timed that not more than one battery is out of action at any given moment.

CHAPTER VI

Signal Communication

SECTION I

General

72. MEANS OF SIGNAL COMMUNICATION.—*a.* The various means of signal communication employed by artillery for which equipment is issued are:

(1) The telephone.
(2) The radio telegraph.
(3) The radio telephone.
(4) Visual signaling (semaphore, wigwag, signal lamps).
(5) Pyrotechnics.
(6) Motorcycle, mounted and dismounted messengers.
(7) Panels (from artillery to airplanes).

b. Except for communication with airplanes, the artillery relies mainly upon the telephone as a means of signal communication. However, no means of signal communication is infallible, and no one means is depended upon to the exclusion of others available, especially in offensive operations where often the advance is so rapid that the installation of telephone lines cannot keep pace.

73. ESTABLISHMENT OF SIGNAL COMMUNICATION WITHIN AN ARTILLERY COMMAND.—*a.* Artillery in combat in-

stalls, operates, and maintains its own system of signal communication within organizations, up to and including brigades. The system of each battery, battalion, regiment, and brigade, although forming an integral part of the system of the next higher unit, is normally complete in itself, and functions under the control of the commander of the unit. If the signal communication system of an artillery unit be not complete in itself, its efficiency in combat necessarily depends largely upon the effective maintenance of a system over which it has no control. For example, the efficiency of a battery which utilizes a battalion telephone line as its only means of signal communication between the firing battery and its firing observation post, depends upon the maintenance of this telephone line by the battalion. This condition should be avoided.

b. Signal communication within an artillery command is vital to combat, and is habitually established as a matter of routine. Ordinarily an artillery brigade establishes signal communication with its regiments, a regiment with its battalions, and a battalion with its batteries. On rare occasions the reverse of this practice is desirable.

c. An artillery brigade commander, through his communications officer, has direct control over the signal communication established by the personnel of his headquarters, and supervisory control over the signal communication established by the subordinate units of his command. The same applies to regimental and battalion commanders. Proper supervision by higher commanders and a spirit of harmonious cooperation among the communications officers of a command secure an equitable distribution of installation, operation, and maintenance, and give the best results with the greatest economy of time, labor, and material.

74. Relation of Artillery System to Other Systems.—An artillery command must take advantage of the systems of signal communication established and maintained by other units, and thereby conserve both material and labor in securing alternative means of signal communication with supported troops, with other artillery units, with flash and

sound-ranging stations, with observation squadrons, with rear echelons and field trains, and between its own various elements.

SECTION II

The Telephone

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75. TELEPHONE EQUIPMENT.—The equipment used by field artillery for establishing telephone communication consists of switchboards of various sizes, field wire (heavy twisted pair), outpost wire (light twisted pair), and reels and other apparatus for laying, maintaining, and taking up wire. The allowances of such equipment for the various field artillery units are published by the War Department from time to time.

76. ESTABLISHMENT OF SWITCHBOARDS.—*a.* The switchboards supplied to the field artillery are used to establish telephone centrals just as commercial switchboards are used in establishing telephone centrals in towns and villages. An artillery telephone central is merely one part of the whole telephone system of the unit to which it pertains. A telephone central is established at the command post of each artillery unit. It has the necessary local lines, and also trunk lines connecting it with the telephone centrals of other command posts. Such a system of connected switchboards and the established local lines, constitutes a telephone net. Any telephone operator is able to call any other operator in the net.

b. At each artillery brigade, regiment, and battalion command post, an 8-line or 12-line switchboard usually is installed, while at a battery command post a 4-line switchboard usually is used. Additional switchboards are supplied to enable the continuity of telephone service to be maintained during an advance, and to enable wire and labor to be conserved in the establishment of axial lines (see paragraph 80). All switchboards installed at places other than the telephone centrals of unit command posts are referred to as switching centrals.

77. INSTALLATION OF TELEPHONES.—The priority in which telephones connected to a particular central are installed is established by the commander, and varies with the situation. Usually the message center is the first office connected. Frequently one telephone serves two or more staff officers. Telephones are installed at rear echelons as necessity requires.

78. SELECTION OF TYPE OF WIRE.—An artillery command relies mainly upon field wire for its telephone communication. Outpost wire is employed where, due to the nature of the terrain, or exposure to hostile fire, it is impracticable to utilize trucks, or horse-drawn or tractor-drawn reels. Outpost wire is especially valuable for signal communication with advanced observation posts and for maintaining telephone communication with the infantry during an advance.

79. LAYING TELEPHONE WIRE.—*a.* Field wire is issued on spools holding about one-half mile of wire. For general use, especially on poor roads and across country, the horse-drawn or tractor-drawn reel provides the simplest means of laying it. However, this wire may be laid directly from the spool, by hand or by utilizing a truck. Artillery battery reels hold about two and one-half miles of this wire, battalion and regimental reels about four miles. Considerable time is required to transfer the wire from the spools to the reels. Small reels are issued to batteries of division artillery in limited numbers and are mounted on caissons. They are very useful for running out short lines by hand from the firing battery. Breast reels are issued to light,

medium, and heavy artillery organizations. They are designed for laying short lines of outpost wire, and each carries about two hundred yards of this wire.

b. Initially it is usually necessary to lay artillery telephone lines on the ground, but as continual traffic soon breaks the insulation they are raised as soon as practicable. Wire on the ground is laid loosely. At points where it crosses traffic routes, it is either buried or passed overhead.

80. Axial Lines.—An axial line is a telephone line connecting the switchboard at the command post of a unit with a switching central of the same unit. Through the use of an axial line, economy in establishment and maintenance often may be gained. For example, assume (see Figure 2) that the artillery regimental command post is

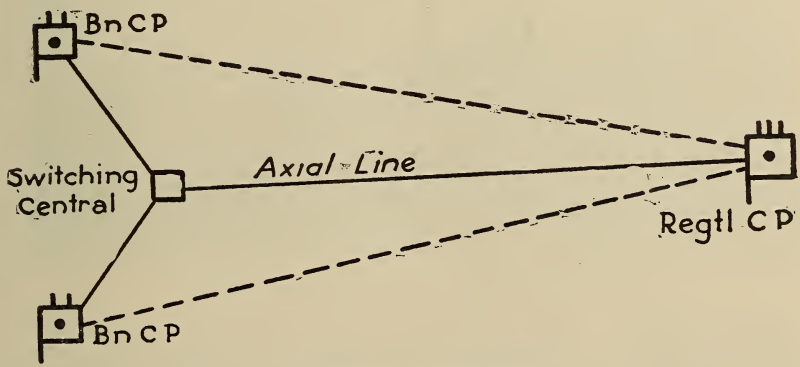

Figure 2—Axial Line

a considerable distance in rear of the battalion command posts. Direct wire communication may be established between the regimental command post and each battalion command post, as shown in broken lines; but a considerable saving in wire and labor may be effected by establishing a switching central near the battalion command posts and laying the lines shown in solid lines.

81. Division Artillery.—*a. Battery.*—(1) (a) In a 75-mm. gun battery, horse-drawn, a signal detail and a battery reel drawn by four horses are provided for establishing, maintaining, and operating the battery signal communication. The main reliance is the telephone. Auxiliary means are used to replace the telephone when necessary.

(b) The signal detail commences its operations as soon as the battery position, observation post, and command post are selected, and signal communication is established usually before the firing battery reaches its position. The principal communications to be established are between the firing battery and the battery observation post or posts, and between the battalion commander and the battery commander. The latter is established usually by the battalion though it may be expedient in a particular situation for the battery

PLATE XX—Battery Reel, Horse-drawn

to establish it. This is decided by the battalion commander. Communication is usually established by telephone, and is primarily a command line between the battalion commander and the battery commander. The link between the battalion and battery telephone nets is established usually between the switchboard at the battery command post and the nearest switchboard of the battalion net.

(c) Signal communication between the firing battery and the limbers is usually visual or by mounted messenger.

(d) Unless acting independently as a tactical unit, a battery seldom has occasion to establish signal communication with other troops unless required to do so in order to relieve the battalion signal personnel of part of its burden where a large number of battalion lines are to be established.

(2) A 75-mm. gun battery, tractor-drawn, when employed for combat, is almost invariably attached to a division, and the principles of battery signal communication are the same as for a 75-mm. gun battery, horse-drawn. The reel and cart are drawn by a 5-ton tractor and the telephone personnel is transported by trailer, in a reconnaissance car, and on the reel and cart.

(3) A 75-mm. gun battery, *portée*, is likewise usually attached to a division for combat and the principles of battery signal communication are, in general, the same as

PLATE XXI—Reel and Cart, Horse-drawn

for the 75-mm. gun battery, horse-drawn. *Portée* batteries are not equipped with reels and carts, and wire must be laid by hand or from trucks. As *portée* batteries usually are placed in position in the vicinity of roads and suitable observation posts, their wire lines are laid mainly along roads and usually are short.

b. Battalion.—(1) A battalion telephone net may be compared to the local telephone system of a small town, except that the former may have more than one switchboard. In the same way that the local telephone system of a small town is connected with the telephone systems of neighboring towns, the battalion telephone net is connected with the telephone nets of other units with which signal communication may be necessary. The battalion communi-

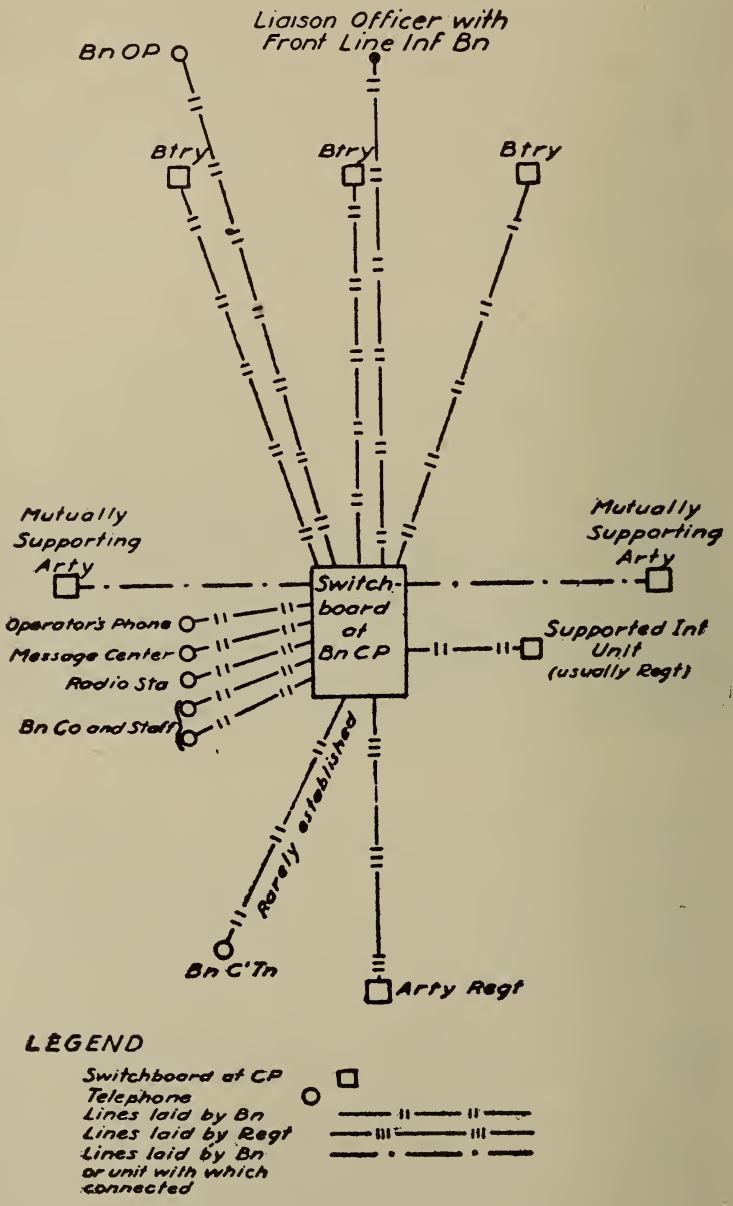

FIGURE 3—Wire Lines to and Within the Battalion

cations officer is responsible, in combat, for the prompt development of such a system, in coordination with the communications officers of other units. Efficient telephone service must be quickly established and maintained with all the units with which the battalion has need for telephone communication.

(2) (a) In a 75-mm. gun battalion, horse-drawn, a signal detail and a reel and cart drawn by six horses are provided for establishing, maintaining, and operating the battalion signal communication. Main reliance is placed on the telephone, but auxiliary means must be arranged to replace promptly or supplement the telephone when necessary. The telephone communication usually essential to a battalion of 75-mm. guns, horse-drawn, is shown diagrammatically in Figure 3.

(b) Figure 4 illustrates a special case requiring supervision and cooperation in carrying out a plan of signal communication for a battalion of 75-mm. guns, horse-drawn, taking up a position in a defensive situation. It is not intended to illustrate either an ideal or a typical disposition, but to exemplify difficulties in signal communication that frequently may be expected. The most essential battalion telephone lines are shown in the diagram in unbroken lines. In this particular case these lines, excluding those to the batteries, require nearly two miles of wire. To connect the batteries with the battalion switchboards nearest thereto requires an additional mile of wire. To establish telephone communication with the command posts of an adjacent artillery battalion (B') on the left requires another mile of wire. There is but one reel and cart with the headquarters of the battalion. To establish and maintain four miles of telephone line is a great deal for battalion headquarters to undertake. In this particular case the batteries have good observation close at hand, on ridge 590 and on hill 625, and consequently have very short telephone lines to lay. To save time and to make a more equitable distribution of the signal communication to be established and maintained, it is probable in this case that the battalion communications officer would make the following recommendations to his battalion commander:

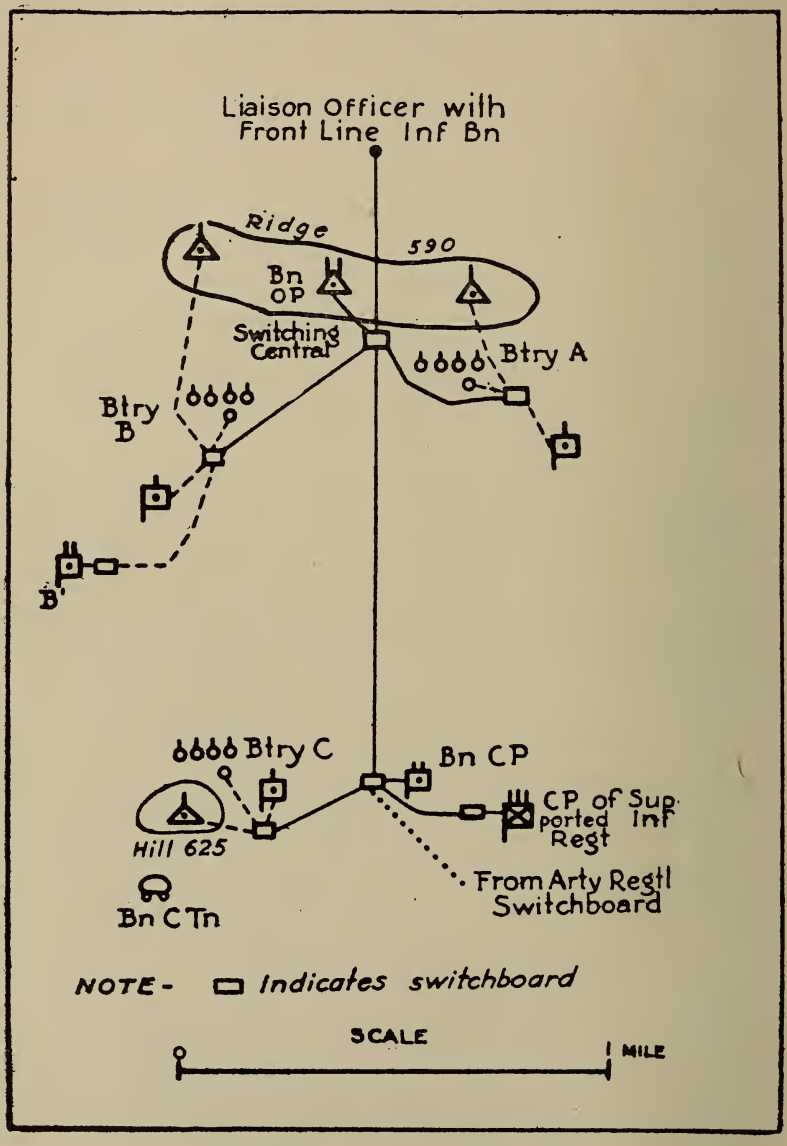

FIGURE 4—Wire Lines of a Battalion in a Defensive Situation

(i) Battalion personnel to establish and maintain the lines shown unbroken on the sketch except as designated in (ii).

(ii) Batteries to establish wire communication with the nearest battalion switchboard.

(iii) Battery B to establish wire communication with the artillery battalion command post at B' (under the principle that lateral communications are run normally toward the left).

(c) In open warfare situations, signal communication between the combat train and the remainder of the battalion is usually visual or by messenger. In stabilized situations a telephone line frequently is laid between battalion headquarters and the combat train.

(3) For a 75-mm. gun battalion, tractor-drawn, the principles of signal communication are the same as for a horse-drawn battalion. The tractor-drawn battalion is equipped with a reel and cart drawn by a 5-ton tractor, and the telephone personnel is transported in reconnaissance cars and on the reel and cart. The telephone communication usually essential is similar to that for a horse-drawn battalion.

(4) For a 75-mm. gun battalion, *portée,* the principles of signal communication, in general, are the same as for a horse-drawn battalion. A *portée* battalion is not equipped with a reel and cart, and wire must be laid by hand or from trucks. The wire lines of a *portée* battalion in firing position usually are short, the batteries being placed comparatively close together and near observation, while the battalion command post is usually near the batteries.

c. Regiment.—(1) Regimental telephone communication corresponds in principle to the battalion telephone communication discussed in the preceding paragraph. Usually a regiment has fewer lines to install than a battalion, and is prepared, whenever necessary, to assist its battalions with their telephone installations. This frequently may be accomplished by establishing axial lines convenient for the battalions to use, especially in situations requiring forward displacement of the battalions. While the signal corps is

the source of supply of signal communication equipment, regimental communications officers, through the brigade communications officer, are responsible for the submission of the proper requisitions for equipment in ample time. They are also responsible for the proper allocation of such equipment in their organizations.

(2) In a 75-mm. gun regiment, horse-drawn, a signal detail, and a reel and cart drawn by six horses are provided for establishing, maintaining, and operating the regimental signal communication. As in the horse-drawn battalion, main reliance is placed on the telephone, but auxiliary means must be ready for prompt use in case of necessity. The telephone communication usually essential to a regiment of 75-mm. guns, horse-drawn, is shown diagrammatically in Figure 5.

(3) The 75-mm. gun regiment, tractor-drawn, is equipped with a reel and cart drawn by a 5-ton tractor. The telephone personnel is transported in reconnaissance cars and on the reel and cart. The telephone communication usually essential is similar to that for a horse-drawn regiment.

(4) The 75-mm. gun regiment, *portée,* is not equipped with a reel and cart, and wire must be laid by hand or from trucks. As with the *portée* battery and battalion, long telephone lines are avoided. As with a horse-drawn regiment, main reliance is placed on the telephone, but other means, particularly motorcycle messengers are used to supplement the telephone and to replace it when necessary.

d. Brigade.—(1) Brigade telephone communication corresponds in principle to the regimental and battalion communication already discussed. The brigade communications officer must associate closely in his work with the division signal officer. In addition to his responsibility for the telephone communication of brigade headquarters, he exercises general supervisory control over the system of signal communication throughout the entire brigade. This supervisory control is for the purpose of insuring:

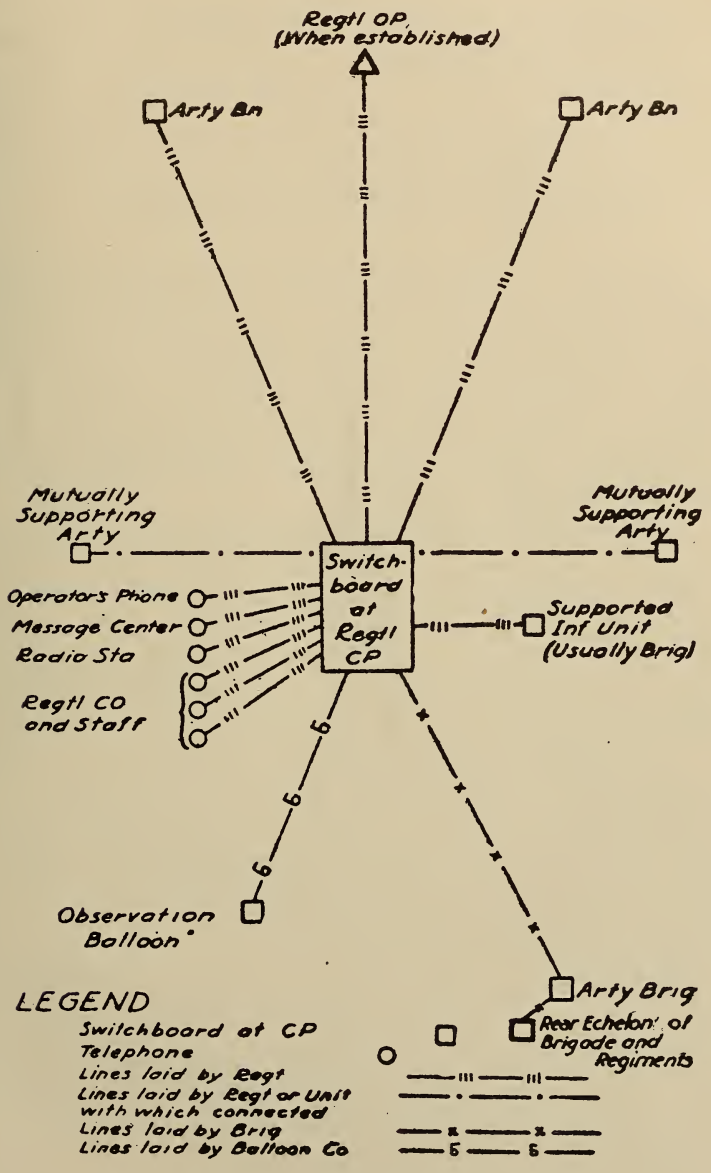

FIGURE 5—Wire Lines to and Within the Regiment

(a) Efficient installation, operation, and maintenance of telephone communication throughout the brigade.
(b) Equitable supply and replacement of telephone equipment and wire to the regiments.
(c) Uniformity in the system of instruction for telephone personnel.
(d) Effective coordination of the artillery telephone system with the systems of other units.
(e) Utilization in the most effiicacious manner of existing telephone lines or of lines abandoned by the enemy.
(f) Salvage of wire from discontinued lines.

(2) In a 75-mm. gun brigade, horse-drawn, a signal detail, and a reel and cart drawn by six horses are provided for establishing, maintaining, and operating the brigade signal communication. As with the lower units, the telephone is the main reliance, but auxiliary means must be placed in readiness. The telephone communication usually essential to a 75-mm. gun brigade, horse-drawn, is shown diagrammatically in Figure 6.

(3) The 75-mm. guns, tractor drawn and *portée,* usually are not attached to divisions in units larger than regiments. If formed into provisional brigades, their telephone communication follows the same principles as the communication of the 75-mm. gun brigade, horse-drawn. Due to lack of personnel and material, only the indispensable wire lines are laid and these are made as short as practicable.

e. Attached medium artillery.—When units of medium artillery are attached to the division, the principles of signal communication and the means of establishing, maintaining, and operating telephone communication are the same as for corresponding units of light artillery except that wire lines to infantry units are seldom laid.

82. CAVALRY DIVISION ARTILLERY.—The 75-mm. gun battalion (horse) which forms an organic part of the cavalry division is provided with a signal detail, and a horse-drawn reel and cart for establishing signal communication as in the 75-mm. gun battalion, horse-drawn. Similarly each of the three batteries of the battalion is provided with a signal detail and a horse-drawn battery reel. The principles of signal communication applicable are, in general, the same as for the corresponding units of the organic artillery of an infantry division. Due to the relatively short

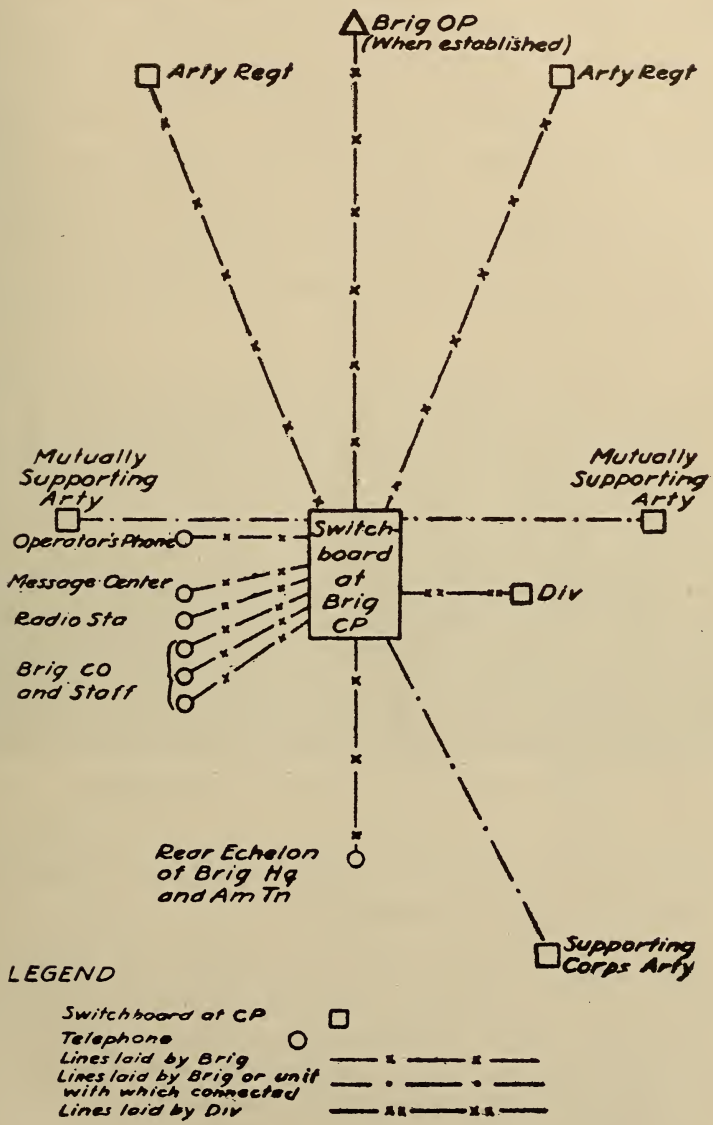

FIGURE 6—Wire Lines to and Within the Brigade

time ordinarily available, the wire lines laid are usually comparatively short and limited to absolute necessities. Means of signal communication auxiliary to the telephone are frequently utilized, especially motorcycle and mounted messengers. Radio is also frequently used, each battery being equipped with a radio telephone-telegraph set. There are, as a rule, no mutually supporting artillery lines to be laid. In combat, the battalion maintains communication with one or both cavalry brigades, according to circumstances. Communication between the battalion and the command post of the cavalry division normally is maintained

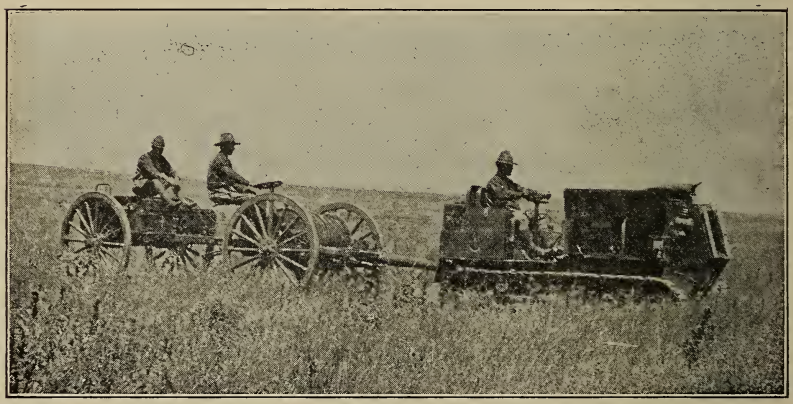

PLATE XXII—Reel and Cart, Tractor-drawn

by the division. The batteries, when attached to, or in direct support of, a brigade or regiment, maintain communication with such brigade or regiment.

83. CORPS ARTILLERY.—*a. 155-mm. howitzer.*—(1) Each 155-mm. howitzer battery, battalion, and regiment is provided with a telephone detail, and a reel and cart drawn by a 5-ton tractor for establishing, maintaining, and operating telephone communication. The personnel of the telephone detail is transported in reconnaissance cars and on the reel and cart.

For 155-mm. howitzer units, the principles of signal communication, in general, are the same as for corresponding units of the light artillery, including the principle that

while the main reliance is placed upon the telephone, auxiliary means of signal communication must always be ready to supplement or replace the telephone. The telephone communication usually essential to 155-mm. howitzer units is, in general, as shown in Figures 3 and 5 for 75-mm. gun units, horse-drawn, except that wire lines to infantry units are not laid.

(2) When a regiment of 155-mm. howitzers is designated to give special fire assistance to a division, a wire line is laid to the command post of the division artillery commander. Where close coordination with a light artillery regiment of the division artillery is necessary, a wire line is laid to the command post of such regiment, also.

(3) When a regiment or smaller 155-mm. howitzer unit is assigned a special mission in connection with counter-battery, direct telephone communication usually is established with the observation battalion, the line being laid by the observation battalion; and with the sound ranging service (if present), the line being laid by the sound ranging service. When this direct telephone communication is not practicable, telephone communication with these agencies is obtained through the switchboard at corps artillery brigade headquarters.

b. 155-mm. gun.—(1) For 155-mm. gun units the means provided for establishing telephone communication are similar to the means provided for corresponding 155-mm. howitzer units, except that the tractor used for drawing the reel and cart of a 155-mm. gun unit is a 10-ton tractor. The principles of signal communication, in general, are the same for the two types.

(2) The telephone lines that usually are required for the two types, are, under similar conditions, the same. Due to the long range, relatively low mobility, and other characteristics of 155-mm. gun units, they are retained by the corps to execute missions of particular importance to the corps as a whole on its entire front, and therefore seldom establish direct telephone communication with subordinate units. Due to the longer ranges at which fire usually is executed and to the considerable period of time required in oc-

cupying positions, it usually is not difficult to plan carefully and establish a system of signal communication for 155-mm. gun units well in advance of the completion of occupation of the position by the firing batteries.

c. Corps artillery brigade.—(1) In the corps artillery brigade, a signal detail, and a reel and cart drawn by a 5-ton tractor, are provided for establishing, maintaining, and operating the brigade signal communication. The telephone personnel is transported in reconnaissance cars and on the reel and cart. The telephone communication of the corps artillery brigade corresponds in principle to the telephone communication of the division artillery brigade, discussed in an earlier paragraph.

(2) The telephone communication usually essential to a corps artillery brigade is similar to that shown in Figure 6 for a division artillery brigade, with obvious omissions (line to division command post and line to supporting artillery), and the addition of a line to the corps command post laid by the corps, a line to the observation battalion laid by the observation battalion, and a line to the sound ranging service (if present), laid by the sound ranging service. When conditions require it, direct telephone communication is established to the corps chief of artillery also, the line being laid by the corps signal battalion.

(3) Main reliance is placed on the telephone, but auxiliary means, especially motorcycles, are used to supplement, and, when necessary, replace the telephone.

d. Attached units.—When units of medium and heavy field artillery are attached to the corps and are retained under corps control, the principles of signal communication and the means of establishing, maintaining, and operating telephone communication are the same as for corresponding units of the organic corps artillery.

84. ARMY ARTILLERY.—*a.* For 155-mm. gun and 240-mm. howitzer units retained under army control, the principles and the means of signal communication are the same as for corresponding 155-mm. gun units of the corps artillery.

b. Unless units of army artillery are organized into provisional brigades or into groupments, they establish wire lines to army artillery headquarters.

c. Direct telephone communication usually is established by the most convenient sound ranging station and corps observation battalion to units of army artillery engaged in counterbattery.

d. Units of army artillery do not establish direct telephone communication with divisions or lower units. When an army artillery unit is assigned missions in assistance of a particular corps, it establishes direct telephone communication with the corps chief of artillery, or with the corps artillery brigade, according to circumstances. Additional direct telephone communication, at times, is established by army artillery units with subordinate units of corps artillery, when close coordination of fire renders such communication necessary or desirable.

SECTION III

The Radio

85. IMPORTANCE AS A MEANS OF ARTILLERY SIGNAL COMMUNICATION.—*a.* Radio now constitutes the principal means of communication between artillery and airplanes. It also constitutes an important auxiliary means of communication between artillery units, and between artillery and supported troops, and as radio equipment is developed and improved, its importance for these purposes will increase.

b. The practical employment of radio communication is to some extent dependent upon atmospheric conditions

including intentional and unintentional "jamming of the air." It is now the most important means of communication between airplanes and ground troops. The wire telephone is the normal means of communication between stations on the ground. Nevertheless, there are occasions when the radio is of greater utility to the artillery than the wire telephone, and perhaps in many instances it will be the only practical means of prompt communication in a crisis.

c. Radio telegraphy is the normal means of radio communication between units on the ground. Radio telephony is the normal means of communication between the ground and airplanes, and between airplanes. The tactical employment of radio telephony and telegraphy are similar.

86. RADIO EQUIPMENT.—The basic allowances of radio equipment for field artillery are published by the War Department. Radio equipment is undergoing constant development and in the event of war, it will be necessary, at the beginning, to make the best use possible of the radio equipment available, and to expedite production of the most advanced types that may have been developed.

87. RADIO NETS.—*a.* In order that proper control, supervision, and coordination of radio traffic may be exercised, the radio station of each superior unit and the radio stations of the next subordinate units are grouped into radio nets.

b. In order that each net may be controlled as the tactical situation may demand, a net command station is designated for each net. Normally the station belonging to the highest tactical unit in the net is so designated, though any other station may be designated when circumstances warrant. The net command station is charged with regulating traffic and maintaining order within the net.

c. Within each net, stations are assigned certain settings to be used by them. These settings may be expressed in terms of wave lengths, frequency, or a tuner setting scale marked on the set.

d. At army headquarters, for purposes of supervision, a radio set is usually assigned the special mission of intercepting our own radio traffic within the different nets. This

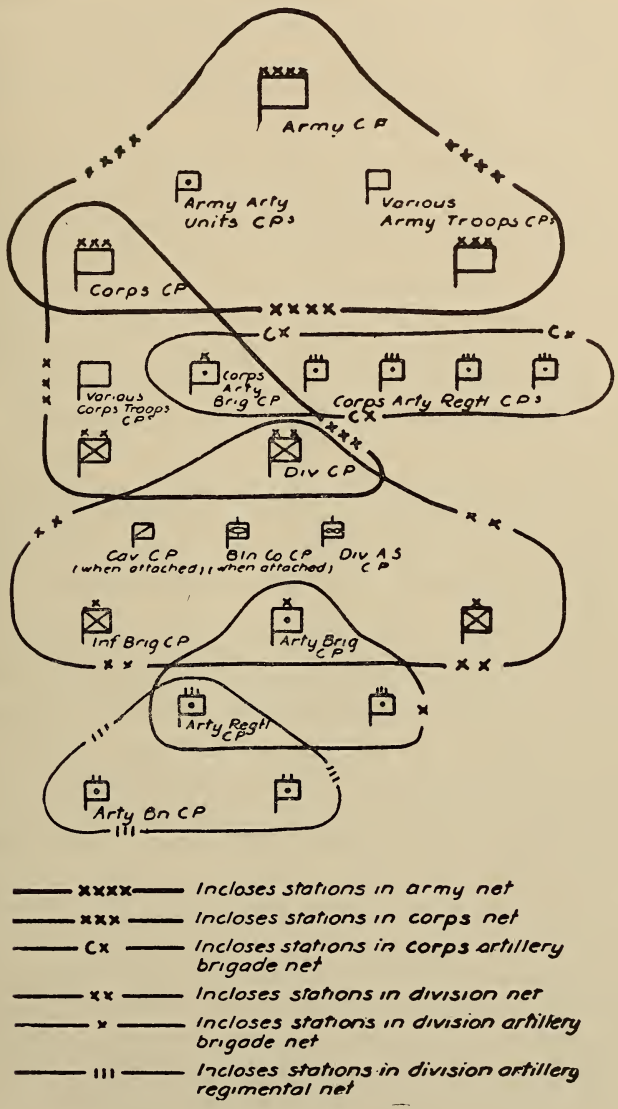

FIGURE 7—Radio Nets

station adjusts to the wave length of the net or station to be supervised and "listens in" on the work being carried on. Any violation of regulations, such as the unauthorized sending of uncoded messages, is reported to the proper authority for correction.

e. (See Figure 7.) (1) The army net is formed by the radio stations at the command post of the army, at the command posts of the corps, and at the command posts of the various organizations of army troops having radio equipment.

(2) The corps net is formed by the radio stations at the command post of the corps, at the command posts of the various divisions, and at the command posts of the various organizations of corps troops having radio equipment.

(3) The division net is formed by the radio stations at the division command post and at the command posts of the infantry brigades, the artillery brigade, cavalry (when attached), the division air service, and the balloon company (when attached).

(4) The division artillery brigade net is formed by the radio stations at the command posts of the artillery brigade and the two 75-mm. gun regiments. A two-way radio telephone-telegraph set is employed in this net. As this set has the same characteristics as the sets employed at the command posts of the corps chief of artillery and the corps artillery brigade, radio communication with these command posts is possible.

(5) The division artillery regimental net is formed by the radio stations at the command posts of the artillery regiment and of its component battalions. The radio set employed in this net is the same as that employed in the division artillery brigade net (two-way telephone-telegraph).

(6) The net of the corps artillery brigade and those of its component regiments are formed in a manner entirely similar to the nets of the corresponding division units. The same type radio sets are employed in all the stations of both groups of nets.

(7) The cavalry division net is formed in a manner similar to the net of the infantry division, the 75-mm. gun battalion (horse) having the same position in regard to this net that the division artillery brigade occupies in regard to the division net. The net of the 75-mm. gun battalion (horse) is formed by the radio stations at the battalion command post and at the command post of each of the batteries, battalion and battery command posts all being equipped with two-way radio telephone-telegraph sets of the same type as that furnished to division artillery regiments and battalions for use in the division artillery regimental net. The cavalry brigades and regiments obtain radio communication with supporting artillery by arranging for the necessary overlapping of wave lengths and a schedule of hours for working the artillery net. The cavalry squadron obtains radio communication with supporting artillery by adjusting the squadron radio set to the wave length employed by the artillery set.

(8) Artillery units attached to organic artillery brigades enter the radio net of the unit to which attached. The radio stations of attached artillery units that have been formed into provisional brigades or groupments are grouped into provisional nets corresponding to the provisional organization or grouping.

88. COMMUNICATION WITH SUPPORTED INFANTRY.—*a*. The radio station at the infantry regimental command post, together with those at the command posts of its component battalions, forms the infantry regimental net (radio telegraph).

b. For radio telegraph communication with the infantry, artillery regiments and battalions enter the infantry regimental net. The equipment (loop set) now supplied to infantry and division artillery regiments and battalions for use in this net has nine different and non-interfering wave lengths. The loop set can easily be carried by two men and can quickly be set up for transmitting and receiving. It is provided with a break-in feature by means of which a message may be interrupted for any necessary repetition.

It is of great value in maintaining communication between advancing infantry and its supporting artillery.

c. The 75-mm. gun regiments and battalions, horse-drawn, are the only artillery units equipped with the loop set, and, therefore, the only artillery units which can communicate by radio with the infantry.

89. COMMUNICATION BETWEEN ARTILLERY AND AIRPLANES.—*a.* The radio set used in the division artillery brigade net also is employed by brigade headquarters to supervise the work of airplanes observing and adjusting for subordinate units.

b. The radio set used in the artillery regimental net by command posts of artillery regiments and battalions is used by the regiment for communicating with observation and fire-control airplanes, and for supervising the work of the airplanes observing and adjusting fire for the battalions. This set also is employed by the battalion for communicating by radio telephone and by radio telegraph (in conjunction with panels) with the airplane assigned to adjust fire for the battalion.

c. All radio stations at artillery command posts are equipped with identification panels. These must be conspicuously displayed in order to be seen from an airplane at a high altitude. Where many radio stations are grouped within a restricted area, it is difficult for the airplane observer to pick out the panel of a particular unit unless its location is known beforehand. It is therefore essential that the air corps unit working with an artillery command be notified promptly of any change in the location of panels.

d. In the adjustment of artillery fire by airplane observation, the observer normally works with the artillery battalion. When panels are employed the usual cycle of communication is as follows:

(1) Airplane to battalion radio station, by radio telegraph message, employing a code of abbreviations.
(2) Battalion radio station to the firing battery and return, by telephone.
(3) Battalion radio station to airplane, by panel.

e. In addition to the signal communication necessary in the adjustment of artillery fire, it may be necessary for

aerial observers to inform artillery units of the location of suitable targets they have discovered or to give them other information of tactical value. This is accomplished by means of the radio telegraph, radio telephone, dropped messages, or by a prearranged code of visual signals.

SECTION IV

Visual Signaling

90. GENERAL CONSIDERATIONS.—*a.* Visual signaling embraces all signals received by the eye, including signaling by means of signal lamps, heliograph, wigwag and semaphore flags, pyrotechnics, panels, and by any other device.

b. The rate of sending messages by visual means, with the exception noted under paragraph 91, is relatively very slow. Since it is slow, and since unfavorable atmospheric conditions affect it less when used over short distance, visual signaling is used mainly for sending prearranged signals or very short messages between small units. Visual signaling is employed by units higher than battalions as an emergency means only.

c. Visual signaling, while a purely auxiliary means of signal communication, is, at times, of great convenience and value, as for example, when the parts of a command are separated by an unfordable stream or other impassable obstacle.

91. SEMAPHORE.—In daylight and when the visibility is good the semaphore can be used very successfully over short distances. At long distances the rate of transmission is slow but with well trained personnel over short distances the rate is reasonably rapid. For transmission of firing data,

prior to the establishment, or during the interruption of, wire communication from firing observation posts to batteries, it is extremely useful. The graphic nature of this signal system renders it susceptible of being learned by the majority of enlisted personnel. It has this unique advantage over all other systems where knowledge of a code is necessary.

92. WIGWAG.—Wigwag may be used for long distances under favorable light and visibility conditions. Its rate of transmission is slow.

93. SIGNAL LAMPS.—Signal lamps are used to transmit flashes according to code. They can be used only when the air is comparatively clear, but they may be used either by day or by night. They can be used effectively at relatively great distances (several miles) and, under some conditions, especially at night, are a most valuable means of communication. They are of particular value in transmitting messages over impassable obstacles, such as bodies of water, and in communicating with advancing infantry when hostile fire or the nature of the terrain has prevented the installation of telephone or radio communication.

94. PYROTECHNICS.—*a. General.*—For certain special purposes, pyrotechnics are highly valuable as a means of signal communication, their principal utilization in connection with artillery being in transmitting information and requests concerning artillery fire from front line infantry units to supporting artillery in both offensive and defensive combat. They are the principal means used in calling for the normal barrage and are sometimes used in calling for local counterpreparations and other defensive fires. By utilizing a prearranged code, pyrotechnic messages can be conveyed instantaneously and simultaneously to several units. Pyrotechnics can be used either by night or by day, but only under conditions of good visibility.

b. Arrangement for use of pyrotechnic signals.—The use of pyrotechnics for the transmission of messages from infantry to supporting artillery must be carefully prearranged. There must be a definite understanding as to the meaning of each signal or combination of signals used. The signals prearranged are as few in number as possible, and

only the simplest and most reliable pyrotechnics are employed. Pyrotechnics used to initiate calls for fire support are fired by the infantry from rocket posts agreed upon with the supporting artillery. Pyrotechnics used to relay such calls to the batteries are fired by the artillery.

c. Rocket posts.—(1) A prearrangement of points or rocket posts from which pyrotechnic signals intended for any particular artillery unit are to be fired is necessary to insure their being observed, and to avoid confusion with pyrotechnics fired by the enemy.

(2) In an advance, the successive locations of rocket posts must be prearranged so that the pyrotechnic details may proceed promptly from one post to another, keeping pace with the infantry advance. As each successive rocket post is abandoned, a prearranged signal may be fired to indicate this fact.

(3) In a defensive situation, rocket posts are first established in the immediate vicinity of the outposts. In case of attack an outpost may be withdrawn; consequently, rocket posts are provided for also in the immediate vicinity of the main line of resistance. A rocket post must be so established that good signal communication is insured to all points of that part of the defensive position that the defensive fire called for from this rocket post is intended to cover. It must also be established in such a position that its signals can be clearly seen by the supporting artillery units. The batteries must have observers continuously watching the rocket posts from which signals are fired and to which they must respond with defensive fires. These observers must be provided with some means of knowing the exact directions to the rocket posts they are required to keep under observation. An improvised rocket board, or stakes set in the direction of the rocket posts, answers the purpose.

Section V

Messengers

95. General Considerations.—Messengers, though an auxiliary means of signal communication, are an indispensable means, for frequently they may be used when no other means of communication is available. Therefore, it is highly important that messengers be carefully trained in their duties, and that arrangements always be made for their prompt and efficient use when required.

96. Employment of Different Kinds of Messengers.—The kind of messengers to be employed, in each case, depends not only upon the kind available in the particular case, but also upon many other factors, such as the nature and condition of the terrain, the available roads, the distance to be covered, and the intensity of hostile fire. Where good roads are available and considerable distances are to be covered, motorcycle messengers, when available, usually are used. Where considerable distances across country or along trails or poor roads are to be covered by daylight, mounted messengers usually are to be preferred. Across rough or shell-torn terrain, particularly at night, and very near the hostile lines, dismounted messengers usually are the only practicable means of messenger communication.

Section VI

Communication with Supported Troops

97. General Considerations.—*a.* To support other arms successfuly, the artillery must have continuous knowl-

edge of the situation and the needs of the supported troops. To obtain this information, the artillery must keep in close touch with the commander of the supported troops, either by the various means of signal communication, by the actual presence of artillery officers at the command posts of supported troops, or by both. (See Chapter VII—Liaison.)

b. The artillery habitually maintains its own means of communication with supported troops, using the means established by the supported troops only in an emergency.

c. Ordinarily the battalion is the lowest light artillery unit to establish communication with supported infantry, though batteries may do so in some situations. Batteries frequently establish communication with supported cavalry. Medium and heavy artillery battalions, as a rule, do not establish separate direct communication with supported troops, but utilize, when necessary, the communications of a convenient light artillery battalion.

98. Signal Communication in an Attack.—*a.* The maintenance of signal communication when the infantry is moving forward in an attack is the most difficult phase of the signal communication problem with which the artillery must cope.

b. A few accompanying batteries or accompanying guns, by frequent changes of position, may keep pace with the infantry advance and maintain close connection therewith, but the bulk of the supporting artillery of large commands must usually fire during a day's operations without more than one or two changes of position. Under these conditions, to obtain the greatest technical effect and the greatest tactical efficiency from artillery accompanying fire, two important problems in forward signal communication present themselves:

(1) Battery commanders must continue to provide for the technical observation of their accompanying fire, in order to make it fit the needs of the infantry.

(2) Artillery battalion commanders must maintain tactical connection with the commander of the infantry assault battalions.

Though closely related, both of these problems require independent signal communication.

c. The accompanying fire of a battery sometimes may be observed from an exceptionally good observation post up to the extreme limit of range of the guns; balloon and airplane observation may be of great assistance; but usually a battery commander must provide for moving his terrestrial observation post forward to successive points of vantage, keeping pace with the infantry advance. The first observation post must not be abandoned until signal communication has been established with the second and it is ready to function; and so on. The continuity of this observation may be maintained through a longer advance if the resources of the battalion and batteries are partially combined to form a single battalion observation detail. By this means, observation may be maintained more or less satisfactorily when the resources of the batteries, working independently, would be inadequate. In close country, where observation for any considerable distance is impossible, battery observation details must accompany the infantry assault battalions, and be provided with the necessary means of signal communication with their batteriees. Signal communication with the batteries is by telephone whenever possible, with all other means held ready in case telephone communication fails. This rule is general.

d. Tactical connection with infantry assault battalions is insured by means of an artillery battalion liaison officer with the commander of each assault battalion. Each liaison officer must be provided with sufficient personnel and equipment to maintain signal communication with the commander of the supporting artillery battalion to which he belongs. For this signal communication between artillery liaison officers and artillrey battalion commanders, the telephone usually is to be preferred.

99. Signal Communication in a Defensive Situation.—*a.* In a defensive situation or in a withdrawal, the maintenance of signal communication with supported infantry does not present a problem that compares in difficulty with the maintenance of signal communication when the infantry is moving forward.

b. In a defensive situation, signal communication can be established with an elaborateness dependent upon the duration of the occupation of the position. Pyrotechnics have an important part in the plan of signal communication in a defensive situation (see paragraph 94).

c. In a position defense, usually there is sufficient time available for the installation of all of the vital telephone lines and the completion of arrangements for suitable auxiliary means of signal communication.

d. In a zone defense, there is opportunity for the installation of all available means of signal communication, including duplicate telephone lines where desirable.

e. All necessary preparations are made for communication during withdrawal to new positions, and for communication after new positions are occupied.

CHAPTER VII

Liaison

100. GENERAL.—*a.* Liaison is the linking together of the different arms, or different units of the same arm, so as to secure proper coordination and cooperation in battle.

b. The primary function of artillery is to assist the other arms in combat. Artillery, to be efficient in this rôle, must be able to deliver accurate and effective fire at the proper time and place. Artillery commanders whose organizations are in support of units of the other arms must, therefore, keep themselves informed, at all times, of the location and disposition of the hostile force and of the units supported and must ascertain the needs of the supported units with respect to artillery fire. This can be accomplished only by close contact with the other arms and a mutual understanding between the artillery commander and the commander of the supported troops.

c. This close touch with the tactical situation is maintained by the artillery commander by personal contact with the commander of the supported unit when practicable. On the march and during combat the senior artillery commander is, habitually, with the commander of troops. The headquarters of the artillery commander is generally located close to or with that of the commander of the troops. By close association with the commanders of supported units, early information of the tactical situation and the needs for artillery support are obtained and timely and effective fire can be delivered. Artillery commanders of subordinate

units, in direct support of organizations of the other arms, maintain as close personal touch with the commander of the supported units as the tactical situation permits, and whenever practicable establish their command posts close to or with the command post of the unit supported. When, however, tactical command of the unit cannot be properly exercised from a command post located near that of the supported unit, by reason of the distance being too great, the artillery commander of a subordinate unit establishes his command post at a point from which command of his unit is possible, and remains with and directs the operations of his organization. Within the division this applies particularly to the battery and battalion and, to a lesser degree, to the regiment.

d. When for any reason, an artillery commander cannot maintain close personal touch with the commander of a supported unit, he sends to that commander an officer from his organization to represent him and to keep him informed of the tactical situation and the artillery fire support required by the supported unit. Such a representative, or liaison officer, is, as a rule, accompanied by a detachment of enlisted men, sufficient to assist in maintaining and operating the necessary system of signal communication between the artillery and the supported unit and to assist the liaison officer in the performance of his duties. It is a principle that the liaison maintained by liaison officers between the artillery and units of the other arms in no way precludes the frequent visits that should be paid the front lines by the commanders of artillery units, for only by such meetings and discussion can that cooperation be achieved which is necessary to success.

101. AGENCIES OF LIAISON.—*a.* The headquarters of each regiment and battalion of field artillery includes in its organization certain officers and enlisted men whose functions are primarily to establish and maintain liaison with other units. They are sufficient in number to meet the requirements of the average situation. When, however, the liaison personnel of a headquarters is insufficient to meet the demands of a particular situation, other officers and en-

listed men of the headquarters may be utilized for this purpose, or the next higher unit may be called upon to assist in the emergency. The brigade and the battery are not furnished with liaison personnel. The brigade maintains liaison with the division by the personal contact of the artillery brigade commander with the division commander. The battery as part of a battalion in direct support of a specified infantry unit, is usually assigned a normal zone for the execution of its fire missions and is rarely placed in direct support of any particular part of the infantry unit. It is, therefore, seldom, if ever, called upon to establish liaison with other units.

b. In the headquarters of each regiment of field artillery there are two lieutenants available for liaison duty. Each battalion of field artillery includes in its headquarters one officer for this duty. These officers when given a mission of establishing liaison with other units are, as a rule, accompanied by one or more scouts and by a detail from the communications section of the headquarters battery. The scouts assist the liaison officer in all the functions pertaining to his office, particularly in connection with such reconnaissance as may be necessary, while the detail from the communications section assists in the establishment, maintenance, and operation of signal communication between the artillery and the supported unit, and such other lines of signal communication as may be established.

102. MEANS OF SIGNAL COMMUNICATION.—*a.* The necessity of keeping the artillery commander informed of the constant changes in the tactical situation and of transmitting to him, without delay, all requests for artillery fire support, requires that a quick and reliable system of signal communication be established between the artillery and the supported unit. The responsibility for the establishment and maintenance of this system of communication habitually rests with the artillery.

b. As soon as the unit to be supported is known, the artillery establishes telephone communication between the command posts of the artillery and that of the supported unit. The lines are laid by the communications section of

the artillery headquarters, and sufficient personnel is detailed with the liaison detachment, to operate and maintain the artillery communication system at the command post of the supported unit. Where it becomes necessary to establish and maintain additional telephone lines with front line battalions or other organizations, the communications personnel of the liaison detachment performs this duty assisted, whenever possible, by the communications section of the artillery headquarters to which the liaison detachment pertains.

c. The principal means of communication between the artillery and the supported unit is the telephone. Until telephone communication with the supported unit is established, or when for any reason the telephone system fails, the liaison officer communicates with the artillery commander by the best means available. He utilizes such existing lines as he can—radio, messenger, and visual signaling—depending on circumstances.

103. FUNCTIONS OF LIAISON OFFICERS.—*a.* The principal function of the liaison officer is, in general, to form a connecting link between the artillery and the troops that it supports. He keeps the artillery commander informed of the tactical situation and of the nature of the fire support required by the other arms, and, at the same time, keeps the commander of the supported unit informed as to the artillery fire support than can be expected in the particular situation. His principal mission is to see that the artillery meets the demands of the supported unit with the least possible delay.

b. The liaison officer, in addition, keeps himself informed of the changes in the tactical situation, the location and changes of his own unit, the location and description of artillery targets, the effect of the artillery fire of his own unit and of that of the enemy, the points upon which his own unit can place fire, the assistance that can be furnished by other artillery organizations, and the general state of ammunition supply. He is prepared to furnish such of this information as is necessary to his own commander and to the commander of the supported unit. So far as is pos-

sible, he anticipates the needs of the supported unit for artillery fire and, upon his own initiative, makes every effort to have this support rendered. He is prepared to conduct the fire of the batteries of his unit when necessary.

c. Much of this information is obtained by the liaison officer through conferences with the commander of the supported unit, but it is only by personal reconnaissance that he can secure the information in sufficient detail and with sufficient accuracy to meet the demands of the situation. He therefore makes frequent personal reconnaissances and utilizes the personnel of his detail to obtain all the information possible.

d. The duties of the liaison personnel do not, in general, vary greatly with the tactical situation. They may be modified somewhat by the difficulty of maintaining signal communication during a movement either to the front or rear.

(1) In a stabilized situation or in a prepared attack, the establishment and maintenance of liaison is comparatively simple. Means of signal communication have been established or planned, and time is available for making the necessary arrangements.

(2) Before an advance is begun, the liaison officer visits the artillery commander, furnishes him with any necessary information concerning the plans of the supported unit, and ascertains the probable changes in the location of the artillery command post that may be made during the attack, at about what hour the batteries will begin advancing, what route will be followed, and where the artillery commander can be reached at all times. Methods of signal communication are decided upon and every question that can be settled in advance is agreed upon.

(3) In a meeting engagement or other moving situation, the problem is a more difficult one, but the same principles apply. The artillery does not know in advance what infantry unit it will support, the location of this unit in the line, or what its plan of action will be. The location of front

lines, command posts, axes of signal communication, and other elements are indefinite.

(4) As soon as orders are received by the artillery commander indicating the infantry unit to be supported, he gives the liaison officer all possible information as to the positions to be occupied by the batteries, the location of the command posts, and the approximate time at which the artillery will be ready to fire, and sends him to join the commander of the supported unit.

104. ARTILLERY LIAISON WITHIN THE DIVISION.—*a. Brigade.*—The liaison of the division artillery with the division commander is of the utmost importance. This is best accomplished by the artillery brigade commander, as division artillery commander, keeping in close and continuous personal contact with the division commander. To maintain such contact, the artillery brigade commander locates his command post close to that of the division commander even though it increases the difficulty of establishing and maintaining communication with the regiments. To assure the best artillery support, a thorough mutual understanding between the division commander and his artillery commander is vital. To gain and maintain this understanding between the division commander and the artillery commander is much more difficult than between the latter and his regimental commanders. The division artillery as a whole functions more efficiently if the artillery commander is in close touch with the division commander though reduced to occasional communication by messenger with his regimental commanders, than when the reverse is the case.

b. Regiment.—(1) For an artillery regiment in direct support of a specific unit, liaison with the supported unit is one of the most important functions of the regimental commander. In order to facilitate the maintenance of this liaison, the command post of the artillery regiment is near that of the supported unit. Close personal contact between the artillery regimental commander and the commander of the supported unit is essential, and is maintained whenever practicable. When this is impossible, a liaison officer is sent from the regiment to the supported unit.

(2) In the case of a light artillery unit in general support, or of a medium artillery unit when attached to a division, liaison officers are, as a rule, sent to the headquarters of the light artillery regiments or groupments in direct support, or to the headquarters of a particular artillery unit with which it is especially necessary that its fires be coordinated. The command post of a regiment in general support is located primarily with a view to facilitating command.

c. Battalion.—In the artillery battalion, tactical control of the unit is the most important function of the commander. The command post of an artillery battalion in direct support of a specific unit, therefore, is located where it is possible to exercise this command rather than to facilitate liaison between the artillery battalion and the supported unit. Close personal contact between the artillery battalion commander and the commander of the supported unit is, however, desirable and the command post of the artillery battalion is located near that of the supported unit when it does not necessitate a loss of tactical control of the artillery unit. When it is impossible to maintain this personal contact between the two commanders, a liaison officer from the artillery battalion is sent to the supported unit. In addition, artillery battalions maintain liaison with the front line battalions of the supported unit. (See paragraph 98.)

d. Battery.—The battery being rarely in direct support of a specified unit, the necessity for establishing liaison with units of the other arms seldom occurs. The command post of the battery is always located near the battery where command of the unit is facilitated. If, however, the battery is placed in direct support of a definite unit, liaison is established by sending an officer or noncommissioned officer to the headquarters of the supported unit.

e. Attached units.—Units of reinforcing light artillery attached to the division follow the same general principles, with respect to the establishment of liaison, as do the units which are organically a part of the brigade.

105. Artillery Liaison within the Corps.—*a.* On account of the wide front covered by the corps artillery and the character of its missions and objectives, direct liaison with front line troops is of minor importance. When a regiment of corps artillery is assigned to give special fire support to a division, liaison with the artillery of that division is established by sending a liaison officer to the division artillery commander. Where close coordination with either of the regiments of light artillery is necessary, the commander of the medium artillery regiment, in addition, sends a liaison officer to the headquarters of the light artillery regiment.

b. The corps chief of artillery establishes his command post with that of the corps commander. The commander of the corps artillery brigade establishes his command post with a view to facility of command of his brigade. The command posts of a regiment of medium artillery, assigned to give special fire support to a division, is, as a rule, located with a view to the exercise of command rather than to facilitate liaison with the division.

c. Units attached to the corps, and retained directly under corps control, follow the same general principles with respect to the establishment of liaison as outlined above.

106. Artillery Liaison within the Army.—*a.* Units of army artillery, held immediately under army control, do not establish direct liaison with front line units. The character of the missions and objectives are such that close coordination between the army artillery and front line units is not necessary.

b. It frequently happens, however, that units of army artillery are assigned to give special fire support to a corps, in which case liaison is established and maintained by the unit of army artillery with the corps chief of artillery concerned. Additional liaison, at times, is established by units of army artillery with the subordinate units of corps artillery, where close coordination of the fires of the army artillery unit with those of the unit of corps artillery are necessary or desirable.

CHAPTER VIII

Artillery Fire

SECTION I

Preparation of Fire

107. GENERAL.—The determination of the data necessary for opening fire upon a given objective constitutes preparation of fire. The object of an accurate preparation of fire is to permit the opening of fire under the most favorable conditions and thus to insure the delivery of a timely and effective fire on the objective. Depending upon the means and time available, and the tactical situation, as great accuracy is sought in the calculation of firing data as is possible. When the preparation of fire is deliberate and accurate, the initial fire is close to its objective and, consequently, adjustment is facilitated, observation made easier, ammunition is saved, and the effect sought is obtained within the minimum time. When tactical conditions require the battery commander to open fire without waiting to complete all the operations involved in the deliberate preparation of fire, he simplifies and abbreviates these operations by making a rapid preparation of fire. The principles applied in the rapid preparation of fire are the same as those in the deliberate preparation of fire.

108. Firing Data.—The basic elements necessary in laying a piece for direction and elevation include the deflection, the site, and the range.

a. The determination of the deflection involves measuring the horizontal angle between the lines: gun—target, and gun—aiming point. This angle may be measured on the ground with an angle measuring instrument or by a rough means such as the hand or field glasses, or from a map when a suitable one is available.

b. The site may be measured on the ground with an instrument for measuring vertical angles, or it may be determined from a contoured map by noting the difference in elevation between the piece and the target.

c. The range may be determined by range finder, by estimation, or by measurement on a map. When the laying is by quadrant the elevation for a particular range is obtained from the firing tables.

d. In time fire an additional element of firing data is necessary, the fuse setting. The fuse setter for the 75-mm. gun is graduated in range to avoid reference to the firing tables.

109. Corrections.—When meteorological and other data are obtainable, and time and the situation permit, the measured elements of the firing data are corrected for certain influences in order to increase accuracy of the data and to save ammunition and time during the adjustment of fire. The variations in the trajectory and the corresponding corrections obtained from the firing tables and made to offset these variations, are considered in three groups:

a. Position corrections.—Position corrections consist of corrections for difference in altitude of gun and target, drift, cant of trunnion axis, and, for some calibers, curvature and rotation of the earth.

b. Matériel corrections.—*Matériel* corrections consist of corrections for variation from standard in weight of projectile, variation in powder lot, and wear of the piece.

c. Weather corrections.—Weather corrections consist of corrections for air density, air temperature, range wind, cross wind and powder temperature. Other atmospheric dis-

turbances such as fog, rain, and snow cause variation in the trajectory but these disturbances are so variable that their influence is neglected in the preparation of firing data.

SECTION II

Observation of Fire

110. GENERAL.—*All artillery fire must be observed except when such observation is impossible.* During both fire for adjustment and fire for effect, observation is of the greatest importance. By observing the points of burst or impact of the projectiles, and judging their positions with respect to the objective (sensing), the modification of the elements of firing data necessary for more certain observation and for adjusting and keeping the fire upon the objective are determined. Observation, however, is not absolutely indispensible for artillery firing. Circumstances that may hinder, or even prevent, observation of fire do not necessarily keep artillery from operating, but it must be remembered that unobserved fire is ordinarily not accurate and, consequently, is wasteful of ammunition and may not be particularly effective.

111. TERRESTRIAL OBSERVATION.—*a.* A firing observation post is organized more or less elaborately according to conditions. It may be merely a point on top of a hill occupied by a single observer equipped with field glasses, or it may be a solidly constructed shelter occupied by several observers, protected from shell fire, containing numerous observing instruments and plotting boards, and with a complete communication system connecting it with the unit or units which it serves. Usually each battery establishes its own observation post, though at times two or more batteries may use the same post.

b. Firing observation posts are of two general classes: those near the battery, and those as near the target as possible. When selecting an observation post, it must be remembered that the search for an observation post near the target, its occupation, and the work of connecting it with its unit by the necessary telephone lines, may take considerable time, while, on the other hand, the battery may be called upon to fire almost immediately after occupation of the position. The battery commander, therefore, often may be obliged to occupy first an observation post near the battery and fire on such targets as are visible therefrom. Later, when an advanced observation post is found and prepared, it will be possible for him to observe fire on other targets.

c. The observation post may be on or near the line: gun—target (axial observation), a considerable distance on either side of that line (lateral observation), directly on the flank of the target (flank observation), or a combination of two or more observation posts may be used, one having axial observation and another having lateral or flank observation (combined observation). Axial observation is the simplest of these methods but it frequently cannot be obtained. Adjustment of fire by lateral or flank observation requires a high degree of ability and training and requires more time than adjustment by axial observation. Nevertheless, it frequently is the only method obtainable. Combined observation is the surest method, but the necessary arrangements are more complicated than in the cases of axial and lateral observation and a greater number of trained personnel is necessary. Wherever the observation post may be located, however, it is essential that it be possible to observe therefrom the terrain in the vicinity of the target and to observe the fire.

d. An accurate conception of the terrain in the vicinity of the target increases the number of rounds which may properly be sensed. Preparatory to opening fire, the study of ground forms around the hostile position is taken up, and this is continued during the action. Auxiliary observers may give valuable information. If maps and air-

plane photographs are available they are studied. Alert and continuous observation of the objective zone is maintained at the observation post in order to discover all details of the terrain, locate and study hostile positions, and to observe all movements of the enemy. When an observation post is to be occupied for a considerable period, a visibility chart is prepared, showing the parts of the terrain visible and invisible therefrom.

112. AERIAL OBSERVATION.—*a.* Aerial observation of artillery fire may be carried on from captive balloons and from airplanes, or, possibly, from airships.

b. Aerial observation of fire in general is supplementary to terrestrial observation. It may at times be the principal or only means of observation. For heavy artillery, due to difficulty of terrestrial observation at long ranges, it is of much greater importance than to light or medium artillery. In fact, it may be said to be the principal method of observation for long range heavy artillery. For medium artillery, particularly for counterbattery fire, it is also of great importance, but since terrestrial observation is frequently possible on targets within the range of the medium artillery, its dependence upon aerial observation is not as great as that of the heavy artillery. Light artillery depends very little upon aerial observation as a general rule. It may, however, be of great assistance at times but usually terrestrial observation is quicker and more certain.

c. Means of communication between the battery and the aerial observer are at present more or less precarious and uncertain. The airplane or airship can communicate with the ground by radio telegraph, by radio telephone, projectors, dropped messages, or signal lights. The most important of these methods and the one most frequently used in artillery observation, is the radio telegraph. The radio telephone as applied to this use is still in an experimental stage. The ground receiving station can communicate with the airplane or airship by cloth signal panels used in conjunction with an indentification panel, by shutter panels, by projectors, and by radio. The surest and most usual method is by cloth signal panels displayed on the ground

at the receiving station. The usual cycle of communication is from airplane to battalion radio station by radio telegraph, from battalion radio station to firing battery and return by telephone, from battalion radio station to airplane by signal panels. Communication between the captive balloon and the firing battery is by telephone.

d. (1) Airplane observation has the following advantages over terrestrial observation:

(a) The ability to sense the amount of error in both deflection and range if the round can be seen at all.
(b) The ability to sense a salvo or volley as a whole and to estimate the position of the center of impact.
(c) A better view of the objective.

(2) It has the following disadvantages:

(a) Unreliable communication between the observer and the battery commander, since radio instruments are delicate and easily put out of order, and radio messages can be jammed or garbled by the enemy's sending sets.
(b) Only short periods of observation possible.
(c) Intermittent observation. Continuous observation is impossible because of difficulties due to clouds, limited radius of radio, obstruction of view by the wings of the airplane, and incidents of aerial combat.
(d) The length of time required for adjustment due to the difficulties mentioned above and to delay in communication.

Section III

Conduct of Fire

113. General.—*a.* Conduct of fire is the employment of the technical means necessary to cause fire of the desired nature to be brought to bear upon the target. Conduct of fire is the function of the battery commander, and he normally conducts the fire in person.

b. (1) The point from which the fire is conducted varies according to the conditions of the combat and the system of observation. It may be conducted from any point which has good communication with the firing battery.

(2) Ordinarily, when terrestrial observation is used, the fire is conducted from the observation post. The usual method of communication between the officer conducting the fire and the firing battery is by telephone. When aerial observation is used, the fire may be conducted from the position of the radio receiving station, or from the vicinity of the firing battery. The radio receiving station is usually in the vicinity of the battalion command post.

(3) In some cases of terrestrial observation, the fire is conducted by an officer of the battery other than the battery commander, or may even be conducted by an officer of another battery. This may occur when the observation post is distant from the pieces, or when a particular objective can not be seen from the observation post of the battery firing, but can be seen from that of another battery.

(4) In some other cases of terrestrial observation, the battery commander may conduct the fire from his command post assisted by observers in position to observe the fire. In this case he transforms the reports of the observers into range and deflection changes for use at the pieces and transmits them to the firing battery.

(5) When the fire is unobserved it is usually conducted from the battery command post where it can be most accurately prepared.

114. FIRE FOR ADJUSTMENT.—*a.* In general, all fire consists of fire for adjustment and fire for effect. There is no definite line of demarcation between fire for adjustment and fire for effect. The former is delivered primarily for the purpose of adjustment, but it is sometimes possible, and always desirable, to produce effect at the same time; the latter is delivered primarily for the purpose of producing effect, but observation of the fire for the purpose of improving or verifying the adjustment is continued throughout fire for effect. The degree of adjustment desirable be-

fore changing to a method of fire adapted primarily to producing effect depends on the tactical situation, the purpose of the fire, and the character of the target.

b. (1) During adjustment, observation is of the greatest importance. By observing the points of burst or of impact and by judging their position with respect to the objective, the necessary changes in the firing data requisite for more certain observation and for adjusting and keeping the fire upon the objective are determined. Preliminary adjustment may be dispensed with only when the tactical situation requires it, or when observation is impossible.

(2) Adjustment is effected upon the target itself, if practicable. In many cases, however, the target is not visible to the officer conducting the fire, though its approximate position is known. For example, the target may consist of troops concealed behind a ridge, or behind a wall or hedge, or in the edge of a village, a forest, or a field of standing grain. Some prominent feature of the terrain in or near the enemy's known position—for example, a tree a house, a mass of rock—is then selected as an auxiliary target, and the enemy's location with respect to this determined within the narrowest possible limits. This may be accomplished by study of the map or by aerial or auxiliary observers. The fire is adjusted upon the auxiliary target, shifted to the area within which the enemy has been located, and the area is then searched by zone fire for effect.

c. (1) During adjustment, fire must be observed and corrected for range, direction, distribution, and in case of time fire for height of burst. Adjustment for range is made by noting whether the projectile strikes or bursts beyond the target or short of it. It is impossible, except from a flank position, to estimate with accuracy, the *amount* of the error in range, and in general, it cannot be determined whether a round is over or short unless it falls on the line: observer—target, except in certain special cases of lateral observation. When a round is sensed "over," the range is shortened by arbitrary amounts until a round is sensed "short," the difference in range of the two rounds sensed is

then split and this process continued until as small a bracket as is desired is obtained.

(2) Adjustment for direction is made by measuring or estimating the angular error in direction of one round and correcting the direction of each piece by a corresponding amount. This adjustment is easiest made when the observer is near the pieces.

(3) Adjustment for distribution is made by noting the relative positions of the fall of a round from each piece and correcting the deflections of the pieces so that the sheaf of fire is evenly distributed over the front of the target.

(4) Adjustment for height of burst is made by noting the mean angular height of burst above the base of the target of a group of one round from each piece, and correcting the fuze setting by an appropriate amount.

(5) These adjustments are carried on simultaneously when conditions permit.

(6) The kind of projectile and fuze employed during adjustment is, if possible, the same that is to be used in fire for effect.

115. FIRE FOR EFFECT.—*a*. Every target attacked presents its own problem which must be solved according to existing conditions and not by adherence to any fixed rule. The choice of the kind of projectile and fuze to be used depends upon the nature of the target and its situation. As previously stated, fire for effect must be continuously observed and corrected to the fullest extent possible.

b. In general, fire for effect may be divided into two classes: precision fire (shell) and zone fire (either shell or shrapnel). Precision fire is used against an immobile target of limited extent which it is desired to destroy and when time is available for making a precision adjustment. In this type of fire the adjustment is carried far enough to determine a single most effective range, giving a center of impact very close to the target, and the fire for effect is delivered at this range. Zone fire is used against mobile targets or in other cases when time or observation is not available for a precision adjustment. In adjustment for this type of fire a wide bracket is obtained and fire for effect is delivered

at successive ranges throughout this bracket, thus covering a large zone quickly. Zone fire is usually delivered at successive ranges differing by fifty or one hundred yards and covering a bracket of from one hundred to four hundred yards.

116. REGISTRATION OF FIRE.—Registration of fire consists of the adjustment of fire on a number of selected points throughout the objective zone. This may be accomplished before the opening of the action or during lulls in firing. Data are thus secured for opening promptly an effective fire upon an enemy appearing at or near the auxiliary targets upon which the fire has been adjusted. In some situations registration of fire must be conducted with caution, for such fire not only reveals the presence of the pieces, but possibly their number and location.

117. DISPERSION.—*a.* Experience has shown that when a certain number of rounds is fired from the same piece with the same elevation, under conditions as nearly identical as possible, that is, with the same atmospheric temperature and pressure, the same direction and velocity of wind, the same lot of projectiles, and the same lot of powder, the projectiles nevertheless do not fall at the same point, but are distributed in a more or less irregular manner about a certain point called the center of impact. This phenomenon is called dispersion.

b. The principal causes of dispersion are the variations from shot to shot in the propelling charge, weight of projectile, action of the gun and mount, irregularities in laying, and the small variations of atmospheric conditions, occurring from one shot to another.

c. Dispersion with respect to range is greater than dispersion with respect to lateral deviation, or, as it usually is called, deflection. For example, the 75-mm. gun firing high explosive shell at 3000 yards may be expected to give 99½% of any number of shots within an area of about 152 yard long and 16 yards wide, 82% within an area 76 yards long and 16 yards wide, and 50% within an area 38 yards long and 16 yards wide. It can be seen from the above that if a number of shots are fired at the same range (3000

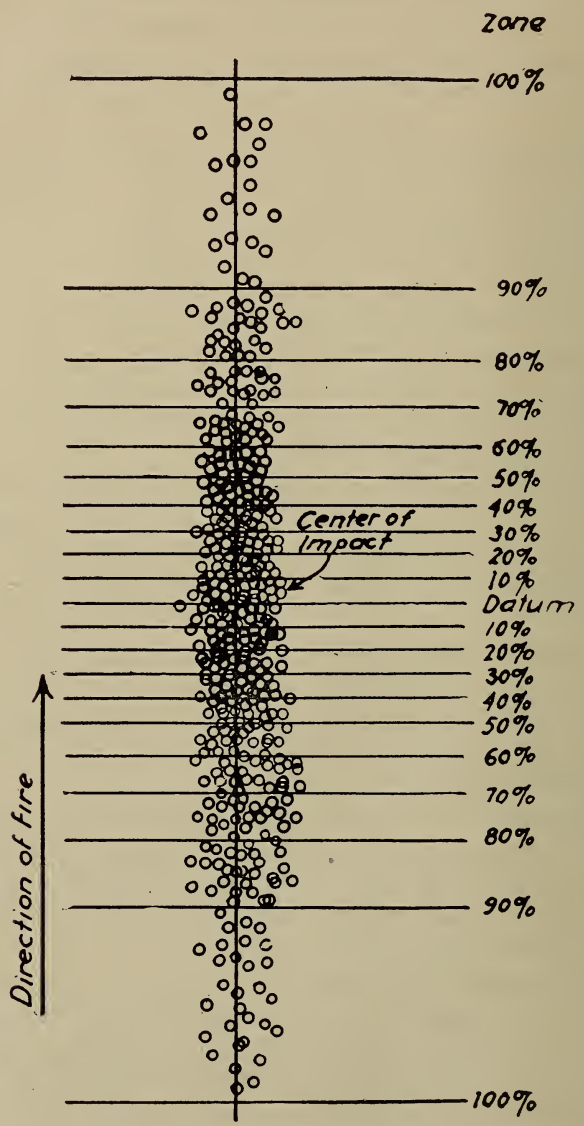

FIGURE 8—Diagram Showing Dispersion

yards) and all other data for each shot are the same, there may be obtained a difference in range to point of fall between two shots of as much as 152 yards and in lateral deviation of as much as 16 yards. This is true, however, for only a very small percentage of the shots (about 3%). Another fact to be noted is that ½ of 1% of shots may fall entirely without the largest area mentioned above.

d. Dispersion must always be taken into account by the officer conducting the fire, especially dispersion with respect to range when firing close to our own troops.

e. The diagram (Fig. 8) illustrates the dispersion with respect to range and deflection of 400 rounds fired from the same piece with the same data.

Section IV

Fire Direction

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118. General.—*a.* The tactical command of one or more fire units with a view to bringing their fire to bear from a suitable position upon the proper targets at the appropriate time is called fire direction.

b. To direct fire intelligently it is necessary to assign spheres of activity to the individual artillery units. The degree of exactness with which these assignments are made depends on the character of the action.

c. Where conditions permit, as in the attack or defense of a defensive zone, the limits of fire for each unit are indicated very definitely. The longitudinal limits of the zones may be indicated in terms of range from a given line by a line described by designation of consecutive points, by natural or artificial features, such as roads or streams, or by lines drawn on the map. The lateral limits of zones are

indicated by any of the three methods last mentioned. The limitation by means of clearly visible natural or artificial features is usually the best if such features exist anywhere near the desired limits. They are easier to locate by direct observation, and are particularly convenient when aerial observation is used. Frequently in war of movement, and especially in the case of small units, the lateral limits of zones are designated by features of the terrain or merely by angular distances from some clearly marked reference point. The latter method, though very crude, is the more common. Longitudinal limits rarely are given in an action of this character, but the ranges possible for division and corps artillery (when the latter is present) are considered in the assignment of missions and objectives.

119. Possibilities of Fire.—The limits of the dead spaces for each battery are determined as soon as possible after occupying a position and marked on the fire-control map, together with the horizontal field of fire. This information is called the possibilities of fire and is furnished to commanders concerned to aid them in fire direction.

120. Normal and Contingent Zones.—*a.* The area beyond the friendly lines included within the lateral limits of fire of an artillery unit is called its objective zone. The zone within the objective zone for which an artillery unit is normally responsible and within which its normal fire is directed is called the *normal zone* of that unit. Areas within the objective zone, but outside the normal zone, within which an artillery unit may be called upon to fire under certain contingencies are called *contingent zones* of that unit. An artillery unit has but one normal zone but usually has several contingent zones. A contingent zone of a unit is not necessarily adjacent to its normal zone. The lateral limits of the normal zone of an artillery unit usually coincide with the lateral boundaries of the zone of action or sector of the unit it is supporting. A battery, however, is not ordinarily assigned to support a specific unit, and the battalion commander designates the normal zones of his batteries as he deems advisable.

b. The normal zone of the division artillery coincides laterally with the division sector or zone of action, and usually extends from the enemy's front line to about 5000 yards beyond that line. This means that the fire of the

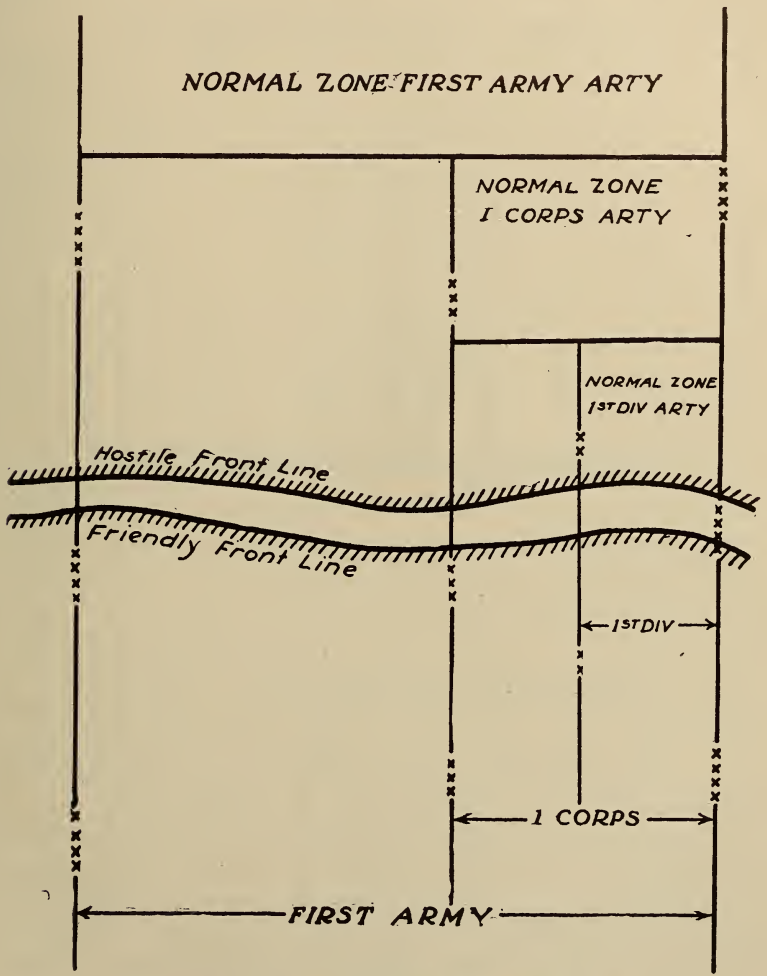

FIGURE 9—Diagram Showing Normal Zones

division artillery normally is delivered in this zone, but it must be understood that the fire is not limited to this zone, especially in the direction of range or when an

emergency demands fire against hostile elements in an adjacent zone.

c. The normal zone of the corps artillery coincides laterally with the corps sector or zone of action, and

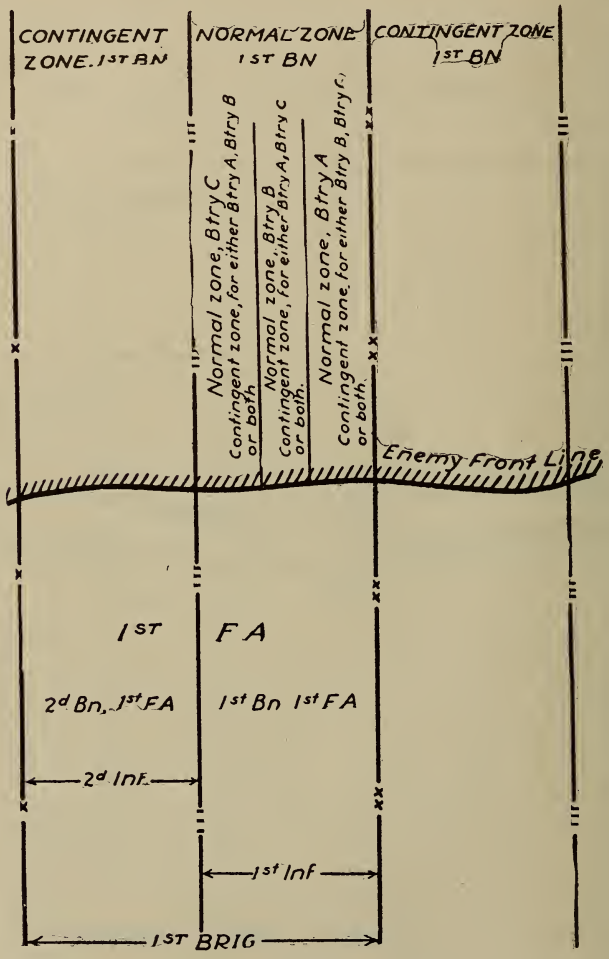

FIGURE 10—Diagram Showing Contingent Zones and Battery Normal Zones

extends from the outer limit of the division artillery normal zone to the limit of range of the bulk of the corps artillery. In the case of a corps operating alone, the outer limit is, of course, the extreme range of the corps weapons. The re-

sponsibility of the corps artillery for counterbattery is not limited to its normal zone but includes all hostile batteries within its range, not otherwise provided for. The corps artillery also frequently is required to fire for destruction or neutralization within the division artillery normal zone.

d. The normal zone of the army artillery coincides laterally with the army sector or zone of action and extends in depth from the outer limit of the corps artillery normal zone to the limit of the range of the army weapons.

121. FUNCTIONS OF ARTILLERY COMMANDERS IN FIRE DIRECTION—*a.* All artillery commanders within their respective spheres of activity as described above, direct the fire of their units, to a greater or less degree. The fire direction exercised by higher artillery commanders usually extends only to the contents of formal orders. On the other hand, the fire direction as exercised by the battalion commander is intimate and continuous. The brigade commander directs the fire of his brigade by designating the location and the normal and contingent zones of the regiments, by prescribing the nature of the fire (preparation, concentrations, barrage, harassing, interdiction, etc.), by assigning certain targets to regiments, and by concentrating the fire of all or part of the brigade on particularly important targets during the course of the action. The fire direction of the regimental commander is concerned with the location of his battalions, their normal and contingent zones, the assignment of certain special targets to battalions, and the concentration of the fire of all or part of his regiment on important targets as necessity arises.

b. The brigade and regimental commanders exercise their fire direction principally in orders issued to their commands before the action commences, except when conditions arise during the action which require the concentration of the bulk of the fire of the brigade or regiment. Such conditions are comparatively infrequent, particularly those requiring action by the brigade commander. On the contrary, fire direction by the battalion commander is continuous. Fire direction is his principal duty and in order to execute it properly, he must not only give preliminary

orders to his batteries but must have an excellent knowledge at all times of the targets fired upon by each battery, its possibilities of fire, the efficacy of its fire, and its ammunition supply. To accomplish this the battalion commander must have good observation, personal when practicable or by assistants when his duties require his presence elsewhere than at his observation post. He watches the fire of his batteries, and shifts their fire from one target to another, assigns additional targets as they appear, concentrates the fire at one point or spreads it over a wide front, according to the expressed desires of the supported unit, or lacking these, according to the need as he sees it. Thus the fire direction of the battalion commander is based on close and continuous observation and close contact with his batteries, as well as on intimate liaison with the supported unit and good tactical judgment.

SECTION V

Fire in Battle

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122. EFFECTS PRODUCED BY ARTILLERY FIRE.—The effects produced by artillery fire may be destruction, neutralization, or moral effect.

a. Destruction is the most effective, but is rarely possible, except against certain fixed objectives or against animate targets in the open. The effect of artillery, however, depends on the accuracy of its fire and the consequent fear of destruction imposed on the enemy.

b. Fire for neutralization is the commonest form of fire on the battlefield. Its object is to immobilize the enemy and to render his fire ineffective without the expenditure of the time and ammunition necessary for destruction. At the same time, it may produce considerable destruction.

c. Even when neutralization is impossible, artillery may still produce great effect on the morale of the enemy and on that of our own troops. Too much fire merely for moral effect renders such fire useless, its value lying entirely in the knowledge by the enemy and our own troops that our fire can, and usually does, produce physical effect. Fire for moral effect is accurately placed on points where the enemy has been located or suspected.

123. Effect of Individual Projectiles.—*a.* The effective pattern of the 75-mm. shrapnel, when burst in air at the proper height, may be taken as extending in the direction of range from 100 to 200 yards (depending on the range), and 20 yards laterally.

b. The area effectively covered by a single high explosive shell, burst at or slightly above the ground, is about as follows:

Caliber	*In depth, yards*	*In width, yards*	*Effective radius of large fragments, yards*
75-mm.	5	15	150
155-mm.	15	70	500

c. Time shell, burst at the proper height, covers about the same area as shell burst at the ground.

124. Fire Against Personnel.—Fire against personnel may be delivered against personnel without cover or against sheltered personnel. The purpose of fire against personnel without cover is to kill or disable as many of the enemy as possible. When the hostile troops are sheltered, the object of the fire is usually to keep them down in their shelters, so as to prevent them from performing the task assigned to them. Such fire is neutralization fire. It is sometimes intended also to destroy the works in which the men are sheltered. In this case the fire is a fire for destruction.

a. Weapons.—Rapid-fire weapons of small caliber such as the 75-mm. and 105-mm. are used when possible, but under certain conditions it may be advisable to use the 155-mm. howitzer or the 155-mm. gun. In general, larger caliber pieces are not used unless the range is such that smaller calibers will be ineffective.

b. Ammunition.—Time shrapnel is the most effective projectile against personnel without cover, provided the height of burst can be properly adjusted. High explosive shell is effective, particularly when the personnel has some cover. When conditions permit their employment, gas shell of all kinds may be effectively used for fire against personnel.

c. Consumption of ammunition.—(1) The approximate number of rounds of high explosive shell, delivered within a brief interval, necessary to cover effectively a zone 100 yards deep and the width of a battery front is as follows:

75-mm.:	from 50 to 80 rounds.
105-mm.:	from 40 to 60 rounds.
155-mm.:	from 25 to 40 rounds.

(2) Shrapnel, with a properly adjusted height of burst, produces the same effect with about half the above expenditures of ammunition. The number of rounds of gas shell necessary to neutralize a given area varies greatly with the terrain, weather conditions, and the chemical agent employed.

(3) The size of the area that can be effectively neutralized by a battery depends on the degree of neutralization desired and on the morale and efficiency of the troops occupying the area. As a rough guide, it may be said that a 75-mm. gun battery can be expected to neutralize effectively an area of about 200 yards by 200 yards, and a 155-mm. battery an area of about 200 yards by 400 yards.

d. Execution of the fire.—To be effective, fire against personnel without cover must be rapid and dense. The opportunity for effective fire is usually of short duration. The fire of several batteries is concentrated on a single objective when possible. To take advantage of the element of

surprise, the fire, especially at the beginning, is delivered with maximum rapidity.

125. COUNTERBATTERY FIRE.—*a.* Counterbattery fire is fire delivered against the enemy's batteries in position. It has one of two objects, neutralization or destruction.

(1) Counterbattery fire for neutralization has for its object the silencing of the batteries attacked. High explosive shell is used or, when conditions permit, gas shell. When time and observation facilities are sufficient, precision fire is used. Frequently, however, due to lack of time, poor observation, or lack of knowledge of the exact position of the hostile battery, zone fire is necessary.

(2) Counterbattery fire for destruction has for its object the demolition of the *matériel* of the battery attacked. Precision fire is always used. It is necessary that the position of the battery be accurately known. The expenditure of ammunition necessary to accomplish destruction is not justified unless both the fire for adjustment and fire for effect are observed. In most cases, aerial observation is necessary.

b. (1) Counterbattery is normally a function of the corps artillery and is directed by the corps chief of artillery. In some situations it will be necessary for the corps chief of artillery to designate an officer of his staff to coordinate, as a member of the plans and training section, the counterbattery on the corps front. This officer is called the counterbattery officer. Information necessary for the direction and conduct of counterbattery fire is furnished by the artillery information service.

(2) It is frequently necessary for counterbattery to be executed by the division artillery, and the information necessary for its direction and conduct must often be furnished by the intelligence personnel of its own units.

(3) The 155-mm. howitzer is the most effective counterbattery weapon at appropriate ranges, except against heavily protected batteries. Light artillery is frequently used against unprotected batteries. Against distant or heavily protected batteries, the heavy long range weapons of the army artillery must frequently be used.

126. FIRE FOR DESTRUCTION OF WORKS.—*a. Targets.*—Fire for the destruction of works includes fire against:

(1) Hostile batteries.
(2) Wire entanglements.
(3) Trenches.

(4) Machine-gun shelters.
(5) Small temporary works or fortifications.
(6) Protected observation and command posts, and dugouts.
(7) Permanent fortifications.
(8) Villages.
(9) Bridges.

b. Fire for the destruction of batteries.—Counterbattery fire has been described in a preceding paragraph. The expenditures of ammunition to be expected in the destruction of a battery, provided the adjustment has been accurate and the fire is observed and corrected during the fire for effect, are as follows:

Calibers	*Rounds (Depending on the range)*
75-mm. gun	from 500 to 800
105-mm. howitzer and 4.7-inch gun	from 300 to 600
155-mm. howitzer	from 300 to 400
155-mm. gun	from 400 to 500
8-inch howitzer	from 400 to 1400
240-mm. howitzer	from 200 to 300

c. Fire for destruction of wire entanglements.—(1) Breaches may be cut in wire entanglements by light or medium artillery. The former is usually employed unless the range or defilade of the objective requires the use of the medium artillery.

(2) To open a breach 25 yards wide on horizontal terrain through an entanglement 15 to 30 yards in depth, requires from 600 to 1200 rounds (depending upon the range) from a 75-mm. battery. Low-bursting shrapnel are effective at ranges under 4000 yards.

(3) When employing the 155-mm. howitzer, high explosive shell with instantaneous fuze is used, 200 to 400 rounds of 155-mm. shell are sufficient to cut a breach 25 yards wide and 20 yards deep.

d. Fire for destruction of trenches, machine-gun shelters, temporary fortifications, observation and command posts, etc.—For the destruction of trenches, machine-gun shelters, temporary fortifications, observation and command posts, etc., the medium artillery is used when possible. Light artillery has little effect against such targets. Against small temporary fortifications which are strongly con-

structed, the 155-mm., the 8-inch, or the 240-mm. howitzer, or the 155-mm. gun is used, depending on the range and strength of the target. Against objectives that are known or supposed to be of heavy concrete construction, or objectives situated at great distances, pieces of larger calibers are used. Against objectives of which the location is somewhat uncertain, it is often advisable to use the concentrated fire of several batteries.

e. Destruction of permanent fortifications.—Strongly built works containing much concrete ordinarily require the use of the heavy railway artillery. Earthworks extending above the ground may be attacked effectively by 155-mm. howitzers and pieces of large caliber. The angle of impact should be as great as practicable.

f. Destruction of villages.—The purpose of such fire is to destroy the buildings that are or may be occupied by the enemy or be of value to him. Against villages of wooden buildings, light or medium artillery is used. Buildings are set on fire by the use of low-bursting shrapnel. Against villages of stone, brick, or adobe, medium and heavy artillery is ordinarily used. It may often be advantageous to reinforce their fire by the fire of some light artillery using shrapnel for its incendiary effect.

g. Destruction of bridges.—Bridges are destroyed by the fire of medium and heavy artillery. Light artillery may be used against light wooden bridges. Against certain very substantial bridges it may be necessary to use the heavy railway artillery. Where conditions permit, the fire is executed by enfilade fire or as obliquely as possible, so as to increase the chance of hitting the long, narrow objective.

127. HARASSING FIRE.—*a.* Harassing fire is delivered for the purpose of annoying the enemy, causing casualties, and destroying his morale. It is usually delivered on camps, billets, shelters, front lines, and assembly places. It is executed by the light, medium, or heavy artillery, according to the range and the importance of the mission. If the fire can be observed, either shrapnel or shell may be used. When conditions permit, gas shell is effective.

b. Such fire, delivered in reply to hostile harassing fire, is sometimes called retaliation fire. It is ordered by the higher artillery commanders and is executed in the same manner as other harassing fire. The ammunition expenditure ordered, if possible, is greater than that used by the enemy in his harassing fire.

128. INTERDICTION FIRE.—*a.* Interdiction fire is fire delivered for the purpose of preventing the use of certain roads or areas by the enemy. Such areas may be probable assembly places, railroad stations or detraining points, or points where working parties may attempt to repair destruction already accomplished by our batteries. Weapons, ammunition, and the conduct of fire are, in general, the same as in harassing fire.

b. Where the road or area can be seen, sudden bursts of fire are delivered, as in other cases of fire against unsheltered personnel, whenever the enemy appears. At night or whenever observation is impossible, the fire may be delivered at a slow rate throughout an extended period of time, or in short and rapid bursts of zone fire at irregular intervals, depending on the character of the objective and the importance of the mission. Even in the former case, the rounds are fired at irregular intervals and distributed in range, as in zone fire, in order surely to include the target within the ranges used. In any case, it is important to fire in such a way that it will be impossible for the enemy to solve the system and to move his traffic accordingly.

c. To interdict traffic on roads, enfilade fire is used whenever possible. Shrapnel fire is very effective in such cases, when the height of burst can be accurately adjusted.

129. FIRE AGAINST TANKS.—*a.* Hostile tanks may be put out of action by artillery fire. When stationary or while moving slowly in close groups, they present a target that can be easily observed from the air or the ground. Tanks can not pass with impunity through a dense barrage of high explosive shell.

b. The piece used preferably in fire against tanks is the 75-mm. gun, firing high explosive shell. When indirect laying is used, it usually is advisable to obtain a bracket of

200 or 400 yards, and then to put down fire with maximum rapidity, using the entire battery, at the short limit of the bracket.

c. Ordinarily, tanks are best attacked by batteries using direct laying. For this reason, the artillery commander usually designates certain batteries, or pieces from certain batteries, to take position well to the front, with the pieces so placed that direct laying may be used and with the primary mission of firing against tanks. The batteries or pieces specially designated for antitank defense are frequently placed very close to our front lines. In this case it is usually better to permit the tanks to approach within about 1000 yards before opening fire. To open fire prematurely may result in the destruction or neutralization of the guns by the enemy's fire before the antitank mission can be accomplished.

130. FIRE WITH CHEMICAL SHELL.—Fire with chemical shell (gas shell and smoke shell) is executed ordinarily by the 75-mm. gun and the 155-mm. howitzer; also, in the case of gas shell, by the 155-mm. gun.

a. Gas shell.—(1) Gas shell are used against animate targets. Fire with gas shell may be delivered on a small objective or on an area, and may be for casualty effect or for neutralization. Fire for casualty effect is with lethal (deadly) gases in high concentrations. The effect depends largely on surprise and it is accordingly desirable to concentrate a number of batteries on the same objective. Neutralization fire is intended to lower the physical resistance and morale of the enemy and interfere with his activities by causing him to wear his gas mask continuously for a considerable period of time. Casualty producing and neutralizing gas shell fire may be combined with other kinds of fire in various ways. The use of shrapnel or high explosive shell during gas shell fire adds to the enemy's confusion and may induce him to remove his mask.

(2) In fire for effect on a small objective, such as a battery, it is necessary to modify the range and deflection in accordance with the direction and velocity of the wind. For casualty effect, the fire is as rapid as possible.

(3) For neutralization, persistent gas is preferably used. The best results are obtained by slow fire with occasional short bursts of rapid fire, particularly at the beginning and the end. The following is a proper ammunition expenditure, based on four hours' firing on a front of 100 yards with a six mile wind:

75-mm. gun	200	rounds
155-mm. howitzer or gun	50	rounds

(4) In fire for effect on a large area the fire is delivered preferably with persistent gases for neutralization. The number of shell required depends on the kind of gas used, the extent of the area to be covered, the length of time fire is maintained, and the weather conditions.

(5) For harassing fire, both persistent and nonpersistent gases may be used. Tear gas and toxic (poisonous) smoke shell are especially valuable for this purpose.

b. Smoke shell.—(1) Smoke shell are employed to conceal our operations from the enemy, particularly by blinding his observation posts, as a feint to draw the enemy's attention from or to a particular point, to mask the use of other chemical agents, or to harass. Weather conditions, particularly the wind, materially affect the rate of fire which must be used to establish and maintain a smoke screen. On sunny days, when there are upward air currents, the ammunition consumption is greater than on cloudy days, when such currents do not prevail.

(2) When laying down a smoke screen, the first fire is rapid in order to form the smoke clouds and is continued, after the cloud is formed, at a slower rate. It is quickened when necessary to build up the smoke cloud. Under ordinary weather conditions, with the wind perpendicular to the front to be screened, the rate of fire for a 75-mm. gun battery to screen a front of 200 yards is about 5 rounds per piece per minute for the first 5 minutes to form the smoke cloud. After this, the fire is continued at a rate of fire of about 1 round per piece per minute. The rate of fire for the 155-mm. howitzer is about one-half the above.

For a wind perpendicular to the front to be screened, the following may be taken as a general guide as to the ammunition required to screen 100 yards of front when there is no sun:

	Wind velocity Miles per hour			
	4	12	20	
75-mm.	200	400	800	*Rounds per battery per hour*
155-mm.	80	170	350	

With a wind across the front to be screened, the fire is concentrated to the windward of the objective. The distances the cloud will drift and still remain effective vary greatly but may be taken roughly as follows: 75-mm., 800 yards; 155-mm., 1500 yards.

131. FIRE SUPPORT ON THE OFFENSIVE.—*a.* Artillery fire in support of an attack may be divided into two general classes: artillery preparation fire and fire during the attack.

b. (1) Artillery preparation fire consists of all fire delivered by the artillery preparatory to an attack prior to the advance of the infantry from its line of departure. The time for beginning the artillery preparation is prescribed in the order for the attack. The objects of the artillery preparation are to paralyze the enemy's system of command, observation, and signal communication, and to neutralize or destroy his works, artillery, and other combat units. Destruction of hostile works, except chance destruction during neutralization fire, can be accomplished only by a deliberate fire, with great expenditure of ammunition.

(2) The duration and the intensity of the artillery preparation vary with the desire for surprise, the strength of the enemy's defenses, the ammunition supply, the morale of the troops engaged, the number of tanks to be employed, and other conditions. In an attack against an elaborately prepared defense, a long preparation, culminating in an intensive bombardment immediately before the advance of the infantry may be necessary. In other cases, where the

enemy's defenses are not extensive or when it is desired to take greater advantage of the element of surprise, the attack may be launched after a short, or without any, artillery preparation. The character of the fire and the objectives attacked vary according to the length of the preparation. In a long continued preparation, many interdiction and other long range fires will be necessary. In a very short preparation, all the fire may be concentrated on points near the enemy's front line.

c. (1) Artillery fire during the attack consists of accompanying fire, concentrations on critical points, counterbattery, interdiction and neutralization of more distant points and of localities which are not to be attacked directly, and fire on transient targets. There is no distinct line of demarcation between preparation fire and fire during the attack. Actually, much of the artillery may continue on the same missions during the attack that it had during the artillery preparation. This applies particularly to medium and heavy artillery.

(2) (a) During the attack, the artillery fires assist in overcoming resistance and hinder or prevent the enemy from bringing up reserves or from launching a counterattack.

(b) When detailed plans for an attack are prepared in advance, much of the fire is prearranged and delivered in accordance with a schedule. Such a plan, however, must always provide for taking full advantage of all opportunities for observing fire and for modification of the schedule when actual observation shows it to be desirable.

(c) When the fire is prearranged, a certain number of elements of army, corps, and division artillery are assigned missions from which they can, without detriment to the general plan, be withdrawn at any time in order to take advantage of opportunities to fire on transient targets (batteries changing position, masses of troops in movement, etc.) located by aerial or terrestrial observation.

(3) Accompanying fire is the artillery fire which precedes the infantry in its advance during an attack. It consists of a rolling barrage or successive concentrations.

(a) (i) A rolling barrage is a system of fire designed to provide a moving fire-swept zone immediately preceding a line of infantry advancing in attack formation. It gives protection against short-range small-arms fire by driving the defenders to cover, destroys or neutralizes machine guns, and neutralizes batteries. It moves in accordance with a fixed time schedule, prepared to conform to the prescribed rate of advance of the infantry, and is followed by the infantry at a distance which should not exceed 100 to 150 yards.

(ii) The barrage consists primarily of a line of 75-mm. shell. To insure effectiveness, the fire of additional 75-mm. guns and of weapons of larger caliber is put down in front of this line to give a total depth of at least 600 yards. The front ordinarily covered by a battery of light artillery in a rolling barrage is 100 yards. A greater front than this gives an ineffective barrage. The barrage usually advances by range changes corresponding to a horizonal distance of 100 yards on the ground. The rate of advance varies between 100 yards in three minutes and 100 yards in eight minutes, according to the expected resistance and the terrain.

(iii) The rate of advance, the front to be covered, the limits, the rate of fire, the time of beginning, and the length of the barrage are fixed by the commander ordering the fire. This information is usually furnished to the battery commander in the form of a barrage chart.

(iv) If the fire can be observed, time shrapnel is sometimes used to advantage in the barrage. Also, at times, a percentage of smoke shell may be used. The smoke serves to indicate the position of the barrage to our troops and may partially screen their movement from the enemy.

(v) An effective rolling barrage requires a great amount of artillery and a very large expenditure of ammunition. Even when these are available it is frequently possible to utilize the fire in a more effective way than in a rolling barrage.

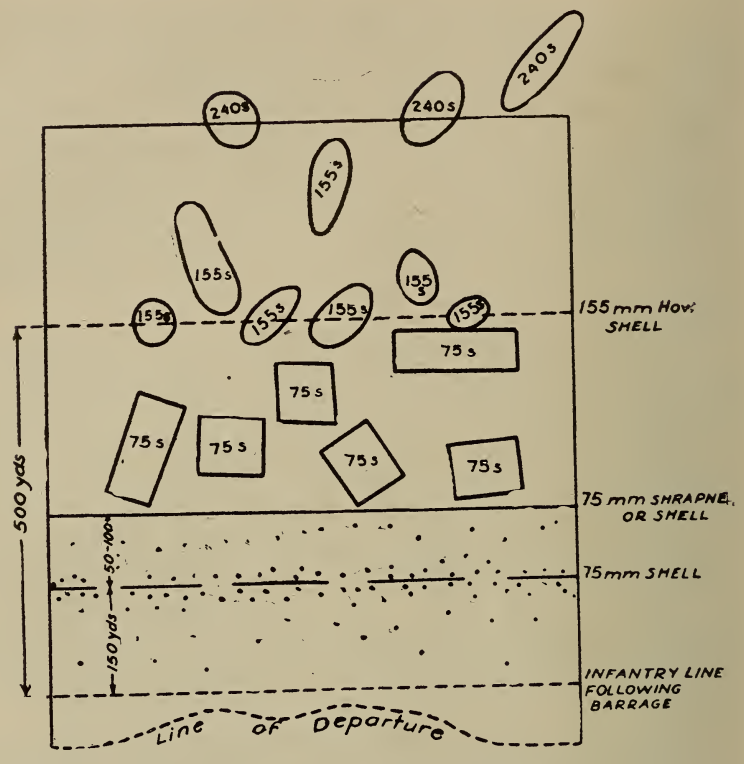

FIGURE 11—A Rolling Barrage

(b) (i) When a rolling barrage is not used, the accompanying fire takes the form of successive concentrations. This form of support may be regarded as the normal one; the use of the rolling barrage, as the exceptional.

(ii) Successive concentrations are merely concentrations of fire placed successively on selected objectives in advance of the attacking infantry. In the selection of the objectives, the interested infantry and artillery commanders usually confer.

(iii) The artillery commander assigns to the units under his command the different objectives which are selected, and thus provides for a series of concentrations which will insure the density of fire necessary for the infantry to take these objectives. The time that each of these

concentrations is to begin and its duration may be fixed in advance by artillery commanders after consultation with the commanders of the supported infantry, or this may be controlled by signals from the infantry or by direct observation by the artillery of the infantry's progress and needs.

(iv) Each battery commander is informed of the different objectives that he will have to deliver fire upon during the advance of our infantry, the location and size of each area to be covered, sometimes the time of beginning and ceasing fire on each area, and, in general, the rate of fire. This information is usually furnished to the battery commander on a chart similar to the barrage chart.

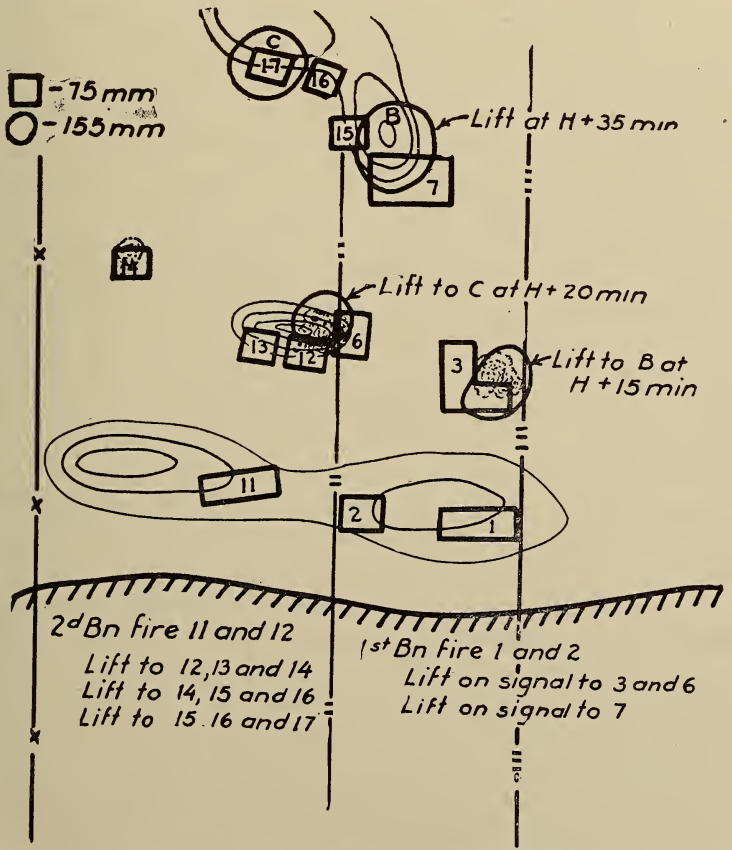

FIGURE 12—Successive Concentrations

(v) The medium and heavy artillery are used to increase the depth of the accompanying fire of the light artillery, and to neutralize the enemy to the greatest possible extent during an attack. Reverse slopes are searched by the fire of the howitzer batteries. These are also used, together with the guns, to deliver fire on hostile strong points and batteries. The assignment of missions and the preparation and conduct of the fire are handled as in the successive concentrations of the light artillery.

(c) Whether the attack be supported by successive concentrations, a rolling barrage, or a combination of both, the fire must have power, depth, and continuity.

132. FIRE SUPPORT ON THE DEFENSIVE.—*a. Purpose.*—The nature of artillery fire in support of the defense is very similar to that in support of the attack. During the period of first contact this fire consists of fire on transient targets, interdiction, harassing, and counterbattery fire delivered upon hostile elements within range. During the hostile preparation for the attack the defender's artillery fire is delivered with a view to preventing the launching of the attack, and consists of fire on hostile assembly points, routes of approach, and probable positions of reserves; the destruction or neutralization of the enemy's works and of his systems of command, observation, and signal communication; counterbattery; and distant interdiction. During the attack proper the fire consists primarily of fire against advancing infantry, tanks, etc.; defensive barrages and concentrations; and accompanying fire for support of counterattacks. Some of these fires are prearranged, others are not.

b. Prearranged defensive fires.—(1) The prearranged fires peculiar to the defensive are primarily of two kinds: counterpreparation, including general counterpreparation and local counterpreparation; and standing barrage, including normal barrage, emergency barrage, and box barrage. In addition to the two kinds of defensive fires just mentioned, fires for defensive concentrations within the friendly lines are prepared when conditions permit.

(2) (a) Counterpreparation is designed to break up the enemy's attack before it can be fairly launched. It consists of prepared fire on previously selected localities delivered on the call of a higher commander for a specified length of time. The call is made when it is evident or known that the enemy is about to launch an attack.

(b) The points on which fire is put down are sensitive parts of the enemy's front line trenches or probable line of departure, woods and ravines which afford cover for assembled troops and are likely to be occupied by supports and reserves, important observation points, and other points or areas probably occupied by his formations. Command posts and signal communication centers are also suitable targets.

(c) The authority to call for general counterpreparation is usually limited to the division commander, or the division artillery commander acting for him. In emergencies, regimental or battalion commanders of artillery are generally authorized to order local counterpreparation. A local counterpreparation is merely a part of the general counterpreparation fired in accordance with arrangements made between local infantry commanders and the commanders of their supporting artillery. It may be fired on signal but usually is fired on telephone call. Emergency counterpreparation fires may also be arranged for in order to reinforce the counterpreparation fire of other batteries during a local attack.

(3) (a) The object of a standing barrage is to place a barrier of bursting projectiles between our troops and the enemy for the purpose of stopping his advance. It is a stationary barrage delivered for defensive purposes in front of an occupied line or position.

(b) If, in spite of the counterpreparation, the hostile attack be launched and progresses towards the line to be defended, a defensive barrage should be put down close in front of that line for the purpose of stopping the attack. This barrage, known as the *normal barrage,* consists of a rapid fire of the light artillery directed on a single line from 200 to 400 yards in front of the line of resistance. The line may be continuous, if the defender's strength in artil-

lery warrants it, but it is usually broken, covering only those parts of the front where it is believed most likely that the enemy will attempt to advance. The normal barrage is a standing barrage. All batteries concerned are kept constantly laid to deliver their part of the barrage when not otherwise engaged. It is fired on any part of the front required, on rocket signal from the infantry, and is the barrage fired in case of a general attack. The front usually assigned a 75-mm. gun battery in a normal barrage is about 200 yards. A frontage much in excess of this makes the barrage so thin as to be ineffective, while a frontage much less in extent causes some of the power of the artillery to be lost. When 155-mm. howitzers are given missions in a normal barrage, their fires are prepared and delivered, in general, as in counterpreparation.

(c) In addition to the normal barrage each battery usually has one or more *emergency barrages* for the purpose of reinforcing the normal barrage of another part of the line in case of a local attack. Such a barrage may be so placed as to fill gaps in the barrage line where the latter is not continuous, or, in the case of a continuous barrage line, it may be used to increase the density of fire. Emergency barrage missions are assigned by the division artillery commander. They are not fired on rocket signal, but on order of a local artillery commander or on the order of the division artillery commander, as the latter may prescribe. The missions assigned are similar to normal barrage missions.

(d) The object of the *box barrage* is the isolation and neutralization of hostile occupants of a limited locality and the protection of our troops in a raid on that locality. The fire is generally delivered first along a continuous line forming the perimeter of a polygon inclosing the locality to be attacked. The fire along the sides of the polygon nearest the attacking force of our infantry is then lifted to allow them to enter the polygon. The fire so lifted is ordinarily used to reinforce the fire on the other sides of the polygon or for other purposes of neutralization. The front ordinarily assigned each battery is from 100 to 200 yards. When

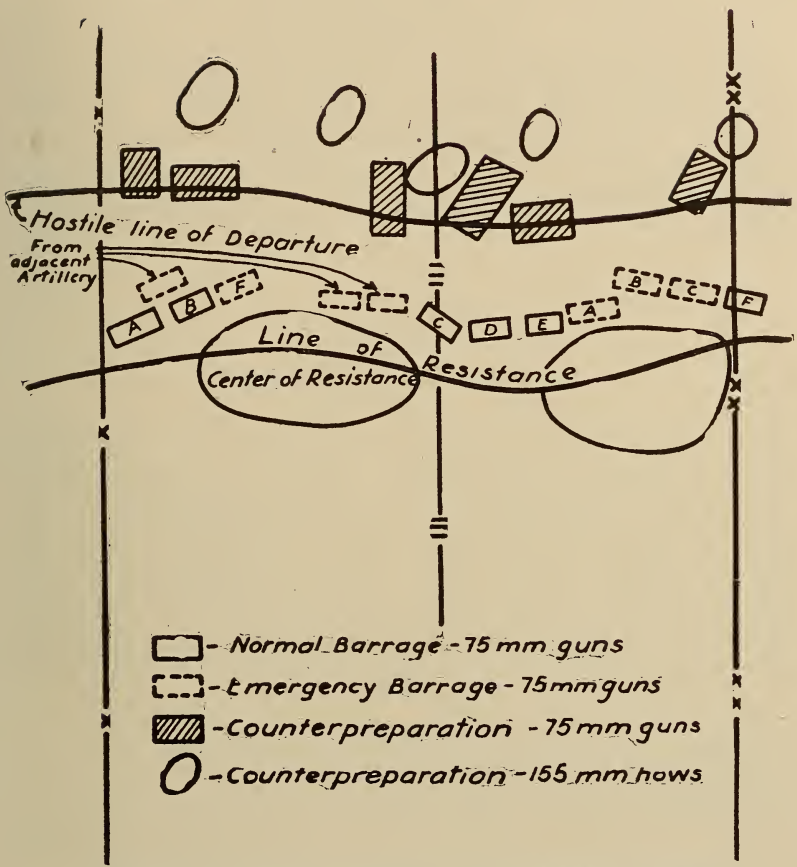

FIGURE 13—Counterpreparation and Defensive Barrages

such a barrage is used, the fire of the heavier calibers ordinarily are assigned to areas covering the hostile approaches to the area to be taken. The principles applied in the preparation of a box barrage are the same as for a normal barrage.

(4) Defensive concentrations are designed to stop and break up the enemy's attack in case it succeeds in making progress within the defender's lines. These fires are prepared for and delivered on points or areas that are of tac-

tical importance to the enemy, such as likely avenues of approach, ridges or hills, observation points, and wooded or defiladed areas that furnish cover to hostile formations. Defensive concentrations consist of concentrations of fire in depth placed on the hostile advancing infantry. Zone fire is used. The fire is directed on the leading elements of the hostile assault waves and by successive range changes are made sufficiently deep to surely include the hostile local reserves.

CHAPTER IX

The Artillery Information Service (AIS)

SECTION I

Organization and Scope

133. GENERAL.—Information employed by artillery units is obtained by the intelligence sections of higher units, intelligence sections of artillery units, and the artillery information service.

134. PURPOSE.—*a.* In general, any item of information concerning hostile artillery has a double aspect; it has an intelligence value as furnishing evidence of the intentions of the enemy, and it has a technical value to the artillery as furnishing appropriate targets to be taken under fire. *The main object of the artillery information service is to insure the effective accomplishment of the artillery fire missions by accurately locating objectives, especially hostile artillery, for the batteries to fire on.* The amount of technical data that is necessary to the efficient location of objectives

and, under certain circumstances, the rapid transmission of this data to insure the prompt delivery of artillery fire upon them, necessitates the forwarding of this information promptly. The artillery signal communication system provides the necessary means without additional installations and affords direct routes of transmission.

b. The headquarters of each artillery organization down to include the battalion has an intelligence section. The purpose of these sections is to collect, collate, and interpret information of the enemy for the use of the commander of the unit concerned and to furnish such information to higher intelligence officers. Intelligence sections are concerned principally with information of a tactical value. The artillery information service is concerned principally with the technical information which can be utilized by the batteries. The information handled by the artillery information service is not in the main a duplication of that handled by the intelligence sections.

135. ORGANIZATION.—*a.* Theoretically every individual of an artillery command is a member of the information service. The artillery information service is furnished as a distinct agency only to the headquarters of corps chiefs of artillery and to superior artillery headquarters. In artillery headquarters below that of the corps chief of artillery, the intelligence section, in addition to its intelligence functions, performs the duties of the artillery information service for that headquarters and is an agent of the higher artillery information service.

b. The dual capacity of intelligence officers of artillery brigades and of lower artillery units will be understood by an examination of Figure 14.

c. Artillery liaison officers and attached personnel, on duty with infantry and cavalry units, are for the purpose of securing cooperation rather than information. They are not members of the artillery information service of their units, but constitute one of the sources of information upon which this service relies. Organically, the artillery information service of an artillery headquarters pertains only to the staff of that headquarters and has no direct control or

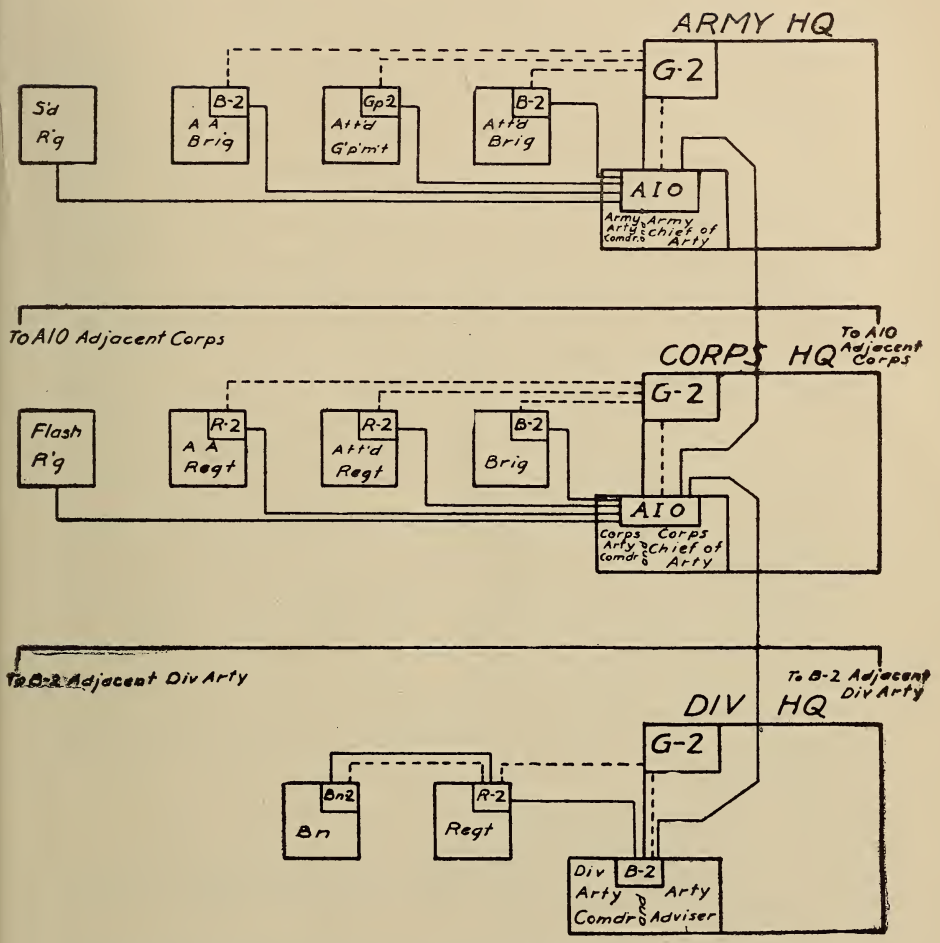

FIGURE 14—Diagram Showing Relation of the AIS to the Intelligence Service

Channels of artillery information are shown by full lines.
Channels of intelligence (G-2 information) are shown by broken lines.

supervision over this service in the headquarters of subordinate units, except as may be directed by the commanding officer of the higher unit. In practice, the artillery information services of the various artillery headquarters work in close cooperation with each other and with intelligence sections, actually operating as a centralized system.

136. SCOPE OF INFORMATION.—*a. Hostile batteries.*—To enable the necessary counterbattery to be carried on in stabilized situations, the artillery information service keeps a record of all known hostile batteries. This record provides the information through which the counterbattery of the corps is planned. In this record all observations made of such batteries are recorded, showing date of firing, target fired at, the number of rounds fired, the results obtained, together with pertinent information concerning the caliber of the battery firing, kind of ammunition employed, fuses used, and in some cases even the names and regiment, obtained from captured prisoners, of the personnel operating the hostile batteries. In nonstabilized situations an effort is made to secure as much of this information as possible.

b. Other objectives.—In addition to keeping records of hostile batteries, the artillery information service keeps a record of other possible objectives. In a stabilized situation, especially in a quiet sector, this record may be very accurate. During very active operations or in moving situations, it is impossible to make this record very complete or very accurate, but the data obtained may still be of great value to the artillery.

137. SOURCES OF INFORMATION.—The artillery information service has at its disposition, as original sources of information:

a. Terrestrial observation.
b. Flash-ranging stations.
c. Sound-ranging stations.
d. Airplane observation and photographs taken from airplanes.
e. Balloon observation.
f. Intelligence from other arms and branches of the service.

138. TERRESTRIAL OBSERVATION.—Terrestrial observation is the basic observation and, when practicable, preferable to all other, but it can not invariably be counted upon. Sometimes the weather prevents extensive view, and this condition may be normal in certain countries and at certain seasons. Observation posts, especially those belonging to batteries, are usually well forward and liable to severe shelling, which may cause them to move and may disrupt signal

communication. Since the enemy conceals his troops and batteries, these can be seen from observation posts only rarely, even when weather conditions are perfect. During hostile attacks, the enemy's advancing infantry may be screened by fog, smoke screens, or barrages, making it difficult to observe by direct observation.

139. FLASH-RANGING STATIONS.—Flash-ranging stations determine the location of hostile batteries by intersection of observations on the flashes of their pieces. They may be used to observe flashes of our own shell falling in the enemy's lines to assist in adjusting our own fires. In such cases air bursts are usually had, and, from observation on these, necessary deductions are made to determine the positions of bursts on the ground and on the target. Flash-ranging stations also observe and locate stationary or moving objectives appearing within view of their stations. Flash-ranging stations comply with requests received from the corps organizations with which they are directly connected.

140. SOUND-RANGING STATIONS.—When sound-ranging units are attached to an army from the general headquarters reserve artillery, they are commanded tactically by the army chief of artillery. They operate directly under the artillery information service and, as the name indicates, locate hostile batteries by sound records from two or more points. These stations give reliable results, provided at least four or more records can be made on the same piece, in which case the location of the piece can be obtained with an error of less than fifty yards. Sound-ranging stations can not be counted on to operate when much artillery is firing simultaneously.

141. INFORMATION FURNISHED BY THE AIR CORPS.—*a.* Valuable information is obtained from the air corps. Photographs furnished by it are examined by specially trained experts of the corps and army artillery information services, who note signs which an untrained person would either not notice or not understand. Photographs may be supplemented by reports of observers. As a general rule, photographs are more reliable than the observer's sight and memory, but the two may supplement each other.

b. The artillery information service makes requests, usually through the army or corps intelligence section of the general staff, for the air reconnaissance and photographic work required. Such requests are accompanied by a map on which is marked the zone to be photographed, the desired scale of the photograph, and the degree of urgency. In situations of rapid movement it is particularly important that photography and reconnaissance be thorough, in order to determine promptly the enemy's tactics and the kinds of positions being used by his artillery.

c. Artillery officers requiring airplane photographs transmit their applications, with the data indicated in subparagraph *b*, above, to the corps or army intelligence service, which considers relative needs and, where necessary, prepares special requests to meet urgent requirements. The artillery information service attempts to anticipate the needs of artillery units and furnish without request all necessary information, reducing to a minimum special calls on the air corps.

142. BALLOONS.—When visibility is good, and when ample protection is afforded by antiaircraft artillery and airplanes, balloons furnish a considerable part of the information concerning the enemy's activity, such as batteries in action, circulation on roads and railroads, working parties, and troop movements. Much of this information is telephoned at once to appropriate batteries so that fire may be opened without delay on fleeting objectives or hostile batteries in action. Under favorable road and weather conditions, balloons may follow an advance and keep close track of the hostile artillery. Balloon observers submit daily reports to the corps artillery information service.

143. INFORMATION FROM OTHER SOURCES.—*a.* The artillery information service works in close cooperation with the intelligence sections, making immediate use of all information of artillery value furnished by the latter.

b. The artillery information service sends officers as liaison officers to adjacent artillery units to obtain and transmit all information pertaining to the artillery.

c. The information obtained by liaison officers with front line infantry units, transmitted through the intelligence officers of subordinate artillery units, is of the greatest value to the artillery information service.

SECTION II

Duties

144. BATTALION AIS.—*a.* The battalion observation posts are one of the main sources of information utilized by the artillery information service. All information obtained is transmitted to the regiment, the battalion liaison officers, and other personnel attached to the headquarters of infantry units, to battalion scouts and reconnaissance detachments, and to the batteries, including their observation posts and reconnaissance detachments.

b. The duties of a battalion intelligence officer are similar to those of the brigade and regimental intelligence officers discussed in the succeeding paragraphs, except that the battalion intelligence officer actually gathers a very large proportion of the information utilized by the artillery information service, while the intelligence officers of the higher headquarters handle the collation, verification, and distribution.

c. The battery reconnaissance officers, in addition to their many other duties, are virtually (though not organically) agents of the battalion intelligence officer. Batteries gather a large amount of information of value to other units

and to the higher commanders, as well as much of value to themselves. The importance of the prompt transmittal of information, of known or possible value, should not be lost sight of by battery commanders and other battery personnel.

145. REGIMENTAL AIS.—Each artillery regiment is provided with a combined intelligence and information service. Its duties are:

a. Collecting all information possible concerning the enemy; forwarding that of interest at once to the artillery brigade, to other units, and to the intelligence section of the general staff; and keeping its own battalion and regimental staffs constantly informed as to the enemy's situation.

b. Obtaining from superior commanders, maps, bulletins, and other publications relating to intelligence and artillery information and distributing the same, together with available data concerning the enemy's positions.

c. Preparing a daily information bulletin for the regiment (forwarded to higher commanders and intelligence sections), containing an accurate report as to the number and kind of hostile shell fired, with the time and place of fall, and the directions from which they came.

d. Examining all information received to determine its reliability and accuracy.

146. BRIGADE AIS.—Each artillery brigade has a combined intelligence and artillery information service, with duties similar to those given in the preceding paragraph and, in addition, the following:

a. Thorough studying of the enemy's tactics and *matériel.*

b. Preparing estimates of the fighting value of the hostile artillery.

c. Preparing maps for the division staff and the artillery brigade showing the enemy's artillery dispositions.

d. Furnishing brief descriptions of captured artillery *matériel,* including ammunition and fuses, to superior commanders. (Ammunition captured should be described as to caliber, length, painting, marks, fuses, etc. Specimens will be furnished when practicable.)

e. Endeavoring to determine the relief of hostile artillery in line. (This is usually indicated by a cessation of fire, followed by erratic firing, or new registration fire. Note is made as to whether there is any change in the caliber or character of the ammunition fired.)

147. CORPS AIS.—The corps artillery information service is charged generally with such of the duties mentioned in the two preceding paragraphs as are appropriate to it and, in addition, the following:

a. Information dealing with the topography and the technical features in the enemy's areas within the corps zone, such as the location of machine guns, batteries, trenches, and railroads.

b. Interpretation of airplane photographs.

c. Supervision of the artillery ground observation service, including direct control of one or more observation posts.

d. Flash-ranging stations.

e. Preparation of artillery maps required by the corps.

It is advisable to maintain an artillery liaison officer at the corps aviation field to confer with pilots and observers upon return from flights, and occasionally to make flights himself for the purpose of securing important information.

148. ARMY AIS.—The army artillery information service is charged with duties similar to those assigned to the corps artillery information service and, in addition, the following:

a. Classifying and studying all information useful to the artillery and drawing inferences from the same.

d. Study of the topography and the technical features in the enemy's areas, within the army zone, and to as great a depth as possible.

149. INFORMATION SOUGHT BY THE ARMY AIS.—*a.* The army artillery information service makes studies of the enemy's order of battle, obtained from G-2, and a special study of his artillery dispositions and of the terrain, in order to determine the best employment of our own artillery. The tactics of the enemy's artillery and the disposition of his command are carefully considered. This includes not only front lines but rear-area dispositions so far as the latter can be ascertained. Such information is embodied in estimates of the situation, used as the basis of assignment for our own artillery; for plans for interdiction fire on the enemy's line of communications; and for harassing fires and bombardments against probable camping grounds, cantonments in woods, and other places likely to contain hostile activities.

b. The detailed information required concerning the enemy is:

(1) Organization: number, character, and morale.

(2) Location: front and depth.

(3) Reserves: location of, and time and place where they can appear.

(4) Fortifications: location and nature in detail; communication trenches most in use.
(5) Lines of communication: circulation, railheads, character of roads, bridges, canals, and railroads.
(6) Posts: observation and command; balloons, airdromes, camps, billets.
(7) Tactics: plan of offense or defense.

Information concerning items (1), (2), (3), and (7) is used by the artillery operations section to determine the deployment of our artillery and its employment in battle. Item (5) is used in planning interdiction fires, and item (6) in planning harassing fires in battle, and at other times.

150. Examination of Captured Positions and Matériel.—The army artillery information service keeps chiefs of artillery constantly informed as to the enemy's artillery and tactics. In cooperation with G-2 of the army, it examines captured positions and *matériel,* including ammunition, fuses, implements, and documents, in order to obtain complete knowledge of these subjects, and prepare bulletins for publication, to be issued as necessary. Much of this information is obtained from the intelligence sections of the division, corps, and army staffs, but much must also be obtained from original investigation and from a thorough analysis of reports concerning the enemy.

151. Cooperation with G-2.—The army artillery information service assists G-2 of the army in the preparation of daily situation maps of the enemy which are issued periodically and show the nature and extent of the enemy's artillery activity, and hostile sensitive points and other suitable artillery objectives of a nontechnical character. These maps, by the use of conventional signs in suitable colors, show graphically and clearly much useful information. Such maps, however, are specifically for intelligence purposes and are not artillery maps.

152. Army AIS Bulletins.—Information bulletins are issued by the army artillery information service giving information as to objectives, including descriptions of hostile batteries, estimates of the situation from an artillery point of view, and a discussion of the enemy's tactical methods and his *matériel.* These bulletins may include administrative

and technical information, and critical comments by the army chief of artillery, combined for simplicity in one publication.

153. G-2 Reports, Corps and Army.—The artillery information service assists the G-2 of the army or corps in the preparation of the paragraph of the G-2 report on artillery. (See Fig. 14.)

CHAPTER X

Tactical Employment of Field Artillery

SECTION I

General Principles Governing the Tactical Employment of Field Artillery

154. DEFINITION.—Artillery tactics may be defined as the art of disposing artillery troops, weapons, ammunition, and means of signal communication in the presence of the enemy so as to apply the maximum fire power of the pieces in a manner best to assist the infantry in accomplishing its mission.

155. CHARACTERISTICS OF FIELD ARTILLERY.—*a.* The basic characteristic of field artillery, and that on which its tactical employment depends, is its power of *concentration*

of fire. This power of concentration is made possible by the long range of the pieces, unity of command, efficiency of means of signal communication, and the great fire power of a relatively small tactical unit. The ability to concentrate artillery fire, without movement of personnel or *matériel,* permits the commander to take full advantage of the element of surprise. This basic characteristic, together with the long range of the pieces, makes it possible to obtain the three essential elements of the tactical employment of field artillery fire, namely: power, depth, and continuity.

b. The power of artillery is limited by its inability to act otherwise than by fire action; by its vulnerability when in movement; and by its comparative vulnerability, even when in position, when attacked by fire at medium or short ranges, especially from the flanks or rear. These limitations prevent the employment of the artillery as an independent, self-sustaining arm.

156. PURPOSE OF FIELD ARTILLERY.—*The reason for the existence of the field artillery is its ability to assist the other arms, especially the infantry, upon the field of battle.*

a. Success in combat, in all but very minor operations, is dependent primarily upon the mutual support of the infantry and artillery. Artillery prepares the way and assists the infantry, but it can not alone carry an attack to a definite conclusion. Infantry, on the other hand, requires the support of the artillery in order to make the advance with minimum loss. Both, therefore, work together as parts of a team.

b. The method of employing field artillery depends, as in the case of the other arms, upon the particular tactical situation; but, in addition, its use must always conform to the plan decided upon by the commander of the troops. For this reason an artillery commander has no independent rôle as a tactician except in locating his units and directing their fire so as best to render the assistance required by the troops which his command supports.

c. The artillery commander must keep constantly in mind and impress on the minds of his subordinates the true purpose of artillery. Opportunities particularly tempting

from the artilleryman's point of view must not divert him from his mission.

157. FIELD ARTILLERY RESERVES.—*a.* In principle, all pieces are placed in position at an early stage of the action, but the fire of only so many of them as are actually necessary is employed at any time. It is not, as a rule, desirable to hold out as a reserve any part of the artillery of a unit actually engaged. *The true reserve of field artillery is its reserve ammunition.* Thus, no part of the artillery with a division actually engaged is held in reserve, though the fire of certain units may be withheld. The artillery of a division held out as a corps reserve may be, according to circumstances, either kept with its division or attached to one of the divisions engaged. Where the corps is operating as part of an army, the latter is usually the case. If the corps is operating alone, the corps commander may want to keep in hand a reserve of full fighting strength and may keep intact a reserve division, including its artillery. The artillery of divisions in army reserve is almost always kept with the divisions, for the same reasons as in the case of a corps operating alone.

b. In corps and army artillery, as in division artillery, it is a primary principle that in any action every available piece is in constant use or available for immediate employment until the battle is won. This principle does not mean that, in major operations, all corps and army artillery is to be kept continually in position for firing. Many batteries can be emplaced or withdrawn from position only after hours of preparation. Some units may be kept prepared for marching, ready to move as soon as the progress of the engagement permits. *Portée* artillery may be employed as a mobile reserve, to be placed in action when the decisive phase arises. There should be a mission for all artillery present, even though that mission does not involve the immediate occupation of position, and no artillery is kept out of action merely to meet unforeseen contingencies.

c. Considering all the armies operating under a single general headquarters, the case is different, and a reserve of artillery must be held at the disposal of the commander-in-

chief of these armies. The organic artillery of corps and divisions is the minimum essential for carrying out their ordinary missions on the battlefield. At critical periods, the organic artillery of units on certain parts of the front must be reinforced, and additional artillery suitable to the special mission of the army and to the peculiarities of the terrain must be added. For this purpose the general headquarters reserve artillery is maintained. It contains artillery of types similar to the organic artillery, and also other types for special purposes.

158. DETERMINATION OF ARTILLERY STRENGTH NEEDED. —*a.* It is the duty of the army chief of artillery in preparing for a special operation, whether offensive or defensive, to make detailed studies of the artillery needs. Based on these studies, request is made for ammunition and for units of the general headquarters reserve artillery. This request is weighed by the chief of artillery, general headquarters, against the requests of other armies, and the final apportionment is recommended by him.

b. In making such studies based upon a thorough understanding of the army commander's plans, the army chief of artillery considers first, the objectives to be attacked. For a defensive action, or for the artillery preparation and the preliminary stages of an attack, these can be determined with considerable accuracy. Barrages (if any), concentrations, destructions, interdictions, and special fires of various kinds may be listed and the amount of artillery of different types and the amount of ammunition required may be determined. Having determined the total needs, he considers the factors which limit the amount of artillery which can be profitably employed. These factors are:

(1) The extent of front, depth, and intensity of the main attack and of the holding attack.

(2) The space available for employing batteries without dangerous crowding or excessive distribution in depth.

(3) Number of roads available for ammunition supply, and the number of vehicles per day which the artillery will be permitted to move over these roads, taking into consideration the other vital needs of the army.

(4) The number of roads available and the road space the artillery will probably be permitted to occupy during the advance.

c. To ask for artillery which can not be supplied with ammunition and the fire of which can not be intelligently conducted, is an inexcusable waste of resources.

d. It is useless to give any figures as to the probable number of pieces per mile of front, etc. In any given case, however, the study of past operations conducted under similar conditions, is profitable.

159. UTILIZATION OF CHARACTERISTICS OF FIELD ARTILLERY.—The tactical employment of field artillery should be such that full advantage is taken of its characteristics. To take full advantage of the ability to concentrate its fire and of the consequent ability to surprise, unity of command, so far as the efficiency of the means of signal communication permits, is essential. The long range of the pieces is used to give effect deep within the enemy's territory and to insure continuity of fire during advance or withdrawal, rather than to protect the artillery from hostile fire. Batteries are emplaced as far forward as other tactical conditions permit. The long range of the pieces permits concentrations of fire on important objectives from a wide extent of front and obviates the necessity for a dispersed fire of little density which produces no results. It also permits oblique and enfilade fire and reduces the number of changes necessary in advance or withdrawal.

160. FUNCTION OF DIVISION ARTILLERY.—*a.* The division is the smallest unit to which artillery is organically assigned. The primary mission of division artillery is the close and immediate support of the infantry of its division. It fires on those hostile elements which are causing losses to the infantry, impeding its advance, or imperiling its security. The purpose of its fire is usually the destruction or neutralization of the hostile personnel. In addition, it accomplishes such destruction of hostile works as may be within the power of its projectiles, as for example, barbed wire, means of signal communication, and trench intersections.

b. The character of the weapons and the purpose of the fire of the division artillery require that it take position relatively close to our front line.

(1) On the offensive, positions are as close to our front line as considerations of dead space and reasonable security from short-range artillery fire and small-arms fire permit. These considerations, on the offensive, usually limit the selection of positions to a zone extending from about 1500 yards to 3000 yards from our front line.

(2) On the defensive, the necessity for distribution in depth to insure continuity of fire in the case of a hostile penetration or of a withdrawal of a part of the front line, requires a part of the division artillery to be emplaced much farther to the rear.

c. In arriving at decisions governing the disposition and the assignment of general missions to the division artillery, the division artillery commander is the chief adviser of the division commander. Nevertheless, the actual decisions are functions of the division commander and not of the artillery commander.

d. The use of division artillery as supporting or attached artillery is discussed at greater length in paragraph 163. In general, it may be stated that, in the opening stages of an engagement, the bulk of the division artillery is employed as supporting artillery and the number of units which must be detached for use as attached artillery is limited. During the progress of the action further detachments may be advisable, but they always are limited to the minimum absolutely necessary. *It must always be remembered that each detachment lessens the power of the division commander to lay down powerful concentrations of artillery fire at critical points, and so lessens his influence over the progress of the battle as a whole.*

161. FUNCTION OF CORPS ARTILLERY.—*a.* The corps artillery provides a very great fire power in the hands of the corps commander to use at his will. It is a corps agency and is employed on those tasks of prime importance to the corps.

b. The most important fire mission of corps artillery, less antiaircraft artillery, is counterbattery. In addition it executes fires for destruction, neutralization, and interdiction within the corps zone of action or sector. It also as-

sists the division artillery either by reinforcing the fires of such artillery for the purpose of giving it greater depth or intensity, or by firing on targets which are not suitable for the type of *matériel* employed by the division.

c. In general, on the offensive, the corps artillery is placed well forward, usually within a zone extending from about 2000 yards to 4000 yards from the forward elements of the supported troops. On the defensive, as in the case of the division artillery, it is distributed in greater depth.

162. FUNCTION OF ARMY ARTILLERY.—*a.* The units of general headquarters reserve artillery retained as army artillery are ordinarily those of long range heavy types.

b. The army artillery is employed on missions of particular importance to the army and those which necessitate the employment of heavy calibers. The army artillery, less antiaircraft artillery, executes long range missions of all kinds, including harassing and interdiction fires on important points deep within the enemy's lines, and counter-battery beyond the range and capabilities of the corps artillery, and assists the corps and division artillery when necessary.

c. In general, on the offensive the army artillery is located as far forward as safety permits and suitable positions are available. On the defensive, as in the case of the corps artillery, it is distributed in considerable depth. It must not be thought that the division, corps, and army artillery are found located in three lines, one behind the other. On the contrary, some of the corps artillery may be found well advanced as far as the bulk of the division artillery, and some units of the army artillery may be well advanced, even as far to the front as some of the division artillery. The location of artillery units depends primarily on the mission assigned, taken into consideration with the facilities of the terrain.

163. SUPPORTING ARTILLERY AND ATTACHED ARTILLERY.—*a.* In the division, the artillery is ordinarily divided into two general classifications, artillery in direct support, and artillery in general support, both in the offensive and in the defensive.

(1) Artillery in direct support operates under the command of its immediate superior artillery commander but has the primary mission of providing fire support to some designated subordinate infantry unit. It does not come under the orders of the supported infantry commander but assists the supported unit in every way possible. The commander of the supporting artillery establishes direct communication and liaison with the commander of the infantry unit supported, and the latter commander makes direct call on the supporting artillery for fire. This arrangement therefore permits the prompt support of the infantry by allowing the infantry to call directly on the supporting artillery for assistance, and at the same time permits the fire of the supporting artillery to be readily diverted to important missions on other parts of the front.

(2) Artillery in general support operates under the immediate control of the division artillery commander and is employed on missions of importance to the division as a whole. It is not in support of any definite subordinate infantry unit but executes missions over the whole front of the division.

(3) In the division, ~~when only the organic division artillery is present~~, a regiment is usually assigned to the direct support of each of the brigades of infantry, ~~in which case there is no artillery in general support.~~ If the division has attached to it a regiment of howitzers, the regiment is usually kept in general support. In independent units smaller than a division, the artillery is employed in a manner similar to that in the division.

b. In the corps, certain of its artillery units may be assigned to give special fire support to a division when from the corps viewpoint the division must have reinforcement of its division artillery fires to accomplish its mission, and when it is vital to the corps that the mission of that particular division be accomplished. In such case the corps artillery must be prepared to give prompt support to the division concerned, and the division commander is authorized to have his division artillery commander call directly on the supporting artillery for fire. At the same time the

corps retains at its complete disposal at all times a part of the corps artillery, prepared to cover the whole corps front and to undertake missions of particular importance to the corps as a whole. The 155-mm. gun regiment is always so retained, as its great range particularly fits it to undertake long range corps missions. The corps is responsible for counterbattery, and a portion of the corps artillery is usually kept on this mission. The practice in the case of the army is similar to that in the corps. Some groups of long range army artillery may be assigned to give fire assistance to a corps while some are employed on specific army missions over the front of the army.

c. Attached artillery is employed under the orders of the commander of the unit to which it is attached. For the period of the attachment the artillery becomes a part of such command and is employed accordingly. The advantage of attached artillery is, that by such decentralization the most intimate contact is maintained with the unit to which the assistance is given. The disadvantage is, that the attached artillery is not readily available for missions on parts of the front other than that of the unit to which attached. In the division then, the light artillery is normally placed in direct support of specific infantry units and is attached only when the division artillery cannot be employed as a coordinated whole, and support can best be rendered, therefore, by a decentralization of artillery command. Supporting artillery is the rule; attached artillery is the exception and must be fully warranted in each case.

d. In the corps, the same principles apply, as are stated in the preceding paragraph. The corps artillery brigade is organized and equipped to execute corps missions. No detachments to divisions are made except where absolutely necessary. Such cases usually occur with a division acting independently, or with a division as a part of a corps operating in such a situation that the corps artillery, as such, cannot render efficient support. Wherever the corps artillery acting under corps control can render efficient support no detachments are made. Most of the general headquarters reserve artillery allotted to the army will probably be

passed on to corps except types of heavy long range artillery which are retained under army control.

SECTION II

Artillery on the March and its Entry into Action

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164. ARTILLERY MARCHING INDEPENDENTLY. — In marches not in the presence of the enemy, it is always desirable for horse-drawn and tractor-drawn artillery to march in columns separate from each other and from troops of other arms. Placing artillery in the same column with troops of other arms renders marching difficult and uneconomical for both, and is avoided except in the presence of the enemy.

165. RATES OF MARCH AND LENGTH OF MARCHES.—*a.* The rate of march of artillery, when marching in a mixed column, is governed by that of the troops with which it is marching.

b. Horse-drawn artillery, marching on roads, moves at a rate of from 3 to 3½ miles per hour (including hourly halts) and can cover from 15 to 25 miles a day. For short distances it can move at 8 miles per hour. Horse artillery marches at a rate of 4 to 5 miles per hour and can cover usually about 25 miles a day. In forced marches the distances given can be increased up to even 50 miles a day for one or two days.

c. Tractor-drawn artillery moves on roads at a rate of from 3 to 3½ miles per hour. Light and medium artillery can, in emergency, increase this rate to 7 miles per hour

but such rates cause rapid deterioration of *matériel*. The average daily march, allowing for the proper care and maintenance of the tractors, is about 25 miles a day. In forced marches, 60 miles a day may be covered for 2 or 3 days.

d. *Portée* artillery moves at the speed of heavy motor columns, that is, 5 to 8 miles per hour.

e. In movements on the battle field, the above rates must not be expected. The rate of movement is greatly reduced, due to congestion of traffic, condition of roads and trails, and delays caused by hostile fire. No figures can be given for the rate in a displacement forward or to the rear, but commanders must not expect the normal rate of march.

166. MARCHES IN THE PRESENCE OF THE ENEMY.—*a.* Marches in the presence of the enemy include all marches, the conduct of which is affected by the presence of the enemy. In such marches, the order of march of the various elements of the command is controlled by tactical considerations. When contact with the enemy is probable, the order is such as to facilitate deployment in accordance with the probable plan of action.

b. Artillery with the advance guard is usually placed at or near the tail of the reserve.

c. In rear guards, the artillery usually is with the support or at the tail of the reserve.

d. In the division, in order to expedite its entry into action, the light artillery is generally near the head of the main body, preceded only by sufficient infantry to provide for its security. Medium artillery, if attached to the division, is generally placed at the tail of the main body.

e. Units of corps artillery are usually grouped and marched in one or more columns in rear of the front line divisions.

f. Army artillery is usually subdivided into suitable groupings and kept well to the rear until the situation requires its use.

167. SUBDIVISION OF ARTILLERY FOR THE MARCH.—*a.* In horse-drawn, horse, and pack artillery, the battalion is the principal march unit. Whatever the size of the march columns, the march is conducted as the march of so many

successive battalions, over which higher artillery commanders exercise a certain amount of supervision. This supervision is usually limited to inspections and to prescribing the time and length of halts when not fixed by the orders of higher commanders.

b. Unless the artillery is marching independently or as a part of an advance or rear guard, the battalion combat train is seldom with its battalion. The road space that would be occupied by the combat train is given to troops needed earlier at the front. Battalion combat trains of artillery units with the main body are usually grouped and marched in rear of the last combat element of the main body. Advance and rear guard battalions are usually accompanied by their combat trains. A single battery on advance or rear guard duty may have attached to it a portion of the battalion combat train, if conditions warrant such attachment.

c. In tractor-drawn and *portée* artillery, the battery is the march unit. Within tractor-drawn units the speeds of the different types of vehicles vary. There are three main classifications; the light motor column of passenger cars, reconnaissance cars, motorcycles, and light trucks; the heavy motor column composed of trucks; and the tractor column which consists of the tractors with their loads. When tactical considerations permit, it is usually advisable to divide the units into one or more heavy motor columns and tractor columns for march purposes. This subdivision allows blocks of traffic of uniform speed to be handled together. It also permits the various types of vehicles to be operated at their economical speeds. The number of vehicles composing the light motor columns are so few, and in many cases are so dispersed on reconnaissance or with the other columns, that a light motor column is seldom formed.

d. The transport of the battalion combat trains of tractor-drawn artillery consists of trucks. These trains seldom march with the tractors of their respective units, but usually are grouped with the other elements of the heavy motor column of the regiment.

e. On the march with other troops in the presence of the enemy, the service batteries of artillery regiments, or the parts thereof attached to subordinate units, march with the field trains of the other troops.

168. RECONNAISSANCE DURING THE MARCH.—*a.* When on the march in the presence of the enemy, artillery reconnaissance is continuous. Artillery commanders of all grades should, by study of the map and the use of their reconnaissance personnel, keep themselves informed as to artillery positions and routes close to the line of march. Parts of the headquarters of all units (brigades, regiments, battalions, and batteries) may be pushed forward in the column, as the artillery commander may prescribe, in order to expedite reconnaissance. As a principle, such dispositions are made that the artillery reconnaissance is completed in time to permit the uninterrupted movement of the batteries into position.

b. The commander of the artillery of the advance guard must be with the advance guard commander. This places him well ahead of his guns. He must keep himself informed at all times as to the location of advanced infantry elements and as to the artillery possibilities (positions, routes, concealment, etc.) of the terrain over which he is passing. His reconnaissance for the actual occupation of position begins as soon as he has received instructions from the advance guard commander as to the location and employment of his guns. Reconnaissance by commanders of artillery attached to infantry brigades or smaller units is conducted in a similar manner.

c. The location of corps and army artillery on the march and the character of its employment are such that ample time is usually available for deliberate and detailed reconnaissance by commanders of all grades.

d. Before making a reconnaissance, commanders of all artillery units must have as thorough knowledge as possible of the plan of the superior commander for the employment of the artillery.

169. ENTRY INTO ACTION FROM THE MARCH.—*a.* When the march is stopped by sufficient hostile resistance to re-

quire the employment of artillery, the advance guard artillery must be prepared to go into action promptly and deliver an effective fire. The advance guard commander decides when the artillery shall open fire. At least one battery is placed in position near its location on the road, from which it will be able to deliver an effective fire. In this, observation of the advanced infantry elements and of the area occupied by opposing hostile elements is essential. Even though this position be not the best and the range be longer than desired, the moral effect, both on the enemy and friendly troops, of a prompt delivery of effective fire more than compensates for the disadvantages of the position. While this battery is firing, other batteries may be moved farther forward to positions selected after a more thorough reconnaissance. Artillery attached to regiments and battalions of infantry is handled in a manner similar to that of the advance guard. When there is no artillery with the advance guard, artillery near the head of the main body is normally employed to support the advance guard action.

b. If the enemy's resistance is strong, and especially if the advance guard artillery is subjected to superior fire, all or part of the artillery of the main body is ordered into action at once. In meeting engagements, it must be realized that time is the important element; that the movement of batteries over considerable distances across country or along roads congested by other troops, involves delay; and that it may be better to open fire from inferior positions—and to open fire promptly—than to hold batteries inactive during a long and exhaustive reconnaissance. Such a condition may require that the leading elements of the artillery with the main body be placed in positions near their locations in the column at the time the column is halted, provided suitable observation can be obtained. Such positions usually require very long ranges and must be considered merely temporary positions from which to cover the advance of other batteries with the main body into more favorable positions well to the front.

The positions occupied and the manner of the employment of the artillery depends upon the plan of action of

the commander of the troops. The entry into action is progressive, but with a minimum of delay once the plan of action is determined upon. The prompt establishment of a superiority of fire is an important consideration.

SECTION III

Accompanying Artillery

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170. DEFINITION.—Accompanying artillery is a form of attached artillery operating with the infantry to which it is attached in more intimate physical contact than in the usual case of attached artillery. It gives close support by attacking emergency targets which impede the advance of the unit to which attached. It consists of accompanying batteries and accompanying guns only.

171. GENERAL PURPOSE.—No matter how powerful the general artillery and other fire support in attack may be, some elements of the hostile resistance, particularly automatic weapons, remain in action and are encountered by the advancing infantry. Provision for attacking these targets can not be made in advance, except in a general way, since their location is not known beforehand. When they actually are encountered, it may be possible for the infantry to overcome them with rifle fire and movement alone, but if the resistance be strong this procedure usually results in undue losses, and causes delay. It may be possible in such cases to employ successfully the special infantry weapons, but these may prove inadequate. In the latter case, the

assistance of the supporting artillery may not be available, due to the difficulty of signal communication, lack of observation, difficulty of target designation at a distance, and inaccuracy of long-range fire. In general, the method of meeting these unexpected resistances is to bring into play a fire action of sufficient power in a minimum of time in order to save the infantry time and losses. To augment the power of the special infantry weapons and to reduce the possible delay and inaccuracy of the fire response of the supporting artillery, accompanying batteries and accompanying guns are used.

172. WHEN USED.—*a.* In deciding to attach batteries or guns to the infantry as accompanying artillery, it must be remembered that their detachment from the mass of supporting artillery weakens the latter. They are removed from the organization of command and supply to which they regularly pertain; the organization with which they are trained and most accustomed to work, and within which they receive the supervision and assistance of more experienced artillery commanders.

b. The use of accompanying artillery is justified only when a probable failure of the supporting artillery to furnish prompt and effective support in some phase of the action is foreseen. Unless such failure is foreseen with reasonable certainty, accompanying artillery is not used. It follows, therefore, that supporting artillery is the rule; accompanying artillery the exception. The ratio of accompanying artillery to supporting artillery in any case is small.

c. In the case of an attack against a single prepared position, it may be expected that the artillery positions of the attacker are well forward with ranges short. Observation is organized, means of signal communication are established, firing data are prepared for a number of points, some adjustment of fire doubtless has been made, and artillery liaison officers are with infantry commanders; there is therefore no reason to apprehend delay or ineffective fire in response to calls for artillery fire. In such cases, the supporting artillery normally is kept intact.

d. In an attack against a defensive zone of two or more prepared positions, the forward part of the outpost area presents the same aspects as a single prepared position. Conditions are different for the main battle position. It must be expected that the attacking infantry units will lack coordination when they arrive at this position; the position usually is out of effective range of the initial division artillery positions, necessitating the advance of this artillery or a considerable portion of it before the attack on the battle position; observation will be possible, but will not be organized; means of signal communication will be established hurriedly and imperfectly, and a certain portion of the artillery may not yet have arrived at the new positions. The attack will have lost some of its cohesion; yet it must be pushed without allowing the enemy time to reorganize. Isolated organized tactical localities may be encountered and unknown machine guns will be developed. Many of these obstacles will be unknown as to location and they may be of such nature that prompt artillery fire is necessary to prevent losses in time and men. If there are switch positions or if there is a reserve battle position farther in rear of the battle position, the same difficulties and obstacles in a greater degree may be expected as in the case of the main battle position. The skilful employment of accompanying artillery where such conditions can be foreseen, provides the assault battalions with prompt and effective support.

e. While the foregoing discussion of the attack against a defensive zone illustrates situations which might call for accompanying batteries and accompanying guns, their use is not restricted to these particular cases. The same necessities may arise in situations where the elements of a defensive zone are lacking; these necessities may be incident to open warfare operations as well as to a stabilized situation. The use of accompanying artillery in appropriate cases is authorized. But, as stated previously, the practice is an exception to the usual procedure of supporting artillery and must be justified by conditions as they exist or as they can be foreseen.

f. From the above it is seen that the decision as to when to use accompanying artillery is dependent on the particular situation. Such use is warranted when it can be foreseen with reasonable certitude that obstacles will be met which have not been destroyed or neutralized by the supporting artillery, and that these obstacles are of such a nature that in order to overcome them the fire power of the infantry and its special weapons must be reinforced or increased, and that the supporting artillery cannot give the needed support. Its use is also warranted when it can be foreseen that the conflict is liable to break up into a series of local combats where central control or coordination of effort by the commander of the force, is impossible.

173. MISSIONS.—*a.* The missions properly assigned to an accompanying battery include those ordinarily incident to the support of infantry by light artillery. Ammunition can not be expended as freely as is possible for the division artillery as a whole. This usually precludes firing at other than definite targets; barrages and the searching of large areas are too costly in ammunition. The battery assists by its fire the unit to which it is attached, taking under fire, targets of importance to that unit. Its particular value lies in its availability for prompt employment.

b. The accompanying gun is essentially an emergency weapon for the infantry battalion. It assists by its fire the advance of the assault battalion to which attached. Typical targets are machine guns, single field pieces, antitank guns, tanks used in counterattacks, or any other target suitable for a single gun. The target usually is such that one well directed hit will put it out of action.

c. Accompanying artillery is detailed for special use in the attack, but may become an important element in the temporary local defense when the attack loses its driving power, particularly in assisting in stopping a counterattack. In this case, the facility for close observation of the enemy's attack affords an opportunity for the accompanying artillery to deliver very prompt and accurate fire, more quickly and probably more effectively than it can be delivered by the supporting artillery.

174. TACTICAL EMPLOYMENT.—Marked differences exist between the proper tactical employment of accompanying guns and accompanying batteries. Their use is distinctly indicated within definite spheres—essentially they are weapons for different infantry units. Fundamentally they have a common purpose.

a. Similarities.—Both the accompanying gun and the accompanying battery are employed to further the advance of the infantry to which attached, by attacking targets insufficiently neutralized or overlooked by the supporting artillery, or to settle an emergency situation calling for prompt employment of weapons additional to or more powerful than those forming an organic part of infantry units.

b. Tactical differences.—The tactical differences should be fully understood by both infantry and artillery commanders. They may be briefly summarized as follows:

(1) Influence of command. The accompanying gun is an emergency weapon of the assault battalion commander. The accompanying battery is the weapon of the infantry regimental or brigade commander.

(2) Movement and safety. The gun moves swiftly from cover to cover, in short bounds, depending on the nature of the terrain. It comes into action quickly and attempts to overwhelm its target by a rapid burst of fire. Its periods of action are very brief, followed by prompt concealment nearby. The battery makes longer and less frequent moves. It can therefore execute a more sustained fire. Vulnerability on the march increase greatly with the size of the artillery unit. The battery seeks initially good concealment behind a mask and advances by bounds usually at a slower gait than does the gun.

(3) Location. The gun usually operates within the area occupied by the assault battalion. Due to its small size it can, if necessary, move through the infantry formations. Its use is usually at ranges less than 1500 yards. On the other hand, the battery operates considerably farther to the rear. Its bulk precludes its use, except in great emergencies, at close range. It usually is employed at ranges of about 2500 yards or less. It must remain within or near the area of the unit to which attached; otherwise, its lines of signal communication become so long as to defeat the purpose of its attachment. The ideal situation is to have the artillery, its commander, and the infantry commander remain as close together as the terrain and situation permit. This condition seldom is realized but its importance should be kept constantly in mind.

(4) Character of fire. The gun usually employs direct laying, due largely to the short range. Even when indirect methods are used because the target is indistinct, there is little or no defilade. The battery on the other hand normally employs indirect laying from concealed positions.

(5) Time of joining unit to which attached. The gun joins the battalion to which attached well before the attack begins in order that the employment of the gun can be carefully considered in the scheme of maneuver of the battalion. The gun, therefore, is not expected to take part in the preparation or the initial phases of the attack. It follows the battalion closely. The battery usually is able to take part in the preparation and even the opening phases of the accompanying fires. It joins in time to move forward at about the same time as the regimental reserves or at latest, with the brigade reserves.

175. Duration of Assignment.—Since the use of accompanying artillery is exceptional and only for special situations, it should revert to its proper organization immediately on completion of the missions contemplated. Orders are as explicit as possible as to the period of attachment; but, if the orders are indefinite in this respect, the commanders immediately concerned initiate measures to return the artillery when it is no longer needed.

176. Units from Which Detailed.—When there is ample light artillery from which to choose, the question may arise as to whether to detail accompanying artillery from units belonging organically to the division which employs it, or whether to detail it from other available sources. The objection to breaking up the organic artillery of the division is that the permanent team is partially destroyed; on the other hand, the advantage in so doing is that the accompanying artillery thus obtained (which should be but a relatively small proportion) fights with units with which it has already trained, and this permits a closer cooperation with the infantry to which it is attached. The detailing of accompanying artillery from the organic artillery is usually preferable.

177. Equipment.—*a.* The 75-mm. gun is the piece ordinarily used as accompanying artillery. The pack howitzer, if available, may be used. Accompanying batteries ordinarily carry only the usual equipment. Accompanying guns, on account of the difficulty encountered in moving them and the animal casualties to which they are liable, are provided with special equipment. In general, the equipment of an accompanying gun includes one gun, two caissons, one extra 6-horse team, and ample signal communication and pioneer equipment.

b. An accompanying gun, whenever practicable, is commanded by an officer. Ample additional personnel for reconnaissance, signal communication, and liaison must be provided.

178. TRAINING WITH INFANTRY.—The full effectiveness of accompanying batteries and accompanying guns can not be attained merely by the development of a high state of individual knowledge and training on the part of the infantry and artillery; a team play is necessary which can be atttained only by the two arms working together. This combined training should be acquired in the training area rather than on the battle field.

SECTION IV

Artillery in the Offensive

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179. KINDS OF FIRE USED.—On the offensive, the types of artillery fire delivered may be divided into two general classifications: the artillery preparation and the fire during the attack. The distinction between these two classifications is a tactical one. So far as concerns the conduct of the fire and the targets attacked, there is no line of demarkation. Actually much of the artillery may continue on the same fire missions during the attack as during the artillery preparation. This is particularly true for a considerable portion of the artillery during the initial phases of the attack and applies especially to corps and army artillery.

180. THE ARTILLERY PREPARATION.—*a.* The decision as to whether an artillery preparation is to be fired and

the time of commencement thereof, is a matter for decision by the commander of the force engaged. The artillery commander is concerned in the making of such a decision only as an adviser to the commander. The character of the fire and of the objectives to be attacked vary according to the length of the preparation. In a long-continued preparation, much interdiction and other long range fire are necessary. In a very short preparation, all the fire may be concentrated on the forward elements of the enemy's troops.

b. The mission of the division artillery is the destruction or neutralization of the hostile personnel, machine guns, means of signal communication, and lighter works within the area assigned for the preparation. Usually the division artillery places the bulk of its fire on the forward elements of the hostile troops within a zone of approximately 2000 yards depth beyond the enemy's most advanced elements. The intention is surely to include within this fire, local reserves and all supporting points capable of bringing rifle or machine gun fire to bear on the assaulting troops at the beginning of the attack, or in their approach to and capture of the enemy's most advanced defenses.

c. The corps and army artillery execute fires for destruction, neutralization, or interdiction within the areas assigned them by higher commanders. The corps artillery normally performs all counterbattery within the corps zone of action so far as the range of its weapons permits, and executes fires in reinforcement of those of the division artillery and on such other targets of importance beyond those of the division artillery as may be necessary. The army artillery fires in assistance to corps and division artillery and on important long range targets beyond those of the corps artillery.

181. Fire During the Attack.—*a.* During the attack, the artillery, by concentrations ahead of the advancing infantry, or by a rolling barrage or both, by counterbattery fire, and by interdiction fire, assists in overcoming resistance and prevents the enemy from bringing up reserves or from launching a counterattack. Whatever the type of fire support used, it should be in sufficient depth to neutralize all

hostile elements capable of bringing effective rifle or machine gun fire on the assaulting infantry at any phase of the engagement.

b. The bulk of the division artillery is usually employed in direct support of the infantry, the remainder, if any, being used in general support. The mission of the division artillery is to neutralize and disorganize the defending force at each locality attacked, until the advancing infantry is ready to capture that locality. The fire lifts from each objective of the infantry either on a time schedule, when directed from artillery observation posts, or on signal from the infantry as arranged prior to the attack.

c. The corps artillery seeks to neutralize the enemy's batteries. Some of the corps artillery also has the important mission of firing concentrations on important points and of assisting in the accompanying fire of the division artillery by deepening the fire of such artillery by firing successive concentrations in advance thereof. Interdiction and neutralization fires on points beyond the fires of corps artillery are delivered by the army artillery. These are delivered on areas, towns, roads, railroads, detraining points, and other places likely to be used in the concentration and movement of reserves, ammunition, and supplies.

d. When detailed plans for an attack are prepared in advance, much of the fire is prearranged and delivered in accordance with a schedule, though such a plan must always provide for taking full advantage of all opportunities for observing fire and for modification of the schedule when actual observation shows it to be desirable.

182. FORWARD DISPLACEMENT.—*a.* As the infantry advance progresses, the fire of the supporting artillery becomes less effective, due to the increased range and difficulty of observation. At this time the need for close support of the infantry is especially urgent since it may be disorganized by its advance and in danger from counterattack. To continue this needed support, the artillery must be advanced to positions from which it can deliver an effective fire.

b. While moving forward, the artillery units are out of action. Only a part, therefore, of the supporting artillery moves at one time, while the remainder continues its fire until the first units are again in position. The number of movements are reduced to the minimum consistent with effective fire support; the bounds, therefore, are of as great length as possible. The number of units sent forward is limited to that for which an adequate supply of ammunition is possible. Provision is made for early reconnaissance of routes and for overcoming the difficulties of a forward movement through the battle area. Engineer troops are attached to artillery units, when necessary, to assist in the forward movement.

c. If a plan for the forward displacement is made before the beginning of the attack, the matter is greatly simplified; it needs then only to be coordinated with the progress of the attack and with the actual conditions as they develop in the combat. The end sought is to have the maximum amount of artillery in position to support the infantry during the hardest tasks. In large commands, this forward displacement is executed by battalion, one battalion of a regiment moving while the other battalion or battalions continue the supporting fire, taking over the essential fire missions of the battalion moving. Prepared schedules for displacement show, if possible, for each unit to be displaced, the general route to be followed, the new location, the time of beginning the movement and the approximate time to be taken in moving.

183. ORGANIZATION OF COMMAND.—*a.* The division artillery is a highly concentrated and powerful force. In any concerted action of the division, it should be held under the control of the division commander. The usual practice is to assign to one regiment of light artillery the mission of supporting directly the attack of each infantry brigade. If the brigades attack with regiments abreast, this permits a further apportionment of one battalion of light artillery to support each infantry regiment. A howitzer regiment, if attached, is usually in general support of the division as a

whole. It then operates in close liaison with the light artillery.

b. During the progress of the attack, there is the greatest need for close cooperation between the commanders of artillery battalions and regiments, and the commanders of the infantry units which they support. This can best be accomplished by the establishment of the command posts of the two commanders concerned in close proximity to each other. However, the artillery commander must locate his command post so that he can exercise the proper control over his organization. When displacement forward of either the artillery units or the infantry command post becomes imminent, the artillery commander must take steps to insure the maintenance of liaison and control during and after the displacement.

c. When the action develops into pursuit and into isolated attacks or other operations of separate infantry units, the difficulty of maintaining means of signal communication sometimes forces the decentralization of artillery command, and the attachment of elements of the division artillery to subordinate infantry units.

d. The command of corps and army artillery usually remains centralized throughout the action. Under certain conditions some of the howitzers of the corps artillery may be attached to divisions. (See paragraph 163.)

184. LIMBERS, TRACTORS, AND COMBAT AND FIELD TRAINS.—*a.* (1) Field artillery must remain mobile if it is to carry out its mission. The maintenance of this mobility depends upon the care and protection from hostile fire given to the means of transportation and upon their proximity to the firing batteries. The location and formation of these essential elements of the artillery depend on the character of the operation and the cover available. To secure the maximum cover and yet be able to carry out properly their functions is the object sought. In rapidly moving situations, it is essential that the limbers or tractors be so placed that they can be concealed from hostile ground and aerial observation and have free and prompt access to the

firing positions. The distance from the pieces, therefore, is controlled by the character of the terrain.

(2) The battalion combat trains are assigned posts by the battalion commander and work from the ammunition distributing point forward to the battery positions. Their location is governed by the same considerations as govern the location of the limbers or tractors, free access to the firing positions by covered approach being of greater importance in this case than proximity. Hence, in open warfare situations the battalion combat trains usually are posted farther to the rear than the limbers or tractors, keeping close to the roads which lead to the front.

(3) The location of field trains of artillery regiments in combat and on the march is controlled by the commander of the troops. They maintain contact with their regiments by agents.

b. When the situation becomes stabilized, the necessity for having the limbers and combat trains in proximity to the batteries decreases, while the danger from hostile aerial or long-range artillery attack increases. In such situations, the limbers or tractors, and the battalion combat trains, may all be located where the work of administration and supply is carried on.

185. MEETING ENGAGEMENT.—*a. Unity of command.*—The vital point in the employment of the artillery in a meeting engagement is unity of command. The uncertainty as to the lines which the development of the battle will follow, renders it essential that the division commander keep the artillery well in hand. He must be prepared to concentrate its fire on any part of the front. The artillery must be prepared to support both the enveloping attack and the holding attack, and to concentrate the fire of the greatest possible number of batteries in support of either, according to their relative needs. At the decisive moment of the assault, the division commander may launch his last reserve. At this instant, he must be able to use every piece available at the critical point of this assault. It is usually possible to keep the artillery close together in areas from which it can support either the enveloping or the holding attack.

This reduces the difficulties of signal communication between the artillery commander and his subordinates to a minimum and facilitates close control by the division commander.

b. Liaison.—The greatest difficulty of the artillery in a meeting engagement is in maintaining liaison with the front-line units of the infantry, and in obtaining artillery information—location of hostile batteries, position of friendly units, hostile front lines and points of resistance. Every facility at the disposal of artillery commanders of all grades must be kept constantly employed to the limit to maintain this liaison and to gain this information.

c. Advance guard artillery.—When contact with the enemy has been gained, the artillery with the advance guard is placed promptly in position to support the advance guard in its covering action and reconnaissance, and, at the same time, to assist in covering the advance of the main body. Its missions during this phase depend upon the tactical mission assigned the advance guard. If that mission be to attack to secure favorable terrain, the artillery supports the advance of the infantry by concentrations of fire on those hostile organizations offering the greatest resistance to the advance of the infantry. If the mission of the advance guard be to hold defensively while the main body deploys, or to retire to a more favorable position, the artillery supports the action of the advance guard as in the defense or in a withdrawal, respectively. In any case, the usual targets are the infantry and machine guns of the hostile covering force, either deployed or moving in small columns to positions—transient targets. Prompt occupation of positions, skilful conduct of fire, and coordination with the infantry are essential to success. The time element is most important.

d. The development.—A decision having been reached by the commander as to the plan of attack, the columns are developed and the roads cleared, so that the artillery with the main body may move promptly into position. The early entry of the artillery into action not only covers the development and advance of the infantry, but also helps to clear up

the situation regarding the enemy's dispositions and intentions. The positions are well advanced. It may be necessary, however, to place some of the artillery units in action at once to bring some fire to bear on the enemy and to support the forward movement of the other artillery units. These units are moved to more advanced positions at the first opportunity. The reconnaissance of routes and positions is completed during the action of the advance guard, and the movement into positions expedited in every way. This does not mean that the artillery moves forward at an excessive speed, but that, by prompt reconnaissance, establishment of means of signal communication, and preparation of firing data, fire can be opened as soon as the pieces arrive in position.

e. Counterbattery.—It is probable that during the development, the hostile artillery will reply to the fire of the advance guard artillery or will open effective fire on the infantry. Thus arises the early need for counterbattery. If the division is acting alone, some of its batteries must undertake this work. The 155-mm. howitzer is an excellent counterbattery weapon and, when with a division, is used for this purpose. If howitzers are not available, the light guns are used to neutralize the fire of such hostile batteries as are inflicting losses on our infantry. This is a very important function of the artillery during the development on account of the losses suffered by infantry columns from hostile artillery fire. The difficulty of locating the enemy's batteries prevents the profitable employment of many batteries for this purpose, but every effort must be made by ground and air reconnaissance, and by liaison with the infantry to locate the hostile batteries and thus permit effective counterbattery fire.

f. Deployment and advance to the line of departure.—During the phases of the infantry deployment subsequent to the development, the artillery continues its covering fires. All artillery units will have been assigned definite missions and will be in position. If there is to be an artillery preparation, it begins during this phase. As the infantry advances to its line of departure, the artillery completes its prepara-

tion fire. The most effective fire during this phase is that which neutralizes hostile machine guns, batteries, and other weapons. Smoke shell may be used to blind hostile observation prior to and during the attack. The time available for an artillery preparation in a meeting engagement is usually limited to the time necessary for the infantry to deploy and advance to the line of departure.

g. The attack proper.—It is, however, during the attack proper that the artillery puts forth its supreme effort to assist, by its fire, in furthering the advance of the infantry. During the advance of the latter from the line of departure to the assaulting position, this assistance is given by fire on transient targets and by concentrations ahead of the advancing infantry. As the infantry approaches the assaulting position, the artillery increases its rate of fire, and a heavy bombardment is placed on the enemy's front line in order to shake his morale and pin him to the ground. The assaulting infantry closes on this final bombardment to the limit of safety, with a view to attacking with rifle and bayonet when the artillery fire lifts. Thereafter, by firing on transient targets or by concentrations ahead of the advancing infantry, the artillery assists in overcoming the remaining resistance and prevents the enemy from bringing up reserves or from launching a counterattack. The infantry attacks by fire and movement; the artillery supporting by fire, assists in gaining that fire superiority which enables the infantry to close with the enemy in bayonet combat.

h. Corps and army artillery.—(1) Frequently, corps artillery intended to be used in a meeting engagement is temporarily attached to the division or divisions leading the advance in such quantity as the situation indicates as advisable. Although the corps and army artillery and such medium howitzers as may be attached to the division are in general not used during the opening stages of a meeting engagement, in many cases the need for more effective counterbattery fire during the development and deployment may make it desirable to place batteries of medium howitzers in position before the situation is fully developed.

(2) Corps and army artillery are brought up as the action progresses, to take advantage of their power and range. In this event, however, the time required for emplacement and for changes of position of medium and heavy artillery, are given serious consideration.

186. AGAINST A FORTIFIED POSITION.—*a. Situation.*—The characteristics of an attack against a fortified position are that the enemy has been longer in position and has adapted his position to take full advantage of the natural features of the terrain. He has constructed more and stronger field works, including possibly one or more belts of wire; his system of signal communication has been better organized; more complete provision has been made for his ammunition supply; and his covering forces have been pushed farther to the front and intrenched. The successful attack of such a position requires superior forces, and deliberate and coordinated action.

b. Preliminary action of the artillery.—During the action of the advance guard in driving in the covering forces and reconnoitering the position, it may be necessary to reinforce the advance guard artillery to support the reconnoitering forces and assist in clearing up the situation. During this preliminary action, the troops of the main body are brought forward and massed under cover, awaiting the time for the attack. This gives additional time for the reconnaissance and occupation of positions by the main part of the artillery, and for the preparation of a more carefully coordinated plan of supporting fires. In order that the artillery fire may reach well to the rear of the hostile position, it is necessary to place the artillery in positions well forward.

c. Artillery preparation against a fortified position.—The artillery covers the infantry during its approach march, deployment, and advance to the line of departure. The opportunity to strike quickly, which offers success in a meeting engagement, is not so apparent here. The commander may, however, keep the enemy in doubt as to the time and direction of his main blow, and, to assist in this element of surprise, he may limit the artillery preparation to light harassing and interdiction fires, with a brief but violent

bombardment immediately before the attack proper. Or, if tactical and other conditions warrant the delay, he may wait for the cover of darkness to advance his infantry to the line of departure for the attack. In this case, the advantages of keeping the positions of the bulk of his artillery secret from the enemy may cause him to limit the artillery preparation.

d. Supporting the attack against a fortified position.—The methods employed in an attack against a fortified position differ from those just discussed, only in that there is more time available for the preparation of plans for fire support, for obtaining additional ammunition, and for perfecting the systems of liaison and signal communication. It is possible to study more carefully the enemy's position and dispositions, and to assign missions and objectives in much greater detail. The accompanying fire usually takes the form of successive concentrations. Under certain conditions it may be advisable to employ a rolling barrage on part of the front. The possibility of using this form of fire to advantage occurs more frequently in an action of this character than in those previously discussed.

e. Corps and army artillery.—During the preliminary action of the artillery during the advance guard action, corps, and army artillery as such, are not expected to take part in the covering fires. Such artillery is probably marching in rear of the divisions and is not present to participate in the action. When the attack is made from temporary stabilization, and the corps and army artillery are already in position, they participate in any fires preliminary to the artillery preparation. Corps and army artillery participate in the artillery preparation and the supporting fires during the attack.

187. AGAINST A ZONE DEFENSE.—*a. Situation.*—An attack against a zone defense involves large forces deployed on broad, deeply organized fronts. A zone defense consists of successive positions and defensive areas, all associated in a general defensive system. It presupposes protracted and determined defense combined with great economy of forces. In general, organized resistance is contemplated,

increasing in strength from front to rear sufficiently to break down a coordinated attack before it reaches the battle position or main line of resistance, where the attack is to be definitely stopped. Organization in depth is the outstanding feature.

b. Positions.—In preparation for the attack, the greater part of the artillery, including corps and army artillery, is located well forward. The long range of the heavy artillery is utilized to reach far into the enemy's territory to destroy the hostile defenses, and to support the infantry in the later phases of the attack. Corps and army artillery are located according to missions assigned them.

c. Preliminary arrangements and plans.—(1) In an attack against a zone defense, very careful coordination of the fire missions of the artillery is necessary. The nature of the enemy's defenses are such that the maximum effort of the attacker's artillery is called for. Almost invariably the organic artillery of divisions and corps is reinforced by the attachment of additional artillery. To prevent confusion, and to insure economy of force, the missions of the units composing this mass of artillery must be closely coordinated. When an attack has been decided upon, an estimate of the amount and types of artillery and ammunition required is made. When it appears that the quantity of artillery and ammunition needed is in excess of what can be secured, the plan of attack is modified until it accords with the means available. Arrangements are made to install all the artillery, ammunition dumps, observation posts, balloons, lines of signal communication, and other facilities needed by the artillery in a manner as secret and expeditious as practicable. As a general rule, in order to reduce to a minimum the probability of the enemy's observing its presence, reinforcing artillery is not brought into line until just previous to the attack. Also, it may be inadvisable to adjust this reinforcing artillery prior to the artillery preparation. In such an event, firing data must be obtained from those batteries which have already been in action and from such topographical work as may be possible.

(2) The plan of fire support includes the artillery preparation and support during the attack. The details of these fires are planned ahead so far as the probable developments of the action can be foreseen. Schedules are prepared accompanied by maps or tracings, which show the targets for each artillery unit, the time at which the fire on each is to be delivered, the number of rounds, the rate of fire, and the kind of projectile. The details for the accompanying fire are worked out by each lower unit so that each gunner has before him a sheet showing the data for each shot he will fire during the advance, and the time and rate of fire. These data are modified by direct observation of fire whenever possible, but every preparation must be made for the probable impossibility of observation. Sufficient ammunition is brought forward and placed near the batteries. A schedule of forward displacement is drawn up, and missions from the new positions may be assigned. These plans may prove to be impossible of execution, especially that of the forward displacement and subsequent missions. To modify a prearranged plan is relatively simple; to develop a new plan, during the course of battle, and to acquaint all concerned with its details is relatively difficult. Hence the necessity for well-developed plans, prepared with the probable course of the action in view. Preconceived ideas, however, are never allowed to prevent such changes of plan as are dictated by changes in the situation.

d. The artillery preparation.—While the decision as to whether a preparation is to be fired, and the time of commencement thereof, must be made by the commander of the force engaged, recommendations covering these points are made by the chief of artillery of the force when called for by the commander. In the attack against a zone defense it is usual to fire an artillery preparation. Normally, such a preparation is longer than in the case where the enemy has not constructed such an elaborate system of defense. The length may depend on purely artillery considerations, such as the amount of artillery available and particularly on the ammunition which can be supplied. In the preparation, the details of the fire of subordinate units are

worked out and published in great detail in orders which are usually accompanied by charts or schedules. The object is to overwhelm the enemy with a mass of fire which neutralizes his means of defense and which paralyzes his communications and observation. The bulk of the fire is usually placed on the enemy's outpost area. The division artillery fires normally on the outpost line of resistance and important localities within machine gun range thereof.

e. Support during the attack.—(1) While the supporting fires during the attack usually take the form of successive concentrations, they may take the form of a rolling barrage where the need therefor is present, and where it is possible to accumulate large supplies of ammunition and *matériel.* The decision as to the general character of the supporting fires is one for the commander (division, corps, or army) to make. Whether the accompanying fire takes the form of successive concentrations or of a rolling barrage or both, it must be distributed in depth (using the division, corps, and army artillery) with a view to bringing under fire at any given movement of the advance of our infantry, all points from which that infantry is visible and from which it can be fired on effectively at the given moment. The density of this fire must be sufficient to prevent effective rifle fire. Beyond the range of such rifle fire, the density of the supporting fire is necessarily less, and it is concentrated on those points most likely to be occupied by machine guns, artillery, or observation posts. A careful study of terrain features, hostile dispositions, etc., makes it possible to vary intelligently the depth and density of the accompanying fire and to render it much more effective while at the same time saving ammunition. At the beginning of the advance, machine gun fire may sometimes be used to supplement or replace artillery fire on certain parts of the front. Artillery, and machine gun plans are carefully coordinated with a view to avoiding useless duplication of fire. It is important that the artillery preparation and the artillery support during the attack be continuous and thorough, as success depends upon neutralizing or destroy-

ing the enemy in his position and preventing him from making new dispositions to meet the advance of our troops.

(2) The rate of advance of the accompanying fire depends upon the rate prescribed for the advance of the infantry. This is not necessarily uniform over the entire front, but varies according to missions, terrain, and hostile resistance expected. The rate of advance must be determined by the commander ordering the attack. It is necessary to anticipate correctly the resistance to be met and the length of time required for neutralization of hostile positions by artillery fire. This is difficult when the information at hand is incomplete or received at a late hour.

f. Forward displacement.—Forward displacement of the division artillery must be anticipated. When this involves batteries which are participating in the accompanying fire, this fire must be correspondingly reduced in depth or in frontage or be taken over by other artillery. To insure accompanying fire during the movement forward, long-range artillery placed well forward and amply supplied with ammunition is essential. It is also during the phases of the action subsequent to the initial displacement that accompanying artillery may lend great assistance to its infantry.

g. Missions of corps and army artillery.—The medium and heavy artillery participate in the artillery preparation by firing on important points or on areas beyond those neutralized by the division artillery, and by reinforcing the fires of the division artillery. During the attack, corps and army artillery continue firing on the more distant objectives, assist the division artillery by deepening the accompanying fires, and by firing concentrations on successive targets beyond the division artillery fires. Plans for all these fires which can be foreseen are prepared by the corps and army chiefs of artillery.

h. Forward displacement of medium and heavy artillery.—(1) In the later phases of the attack, little of the medium and heavy field artillery, as a rule, has been moved forward. Artillery advancing through a captured defensive zone generally requires reconstruction of roads and bridges. If necessary to move heavy artillery forward at an early

hour, specified artillery units are ordered to be in march order at a designated place in ample time to enable them to withdraw their pieces from the emplacements and place the command in order of march. The next probable mission of the unit and the next probable position of the batteries are announced before the march commences in order that the proper kind of ammunition may be taken, as it is impracticable to carry with the firing batteries a complete supply of all kinds of ammunition.

(2) The amount and kind of artillery to be moved forward for an advance after an attack, are determined after consideration of the plan of the commander, of the available routes, and of the number of other troops and trains which will have to use the same routes. Allowance must be made for delays due to hostile artillery fire, aerial attacks, or road mines. For heavy field artillery, it is usually advisable to postpone advancing the batteries until after the fire supporting the attack has ceased, at which time the receipt of reports as to road conditions enables better judgment to be used. This is particularly true of the larger pieces, which require considerable time to take up the march. Medium artillery may be moved forward with considerable facility and on short notice, in country which is not wooded or swampy.

(3) If it is foreseen from the condition of the terrain that difficulties in moving artillery are likely to occur, engineer troops are provided in time to repair roads, clear away obstacles, or construct bridges. A program of work is prepared in advance, and the necessary material and personnel procured in ample time. Chiefs of artillery take the necessary measures for securing the assistance required for artillery movements, and base their orders and instructions upon what can be provided.

(4) In utilizing medium and heavy artillery during an advance, consideration is given to future ammunition supply. This can best be accomplished by assigning such artillery to positions along roads, or on or near railroads, requiring the more mobile division artillery to take, if necessary, less accessible positions.

SECTION V

Artillery in the Defensive

188. GENERAL.—*a.* All defensive positions imply an organization of the ground, more or less elaborate, depending upon the time and material available and upon the plans of the commander. The defensive rôle may be assumed at the beginning of a meeting engagement. It may consist of a delaying action only; of the defense of a position hastily assumed and which may later be developed and elaborated depending upon the success of the defense; or of the defense of a position which may have been thoroughly developed for defense before an enemy has appeared.

b. While the fundamental mission of the artillery remains always the same (the support of the other arms), the disposition and tactical handling of the artillery varies with the form of the defense and with the situation. In general, it may be accepted that distribution in depth of the artillery as a whole is used in the defensive. The degree of distribution varies with the degree of organization of the position and the strength and activity of the enemy. On the defensive the mission of the artillery is to assist in stopping the enemy's advance. The commander having designated the line or lines to be defended, all artillery is placed in positions best adapted to assist in this defense. The desire to bring the full power of all the artillery to bear in the defense of the main line of resistance, and to continue this defense without interruption after the enemy may have driven in or broken through the covering forces, leads towards a selection of positions in rear of this main line of resistance. On the other hand, outposts must be

covered by artillery fire, the defensive barrage and counterpreparation missions must be carried out, and some batteries must be able to reach well into the enemy's lines to break up his formations, counter his batteries, and interdict his routes of supply and communication.

c. These conflicting considerations lead to a distribution in depth of the artillery (division, corps, and army). Such dispositions also permit the advanced elements of the artillery to be withdrawn, should the necessity arise, under cover of the fire of the units farther to the rear. The most advanced elements are those which have the greatest mobility, so far as the proper assignment of missions permits.

189. ARTILLERY MISSIONS.—*a.* On the defensive the artillery is employed to prevent the enemy from launching a coordinated attack and to assist in stopping his attack should one be made. The principal targets are hostile personnel. Depending on the time available, prearranged fires are prepared to cover all probable routes of approach. These fires are carefully coordinated with those of the infantry weapons.

b. Prior to the formation of the hostile troops for the attack, the artillery interdicts the routes of approach, harasses the hostile troops, fires on transient targets, and delivers counterbattery fires. As it becomes evident that the enemy is forming for an attack, the artillery puts down a counterpreparation with a view to breaking up the attack before it is launched. If a general attack is expected, the artillery puts down what is called a general counterpreparation. This covers the front of the unit and is prepared to cover all probable locations of the attacking troops and their reserves. For local attacks partial counterpreparations are prepared covering threatened points. Counterpreparation fires are held on the designated targets for a certain period prescribed in orders. After firing the counterpreparation all batteries must be able to shift quickly to their defensive barrage or to concentrations covering the approach to the outpost line of the defender. As the enemy begins to pass through the outpost lines, defensive concentrations are begun, attempt being made to fire on the areas where the enemy is actually advancing. These fires are in

sufficient depth to include the local reserves of the attacking troops. They are fired when direct observation or reports from the infantry indicate that the enemy is in the predetermined locality.

c. As in the offensive the bulk of the division artillery is usually employed in direct support of the infantry, the remainder, ~~if any~~, being used in general support. It operates in close support, takes part in the barrage of combined infantry and artillery fires in defense of the position, and takes under fire the most advanced elements of the assault waves. Liaison between the artillery and the defending infantry therefore must be carefully worked out beforehand.

d. The corps and army artillery take part in all the fires mentioned above. During the counterpreparation, fire is placed on important troop concentrations, stream crossings and defiles, on routes of approach, and troops under cover not suitable as targets for division artillery. Some counterbattery is conducted by the corps artillery although it is not expected that the defender's artillery can profitably engage in an artillery duel with the attacking artillery, which is usually the stronger. After the attack is launched, corps and army artillery continue concentrations on the attacking troops, gradually shortening the range. The targets are usually beyond those of the division artillery and consist of the larger bodies of reserves and suitable points for interdiction of approaches. Also, this artillery fires in reinforcement of the division artillery. The corps and army artillery provide the corps and army commanders respectively with a mass of fire to be concentrated on critical points or areas.

190. ORGANIZATION OF COMMAND ON THE DEFENSIVE. —On the defensive, the command of the artillery is centralized. The greater opportunity for the establishment of an efficient system of signal communication and of liaison with the infantry usually makes it unnecessary to employ any part of the artillery as attached artillery. The extent to which such systems may be perfected depends on the time available. This depends usually on the form of defensive combat and varies from a hurried occupation of positions

and general instructions given verbally as in a meeting engagement, to a deliberate occupation of carefully selected positions in which an elaborate system of signal communication is installed and liaison perfected in every way possible, as in a defensive zone. Centralized control of the artillery permits of the prompt concentration of fire at threatened points.

191. MEETING ENGAGEMENT.—*a. Positions of the artillery.*—In a meeting engagement, the artillery of the advance guard is so placed as not only to cover the immediate front of the chosen position but also to reach well into the enemy's territory. Its purpose is to cover his lines of approach, cause early deployment, delay the hostile advance, and break down the attack of the hostile force. Missions and normal zones must be assigned promptly to the smaller artillery units. During the deployment of the main body, the artillery marching therewith is placed in position. It may be advisable to hold a part of the artillery not committed to action until the direction of the hostile attack becomes known.

b. Missions.—The decision to assume the defensive is generally, though not necessarily, taken to indicate an inferiority in strength, including an inferiority in artillery. The enemy's attack can have no decisive success if the advance of his infantry can be stopped. Artillery, therefore, is used against the hostile infantry, including tanks, and against cavalry, and does not allow itself to be drawn into an unequal contest with superior artillery. If enough artillery is available, some of it may be assigned the duty of replying to the hostile batteries and neutralizing their fire, but the principal targets for the artillery on the defensive, especially for the division artillery, are those elements of the enemy which most seriously threaten our position—usually the advancing infantry.

c. Support during defense.—Depending upon the enemy's advance, fire is opened as prescribed by the commander of the force. It may be desirable to withhold the fire of some batteries, especially if the enemy is much superior in artillery, until the attack has reached a more vulnerable

stage in its approach and deployment. In the situation under discussion no opportunity is offered for the preparation of prearranged fires. Within its normal zone, each artillery unit seeks to inflict casualties upon and to stop the advance of the enemy during his approach march, deployment, and advance to his first firing position. Each unit should be able to fire in the normal zones of adjacent units, thus enabling artillery brigade, regimental, and battalion commanders to coordinate the fires of their commands and to concentrate them on the most threatening part of the advancing force. When the enemy begins the advance from his first firing position, it is especially important that the artillery direct its fire against the advance waves of the attack. This fire is so placed as to include the leading elements, and has sufficient depth to include the local supports and reserves. Coordination with the infantry is necessary during its withdrawal from the covering or advance positions. If the attack breaks through the position, the artillery continues to fire on the advancing hostile infantry, assists in counterattack, or covers the withdrawal.

d. Corps and army artillery.—(1) Corps artillery is employed earlier when the mission is defensive than when it is offensive. The danger of losing artillery pieces in case of a forced withdrawal is greater, but the value of long range artillery in forcing an early deployment of the enemy and in delaying his deployment and attack more than compensates for this danger. The corps artillery is used for counterbattery, for firing on distant bodies of hostile infantry and forcing them to deploy, and for distant interdiction. When circumstances require, it assists the division artillery in its mission.

(2) Army artillery is very rarely employed in the early stages of a meeting engagement.

192. DEFENSE OF A POSITION.—The meeting engagement, previously described, is an example of hasty deployment and organization for defense. Following this paragraph, the rôle of the artillery in a zone defense is described. The descriptions of the action of the artillery in the above two types of defensive engagements represent the two ex-

tremes of all types of defensive combat. Both apply to a greater or less extent in the defense of a single fortified position. Depending on the completeness of the organization of the position, the preparation of a plan of defensive fires therefor varies between the two extremes mentioned. Taking the position as thoroughly organized, the action of the artillery more nearly approaches that in defense of a zone. In such case there is usually sufficient time to prepare a fairly complete plan of defensive fires. There may be a difference as to the location of the artillery. In the position defense the outpost line of resistance is usually close enough to the battle position to permit artillery support from positions in rear of the battle position. This is often not the case in the zone defense. For the reasons given above, no special discussion of the action of the artillery in this form of defense is given here.

193. A ZONE DEFENSE.—*a. Preliminary arrangements.*—In a zone defense, the artillery is given its greatest opportunity for fire effect. Ample time for complete plans and arrangements for the defense is presumed. Systems of command, signal communication, observation, ammunition supply, and liaison are brought to a high state of perfection. Alternate lines of telephone circuits are laid, wires buried, and all means of signal communication installed. Observation is of vital importance and is organized so as to eliminate as much as possible, invisible areas in critical localities. Ammunition is placed in dumps convenient to batteries. Fire is carefully registered and ranges measured.

b. Positions.—As in all defensive situations, the artillery is disposed in depth. There is a further opportunity, however, to select carefully the best available positions for the missions assigned. In order to reduce dead space in critical areas to a minimum, it may be necessary to disperse batteries more than in the normal case. Alternate positions are selected for each battery. Batteries may be prohibited from firing from their normal positions except in case of a serious attack, in order to keep these positions secret. Positions are carefully camouflaged. All batteries usually are able to fire in defense of the hostile position. Some of

the artillery must support the outpost troops. Where the outpost line of resistance is at such distance in front of the battle position as to prevent adequate support from positions in rear thereof, some batteries must be advanced into the outpost area. The proportion so placed is small. Additional defense against tanks is provided for by detailing single pieces as antitank guns. These pieces are posted well forward in concealed positions and, except for their own close defense, are employed only against tanks. Other pieces called roving guns may be sent from place to place to conduct regular schedules of fire and at the same time deceive the enemy as to the amount and location of the artillery.

c. Defensive fires.—The defensive fires already described in paragraph 191 are used in the same manner and for the same purposes in the defensive zone. Any variation therefrom is in the nature of more complete organization of the fires and, therefore, a better coordination of the fires of the artillery available. In this form of defensive combat, the enemy's intention to attack is probably known many hours or days before the actual launching of the attack, though the time and place may be unknown. During the time the enemy is concentrating troops and munitions, the artillery executes daily interdiction, harassing, and counterbattery fires and some fires for destruction, such as will interfere most with the preparations being made by the enemy. When the attack is about to be launched, counterpreparations, general or local, are fired and are followed, after the attack begins, by the usual barrages and defensive concentrations. At all times after the launching of the attack, the artillery seeks to keep the enemy's assault echelons and reserves under a fire in considerable depth. All efforts are directed to insuring the integrity of the battle position. In doing this, the artillery assists the troops of the outpost area in breaking up the cohesion and momentum of the assaulting waves before they reach the battle position. The artillery strives not so much to lay down a barrier of fire through which the enemy must advance, as to attack the enemy with a mass of fire wherever he is at any given time.

194. COUNTERATTACKS.—The artillery supports counterattacks in a manner similar to that already discussed for the offensive. The essential factor is that the artillery be prepared at all times during the defense to support counterattacks. Since it cannot be known before the enemy attacks, where and when a counterattack will be launched, preparations are made for the support of various possible counterattacks as far as can be foreseen. The particular factor of importance in the support of local counterattacks is the fact that the artillery means of signal communication may be destroyed or disorganized by the enemy's attack. Every preparation must therefore be made to support such counterattacks by fire controlled by direct observation, and to maintain liaison with the infantry unit making the counterattack.

SECTION VI

Artillery with a Cavalry Division

195. GENERAL PRINCIPLES OF EMPLOYMENT.—The general principles of employment of artillery in the offensive and in the defensive apply equally to artillery operating with cavalry. The only modifications in such use are those due to the smaller size of the artillery command and to the greater mobility of the troops supported, and the consequent more rapid development of the phases of an engagement and the more rapid changes in tactical situations. For these reasons, horse artillery is more often required to occupy positions in a minimum of time, the positions are more often in the open, and the use of direct laying is much more frequent than in the case of artillery operating with infantry.

196. LOCATION OF THE ARTILLERY IN THE COLUMN.—Artillery is normally attached to the advance guard of a cavalry division when the advance guard consists of a regi-

ment or more. It generally marches at the tail of the reserve. The artillery with the main body is generally found near the head of the column. When the enemy is not aggressive or is demoralized, or retreating, artillery may march with advance guards composed of forces smaller than a regiment so as to obtain the fire effect earlier.

197. ENTRY INTO ACTION.—The conduct of the march, the reconnaissance, and the entry into action closely resemble the same phases of the operation of artillery with an advance guard. Instant decision by the artillery commander and a prompt occupation of position and opening of fire are of vital importance. The artillery commander's decision must be based on what he himself sees and hears as he accompanies the cavalry commander. The orders of the latter usually are extremely brief and general in their terms. The artillery commander is always with the cavalry commander and makes such disposition of his detail and of the battery commanders and the battery details as will best facilitate rapid reconnaissance and occupation of position.

198. CAVALRY COMBAT.—Cavalry, in general, initiates an offensive action by establishing a pivot of maneuver by engaging groups within mutually supporting distance. The artillery battalion goes into position at once to support these groups. The batteries of the battalion are usually kept together. This pivot employs the minimum strength consistent with the opposition which it expects to encounter. The main effort is usually made by the maneuvering mass, which endeavors to reach the flank and rear of the enemy. At this time the artillery may possibly change position in order better to support the main attack, though in many cases, this support can be given equally well from the original position. Surprise and rapidity of movement are essential. If the attack of the maneuvering force is based on a wide movement and a direction of attack which makes it difficult for the artillery from a central location to give timely and effective support to the main attack, some artillery is attached to the maneuvering force.

Section VII

Tactical Employment of Special Units

199. Portée Artillery.—The characteristics on which the tactical employment of 75-mm. *portée* artillery is based are its great strategical mobility and its inferior tactical mobility. It may be moved rapidly from great distances for employment at critical points on the front, but, once emplaced, further movements on the battlefield are executed with difficulty. This type of artillery is used as a light artillery reserve. It is employed most frequently in the initial stages of a large offensive. In the defensive, it may be used to advantage to augment the artillery defense against attack on a large scale or to strengthen the resistance in any sudden emergency, such as a penetration by the enemy.

b. Normally, positions for *portée* artillery are selected near good roads. If necessary, guns may be emplaced some distance from the roads, using the tractor assigned each battery to haul them to positions one at a time. In the offensive, *portée* artillery is emplaced well forward. It can usually take no part in the forward displacement and consequently is placed so that it will be able to fire to the last possible moment in support of the advancing troops. The disposition of the *portée* artillery after the completion of its mission is prescribed by the authority making its assignment. It is rarely advisable to attempt to move it forward over shell-torn roads to take part in the later stages of the action. In the defense of a zone against an attack in force, it is usually posted far to the rear and furnishes the rearmost element of the light artillery defense.

c. The tactical employment of the fire of *portée* artillery, once in position, is exactly the same as that of other 75-mm. guns.

200. PACK ARTILLERY.—*a.* Pack artillery is designed and intended primarily for use in difficult terrain. The transport is practically entirely by pack mule. The characteristics of pack artillery are its greater mobility over difficult terrain and its inferior fire power. In general, any place accessible to the infantry soldier without using his hands can be reached by well-trained pack artillery. Marshy ground is the worst obstacle to the pack mule.

b. The tactical employment of pack artillery is entirely similar to that of other light artillery. Its characteristics make it especially suitable for operations in mountains or jungles; for the irregular operations of minor warfare; for use as a landing gun in small overseas expeditions; for night operations; and for use as an accompanying gun. Lack of power makes it inferior to the 75-mm. gun when the terrain is suitable for the latter.

201. FLASH RANGING.—*a. Object.*—Flash ranging has two objects: to locate the position of hostile batteries which otherwise, due to careful concealment, might remain hidden; and to assist batteries in the adjustment of fire.

b. Employment of flash ranging.—(1) Flash ranging is employed by the corps. It consists of a number of observation posts placed so as to secure the greatest depth, as well as width, of field of view. They may be located in towers built in woods or at other locations, such as high points, affording an excellent view of the hostile terrain. Each post is provided with an oriented observing instrument measuring azimuths, the posts being connected with each other and with a central station, by telephone. The central station operates a plotting board on which is located accurately the location of the posts. The location of the target is determined by intersection of lines representing the azimuths telephoned in from the observing posts.

(2) A flash ranging section can be installed in about half a day and is therefore suitable for operation in a moving situation. Wherever the situation is such as to permit the employment of the corps artillery, flash ranging may be used to advantage.

CHAPTER XI

Artillery Plans and Orders

SECTION I

General Discussion

202. PREPARATION OF PLAN OF EMPLOYMENT.—*a. By whom prepared.*—When any tactical unit containing artillery is to undertake an offensive or defensive operation, it is the duty of the artillery staff (chief of artillery and his assistants) to prepare, for the approval of the commander of the unit, a plan for the employment of all the artillery with that unit. The purpose of the plan is to coordinate the tasks, and to utilize most effectively the support which that arm is capable of rendering.

b. Coordination.—The artillery plan is not a separate one prepared solely from an artillery viewpoint, nor is it superimposed upon the general plan of the commander of the force concerned, but it is developed as a part thereof. Tentative artillery plans are altered so as best to fit in with the parts to be played by the other arms. Likewise, plans for the employment of the other arms may be modified so that the full capabilities of the artillery may be utilized.

c. Artillery staffs.—By the term artillery staff as used in subparagraph *a* above is meant the chief of artillery and his staff, of the tactical command concerned. For the army

and corps it is the army chief of artillery and the corps chief of artillery respectively, with their own staffs. For the division it is the commander of the division artillery and his staff, acting as the artillery adviser of the division commander. For forces smaller than the division to which artillery may be attached, the same principle applies as in the division. The senior commander of the attached artillery acts as the artillery adviser or chief of artillery for the commander of the force, and, assisted by his own staff, prepares for the approval of the commander, the necessary plans for the employment of all the artillery with the force.

d. The decision.—The decision as to the general plan of tactical employment of the artillery with any force rests with the commander of such force. The plan adopted is his. The artillery staff is merely a group which assists him in the preparation and supervision of technical details.

203. PUBLICATION.—In published form, so much of the artillery plan as pertains to the situation, appears in the artillery subparagraph of the field order of the commander of the force, in the annex, if any, to the order, and in the artillery field order. The first two express the artillery plan of the commander; the last expresses the detailed plan of the artillery commander and is based on the commander's order.

204. THE DIVISION.—*a. The division commander's plan.*—The general plan of employment of the division artillery is prepared by the commander of the division artillery in his capacity as adviser in artillery matters to the division commander. These plans vary from a carefully prepared and well coordinated scheme of employment accompanied by maps, charts, and tables explaining the plan, to merely verbal recommendations as to general locations and missions for the major units of division artillery. When the division commander approves the plan, with or without modifications, it becomes his plan.

b. The artillery subparagraph.—The artillery subparagraph of the division field order is the division commander's order for the employment of his artillery. It is as brief as practicable, yet clearly sets forth his plan. It

must contain his decisions on artillery matters together with those received from higher authority. These decisions generally are, (1) assignments, (2) general artillery locations, (3) general missions and fires to be executed, (4) any special missions desired, and (5) instructions for the use of chemical shell if used. It may contain orders as to preparation for future movements and, in the case of movements actually ordered, may designate routes or fix the responsibility for their selection. When the division commander's plan for employment of the artillery, if embodied in the artillery subparagraph, makes the field order unduly long, the details are embodied in an annex (see Section III).

205. THE CORPS AND ARMY.—*a. Orders of higher commanders.*—Orders for the employment of artillery emanating from the higher commanders are primarily instrumentalities of coordination. It is not their purpose to deprive division commanders of their proper functions of control and employment of their artillery. The plans evolved are limited by the sole requirement that all the artillery be employed so as to render maximum support.

b. The corps commander's plan.—The corps chief of artillery recommends the missions and prepares the plan of employment of all the artillery with the corps. He plans for coordination between the artillery of the respective divisions, and between the corps artillery and the division artillery. When the corps is a part of the army, he studies the army orders and prepares a plan which provides for the missions and employment of all the artillery with the corps in accordance therewith, and includes any special missions directed in the army order, and any which he considers necessary. The plan when completed and approved by the corps commander, becomes the corps commander's plan, and orders therefor are published in brief in the artillery subparagraph of the corps field order and in detail in the artillery annex thereto. When time does not permit or warrant the preparation of an annex, more elaborate instructions are inserted in the artillery subparagraph of the corps field order.

c. The army commander's plan.—The distinguishing characteristic of the army commander's plan for the em-

ployment of the artillery with the army is that it considers the inter-relation of all the artillery elements of the army and regulates their employment from the viewpoint of the success of the operation as a whole. It definitely assigns only such missions and imposes only such restrictions as are necessary to this end. The artillery plan is prepared under the direction of the army chief of artillery, and orders based thereon are published in brief as the artillery subparagraph of the army field order, and in detail in the artillery annex thereto.

d. The artillery subparagraph.—No definite statement can be made as to the amount of detail which is included in the artillery subparagraph of corps and army field orders. The orders as there set forth are as brief as practicable. Usually both the corps and army issue an artillery annex to the field order for any particular operation. However, those more important decisions which the corps or army commander must make concerning the artillery, such as the organization of the artillery for the operation, general areas assigned organic or attached artillery for positions, general fire missions of corps or army artillery respectively, important special missions, and whether chemical shell is to be used, are briefly stated. Also there is included in general terms any instructions which it is necessary to give to subordinate units as to the employment of their artillery.

SECTION II

Artillery Field Orders

206. PURPOSE.—Artillery field orders publish to subordinate artillery units the artillery commander's plan of

employment of the artillery over which he exercises command. This plan is based on the artillery plan of the next superior commander, and consists primarily of the assignment of missions to subordinate units and of such instructions as will coordinate the assigned missions so as best to fit in with the artillery plan of the superior commander.

207. CONTENTS.—*a. Form.*—The artillery field order is issued in the usual five paragraph form. There is a slight difference in the manner of presenting the instructions contained in paragraph 3 thereof. (See subparagraph *d,* below.)

b. Paragraph 1.—The artillery commander's viewpoint is that of the commander of the unit supported. For this reason, sufficient detail must be given in paragraph 1 of the artillery field order to present to subordinate artillery commanders a picture of the situation from the viewpoint of the commander of the supported troops. Paragraph 1 also includes information relative to other artillery which has been directed, or which may be called upon, to fire within the normal zone of the artillery unit issuing the order.

c. Paragraph 2.—In paragraph 2, in addition to stating the mission of the unit, is given, when necessary, the general nature of the supporting fires. The mission here given is usually that assigned in the orders of the next superior commander.

d. Paragraph 3.—Paragraph 3 is divided into subparagraphs, usually one for each major subordinate unit and the general one, *x.* In the artillery field order, instructions given therein concerning any particular subject are prefaced usually by suitable subheads appropriate to the subject matter. For example, the following subheads may be given separate sentences or subparagraphs: *Position, Route, Mission, Counterbattery,* and *Ammunition.* Such subjects as apply to only one unit are placed in the subparagraph for that unit while those that pertain to two or more units are generally placed under subparagraph *x.* The examples of subheads given, and the more extended examples found in *Combat Orders,* G.S.S., are guides only. Any subhead which sets forth briefly the subject matter concerned, may

be used. Certain of these subheads are necessary in each subparagraph for subordinate units. For example, *position* and *mission* usually, and *route,* frequently, appear in each subparagraph devoted to any subordinate unit.

e. Paragraphs 4 and 5.—Paragraphs 4 and 5 are similar in form to the corresponding paragraphs in any other field order. Command posts of units supported may be given.

208. DIVISION ARTILLERY.—*a. The brigade.*—The brigade usually issues a written field order. The order is preceded normally by such verbal or dictated orders as will allow regimental commanders to proceed with their plans. The order is based on the division commander's plan of employment for the division artillery as expressed in his orders, and its most important function is to assign and coordinate the missions of the regiments so as best to carry out the division commander's plan. Paragraph 1 contains most of the matter in paragraph 1 of the division order and a brief summary of paragraphs 2 and 3. At least, it gives enough of the division commander's instructions, to show the scheme of maneuver of the division and of its infantry brigades, and the location and fire missions of supporting corps or army artillery units, if any. Also, in the case of an attack, the zones of action of the infantry brigades, time of attack, line of departure, rate of advance, if given, and so much of the formation for attack as is known, are included. For the defense, the general organization of the position is stated, together with the assignments of infantry units to sectors. Paragraph 4 usually consists of a reference to the division administrative order. When movement is contemplated, the artillery brigade axis of signal communication is stated in paragraph 5, and those of regiments prescribed in cases where their locations can be foreseen.

b. The regiment.—The regimental order is usually issued in verbal or dictated form, and later put into written form. The regimental commander bases his order on the mission assigned by his brigade commander. Then, after consultation with the commander of the supported infantry, the regimental order is issued assigning missions to bat-

talions in such way as to carry out the orders of the brigade commander to the regiment, and in such manner as will contribute best to the support of the infantry. The amount of detail in paragraph 1 must be such as to present a clear picture of the scheme of maneuver of the supported infantry. Paragraph 4 frequently contains instructions as to supply. The division administrative orders are distributed down to include regiments, and it may be necessary to include in the regimental order some of the matter contained in the division administrative order in addition to supply arrangements originated in the regiments. In case movement is contemplated, the regimental axis of signal communication is stated; and when the location of battalion axes can be foreseen, they, too, are given. When displacement is carefully planned and orders issued therefor prior to the engagement, the battalion axes are given.

c. The battalion.—The battalion order is usually issued verbally. Frequently it is not issued formally or to all battery commanders at the same time, though this is desirable. As in the case of the higher units, paragraph 1 contains sufficient detail to give subordinate commanders a picture of the scheme of maneuver, boundaries, etc., of whatever unit the battalion is to support. Paragraph 4 frequently contains more detail than is given in the corresponding paragraph of the regimental order for the reason that most of the data given in the regimental order is repeated, and, in addition, the battalion commander usually has some instructions of his own. No battery axes of signal communication are given.

d. Preparation of the order.—(1) The artillery commander receives the artillery order of his immediate tactical commander which includes the mission of his artillery unit. The commander of the supported unit is consulted as to the location of fires particularly desired by him. The artillery commander then makes his own decisions and issues his order.

(2) Every effort is made to furnish fire desired by the supported troops when and where it is wanted. In the assignment of targets, considerable latitude is usually left to

subordinate commanders. Those artillery commanders in closest touch with the front line infantry are best situated to select the targets of most importance to the infantry, and the greater part of the fires delivered by the division artillery is so selected in consultation with infantry commanders. Therefore, brigade and regimental commanders formally assign only such definite targets as are assigned them by higher commanders and, in addition, any which are of special importance to the infantry commander whom they support, and leave to battalion commanders the assignment of the greater part of the definite targets to be fired upon. This is particularly true in a moving situation. The plans for these fires are then examined by higher commanders with a view to coordinating the fires of adjacent units, and to seeing that the plans conform to the missions of the higher units. The completed plans may then be approved and issued as an annex to the brigade order.

209. Corps and Army Artillery.—*a. The corps artillery.*—As tactical commander of the corps artillery, the corps chief of artillery is responsible for the preparation of the plan of employment of the corps artillery. Usually, the annex to the corps field order, together with the corps field order of which it is a part, is in sufficient detail to allow commanders of the major units of the corps artillery to proceed, upon receipt of copies thereof, with their more detailed plans and orders. At times it may be necessary to amplify this annex by means of additional orders to the commanders of the major units of corps artillery. In some situations, for example, when considerable artillery is attached to the corps, the corps chief of artillery may issue a field order containing more detailed instructions for the corps artillery.

b. The army artillery.—As tactical commander of the artillery, the army chief of artillery is responsible for the preparation of the plan of employment of the army artillery. In a manner similar to that just described for the corps artillery, he furnishes commanders of the major units of army artillery with instructions in such detail as will permit the latter to proceed with their more detailed plans.

c. Subordinate artillery commanders.—Based on the corps or the army field order with its annex, or upon the field order of the tactical commander of the corps or army artillery as the case may be, commanders of the major units of corps or army artillery prepare plans for the employment of their units and then issue field orders allotting to their subordinate units the necessary tasks which, considered together, carry out the mission assigned. In like manner each other subordinate artillery commander prepares his own plans and orders. In the preparation of their plans, commanders proceed, in general, in the manner outlined in paragraph 208 *d* above for division artillery, except that normally it is not necessary for subordinate commanders to consult with commanders of front line infantry units. The missions of corps and army artillery usually are such as are of importance to higher commanders. Knowledge of the requirements of the infantry can best be obtained through the division artillery commanders. For the above reasons commanders of corps and army artillery major units usually assign targets to subordinate units in more detail than in the case of the division artillery. This practice serves another useful purpose, since the division artillery commanders, knowing the targets or areas to be fired upon by the heavier calibers, can arrange their fires in coordination therewith.

210. USE OF MAPS AND CHARTS.—In all artillery field orders, free use is made of explanatory maps, tracings, charts, or tables. Areas for positions, locations of prearranged fires, zones of fire, zones or sectors of supported troops, and many other details of orders issued, can be shown more clearly in this manner than by description. The use of these means also allows the written order to be shortened. In the case of especially important instructions, the possibility of error is minimized by the use of both maps and written instructions.

Section III

Artillery Annexes

211. Purpose.—The artillery annex to the field order of the commander of any force containing artillery is an amplification of the artillery subparagraph of the field order. It publishes the commander's complete orders for the employment of the artillery with the force concerned. As already mentioned (paragraph 202 *a*), it is prepared by the artillery staff of the commander. The prepared plan when accepted becomes the commander's plan. It is published briefly as the artillery subparagraph of the field order and in detail in the artillery annex, when an annex is issued. The annex goes into such detail as is necessary to enable immediate subordinate commanders to conform to the general plan in the employment of their artillery.

212. When Issued.—The artillery annex is issued, whenever the commander's orders for the employment of the artillery are so extensive as to lengthen unduly the field order if details be published in the artillery subparagraph thereof. This usually results from the fact that either the artillery has been considerably reinforced, and missions and positions must be given in some detail to prevent confusion, or that the time available is such that it is possible to plan, in more or less detail, the fire missions assigned and to coordinate these missions so as to get the maximum effect with the artillery available. Usually, the corps and army issue artillery annexes for any contemplated operation. In the case of the division, an artillery annex is seldom issued in open warfare situations. The need usually arises in attacks

from stabilized situations, and in the defense. In the division, an artillery annex is issued only when the situation cannot be met through the artillery subparagraph of the division field order.

213. FORM.—*a.* The written annex follows the field order form. In those cases where the annex does not consist of the field order of an artillery commander, the field order form is used. In such cases, those paragraphs not necessary to the purpose of the annex are omitted and the paragraphs used are numbered serially beginning with 1. For example, matter usually contained in paragraphs 1, 2, 4, and sometimes 5, of a field order is seldom, if ever, needed for the purposes of the annex and therefore may be omitted. When a field order of an artillery commander is used as an annex, the order is taken in its entirety.

b. The artillery annex is given a caption as follows:

ANNEX NO —— TO *FIELD ORDERS NO* ——, —— (DIVISION, CORPS, ARMY)

ARTILLERY

214. ARTILLERY ANNEX, DIVISION.—In the division when an artillery annex is issued, it usually consists of the field order of the division artillery commander, who is normally the brigade commander of the organic artillery brigade. In this case the order is taken in its complete form, given the usual caption, and, after authentication by the division G-3, is attached to the division field order as an annex. This use of an artillery field order arises from the fact that the artillery adviser of the division commander is primarily the commander of the division artillery. It is necessary that he issue a field order based on the division commander's artillery plan expressed in division orders. As a staff officer of the division commander it is his duty to prepare this plan for approval. For this purpose he might prepare a plan containing only such instructions as in the case would properly be issued by the division commander, but such a plan would contain most of the matter in paragraph 3 of the artillery brigade order and in about the same amount of detail. The division artillery command-

er has but one staff which usually is fully occupied with plans for the employment of the artillery brigade, and it is an economy of effort to use the brigade field order as the annex, even though it may contain some matter with which the division commander is not immediately concerned. Notwithstanding the expediency of using the field order of the division artillery commander as the artillery annex to the division field order when an annex is necessary, cases arise in the division when it is preferable to use the modified form mentioned in paragraph 213. These situations usually occur when the field order of the division artillery commander is issued in considerably more detail than is necessary to set forth the more general instructions of the division commander to his artillery. This situation arises more often when the division artillery is heavily reinforced and time is available to prepare carefully coordinated plans for the artillery support. When the written annex is prepared in the form here mentioned it is given the usual caption, the heading is that of the division and it is signed, in the name of the division commander, by the chief of staff and authenticated by the division G-3.

215. Artillery Annexes, Corps and Army.—The artillery annex to the corps or army field order is prepared by the corps or army chief of artillery as the case may be, and publishes to subordinate commanders the corps or army commander's orders for the employment of all the artillery with the unit. The artillery annex to the corps field order may contain certain instructions for division artillery, and likewise the artillery annex to the army field order may contain instructions for the employment of both corps and division artillery. As mentioned previously, these instructions are confined to the assignment of specific fire missions considered of importance from the corps or army viewpoint, or to very general instructions as to the methods of employment considered by the corps or army commander to be necessary for the coordination of all artillery units to be employed. They must not interfere with the proper authority of corps and division commanders. The annex is given the appropriate caption as mentioned in paragraph

213, above. The heading is that of the corps or army, respectively. The annex is signed by the chief of staff in the name of the commander and authenticated by the corps or army G-3. If any instructions are given subordinate commanders relative to the employment of their artillery, they appear usually under the major subheads, *Division artillery*, *Corps artillery*, and *Army artillery* in the order given. In general, no special mission is assigned a subordinate unit which can be performed by the major unit.

216. Use of Maps and Charts.—In the same manner as in the case of field orders, much of the detail of the annex is set forth graphically on maps, charts, tables, or tracings. These are attached as annexes to the annex, and are numbered serially in the same manner as other annexes. They each show on a legend the particular purpose for which intended; for example, *Annex No 1—Artillery Preparation*, or *Annex No 2—Accompanying Fires.*

217. Annexes to Artillery Field Orders.—Artillery field orders like other field orders may have annexes attached. These annexes usually consist of maps, tracings, charts, or tables, such as mentioned in paragraph 210, above. The legend or caption of these annexes shows the purpose of the annex and, as in the case of all annexes, the field order to which it belongs; for example:

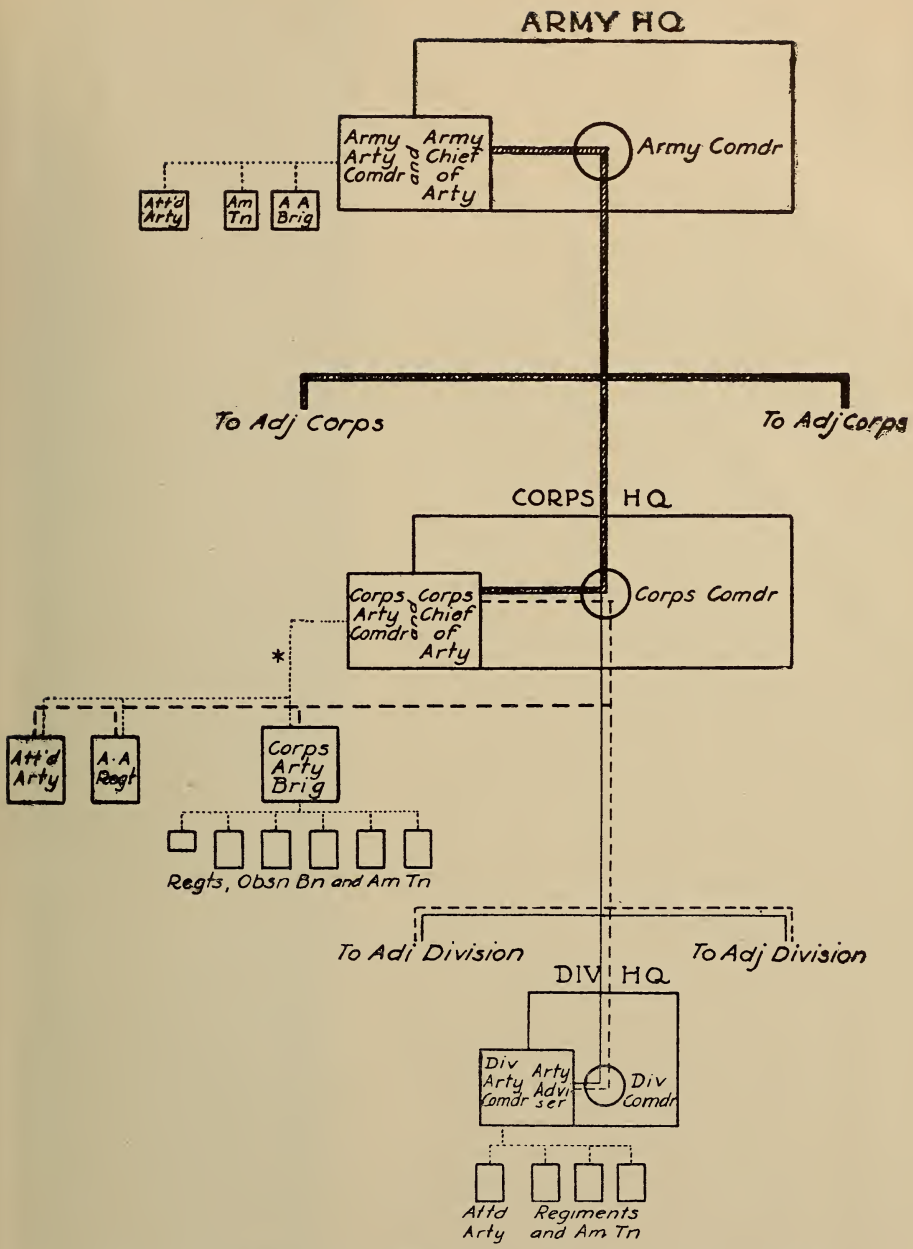
ANNEX NO —— TO *FIELD ORDERS NO* ——, —— FIELD ARTILLERY BRIGADE

ROUTES FOR DISPLACEMENT

Almost all data required by the artillery covering the tactical situation, the dispositions to be made and the missions to be undertaken can be so published.

218. Channels through which Command is Exercised.—Annexes appended to corps and army field orders, pass down, as information and instructions, to the next subordinate units, divisions, and corps, respectively. Instructions contained in the annexes are directions to these commanders, and not to their subordinate artillery commanders. There is no chain of direct command from army artillery to corps artillery or from corps artillery to division artillery.

Commanders of division and corps artillery receive their orders from the division commander and corps commander, respectively. The distribution shown in Figure 15, is that incidental to command. For purposes of information there usually is further distribution of artillery field orders, as, for example, copies of army artillery orders to corps chiefs of artillery.



†FIGURE 15—Diagram Showing Channels Through Which Command is Exercised:

1. By means of artillery annexes, together with field orders to which they pertain.
2. By means of artillery field orders.

*When required by the situation (see paragraph 209).

†Heavy solid lines, connecting headquarters indicate origin of the artillery annex of the army and its normal distribution to corps.

Light solid lines connecting headquarters, indicate exceptional distribution of artillery annex of the army to divisions.

Broken lines indicate origin of artillery annex of the corps and its distribution to corps artillery and to divisions.

Dotted lines indicate artillery distribution of field orders to next lower unit.

	Heavy	Medium	Light	
				2
				7
				1
		4		
		1		
	1			
	8			
	2			

CHARACTERISTICS OF FIELD ARTILLERY

	Caliber and Types	Ammunition: Kind	Ammunition: No. of rounds per box	Ammunition: Weight (approx) of complete round Lbs.	Area effectively covered by burst (approximate): Range Yds	Area effectively covered by burst (approximate): Lateral Yds	Range, extreme Yds	Traverse permitted by carriage Degrees	Rate of Fire: Rounds per piece per minute: Prolonged	Rate of Fire: Rounds per piece per minute: Short Burst	Day of Fire, World War: Rounds per piece	Time to Emplace in Firing Position or Change from Firing to Traveling Position	Piece Transport	Ammunition Transport: Kind	Ammunition Transport: Rounds per Vehicle	Total Weight (approx) of Piece, Carriage and Limber (filled) Lbs	Number of Loads	Width of Track: Feet	Width of Track: Inches	Marches: Average Rate Miles per Hour	Marches: Average Day's March
LIGHT	2.95-inch howitzer	(Fixed) Shrapnel Shell: HE	 5 5	 15.5 15.0	 100 5	 20 15	 4,500 (a) 4,800	0	1	3	300	3 minutes	Pack	Pack	10	830	4 (g)	2 (assembled)	8	2½ to 3½	15 to 25
	75-mm. gun (Model 1897)	(Fixed) Shrapnel Shell: HE, Smoke, Gas	 9 9	 20.5 (15) (c) 15.5 (12) (c)	 150 5	 25 15	 5,700 (a) 8,800	5	2	5	300	3 minutes, horse-drawn or tractor-drawn. 5 minutes, *portée*	6-horse team Truck Tractor	Caisson body Limber Truck, 3-ton Wagon	70 35 200 100	4585	1	5	0	2½ to 3½, horse-drawn. 8 to 10 *portée* 8½ tractor-drawn.	15 to 25, horse-drawn. 50 to 100, *portée*. 20 to 35 tractor-drawn.
	105-mm. howitzer (h)	Shrapnel Shell		34 (c) (f)			12,000 (f)						6-horse team	Caisson body Limber			1			2½ to 3½	15 to 25
MEDIUM	4.7-inch gun (1905)	(Fixed) Shrapnel Shell	 2 2	 74.0 (50) (c) 50.0 (45) (c)	 10	 50	 10,500 (a) 14,000	8	½	2	180	5 minutes	Tractor, 5-ton	Caisson body Truck, 3-ton	28 70	10,015	1	5	0	3½	20 to 30
	155-mm. howitzer (Schneider 1918)	(Separate loading) Shell: HE, Smoke, Gas		 105 (95) (c)	 15	 70	 12,400	5	½	2	150	10 minutes or more	Tractor, 5-ton	Caisson body Truck, 3-ton	14 40	8,925	1	5	0	3½	20 to 30
HEAVY	155-mm. gun (Model 1918)	(Separate loading) Shell: HE, Gas		 120 (95) (c)	 15	 70	 18,000	50	¼	1	100	1 to 5 hours	Tractor, 10-ton	Truck, 3-ton	40	29,400	1	7	5	3½	25
	8-inch howitzer (Mark VI)	(Separate loading) Shell: HE		 220 (200) (c)			 10,700	8	¼	½	100	1 to 4 hours	Tractor, 10-ton	Truck, 3-ton	20	21,700 (e)	1	7	4	3½	25
	240-mm. howitzer	(Separate loading) Shell: HE		 382 (345) (c)			 15,400	20	¼	½	50	5 to 12 hours	Tractor, 10-ton	Truck, 3-ton	12	58,500	4 (d)	5	0	8½	25

NOTES

(a) Extreme limit of fuze.
(b) Under development (1926).
(c) Weight of projectile only.
(d) Weight of maximum load, 15,230 lbs.
(e) Exclusive of firing platform and trailer which weigh 71,840 lbs.
(f) Estimated.
(g) Weight of maximum load is 235 lbs.

APPENDIX B

NUMBERS OF WAR DEPARTMENT TABLES OF ORGANIZATION FOR FIELD ARTILLERY UNITS

	75-mm. gun				*155-mm. howitzer*	*155-mm. gun*	*Miscellaneous corps artillery units*	*Miscellaneous army artillery units*	*240-mm. howitzer*	*Miscellaneous G.H.Q. artillery reserve units*	*2.95-in pack howitzer*
	Horse-drawn	*Horse*	*Tractor-drawn*	*Portée*							
Army Arty								254			
Army Arty Hq								255			
Corps Arty							118				
Corps Arty Hq							119				
Brig	31		517½	522			131			541	
Brig Hq & Hq Btry	32		132	132			132			552	
Regt	33		518	523	133	139½			529		533
Regt Hq & Hq Btry	34		518½	524	134	140			529½		534
Ser Btry	35		519	525	135	140½			530		535
Bn	36	436	519½	526	136	141			531		536
Bn Hq & Hq Btry	37	437	520½	527	137	141½	Obsn 153		531½		537
Btry	38	438	521	528	138	142	Obsn 154		532		538
Bn C Tn	39	439			139	142½	Bn 155		532½		539
Am Tn	56						156	256			
Bn Hq & Hq Det							159				
T Btry	57						157				
Am Btry	58						158				
Ord Co (maint) att'd							12			112	

Cat.
Powder of lavender
flowers of Carbonic phenol
with Carbol.