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USE OF
HEAVY ARTILLERY

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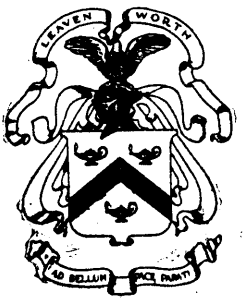
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The following pamphlet entitled "Use of Heavy Artillery" is published for the information of all concerned.

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BY ORDER OF THE SECRETARY OF WAR.

TASKER H. BLISS,
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The Adjutant General.

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INSTRUCTION IN THE USE OF HEAVY ARTILLERY.

FOREWORD.

1. In view of obtaining uniform consistency, all instructions, notes, etc., concerning the use of heavy artillery, previous to the present instruction, are abrogated, and it is strictly forbidden to the command, of all grades, to modify or add to the present instructions.

Supplementary rulings are only authorized when applying to a concrete case; those rulings are always formulated in the shape of an order.

GENERALITIES.

2. Heavy artillery means artillery of medium and large caliber (95 and above).[1]

From a maneuvering point of view, there are to be distinguished in heavy artillery—

First. Heavy field artillery, consisting of batteries movable by their own means.

Second. Heavy artillery consisting of batteries not self-transportable.

In this last category are included the "special" artillery, consisting of siege guns (mortar of 370) and coast and marine batteries, which normally can only be moved by railroad (normal gage or 0 m. 60).

A table annexed to the present instruction gives the nature and ballistic properties of the different guns belonging to the heavy artillery.

The following orders have been especially compiled for the heavy field artillery; they can be also applied to heavy artillery proper, but only in cases where it can easily be moved.

[1] It differs from field artillery (calibers of 65, 75, 80, and 90) and from trench mortars.

DIVISIONS.

3. Heavy artillery is called upon to cooperate with the other arms in the offensive and in the defensive.

In both cases it will start from a period of expectancy, called "stabilization."

The way to use it in these three situations is based upon characteristics of its armament and upon its maneuvering capacity.

Its working demands the cooperation of a certain number of special services attached to the command.

4. The present instruction treats successively these different questions, i. e.—

Title I: Characteristics of the heavy artillery armament and maneuvering capacity.

Title II: Omitted.

Title III: Use of heavy artillery in the period of "stabilization."

Title IV: Use of heavy artillery in the defensive.

Title V: Use of the heavy artillery in the offensive.

Title VI: Organization of services.

TITLE I.

CHARACTERISTICS OF ARMAMENT AND MANEUVERING CAPACITY OF HEAVY ARTILLERY.

A. Characteristics of Armament.

5. *Range.*—The maximum ranges indicated are based on normal atmospheric conditions. It is necessary to lessen those ranges 500 or 1,000 meters, according to whether howitzers and mortars are dealt with or long guns, in order to obtain the distance where the batteries must be placed to reach the objective at all times.

6. *Dispersion.*—Even when a fire is accurately ranged, the points of impact are scattered over a zone of dispersion equal to eight times the probable errors for deflection and range,[1] the

[1] The probable error is the error not usually exceeded in one out of two shots. It is admitted that the practical "probable error" on the battle field is equal to one and a half times the probable error fixed under proving-ground conditions.

density of the points or impact grows less as one goes farther from the center. Certain accidental causes may increase the dimensions of the normal dispersion zone (variations of atmospheric conditions, mainly direction and power of wind, wearing out of guns, lack of similarity in ammunition, of error of the layer). It is necessary to remedy it by continually perfecting the gunner's instructions and carefully allotting ammunition. Certain firing can only be executed in calm weather with guns in perfect condition and whose special characteristics are well known and even in certain cases with one single gun.

The dimensions of the normal zone of dispersion depend on the caliber, the range, and the charge; they can be calculated by the complete range tables. We shall therefore show but few examples:

Caliber.	Charge.	Range.	Zone of dispersion for elongated shells.[1]	
			Width.	Depth.
155	2	3,500	25	160
220	1	3,000	25	240
120 L	1	5,000	48	360
155 L	1	5,000	25	270

These indications enable us to find the minimum distance at which friendly troops can stay to avoid the risk of being hit even by a perfectly well-ranged fire.

It is understood that in the above rules the only dispersion dealt with is that of shots fired at the same range. Special precautions (very careful adjustment of bracketing fire, sheltering of personnel, evacuation of certain zones of ground) must be taken for ranging shots.

7. *Effects of projectiles.*—Shrapnel and high-explosive shrapnel can only be effectively used against unsheltered personnel.[2] In that case, especially when the objectives are of great dimensions, it is advantageous to use shrapnel, because its effect is less localized than that of the explosive shells.

High-explosive shrapnel of 155 is effective even when it is impossible to regulate exactly the bursting height.[3]

[1] The dimensions of the zone are notably larger with the ordinary shell.

[2] These percussion shells are only effective up to 2,000 meters.

[3] 416 bullets of 25 grams, 288 fragmets of 43 grams.

Explosive shells have a powerful but localized effect. They can be fired with or without delay; in addition, certain calibers use instantaneous fuses.

The shell with instantaneous fuse is particularly efficient in bringing down, destroying, or dislocating objectives on the surface of the ground; the shell without delay is efficient against embankments and armor plates. Both are efficient against guns. The shell with delay is only used with big calibers to reach deeply buried objectives; when the angle of fall or the nature of the soil favor ricochets, the results are notably reduced.

Against reinforced wooden shields of medium resistance, capable of being moved by straight fire, the effects of the explosive shells of 75 will sometimes prove sufficient. This fire is sufficient to make a gap in the barbed-wire system.

8. *Use.*—From the above characteristics the following rules for using the different calibers are drawn up:

First. The long guns are used in preference against unsheltered personnel, batteries, earthworks, and shelters within range of straight fire. The angle of fall at long ranges allows them to reach sheltered objectives; at those ranges the long guns can replace in a measure howitzers and mortars against that kind of objective.

Second. Howitzers and mortars are used in preference against earthworks and shelters which can only be reached by plunging or vertical fire.[1]

The howitzer of 150 mm. and the mortar of 220 mm. replace advantageously the long guns in firing on objectives protected by wood (personnel or batteries). Instead of guns of 75, howitzers (120 and 155) can be used to make a gap in the barbed-wire entanglements. They must be used when the wires placed on the reserve side of a slope escape the straight fire and are at too considerable a distance for trench mortars.

B. Maneuvering Capacity of Heavy Artillery.

9. The time necessary for moving and installing the heavy artillery varies a good deal with the caliber and the lay of the land.[2]

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[1] Trench mortars replace howitzers or mortars within the limit of their range.

[2] The adoption of elastic wheels will modify that situation. Of course, the speed of the batteries carried by automobile trucks means the speed of those trucks.

The batteries of 95 on field carriages of 105 and howitzers of 155 can trot for short periods on the roads; their speed may then reach 7 kilometers an hour.

The horse of batteries of 100, 120, 155 have a speed varying from 5 to 3 kilometers.

As for batteries with tractors they can not, under actual conditions, exceed 6 kilometers without excessive wear of the matériel.

Only the horsed batteries of caliber smaller than 155 and howitzers of 155 can be moved over rough ground. The 155 needs firm and consistent ground.

As for batteries with tractors, they can only move on very firm soil and along routes reconnoitered in advance.

The batteries with metallic platform (howitzers of 155, type 1881–1912, and mortars of 220 and 270) need from 5 to 10 hours (by daylight) to install the matériel.

Those of 95, 105, and howitzers of 155 only need 15 to 30 minutes. Those of 100, 120, and 155 need from one to two hours and a half (not including the time necessary for the placing of caterpillar wheels).

10. Every time that the heavy artillery has to come into action it will be necessary to allow not only for the time of its movement and installation, but also for the establishment of observation stations and telephone connections, and for the organization of the fire.

11. The latter varies a great deal with circumstances and is generally much longer than the first. It is therefore important to try to shorten it by a thorough drilling of the personnel; the operations following the reconnaissance must be started as soon as possible.[1]

Road accidents of batteries with tractors and horsed batteries of 155 (in a certain measure, as well as those of 120 with horses) may produce serious entanglements in the columns.[2] On the other hand, the marching speed of those batteries sensibly differs from that of other arms. For these reasons it will be advisable to have these batteries form independent columns.

12. In the selection of positions reserved to the heavy artillery one must take into consideration—

[1] The duties of the officer in charge of orienting battery positions for the group are, from this point of view, of the first importance.

[2] The half turn, for instance, necessitates a very wide road or a cross-road.

The concealment of batteries from ground observation and their concealment or masking, as much as possible, from air observation.

In the case of an offensive, push them as far to the front as possible, to avoid moving them in the course of the operation, taking, however, into consideration facilities of supply and difficulties which might arise in engaging the first-line objectives.

They must be supplied by roads capable of standing the necessary strain.

Finally, the "group" must not be scattered.

To realize powerful concentrations of fire on the whole front and to the extreme limit of the batteries' range, the positions selected for the guns and the batteries should allow as wide a field of fire as possible; for batteries with a reduced field of fire all arrangements should be made to change the direction of the emplacement in the minimum time (1 hour for matériel of 155 howitzer, type 1881–1912; 4 hours for the 220; 6 hours for the 210).

In case of defensive, the greater part of the heavy artillery, especially the heavy artillery of position, must be held at such a distance from the first line that the dead space does not include the first-line trenches in case of attack by the enemy. It will be placed with advantage on level with or at the rear of the secondary defense so as to be able to remain in action longer in case of the enemy's advance.

A few long guns selected from the lightest will, however, be pushed forward to show aggressiveness on remote objectives.

13. The organization of command is based on the following principles:

First. All the artillery at the disposal of either a division army corps or army is grouped under the orders of one single chief.

Second. Calibers are divided between the echelons, leaving to each one the batteries which normally work for it and grouping at the superior echelon the batteries covering several sectors.

Third. The rapid intervention of the greatest possible number of batteries for the benefit of the troops which need it is arranged beforehand in every detail.

In the army corps, the colonel or lieutenant colonel commanding the heavy artillery directs the fire.

Of the army corps heavy batteries (heavy field artillery and heavy artillery) excepting, of course, the batteries of howitzers attached to the divisions.

Of the army heavy batteries definitely attached to the army corps, when either in view of reinforcing the heavy artillery of an army corps or for the purpose of concentrating fire on a group of objectives situated in the zone of action of that army corps; the army commander will temporarily put at his disposal units of heavy artillery belonging to the army or to neighboring army corps. The task of the commander of the heavy artillery affected will consist in allotting the objectives between the heavy artillery which he directly commands and that of the army or neighboring army corps, and to fix the conditions and execution of fire.

To the commanders of heavy artillery of those neighboring army corps and of the army will be intrusted the direction of fire on objectives given to them and the achievement of results.

14. Within the army corps, the heavy batteries of army corps and army are organized in "groupings" commanded by superior officers or occasionally by qualified captains.

In an army corps sector the number of "groupings" of counter batteries and long-range action depends upon the duties incumbent upon them and of the possibilities of air and ground observations; breaching batteries generally form one grouping per division, and according to their duties can be divided into subgroupings.

15. Each grouping includes a certain number of groups of batteries, corresponding as much as possible to the organic group of heavy artillery regiments.

The artillery's duties are fixed by the command in an order which determines the normal and eventual zones of action of the artillery attached to the infantry divisions of the army corps and the army. To that order is annexed, if need be, an instruction containing all necessary information for the execution of the duty and the liaison of the different groupings.

Once the duty is assigned by the command, the executor may choose his technical means of fulfilling it within the limit of the orders or under his own responsibility when he is obliged to differ from them. If necessary, he reports without delay to the command whatever additional support he needs for the execution of the duty.

TITLE III.

THE USE OF HEAVY ARTILLERY IN THE PERIOD OF ESTABLISHMENT.

A. RÔLE OF HEAVY ARTILLERY.

17. Modern attacks necessitate a considerable expenditure of ammunition.

Barrage fires and bombardments, in case of the enemy's attacks, are also very expensive. Ammunition must therefore be reserved for attacks or in case the enemy should attack.

Consequently in the period of establishment, ammunition and especially heavy artillery ammunition must be spent most carefully and only fired with good effect.

(*a*) *Adjustment fire.*—Conducted with economy but enabling the artillery to fulfill all requirements in case of the enemy's attack.

(*b*) *Barrage fire.*—On defilade parts of the front escaping the 75 fire; on certain communication trenches, and on supply lines of the enemy.

These methods of fire shall only be executed in case of threatening attack and upon the commander's order.

(*c*) *Destruction fire.*—Executed when circumstances are favorable and when the trench mortars are not sufficient, against works particularly dangerous for the defense, and against enemy's works of approach.

(*d*) *Fire against the enemy's artillery.*—Destruction or progressive fire, with cooperation of aerial observers, against aggressive and dangerous batteries, whose positions have been exactly determined.

Retaliation fire against enemy's batteries in positions that have been accurately spotted or located fairly accurately in one of two or three positions already registered, 2 or 3 salvos at the most on each one of those positions. If, after such fire, the hostile artillery is not silenced, or if the position has not been ascertained, stop counter firing and leave its destruction until later, applying if necessary for aerial observation and execute retaliation fires with field artillery by volleys on the enemy's trenches and cantonments.

Counter-battery fire must only be executed by the heavy artillery when the light field artillery is unable to act owing to the target being out of range or in dead space.

(*e*) *Bombardment of the enemy's cantonments when situated out of range for 75 guns.*—Lengthy bombardments of localities are generally inefficient and should be absolutely avoided. A few single rounds or, in important cases, isolated salvos at irregular hours should be fired by day, and more especially by night, to develop the enemy's sense of unsafety in the cantonments.

For counter-battery work and for cantonment shelling, second category shells should be used in preference (shrapnel, high explosive shrapnel and ordinary), keeping as much as possible explosive and elongated shells for destruction fires.

(*f*) *Fire on roads and highways.*—Mostly directed on important crossings and on point of traffic shown on photographs. Executed at irregular intervals, fire should only become intense at the probable hours of supply or if large bodies of troops or matériel have been signaled as moving.

18. Outside of particular cases considered above, unforeseen occurrences may necessitate the action of heavy artillery. Full latitude must be given to officers to act for the best, but under the following restrictions:

First. The officer ordering the fire does so on his own responsibility and must not hesitate to do so; he reports his decision to higher authority.

Second. Adjustment fire, executed on an assigned target, must be at once followed by fire for effect on the same target.

B. Division of Heavy Artillery in View of Its Use.

The heavy artillery of a sector is subdivided into artillery of safety and artillery of reinforcement.

19. *The artillery for safety comprises*—The batteries of foot artillery serving the siege artillery which constitutes the backbone of the artillery defense.

A certain number of batteries of movable heavy artillery of the army corps or of the army in sufficient number, as judged by the commander, to complete the safety of the front.

The batteries composing the artillery of safety are in position, but except in exceptional and justified cases, the same positions must never be permanently maintained.

In addition to their own duties, each one must have all the orders to execute in case of the enemy's attack, as well as plotting boards and data books for the various positions they may be called upon to occupy.

20. *The artillery of reinforcement comprises*—The batteries of heavy artillery of the army corps or of the army not included in the composition of the artillery of safety.

Eventually, the heavy horse artillery of groups of armies and the heavy artillery with tractors.

The foot batteries constituting reserved commands.

The batteries composing the artillery of reinforcement are taken away from the front and grouped, as much as possible, in certain units (tractor regiments; third group of horse regiment; groups of heavy artillery of Army corps) in view of their instruction.

In order to have these batteries ready to intervene in good time either to reinforce a local offensive action, or in case of attack by the enemy, they must find emplacements ready on the positions assigned to them as well as special fire records for these particular positions.

It will be consequently advisable to multiply the battery positions on the front and to prepare for each position a fire record, plotting boards, and data books, a copy of which will be kept by the commander of the sector heavy artillery.

In case of an alarm the batteries of reinforcement, assigned to such or such position, will receive their papers and records at the commander's post of the heavy artillery in the sector affected. Every time it is possible to foresee the cooperation of the batteries of reinforcement in a certain zone (particularly for the army corps and even for the army heavy artillery) the preparation of the operation will be perfected still further.

The group and battery commanders will reconnoiter their C. O. posts, observation stations, battery positions, and look over the records for fire. The work will be prepared for the installment of telephone connections and wireless stations, to be started, unhesitatingly, at the first signal.

21. The multiplication of battery positions on the whole front will not only facilitate the artillery reinforcement of such or such a point of the front, but will cause the enemy to ignore the real force of opposing artillery and complicate the task of his counter batteries.

For the same object the greatest possible use must be made of sham batteries.

C. ALLOTMENT OF AMMUNITION.

22. In Army corps and armies ammunition is divided into 4 lots:

Reserve supply of batteries. Supply of current service. Reserve supply of the army corps. Army supply.	Army corps.

23. The supply of batteries of safety[1] must only be used in case of the enemy's attack. It is given out once and can only be resupplied by a demand addressed to the army.

24. The supply for current service satisfies daily needs which themselves depend upon the local situation and the intensity of hostile manifestations; indispensible adjustments, counter-battery fires, bombardments of cantonments, etc., in conditions specified in paragraph 1.

That supply, of course, only concerns batteries in position on the front.

The determination of daily expenditure is strictly prohibited in all cases. The maximum lump allowance only will be fixed for determined period for all units.

These allowances can only be exceeded if a favorable opportunity presents itself and a well-defined result can be obtained.

25. The object of the reserve supply of an army corps is to allow the army corps commander to fill up again the batteries which have had to exceed their maximum allowance, and also to order, at opportune times, the execution by a certain number of groups or batteries of fire for effect against particular targets; destruction fire with aerial observations, against aggressive or dangerous hostile batteries, against hostile works particularly hampering the defense, etc. This fire, executed by order of the army corps commander will be reported after execution to the army.

To constitute and keep up the current service supply, and the reserve supply, the army corps commander disposes of a quantity of ammunition periodically allotted by the army commander.

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[1] The number of batteries of safety is fixed by the general commanding the group of armies.

The army supply is subdivided into two fractions:

First. The reserve supply[1] which enables the army commander to reinforce in case of attack the supply of the batteries in the attacked sector while waiting for the ammunition to come from the rear.

Second. The current service supply which satisfies the daily needs of the army corps.

26. The army is supplied with a periodical allowance of ammunition by the group of armies.

TITLE IV.

USE OF THE HEAVY ARTILLERY IN THE DEFENSIVE.

27. With the present war conditions an attack by surprise on a fortified position, whose barbed-wire system and flanking works are intact, may be considered doomed to certain failure, unless the defender shows an inadmissible negligence. The attack will be generally preceded by an artillery preparation more or less prolonged.

28. The study of usual German ways of attack enables us to recognize a certain number of signs indicative of an assault. These signs are as follows:

Intense bombardments, lasting from a few hours to several days, according to the case and for the same attack, according to sectors, with or without interruption of fire, and executed on batteries, on principal organs of defense, and on communications. Particularly, great activity among minenwerfers.

Preparatory works and especially construction of an assembly trench or even simple saps in the direction of the first line of defense.

Mine explosions, either creating large craters to open up the assembly trench or destroying the defense trenches and the wire entanglements in front of them. In this last case the attack may be considered imminent. Waves of asphyxiating gas before the assault.

29. When the bombardment assumes an abnormal intensity, and above all when it becomes general, all measures must be taken to parry an attack.

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[1] The number of batteries of safety is fixed by the general commanding the group of armies.

While the counter batteries of the reserve artillery (heavy and field artillery) try to neutralize the enemy's fire, all means of aerial observations are called upon, so that the artillery battle may be waged under the most favorable conditions.

On the other hand, the heavy artillery of reinforcement occupies the positions prepared in case of an alarm. As soon as the long-range guns are in position, the batteries cooperate with the artillery of safety.

If the enemy has executed, during the night, works of approach on certain points of the front, the howitzers and trench mortars will endeavor to destroy them.

On the rest of the front, and in the most threatened sectors, the heavy artillery destruction will systematically bombard the enemy's first-line trenches, communication trenches, and shelters and dugouts which may contain assembled troops.

Finally, the action of heavy artillery is completed by intense concentrations executed by heavy and field artillery:

On concentration points situated at the rear of the first line (balloons, villages, woods, etc.).

On supply lines and usual traffic arteries.

On observation stations and C. O. posts.

30. When attack is started or when it is judged imminent by certain warnings (gas waves or mine explosions), all the available batteries of heavy artillery (howitzers and long guns), capable of acting on the threatened front, concentrate their fires on trenches and communication trenches, while the field artillery will begin a barrage fire.

This concentration of fire will be maintained at full pitch as long as is judged necessary by higher command.

There can be no question of slackening down the artillery fire during the critical period, preceding the assault, as long as the situation in the sector attacked is uncertain.

31. If the command receives definite information that the enemy has set foot in a certain part of the defensive position measures must be taken to prevent his establishment and then to drive him out of it.

Consequently all the heavy artillery which is not indispensable for counter-battery work, particularly the heavy artillery of destruction, will systematically bombard the conquered trenches.

This bombardment will, furthermore, prepare way for the counter attack, which should be executed as soon as possible by the reserves in the sector. At the hour appointed for the counter

attack, the heavy artillery assigned to make the breach will automatically switch their fire onto the enemy's communication and assembly trenches.

TITLE V.

USE OF HEAVY ARTILLERY IN THE OFFENSIVE.

A. Studies and Works Preparing for an Offensive Action.

32. The preparation of an offensive operation under actual war conditions necessitates a minute study of probable conditions and circumstances of the operation following the staff's plan of attack.

This study, conducted as far as possible, will tend to show what needs may be expected at the successive stages of the fight and enables us to determine: Organization of command, artillery commands to be formed, as well as general duties to be given. A minute examination of the terrain will complete the preparation, as that alone enables us to draw up plans for the installation of the artillery.

These measures will give a clear plan of the works (C. O. posts, observation stations, battery positions, ammunition stores, narrow-gauge railroads, telephone lines, and central stations).

Such a plan needs, in order to be realized, the assembly of matériel and the necessary personnel, the division of work, organization of workshop, finally the execution of the work itself, following the necessary orders.

Only after the preliminary work will it be possible to bring up the ammunition, to allot it, and to install the matériel.

B. General Mechanism of the Attack.

33. In order to avoid excessive and unnecessary infantry losses, an attack can only be successful if it has been *prepared* and if it is continually backed up by a powerful artillery.

In the actual situation—that is, in the attack of fortified fronts combining successive lines of defense—the rupture of the enemy's front can not be generally made in one single operation. On the original situation of the artillery attacking depends the possibility of preparing the attack of a certain number of these successive lines. As the attack develops and according to the magnitude of first success, the organization of the artillery will

have to be modified, either to complete an insufficient preparation on certain lines too distant or too hard to observe, or to prepare new attacks on rear positions.

Consequently, unless the enemy is utterly routed, the attack of a modern fortified front presents phases each of which depends on the artillery's power of action.

This power of action not only consists in being within good range of targets but also in the ability to observe from ground station, with the greatest precision, the shots fired on these targets.

It is therefore essential to study carefully all measures capable of reducing the number of ineffective "periods" which so delicate an operation as the moving of a mass of artillery will necessitate. These measures include:

Rapid installation of the batteries on the new positions; or simply sending forward the observers of certain batteries to forward points of the conquered positions (these points should be studied in advance and determined according to the lay of the land); improvised connection between this observing post(s) and the batteries (signals, searchlights, etc.) before the installation of telephone connections or during interruption, if it should happen to be cut.

C. Organization of Artillery in View of an Attack.

34. The artillery organization for an army, in view of an attack, must be based on the decentralization of services as wide as possible, so as to insure the rapidity and timeliness in the action of the artillery in direct connection with the infantry it works for.

The following allotment is given as an instance:

To divisions.—The field artillery, trench mortars, heavy artillery for destruction (short range).

To Army Corps.—Heavy artillery (long range) for counter batteries, remote destructions, action on the thoroughfares.

To the Army.—The portion of high-powered heavy artillery necessary for special duties which affect the sectors of several army corps and for counter shelling the hostile artillery which fires from one sector into another.

The general commanding the artillery and the generals commanding the army corps determine the allotment of their artillery among the units under their orders. The diffusion, if not

carefully made, may lead to dangerously independent action, the artillery must consequently be distributed, but coordination must be maintained between the different commands to obtain the maximum results.

The supreme command appoints to that effect the generals commanding the army and the army corps artillery whose action must be very prompt.

35. The experience of the last operations enables us to estimate approximately the quantity of heavy artillery necessary for an attack on a given front.

Per division sector (average front 2 kilometers), 2 groups of howitzers.

Army corps sector (average front 4 kilometers), 4 groups of long guns.

In this estimate no mention is made of special guns (heavy railroad artillery, naval guns of very long range, mortars of 270 mm., 370 mm., etc.) or of the reinforcement in long guns for the neighboring sectors.

36. The duration and development of an ensemble action, being as unknown as the ever-increasing strength of hostile organizations, do not allow of any estimate being placed on the amount of ammunition necessary.

However, it is possible to fix, from past experience, the average expenditure, per piece and per day, for the periods of preparation and execution of an attack, as well as for the intervals between two successive phases of the operation.

These expenditures for a large number of guns are as follows:

Calibers.	Period of preparation.	Period of execution.	Interval between two phases of operation.
75	250	300	150
90	100	150	50
95	150	150	50
105	150	150	50
120 long	120	120	50
155 long	100	100	40
155 howitzer	120	120	50
155 howitzer T. R	150	150	50
Mortar 220	80	80	30

At any rate the initial supply must be so regulated that every battery has at its disposal, at the start of a preparation, three

"days of fire,"[1] calculated on above bases, and stored either in battery stores or in immediate neighborhood of the batteries, and three other "days of fire" must be stored, for the general use of all the guns of the sector in the intermediate stores. Total, 6 days of fire.

Furthermore, at the start of the action, the Army has at its disposal a reserve of half a day's fire for all the guns.

Finally a rolling reserve of another half day for all guns is held by the general commanding the group of armies.

This initial supply is fed continuously from the rear to provide necessary ammunition until the end of the operation.

D. Use of Heavy Artillery.

Fire for destruction executed against defense works.

39. The two main operations constituting the preparation of an attack are:

The cutting of gaps in the barbed-wire systems.

The destruction of trench defensive works and communication trenches in the zone of attack and on the flanks.

Past experience has shown that the action of the 75, aided by trench mortars, was generally sufficient to make gaps in wire systems.

It is consequently not necessary, as a rule, to use large-caliber shells for that purpose.

Heavy guns firing at short range on trenches will reinforce, moreover, the action of 75 guns and trench mortars against the barbed wire.

However, against wire systems on reverse slopes it will be almost always necessary to complete the action of 75 guns and trench mortars by that of a small number of 120 Schneider and howitzers of 155.

40. The destruction of defensive works in the enemy's lines is allotted to heavy artillery and, as a rule, to the howitzers.

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[1] The expression "days of fire" corresponds to the figures given in the third column (period of execution) of the table, page 22. This term, used for supply, does not mean that the guns can or must only fire this amount of ammunition in one day; when it is necessary and with a fresh personnel capacity of fire is notably superior and may reach once and a half the amounts given in column 3, but the fire must be conducted so as not to interfere with the preservation of matériel or the precision of fire.

This operation does not consist in shelling the enemy's trenches on the whole front, the supply would never be large enough for that purpose and the process would not be efficient. Fires for effect must be executed on particular points (flanking casemates, machine-gun shelters, observation posts, assembly trenches).

The location, as exactly as possible, of these targets results from information of all kinds gathered on the front or from prisoners, compared with indications furnished by aerial photography.

It must be established from reconnaissance executed after prearrangements between the commanders of first-line infantry units and the commanders of heavy batteries entrusted with duties of destruction.

41. On certain parts of the enemy's front of special importance for the attack, such as the salients or the stronghold of the defense, fire of concentration must be executed by several batteries, but the points of the front thus bombarded must be determined with great precision.

Zone firing will only be used in case of absolute impossibility of observation.

In most cases the destruction desired can be effected with the howitzer of 155, but against especially reinforced points the mortar of 220 may be used. As for the mortars of a caliber superior to 220, their use must be justified by the necessity of producing very powerful crushing and moral effects or reaching points beyond the range of 220 mm.

FIRE AGAINST HOSTILE ARTILLERY.

42. Fire against heavy artillery will be executed by the heavy artillery and, as a rule, by long guns.

In certain cases, however, where large angles of fall are necessary to reach the target, or against strongly casemated batteries, howitzers must be used.

As a general rule, they will be distributed among the divisions, especially in view of a preparation, but all arrangements will have to be made for the commanders of the army corps heavy artillery to take command of all or some of them.

43. It must be remembered that the heavy artillery should aim, before anything else, at destroying the hostile artillery by closely adjusted fire regulated and controlled by aerial observation.

Terrestrial observing posts, while useful for that purpose in few cases only, must be looked for with great care in view of their much greater efficiency.

When circumstances warrant only the neutralization of hostile artillery by zone fires the use of elongated shells must be avoided as often as possible.

OBLIQUE AND ENFILADING FIRES—FIRE CONCENTRATIONS.

44. The long range and the wide field of most heavy-artillery guns enable them to execute frequently oblique and enfilading fires. But this kind of fire necessitates a close communication between the commanders of neighboring zones and a minute preparation of fire.

This use of artillery must have been prearranged and organized in all its details; each battery capable of firing in the zone of action of the neighboring sector must know in advance what targets of that sector it may be called to fire on and make all necessary adjustments thereon.

45. The possibility of realizing in periods of crisis concentrations of fire on certain parts of the battlefield equally results from the above characteristics of heavy artillery.

When oblique or enfilading fires can not be regulated by aerial or terrestrial observation explosive shrapnel and time shrapnel, which form a certain percentage of the ammunition lots, should be employed in preference.

FIRE AGAINST REMOTE TARGETS—BARRAGE OF THE ENEMY'S SUPPLY LINES.

46. It is advisable to prepare the use of a certain number of batteries of long guns and especially of special guns of extremely long range (heavy railroad artillery) to execute, with the cooperation of aerial observers, fire on remote targets, such as cantonments, bivouacs, gatherings of troops, communication thoroughfares, etc.

47. As regards firing on the enemy's supply lines, a certain number of pieces will be detailed, which will be ranged by aeroplanes and situated so that they command the usual traffic thoroughfares used for supply. These guns will execute barrages either at the request of aerial observers or systematically at irregular intervals.

SPECIAL ORDERS.

48. Destruction fire must be stopped occasionally during the night or at least be executed with the most economical projectiles; every time it is possible the small-caliber batteries or the field artillery will be used to prevent or hinder the repairing of the works.

49. The allotment of ammunition will be modified in the course of the operation in order to supply in larger quantities the batteries whose fire will have been observed to be most efficient.

Following out this idea certain batteries will be ordered to stop firing if their ammunition is seen to be misused.

E. Change of Position of Heavy Artillery.

50. The changes of positions caused by the infantry's advance do not present insurmountable obstacles as to the lay of the land (taking into consideration the enemy's fire) provided that the details of execution have been prearranged with the greatest care.

The implements for bridging trenches will be set up during the preparation; if this is impossible, they will be assembled near the approach trenches.

In each division's sector several designated batteries will accompany the infantry as soon as its progress will enable them to advance, but the operation of pushing the heavy artillery forward must be effected with method and prudence to avoid a slackening of fire and consequently a period of danger.

A battery changing position unnecessarily loses all the benefit of its former registrations and established communications.

According to the magnitude of success the observing posts alone or the batteries themselves will be shifted forward. The authority who is to issue orders for an advance must be clearly specified beforehand. It should be either the commander of an army corps or even an army commander, according to the zone of action of each of those commands.

51. The batteries selected to advance immediately with the Infantry will generally include one group of howitzers per division (120 or preferably 155). They will be placed under the orders of the generals commanding the divisions. They will be used to break down the first resistance in the same way

as the normal division artillery, which is often powerless on account of its caliber or the flatness of its trajectory.

In the initial plan of artillery preparation the position and rôles assigned to these groups must enable them to be set free first by the infantry's advance.

52. The advanced positions liable to be occupied near the first-line trenches will be reconnoitered by their future occupants. Some of them can even be built during the period of preparation.

Minute study must be made, to insure permanence of communications, by telephone or temporarily by any other means and continuity of action between the artillery and aerial observation.

The forward supply of ammunition must also be organized in all its details.

F. Rules for the Use of Heavy Artillery in an Offensive Operation Executed in Open Country.

53. We see by studying German regulations and fighting methods that before attacking they always make sure of reassembling their artillery.

This gathering of forces is effected under protection of the tactical advance guards, which establish themselves at the first resistance encountered.

Their rôle is neither to keep watch over the enemy, whose least movements are signaled by aerial observers and the intelligence service, nor to determine his position, for he will do that for himself, but only to cover the deployment of artillery and infantry.

The establishment of the advance guard consists in the occupation of strategical points of the terrain on the whole front of deployment of the corresponding unit and in the reinforcing of these points as well as the intervals between them with trenches and earthworks.

In certain cases, and especially when the field artillery run the risk of coming under the fire of hostile artillery already in position, the deployment will be executed under the protection of the heavy artillery in the rear and by taking advantage of its superior range.

54. From preceding considerations it may be deduced that an offensive operation on our part will present itself under the shape of an attack on the enemy's positions with a front following the general line of his advance guards.

There can be no question of undertaking the attack without having at one's disposal all the necessary artillery, and consequently being strongly established opposite the enemy so as to cover the assembly of that artillery.

The general appearance of the action will generally be that of an offensive operation against a fortified front.

The only difference will consist in the fact that the position attacked will not have the strength of actual field fortifications, and that the sooner the attack is started the more reduced will be the strength of the position.

Consequently the whole question, as regards the artillery, is the deployment of that artillery in the best positions as quickly as possible.

RAPIDITY OF DEPLOYMENT OF HEAVY ARTILLERY.

55. The rapidity of deployment of heavy artillery depends on its maneuvering capacity and on the place it occupies on the march.

(*a*) Maneuvering capacity results from the officers' quick judgment and rapidity of decision from their technical instruction, from the troops' ability in building the position, in their practice in handling the separate parts in setting up telephone connections, etc.

(*b*) *Place of heavy artillery on the march.*—The reconnoitering party must always be sent as far forward as possible to be able, as soon as orders are given for action, to reconnoiter the terrain and prepare the way for the placing and setting up of C. O. posts, observation stations, positions of batteries, fire organization, liaisons, etc.

As a rule the commander of the army corps heavy artillery will remain with the commander of the army corps artillery; the reconnoitering personnel of groups and batteries of heavy artillery will march in front of the main body of the corps.

The army heavy artillery generally marches independently.

56. The coming into action of heavy artillery is generally effected in the following order: Long guns, howitzers.

It is clear that the infantry's deployment, its establishment on the terrain, and the digging of approach works, as well as the deployment and placing of the field artillery and the heavy destruction artillery, will be difficult to carry out under the fire of the enemy's artilery already in position and free to act.

On the other hand, before even thinking of attacking the enemy, however weak his position, it is indispensable to be able to countershell its artillery. In spite of the possible destruction of defense works, the attack would inevitably fail before hostile barrages.

57. The way to use the heavy artillery during the preparation and the execution of the attack will follow, in its general characteristics, the principles laid down in the preceding chapter.

The principal duty of long guns will consist in mastering the enemy's artillery during the whole period of the battle. If an improvised situation renders the adjustment of fire more difficult, the effects of destruction they will produce will compensate for the difficulty by reason of the greater vulnerability of targets.

There should be no modification in the long barrage of the enemy's lines of supply.

The opportunities for shelling communications and massed formations of the enemy will be probably more numerous than in the war of position.

The principal duty of howitzers will consist, as before, in destroying the enemy's defense works. But in the present case this duty of destruction will be limited, in general, to the crushing, by concentration, of the strong points along the enemy's line or to making gaps in the wire when the 75 has not been able to do so.

TITLE VI.

ORGANIZATION OF SERVICES.

58. Intelligence service concerning artillery targets (S. R. A.), such as intelligence service, is organized at the artillery staff of each army corps and at the artillery staff of the army.

At the artillery staff of an army corps the chief of staff centralizes and classifies all information concerning targets which are given by the different services working within the army corps, second bureau of the army corps staff, air service.

He adds to them the information furnished by ground observation posts, specially created to that effect and working under the direction of an artillery officer detached from the staff of the general commanding the army corps artillery.

As this information is being classified the army corps intelligence bureau makes out information cards, which are addressed

to the general commanding the army corps (second bureau of staff), to the army corps artillery commands, to the general commanding the army's artillery, and to the commander of the air service.

The information cards of the army corps are centralized and classified by the chief of the army artillery staff (army S. R. A.), who supplements this information by that of the second bureau of the army staff by the sound and flash-ranging sections attached to the army by the topographical sections.

The information thus gathered is written on an intelligence bulletin sent daily to the generals commanding the artillery, the generals commanding the army corps, to the army commander (second bureau of staff), and to the commander of the army air service.

59. *Aerial observation service.*—The workings of this service follow the instruction on aerial observation in liaison with artillery (1915).

In view of insuring as close a communication as possible, the observers must live with the commands they are assigned to.

60. *Sound and flash ranging.*—The location of targets by sound and flash is carried out by a certain number of sections assigned to every army. The organization and working of these sections is regulated by a special order.

61. *Organization of fire.*—The organization of fire is based upon the special map made by the topographical section assigned to each army.

The coordination of the work of neighboring armies is the duty of the general commanding the group of armies.

The position of the ranging guns, datum points, auxiliary targets and terrestrial observation stations is made by the lieutenants of topography belonging to the groups under the technical direction of the officer commanding the army topographical service, who detaches, if necessary, an officer of his service to each command.

62. *Telephone connections.*—The telephone system is described in the notice on "Telephone material used by artillery, 1915."

The setting up, the upkeep, and the good working of the system, up to group-commander posts exclusive, are looked after by the chief of the first-line telegraph service, who requests, if need be, from the services and corps affected the necessary personnel to reenforce the telegraph sections.

The setting up, the upkeep, and the good working of the telephone fire system from the group commanders' posts, inclusive, is incumbent upon lieutenants of topography who follow the general rules given by the army corps telegraph service.

This service provides the necessary material to complete the batteries' allotment.[1]

63. *Meteorological information.*—The army air service sends three times a day to the generals commanding the army artillery and the generals commanding the army corps artillery the following information:

Barometer pressure.

Speed and direction of the wind at intervals of 500 meters in height.

64. *Park service.*—Every large army park includes a special section assigned to heavy artillery (P. A. I.) and used—

To arrange at convenient times for the shipping through general reserve stores of the necessary matériel and ammunition of heavy artillery.

To send them to intermediary stores (D. I.) organized according to the orders of the first bureau of the army staff, an artillery officer, specialist of ammunition, is for the purpose, permanently detached by the heavy artillery park to the first bureau as liaison agent.

To mend or send back to rear workshops the deteriorated matériel.

In order to accomplish this duty, the heavy artillery park has at its disposal a part of the personnel of the large artillery park and a number of professional and battery caretakers, varying with the importance of the large artillery park—

Troops including a certain number of park batteries (generally 3).

A detachment of artillery workmen and a park section.

An ammunition reserve for all the guns in the army.[2]

Of spare parts of all kinds.

Of repair shops.

Of mobile repair squads,[3] generally one per army corps.

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[1] The description of matériel, type 1909, used in artillery, and conditions of setting up that material, are given in the instruction on "service of observation and communication of foot artillery," approved Nov. 18, 1911, and revised Aug. 20, 1914.

[2] The reserve ammunition of the army corps is attached, if needed, to the park of the army.

[3] On automobile trucks.

The detailed composition of the heavy artillery park is given in the instruction on the heavy artillery park (being studied).

The heavy artillery park is always supplied with broad-gauge railroad.

65. *Ammunition service.*—The ammunition put at the army's disposal is divided between the batteries (3 days of fire) and the heavy artillery park (½ day).

The intermediate depots are established at unloading railroad stations equipped with normal gauge and gauge of 60 cm.[1] and in many points connected with the batteries by the 60 cm. gauge.[2]

Their capacity depends on the protection afforded by the ground and their distance from the batteries. It is advantageous to shift ammunition as far forward as possible, but this is limited by conditions of safety.

In any case the distribution of risk is essential and results in the creation of three or four depots in every army corps zone.

The batteries of one group must receive their ammunition supply from the same store.

The personnel in the depots is supplied by permanent detachments taken from park batteries which temporarily come under the army's orders (first bureau of staff).

Each store is managed by a battery caretaker or a noncommissioned officer in that function. The most important, especially those installed at unloading railroad depots, are managed by officers.

Ammunition is sent from the stores and warehouses in the rear in special cars designed for one kind of ammunition, containing ammunition of the same nature (projectiles, charges, fuses, primers).

The ammunition is generally divided in wagonloads. The conductor carries a detailed list of the freight.

The allotment is verified at the park, in the depots, and in the batteries, which, for that purpose, possess the proper scales.

Explosive shells with exploders are fused just before firing.

The ammunition service is superintended, from a technical point of view, by the chief ammunition inspecting officer for the group of armies, who communicates directly with the generals commanding the armies' artillery.

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[1] In certain cases, especially when the 60 cm. gauge is not yet set up, these stores are delivered by means of automobile lorries.

[2] On automobile trucks.

66. *Matériel.*—In certain intermediate stores, called "mixed," there is an assortment of the most frequently used spare parts.

67. *Transportation by 60-cm. gauge.*—A wide use of the 60-cm. gauge will be made every time it is possible, as transport by automobile trucks is inefficient and depends to a great extent on the condition of the roads.

Consequently the lines of 60-cm. gauge will always be established to enable the transportation of one day's ammunition to the batteries, not counting ammunition supply for 75 guns and trench mortars, as well as transportation for other services, the total tonnage must be calculated in advance by the first bureau of the army staff.

Lines of 60-cm. gauge, fitted onto normal gauge at the unloading depots, are constructed in sufficient number to serve in the army zone and carry precalculated tonnage in conditions stipulated above; the rolling stock assigned to each line is determined in consequence.

From each line branch lines are built to supply the stores and establishments of the different services. The system is completed by one or several cross lines, so as to avoid temporary obstruction of a forward line, and so as to be able to deliver stores of special matériels parallel to the front line.

Each railroad system serving an army is supervised by a superior officer, who receives orders from the general railroad director at general headquarters, and who receives from the general staff all instructions concerning transportation.

The system is built and worked by special troops under orders of the railroad director. These troops are reinforced for the purposes of construction and, if need be, for the upkeep by auxiliary detachments furnished by the army.

For the construction of new lines the proportion of auxiliary men in proportion to the number of specialists is 3 to 1; for the upkeep it varies according to the condition of the track and that of the soil.

68. *Road transport.*—Automobile or horse transport replace, each time it is necessary, transportation by rail of 60-cm. gauge, especially in moving artillery.

They are under the same rules as the transport of other branches.

69. *Principles concerning supply.*—The heavy artillery supply service is centralized at the first bureau in each army.

This bureau receives every day, before 9 a. m., a report on the ammunition situation of the previous day at 6 p. m., for each group centralized by the army corps.[1]

The order of supply is sent before 12 o'clock to the depots and to the head of the railroad system.

This order mentions the quantities and nature of ammunition to be shipped by each depot to the batteries and to be received from the rear.

The store commanders take immediately all preparatory measures and commence loading, if possible.

The head of the railroad system sends, before 2 p. m., to the depot commanders and the army corps commanders, the extracts of the army supply order, to which is added the necessary hours of delivery.

It is essential to start supplying, as soon as possible, with the condition that the trains do not enter the danger zone before dark.

J. JOFFRE.

GENERAL HEADQUARTERS,
November 20, 1915.

[1] In each firing battery it is extremely important to have a noncommissioned officer to keep up a list of expenditure and thus always have up to date the situation of the ammunition stock.

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