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REPORT DOCUMENTATION PAGE

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18. SUPPLEMENTARY NOTES

This report includes various blueprints and photographs which depict mortars in being during WWI.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Artillery, Board of Officers, Army Planning, Materiel, Ordnance, Military Organizations, Military Planning, Warfare, Mortars

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

On March 22, 1919 (?) MG Ernest Hinds submitted this series of recommendations to the Chief of Staff, American Expeditionary Force on the suggested composition of the "New Artillery" which was neither heavy, field, or trench but preserved the best of trench artillery, through the use of mortars. Various comparisons with European mortars in use during WWI are indicated. The findings of the Trench or Mortar Board are complimentary to those of the Caliber Board which was also chaired by BG William I. Westervelt.

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RECOMMENDATIONS
ON
THE NEW ARTILLERY

E.H.

Office, Chief of Artillery, A.E.F.

March 1919.

From: Chief of Artillery, A. E. F.

To: Chief of Staff, A. E. F.

Subject: Report of a Board of Officers appointed to make a study of the experience gained by the Artillery of the A. E. F. and to submit recommendations based thereon.

1. There is transmitted herewith the report on this subject submitted by a Board of Officers convened in this Office by an Office Memorandum of this Office, dated December 9th last.

2. It is believed that this report is of such value that it should be forwarded to the War Department for consideration in connection with the study of the future organization, armament, equipment and training of the Field Artillery. It will be of great value for use in connection with the Report of the Westervelt Board - the two reports are complementary.

In order to make it available to the War Department authorities without delay so that their studies thereof may be pursued simultaneously with ours in the A. E. F., and that it may be available also in connection with that of the Westervelt Board, I am transmitting herewith an additional copy for that purpose.

It is believed that G-3 has probably a greater interest in this report than the other sections of the General Staff at these headquarters, and in order that that section may have uninterrupted use of this copy the retained office copy of the report will be loaned by this Office to G-4 and G-5 for such study as those sections may desire to make of it.

3. The value of the report consists not only in the views and recommendations of the board, but to a still greater degree in those of a great number of our ablest and most experienced artillery officers, which are collated and classified in the various Annexes to the report, and which are therefore available in permanent form for future study of the many questions covered by them. From these the War Department authorities can draw their own conclusions which may or may not agree with those of the Board. The conclusions drawn from these experiences by officers who study them will vary with the weight assigned by them to the views of the various officers quoted. While there is a general agreement in regard to most of the questions considered, the views differ widely on certain points. This is due, of course, to the fact that such views depend largely upon our personal experiences which are generally the result of local conditions of limited application and which are rarely reproduced elsewhere. Generally I have concurred in the views of the Board, but in some most important points I do not think their conclusions are justified.

4. My recommendations are submitted in the form of an indorsement in which the various subjects are considered in the order in which they appear in the Report.

Enclosures.

ERNEST HINDS
Major General,
Chief of Artillery, A. E. F.

THE NEW ARTILLERY

Foreword.

One of the products of the European War is a new artillery. On account of the abrupt cessation of hostilities no opportunity was offered for a trial of this new arm on the field of battle. It is the result of striving for an improved accompanying piece for infantry. The idea was perfected about the first of October, 1918, and sufficient material for one regiment was at once requested. By the middle of November the regiment had been trained as a unit with the new material and was ready for service at the front. The results on the maneuver field gave such promise that plans were made for an extensive use of the arm.

This new artillery is neither heavy artillery, field artillery nor trench artillery, but partakes of the nature of all three and retains the most desirable features of our old trench artillery. It was evolved from trench artillery at the Trench Artillery Center, A. E. F., and for this reason it is referred to in this paper as trench artillery in spite of the fact that it is as much field artillery and heavy artillery as these latter themselves are.

The term Bombardier would be quite descriptive of the arm and has been suggested. Except for the revulsion so common among us for army terms, such as trench artillery, which implies position warfare to the uninitiated, the name is of little moment.

The real thing to be considered is the mortar and its high angle fire vs. the gun and its direct fire. This paper attempts to show that, with the exception of range, the mortar always compares favorably with the gun and often greatly surpasses it in the points considered.

Two facts stand out:

1 - The gun has been fully developed, and with success.

2 - The mortar has not been developed as a field weapon, but presents great possibilities as such.

If the mortar is developed as a result of the work of what we now know as trench artillerymen and as a result of this paper, they will have accomplished their purpose.

RECOMMENDATIONS

ON

TRENCH ARTILLERY.

Submitted to a Board of Officers composed as follows:

Brigadier General William I. Westervelt.
Brigadier General Robert H. Callan.
Brigadier General William P. Ennis.
Colonel James B. Dillard, O. D.
Lieutenant-Colonel Ralph T. Pennell, F. A.
Lieutenant-Colonel Webster A. Capron, O. D.
Lieutenant-Colonel Walter P. Boatwright, C. A. C.

In compliance with the following letter:

GENERAL HEADQUARTERS, AMERICAN EXPEDITIONARY FORCES.

Office of the Chief of Artillery.

23 December 1918.

From: Brig. Gen. W. I. Westervelt.

To: Colonel F. E. Williford, C. A. C.

Subject: Trench Artillery Materiel.

1. There is attached hereto copy of paragraph 1, cable No. 2332-R, December 19th, from the War Department, for your information.

2. Will you please submit for the consideration of the Board, a memorandum giving your recommendations for Trench Artillery armament, including calibers, mounts, method of transport, kinds and proportion of ammunition. It is requested that you cover in detail all questions relating to Trench Artillery materiel required for a Field Army or Armies.

1 incl.
GJM

W. I. Westervelt.

C O N T E N T S.

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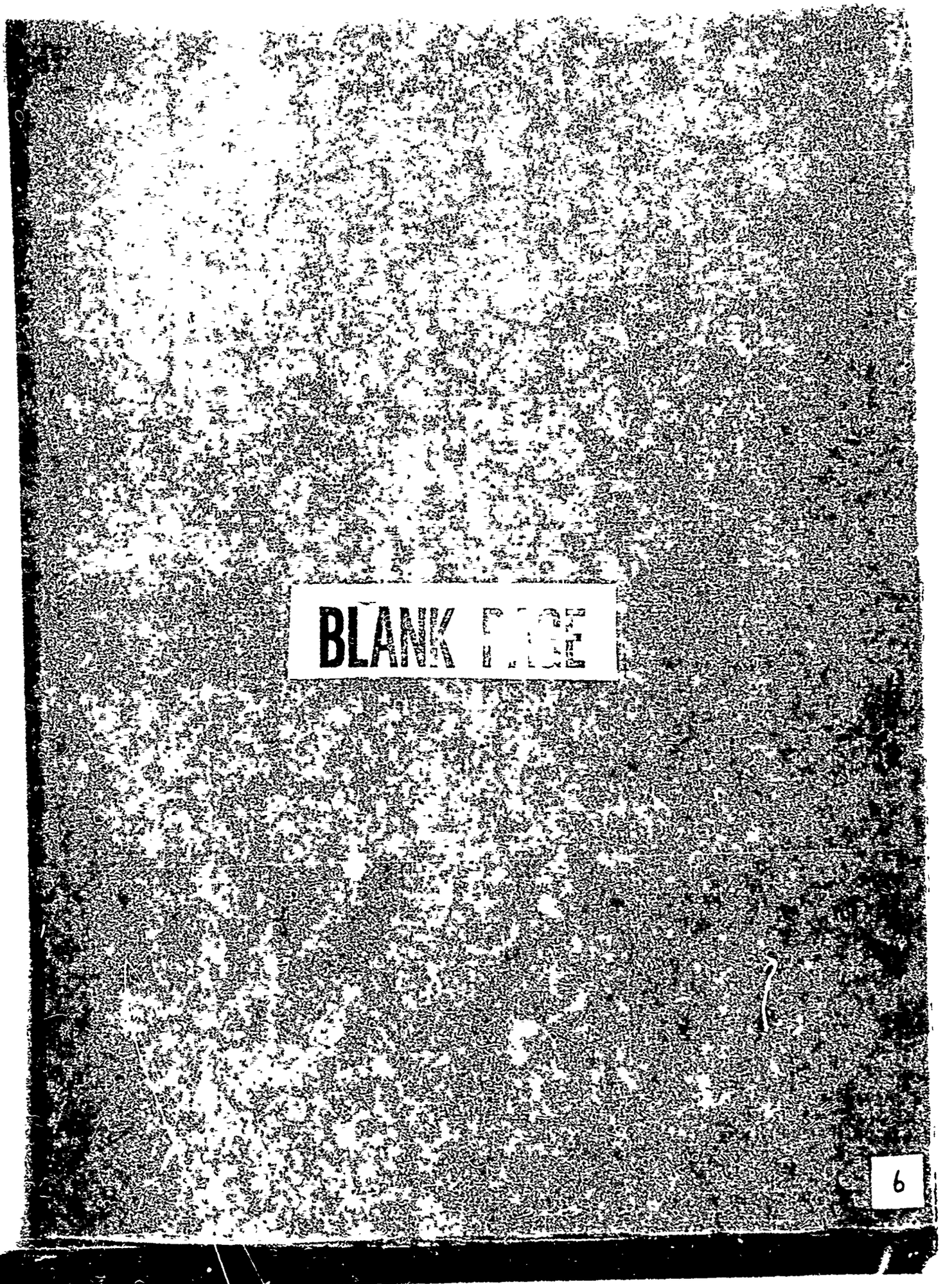
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PART I

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RECOMMENDATIONS.

PART I

INDEX

R E C O M M E N D A T I O N S .

ARMAMENT:

1. That Trench Artillery be of two classes:

(a) Light, as exemplified by British 6-inch Newton.

(b) Medium, as exemplified by French 240 m/m.

(c) And that 4 Italian 400 m/m mortars (two each of two types of carriage) together with 400 complete rounds of ammunition, be purchased from the Italian Government with a view to exhaustive study as to the advisability of having a third class, Heavy Trench Artillery, as exemplified by the Italian 400 m/m mortar.

CALIBER:

2. That pending further development the mobile 6-inch Newton, as developed at the Trench Artillery Center, be used by light Trench Artillery.

3. That pending further development the mobile 240 m/m mortar, as developed at the Trench Artillery Center, be used by the medium Trench Artillery, and that a recoil mortar of about this caliber be designed and adopted.

MOUNTS:

4. That pending further development a one-piece box with spades, as developed at the Trench Artillery Center, be the mount used by light Trench Artillery.

5. That a recoil caterpillar mount be developed for medium Trench Artillery and that pending the availability of this mount the one-piece direct-thrust mount, developed at the Trench Artillery Center, be used by medium Trench Artillery.

6. That the mounts for medium weapons have traversing mechanism. This question for light weapons should be further studied.

METHODS OF TRANSPORT:

7. That light weapons be transported on a universal hand cart appropriate also for carrying bombs, projectiles, and their ammunition, 37 m/m guns and their ammunition, small arms ammunition, a litter with patient, rations, water tanks, field telephone switchboards and equipment, and indeed everything for which a light hand cart is needed.

8. That this universal hand cart be adaptable for draft by man power across country and for draft in tandem by animal power or by motorcycle or truck on roads.

9. That standard 4-wheel drive 2-wheel steer 3-ton truck with standard cargo bodies be provided for transporting personnel, materiel and ammunition of light Trench Artillery over long distances and for administrative and tactical use in the supply of ammunition during stationary warfare.

10. That for the immediate future trucks of Recommendation No. 9 be used to tow the mobile 240 m/m materiel mentioned in Recommendation No. 5.

11. That a universal caterpillar chassis with power unit capable of serving as a travelling and firing platform for the 240 m/m medium materiel mentioned in Recommendation No. 5 be designed and adopted. This chassis should be of standard design upon which can be interchangeably mounted a mortar, a field gun or a tank body.

12. That there be developed an appropriate trailer (possibly caterpillar) for carrying ammunition of all caliber and personnel.

FUZE AND PROPULSION OF AMMUNITION:

13. That the present charges and fuses be continued in service pending the development of better charges and fuses.

14. That there be designed and adopted a fuse which is essentially delay, but which may be readily converted into an instantaneous fuse by the removal or alteration of an external delay element. This fuse may well be universal for all calibers of Trench Artillery.

15. That for all calibers the charge be weatherproof.

16. That for all calibers the charge be supplied in complete units of the heaviest charge, lower charges being obtained by the removal of increments.

17. That the light weapon be the standard gas weapon and that an appropriate gas bomb therefor be developed.

18. That incendiary and smoke bombs be developed for the light weapon.

19. That for light Trench Artillery ammunition be manufactured in the following percentages:

H. E.	80%
Gas	10%
Smoke	5%
Incendiary	5%

20. That for the present only H. E. bombs be supplied for medium Trench Artillery and that a gas bomb for this caliber be studied.

21. That pending further development present types of bombs be continued in service.

22. That the study of vaned bombs (now in its infancy) be exhaustively pursued.

ORGANIZATION:

23. That there be light and medium regiments, each regiment to have two battalions, each battalion to have three batteries. See attached tables of organization.

24. That during the development and instruction of personnel, and pending the development and supply of improved appropriate materiel, all Trench Artillery be Army Artillery.

25. That in an army there be provided five regiments of Trench Artillery as follows:

1 Regiment of medium Trench Artillery,

4 Regiments of light Trench Artillery.

26. That the Trench Artillery of Recommendation No. 25 be the peace time Regular Army strength of Trench Artillery and that it be immediately provided to the end that proper instruction and development may proceed.

27. That Trench Artillery as mentioned in Recommendation No. 25 be organized and trained for each army called for, or to be called for, in first or other Reserves.

28. That a reserve of 20% of the commissioned strength and 10% of the enlisted strength of the Trench Artillery of the Reserve Armies mentioned in Recommendation No. 27 be trained to insure that the organization of each Reserve Army be at all times intact and ready for mobilization.

29. That to insure continuity of policy, energetic systematic development, and to fix responsibility for these advances and the efficiency of Trench Artillery, the office of Chief of Trench Artillery be created.

30. That to insure proper coordination and concurrent development with Infantry, Field Artillery, Heavy Artillery and other line and staff branches, the Chief of Trench Artillery report to and operate directly under the Chief ofStaff, U. S. Army.

TRENCH ARTILLERY CENTER:

31. That in order to make development possible and to insure uniformity in this development and in instruction, a permanent Trench Artillery Center be established in the United States.

32. That a Board of Officers be at once appointed to select suitable site and to recommend an appropriate layout of this permanent Trench Artillery Center conforming to what actual experience has shown to be sound.

33. That, in order that the development made up to date be not lost to the service and that progress may continue uninterruptedly, the Trench Artillery Center, A. E. F., be at once moved to the United States, and put into operation pending the establishment of the permanent Trench Artillery Center mentioned in Recommendation No. 31.

PART II

DISCUSSION OF RECOMMENDATIONS

PART II

INDEX

R E C O M M E N D A T I O N N O . I

ARGUMENT:

1. That Trench Artillery be of two classes:

(a) Light, as exemplified by British 6-inch Newton.

(b) Medium, as exemplified by French 240 m/m.

(c) And that 4 Italian 400 m/m mortars (two each of two types of carriage) together with 400 complete rounds of ammunition, be purchased from the Italian Government with a view to exhaustive study as to the advisability of having a third class, Heavy Trench Artillery, as exemplified by the Italian 400 m/m mortar.

A - Why Trench Artillery?

Trench Artillery is especially appropriate for certain missions on account of:-

(a) High angle of fall. Most effective distribution of fragments against personnel, can reach steeply defiladed targets, attacks material targets on top, then weakest point (Plate I).

(b) Ability to take cover in small space and behind steep defilade. Can be fired from trenches, from behind steep hills and in mountains.

(c) Ability to throw large explosive charges. Great destructive and moral effect.

(d) The low price of the materiel and ammunition. Reduces the amount of high power artillery necessary, or releases this amount for the more distant targets. The initial cost of the gun is about ten

TABLE A.

Gun	Weight of Projectile in lbs	Weight of Barrel in lbs	Weight of Barrel per pound of Projectile in lbs	Range in Yds	Weight of Barrel per pound yard in lbs	Efficiency Compared with 6" Newton
75 mm Field Gun	16·48	1042.	63·60	12000	·00529	31.5
155 mm Howitzer	96·55	2739	28·36	12200	·00232	71.5
3" Stokes Trench Mortars	9·35	52	5·55	795	·00699	23.7
6" Newton * Trench Mortars	50	160	3·20	1800	·00166	100
58 *2 Trench Mortars	37	100	2·70	1526	·00177	93.8
150 Fabry Trench Mortars	37	265	7·17	2180	·00329	50.4
240mm French * Trench Mortars	190	690	3·64	2240	·00162	102.00
400mm Italian * Trench Mortars	580.	2442	4·21	4470	·00153	108.00

* Note specially the favorable showing of these Mortars when compared to the others.

The figures for the 75mm field gun are based upon the weight of the recording mass. The figures for the other guns are based upon the weights of the barrel and breech block only.

of twenty-five percent of that of a long range gun of similar power. The ammunition costs ten to forty percent less per round of effective metal and explosive delivered to the enemy.

These four characteristics are thereasons for Trench Artillery coming into existence and remaining in use. Trench Artillery is capable of great development.

Trench Artillery has already been developed until the tube or barrel proper of the trench mortar is the most efficient engine in existence for propelling projectiles. Table "A" shows the weight of the tube per pound of projectile thrown; the weight of the tube per pound per yard of projectile thrown; and compares the weight efficiency of various tubes with that of the 6-inch Newton mortar. It will be observed that its weight efficiency is three times that of the 75 m/m field gun, and that it is 33 percent more efficient than the 155 howitzer. This great advantage of the trench mortar over other guns has been completely lost in the inefficiency of the mount given to this type of weapon. The table shows conclusively that when the mount has been developed to the same degree as the barrel we shall be able to obtain from the trench mortar, the lightest gun for its power, and consequently the most one which can be made mobile. Steps toward this end have been taken at the Trench Artillery Center and the result is seen in the Mobile 6-inch Newton, Model 1918, and in the Mobile 240 m/m Mortar, Model 1918, which are the most mobile guns of their power in any army. And in them development has only begun and the end of it is not yet in sight.

As a corollary to the above we may also say that when the bomb is developed to the same degree as the barrel, the trench mortars will for

the same weight of tube per pound of projectile thrown show a much greater range with a given weight of bomb. This feature has hardly been studied at all. We will then, by properly apportioning the weight of the gun, the power of the bomb and the range, be able to make guns with a new standard of efficacy and with a great variety of uses.

B - Why a Light and a Medium Trench Artillery (6-inch Newton and 58 m/m)

Light Trench Artillery has already shown its effectiveness against personnel, wire entanglements, trenches, light shelters and even against tanks (117th Battery in Champagne July, 1917).

Medium Trench Artillery (French and Italian 240 and British 9.45-inch) has already shown its effectiveness against deep dugouts, villages, and strong points.

The mobile 6-inch Newton mortar was designed especially for the support of advancing infantry and for harassing fire as a roving gun, without changing its effectiveness as a trench weapon.

The mobile 240 m/m mortar was designed for use in the open in mobile warfare, in addition to its use as a weapon of trench warfare.

What these guns have already done justify the retention of a light and medium Trench Artillery in our service. The glimpse we have had of their possibilities of development show why this development should be pursued to its limit.

C - Why the 6-inch Newton as the Type of Light Trench Artillery Weapon?

The 6-inch Newton fires a 50-pound bomb which marks it as a piece of artillery rather than a grenade thrower. The 3-inch Stokes mortar, firing a 10-pound bomb and manned by the Infantry, is clearly a large

grenade thrower. The 4-inch Stokes is an enlargement of 3-inch, but mortars of this size commence to become unwieldy as grenade throwers but scarcely have distinct enough characteristics to be classed as artillery. A 5-inch Newton mortar would probably possess many desirable features and the merits of such a gun are worth investigating. Such a caliber does not exist. In the 6-inch Newton mortar we have a gun which is light enough to be taken anywhere, and which throws as large a bomb as so light a gun can be expected to throw ato reasonable ranges. A 7-inch mortar of similar type would be less mobile and its bomb would be of such a weight that ammunition supply would be more difficult. To facilitate ammunition supply, bombs should be of such a weight that integral multiples of this weight make a convenient load for a man. One man can carry three 33-pound bombs or two 50-pound bombs. One 60-pound bomb would be less than a man could carry, while two would be too big a load for the average man over rough country. Hence the 7-inch mortar does not seem a desirable one for the light Trench Artillery.

In addition to being light and powerful, as well as available in quantity for our army, the Newton possesses the advantage of simplicity. It fires bombs having vanes flush with the wall, which are more convenient to handle and less liable to damage than those having projecting vanes as has the 58 m/m.

Mortars of the minenwerfer type, which use rotating projectiles, are of interest, but this construction is less simple, requires a heavier barrel, and uses energy in rotating the bomb which would be more ~~m~~ useful in propelling it.

Mortars of the type of the 150 m/m Fabry are of interest, but as developed to date are more complex and heavier than the 6-inch Newton.

Mortars of the Van Buren type are light, but the bomb carries a large weight of ineffective metal.

A study of all these features lead to the conclusion that the 6-inch Newton mortar is the type most suitable for our Trench Artillery.

D - Why the 240 m/m as the Type for Medium Caliber Trench Artillery? Caliber:

As the power of the light Trench Artillery is limited by the requirements of maximum portability for the gun and ammunition, so the power of the medium caliber weapon will be limited by the heaviest projectile that can be loaded and handled without mechanical means. One man can carry and easily handle for short distances a bomb weighing up to 120 pounds and a strong man can handle for very short distances a bomb weighing 180 pounds. The 240 m/m trench mortar fires two bombs, one weighing 110 pounds and one weighing 163 pounds. With the 6-inch Newton as the light weapon and the 240 m/m mortar as the medium, the following scale of power would be obtained:

Bomb	6-inch Newton	240 m/m Light	240 m/m Heavy
Weight of Bomb	50 lbs.	110 lbs.	163 lbs.
Weight of Explosive Charge	10 lbs.	44 lbs.	90 lbs.
Range	1800 yds.	3270 yds.	2240 yds.

Type:

As a type, the 240 m/m gun possesses the advantage of having one of the lightest tubes for the pound yard of projectile thrown and therefore is capable of great development towards mobility. It is available in quantity for our army. It uses a flush vaned projectile which is capable of equal development with the 6-inch Newton. Part of the metal in the vanes of the projectile is not effective as fragments, but it would seem that in a properly designed bomb this percentage can be reduced. The possibility of using a grooved bore and lugged projectile as in the minenwerfer is worthy of study in this gun as the percentage weight increase caused by the lands would not be so great as in the 6-inch gun, and the longer range for which this gun is appropriate might render it desirable. But among the mortars available at the present moment, the 240 has more advantageous characteristics than any other of about equal power.

The necessity for a trench mortar more powerful than the 240 m/m is a question which deserves serious study at this time. The Italians found such a weapon necessary in their mountain warfare and constructed a 400 m/m trench mortar of very good design. Their interest in these heavy guns is shown in the fact that very few were produced before they called for additional mortars of the same caliber and with still more refinements. The tendency is towards heavier calibers and correspondingly stronger protection for personnel and batteries. As this tendency progresses there will come a need for a heavy trench mortar which bears the same relation to the 16-inch gun that the Newton mortar does to the 6-inch howitzer and the 240 m/m does to the 10-inch gun. In our army we should

provide for the supply of these guns when the need [illegible] the meantime experiment with them towards obtaining the most efficient one. The Italian 400 m/m trench mortar is the only heavy one yet produced. Some batteries equipped with these weapons will be our only means of studying their effects and the features which should be embodied in such a mortar.

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RECOMMENDATION NO. II.

CALIBER:

2. That ending further development the mobile 6-inch Newton, as developed at the Trench Artillery School, be used by Light Trench Artillery.

. . . . . .

The qualities which should be embodied in a light Trench Artillery weapon are:-

1 - It should be sufficiently mobile to accompany infantry closely enough to support it on all terrain suitable for Trench Artillery.

2 - It should be equally useful in either stationary or open warfare.

3 - It should have a minimum range of 3500 yards..

4 - It must be simple - no loose or small parts to become lost; no delicate parts to jam.

5 - It should have the maximum power consistent with mobility and range.

6 - It must have rapidity of fire and be convenient to serve.

An examination of all the mortars now in existence shows that the following are the only ones which approach these qualifications:

	Mobile 6" Newton	150 m/m Fabry	3" Stokes	76 m/m Minenwerfer	17.5 c/m Minenwerfer
Weight	688 lbs.	1500 lbs.	108 lbs.	312 lbs.	1232 lbs.
Range	1800 yds.	2180 yds.	795 yds.	1432 yds.	1168 yds.
Weight Bomb	50 lbs.	37 lbs.	435 lbs.	10.06 lbs.	108 lbs.
Explosive Chg.	10 lbs.	12 lbs.	2.09 lbs	1.45 lbs.	26 lbs.

The Fabry, while slightly superior in range, weighs more than twice as much as the Newton, and on account of the design of the bomb about 20 percent of the metal is ineffective. Moreover, while the Newton mortar consists of but two parts, the Fabry is complex. The 3-inch Stokes and the 76 m/m Minenwerfer are eliminated on account of their lack of power and range. The 17.5 c/m minenwerfer is not nearly as mobile as the Newton and has less range. None of these mortars meet the requirement of range, but the Newton can probably be given this range without sacrificing its other desirable features. The Newton ammunition as presently packed is inconvenient to handle and is easily ruined in bad weather. This can be remedied.

. . . . . .

For more detailed information of the mortars mentioned see:

Manual for Trench Artillery, Part III - "The Newton 6-inch Trench Mortar".

Description of the 6-inch Newton Mobile Trench Mortar.

"The Future of Trench Artillery", Part I.

Table I - "Comparative Data on the Principal Trench Mortars".

"Notes on German Artillery", Part II Trench Artillery.

THE 6-INCH NEWTON MOBILE TRENCH MORTAR, MODEL 1918.

Description of Material.

The 6-inch Newton mobile trench mortar, Model 1918, is a modification of the 6-inch Newton trench mortar which, together with certain additional equipment, make it equally adaptable for use in stationary or mobile warfare.

The piece and the equipment for its service consist of:

Barrel.

Modified bed, Model 1918.

Two or more hand carts.

Two or more ammunition chests.

Gas ejector.

Clinometer.

Prismatic compass.

Compass stake.

Aiming stake.

Pick.

Shovel.

Flashlight for night laying.

The articles enumerated in italics are not changed in any way from those described in Chapter I, Manual for Trench Artillery, Part III.

THE MODIFIED BED, MODEL 1918.

The modified bed, model 1918, is made up by reinforcing the regular bed (see Chapter I, Manual for Trench Artillery, Part III) with a steel plate, adding a main spade and two lateral spades, and providing it with brackets for holding the barrel in transportation. There are also

added sockets for securing the bed on the hand cart, and sockets for porter bars. The wire handles are removed.

The reinforcing plate is of good quality steel 2'3" x 3'6" x 1/8". It is bolted to the bottom of the wooden bed so as to cover its entire under surface. Four inches from the rear of the reinforcing plate, extending across it, and making an angle of 105 degrees with its forward surface is the main spade. It is of 1/8" steel plate good quality and is rivetted to the reinforcing plate and further strengthened by triangular brackets. The main spade has a surface of 2'3" x 8". On each side of the bed and 3" from the front end are two lateral spades each 6" x 6" x 1/8".

On top of the platform at the center of each the front and rear is bolted a bracket. The brackets are shaped to hold the barrel clear of the cast iron block, the front one being 8" above the bed and the rear one 9½" above the bed. The rear bracket is provided with a hole for taking the barrel stud, which holds the barrel secure during transportation.

On the edges of the bed on each side are bolted two sockets. These sockets are 15-3/8" between centers and are placed so that when the bed and barrel are mounted on the two-wheel hand cart, the studs thereon will engage in these sockets and the load will be properly balanced.

At the four corners of the bed are sockets for the insertion of porter bars to be used for carrying the bed over difficult ground.

With the model 1918 bed the mortar may be placed on any level piece of firm soil and fired with all charges and at all angles of elevation from 45 degrees to 75 degrees. When the mortar is to be used on gravelly soil sounding should be made with the pick to insure that the spade will not be caught on a rack and the platform thrown out of level. If it is necessary to fire the mortar on rocky ground a foundation of sand bags must be constructed of sufficient depth and size for the spades to obtain a grip. In swampy

ground, or for trench warfare, where a great number of shots will be fired from the same position the platform (see Chapter I, Manual for Trench Artillery, Part III) with suitable slots for the spades may be used.

THE HAND CART.

The hand cart consists of a steel and wooden frame 30½" x 17½" mounted on ball-bearing motorcycle wheels with 28" x 3" pneumatic tires. At the corners of the frames spaced 27½" x 15-3/8" are four studs 2½" x ½". These studs engage in the sockets on the mortar bed or in the holds in the ammunition chests to hold them on the cart. The cart is drawn by a wooden tongue which is attached to the axles and the wooden frame. A prolong is attached to the tongue to enable drawing by any number of men. The carts are interchangeable for carrying either the model 1918 mortar or the ammunition chest and the complete load may be hauled by four men over roads or by six men across country. When the hand cart is used for transporting the mortar it is referred to as a gun cart; when used to carry the ammunition chest it is called a caisson.

THE AMMUNITION CHEST.

The ammunition chest is a wooden box 30" x 27" x 15" outside measurements. It is divided into eight horizontal compartments for carrying eight bombs and has a sliding door at the rear. On top are placed cleats of 1⅛" wooden strips for holding a powder chest (21" x 13" outside measurements) over its center. A strap is provided to secure the powder chest during transportation. On the underside of the box are bored four holes spaced 27½" x 15-3/8" to engage the studs on the hand cart. Porter bars are secured to the side for lifting the chest.

ACCESSORIES.

Prismatic compass. Any accurate compass with good sights and degree graduations may be used for laying the gun on a magnetic bearing.

The compass stake is a stake about two inches in diameter and three feet long, pointed at one end, and with the other end squared off. It is used as a jackstaff when laying by compass.

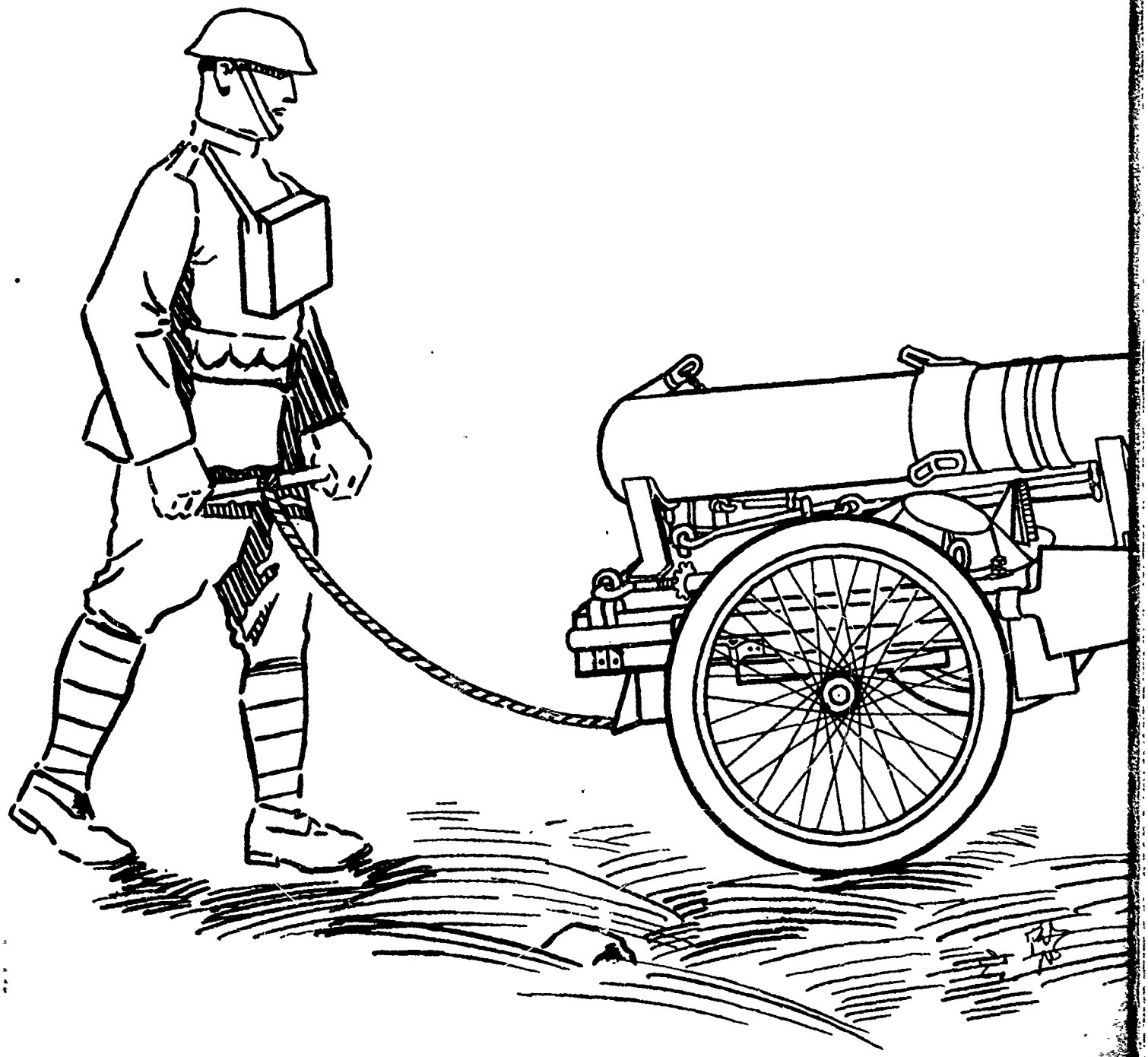
The aiming stake is any stake about four feet long and one inch in diameter. It, with the compass stake, is used to indicate the line of fire when laying with the compass. It may be pointed white to be more easily seen at night.

The pick and shovel should be carried with the mortar at all times for preparing the ground when necessary.

The flashlights should be shaded and give only sufficient glow for reading the clinometer and compass.

WEIGHTS

	Kilograms	Pounds
Barrel	73	160
Modified bed, Model 1918	175	385
Hand cart	57	114
Gas ejector	4	9
Ammunition chest, empty	51	102
Gun cart with complete equipment	312	688
Caisson with eight rounds	307	675



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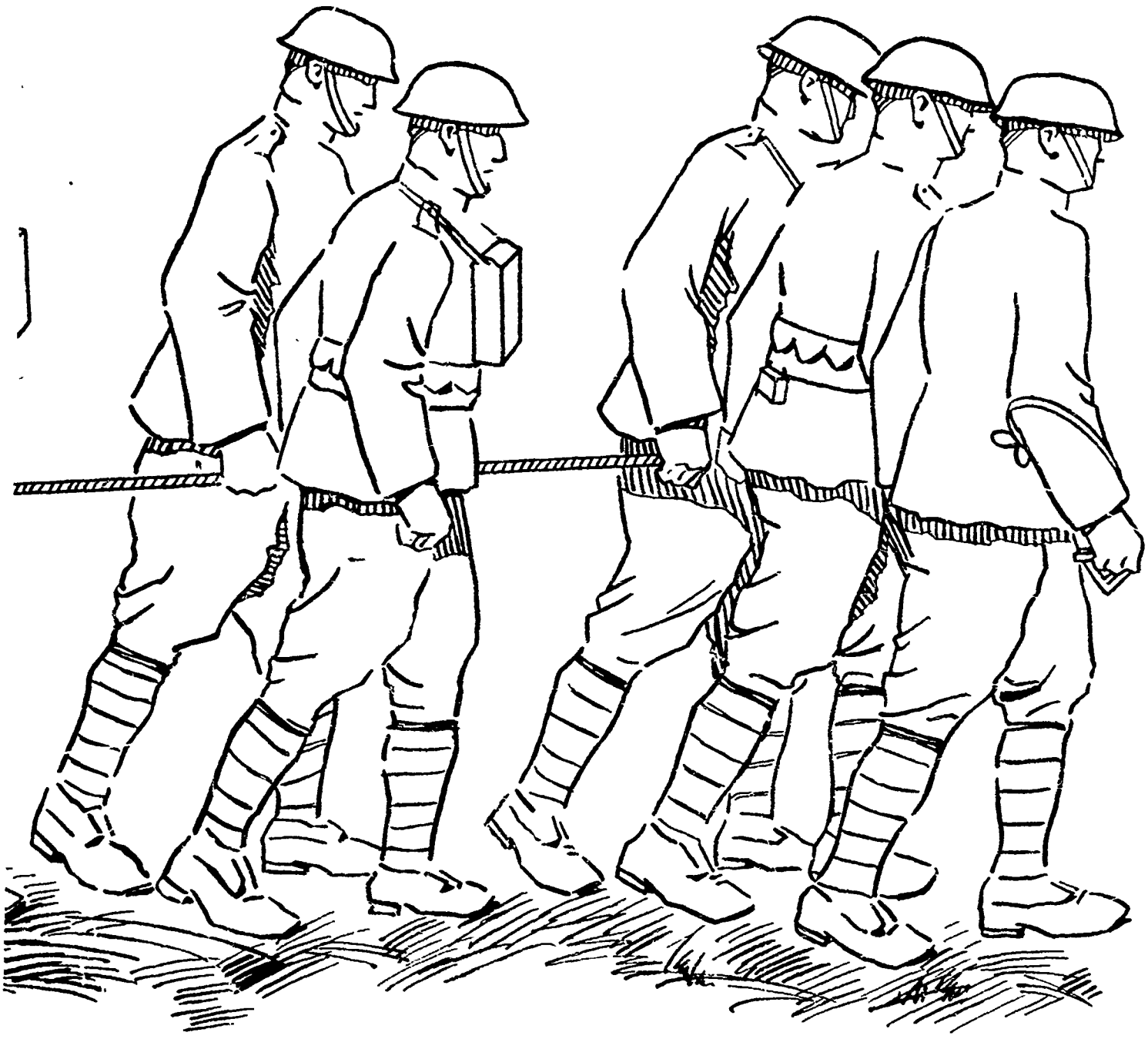
NEWTON—MOBILE WARFARE—1918



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Printed at Base Printing Plant 29th. Engineers, U.S. Army 1918.

THE FUTURE OF TRENCH ARTILLERY

PART 1

LIGHT MOBILE TRENCH ARTILLERY.

A consideration of the following questions:

1 - What is "Trench Artillery"?

2 - What is a trench mortar?

3 - Why did the armies use trench artillery?

4 - Why is trench artillery necessary in open mobile warfare?

5 - What is a mobile trench mortar?

6 - Which is the most efficient weapon for use against personnel?

7 - Why is trench artillery a necessity in any army?

8 - What is the present state of development of trench artillery?

9 - What are the possibilities for the future development of trench artillery.

10 - What is the most desirable range for light trench artillery?

11 - What is the weight limit for light trench artillery?

12 - What is the most desirable bomb for light trench artillery?

13 - What features should be included in the light mobile trench mortar of the immediate future?

14 - What is necessary to the development of this new arm?

15 - What can be done towards the coordination of materiel design for several branches of the service?

Trench Artillery is that arm of themilitary service which mans trench mortars of greater caliber than those which are served by the infantry personnel.

A Trench Mortar is a gun which was primarily designed to throw a bomb containing a high percentage of explosive, from one trench into another trench or similar cover. As originally made, these mortars were of great weight, required considerable time to install for firing and were useful only in trench warfare. Recently their construction has been modified so that they retain all of their old advantages and at the same time have become the most mobile of all artillery. So the term "Trench Mortar" now describes the origin of the weapon rather than its present use.

Trench Artillery came into being as a necessity of trench warfare. Heavy Artillery was required to harass the enemy, and to destroy his dugouts and wire. But Heavy Artillery, on account of its great weight and bulk, had to do this from a considerable distance behind the front lines. As the front line trenches approached one another closer and closer, it became increasingly difficult for the artillery to fire upon the enemy's front line works without endangering their own. The firing battery was a long distance from its target, ~~xxxx~~ which increased the dispersion of the shots. The targets and the results of the fire were seen by but few members of the battery. There arose an increasing need for a gun which could be taken into the trenches and close up to the target, so that its dispersion would be reduced to a minimum; and so that the gunners would be so close to their objective that each would take a personal interest in its destruction, a thing which is impossible when they do not even know upon what they are firing. A gun was desired which could actually drop bombs within the enemy's trenches and on top of his shelters. The first trench mortars came to supply this need, not without much prejudice against **them.** By engaging all targets within their range they released a large amount of other artillery for the more distant targets and thus doubly contributed towards artillery superiority at a time when the facilities for the manufacture of field and heavy artillery were already taxed to their utmost. Their efficiency was such that at times they appeared in the active sectors at the rate of one trench mortar per ten meters of front.

In July, 1918, when the Allies commenced their advance north of Chateau-Thierry, the enemy lines became thinly held and indefinite in outline. Roads were destroyed so that it was only with the greatest difficulty that the tractor or horse-drawn artillery could advance. The enemy machine guns were concealed in all available cover. They were difficult to locate and were discovered only as the infantry advanced. When discovered, artillery was required instantly tosilence them, otherwise the advance was held up or made only at a great cost. A gun was required which could, under the difficult conditions existing, advance close enough to the infantry to keep constant liaison with it,

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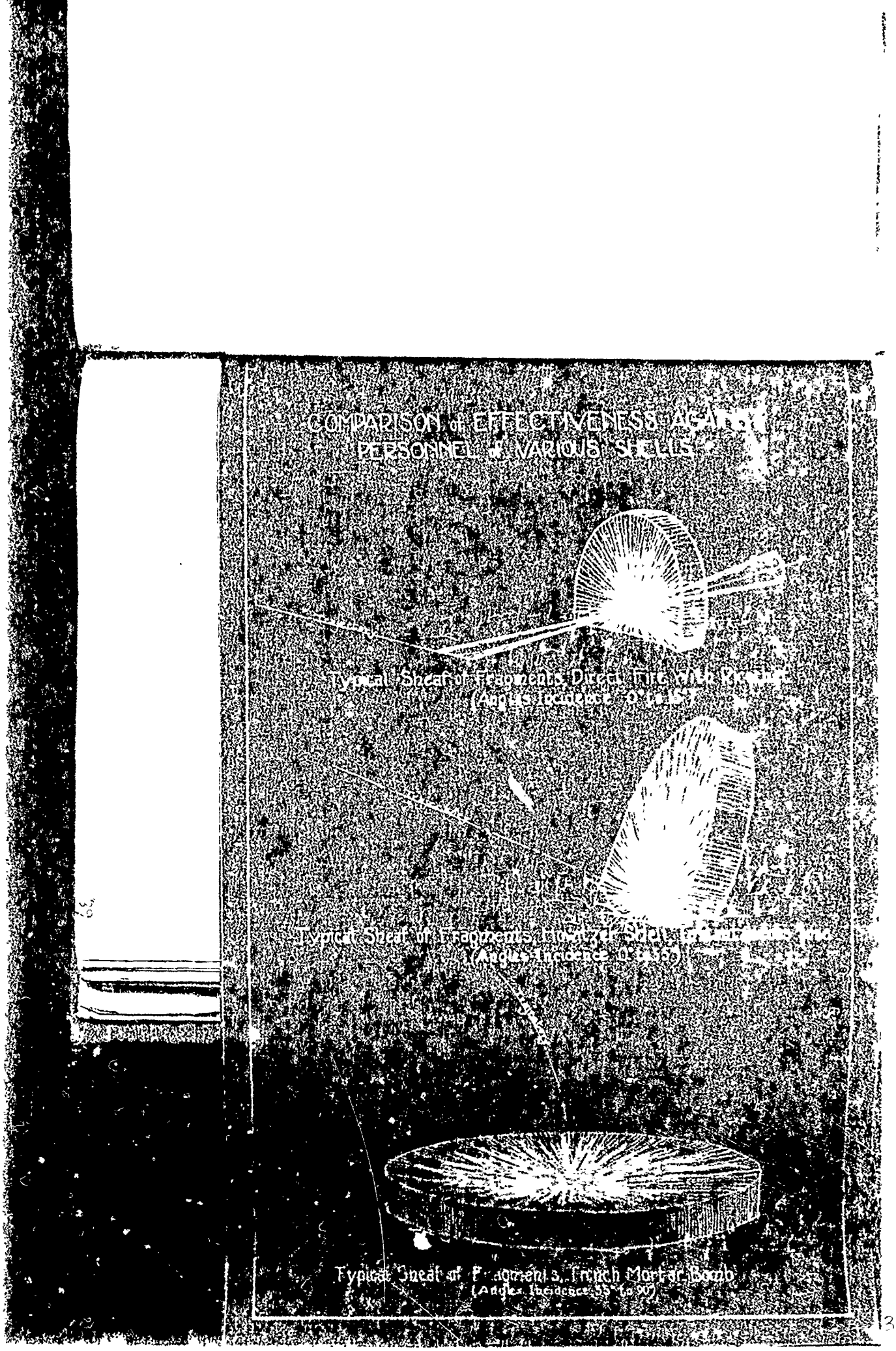

COMPARISON of EFFECTIVENESS AGA
PERSONNEL of VARIOUS SHELLS
Typical Spread of Fragments, Direct Fire
(Angle of Incidence 0° to 5°)
Typical Spread of Fragments, Direct Fire
(Angle of Incidence 0° to 5°)
Typical Spread of Fragments, French Mortar Bomb
(Angle of Incidence 35° to 90°)

and which was powerful enough to silence their indefinitely located strong points. No such gun then existed. The nature of the work called for a weapon similar to the trench mortar, but all trench mortars then available had been constructed solely for trench warfare and were not suited for rapid transportation. Steps were immediately taken to adopt the trench artillery for this work and the result was the 6-inch Newton mobile trench mortar.

A mobile trench mortar is a gun which has all the characteristics and advantages of the trench mortar and in addition is mobile. The 6-inch Newton mobile trench mortar (Plate I) retains all the power that it had as a trench weapon and yet it is more mobile than a machine gun. A comparison of this gun with various others is given in Tables I and II. Its mobility and efficiency is shown by the fact that to deliver 1,000 pounds of metal to the enemy's lines will require only five minutes (one gun) and the gross weight to be transported to accomplish this is only 37 percent of the next-most mobile gun - the 75 m/m field gun. Its high angle fire gives the bomb a more efficient sheaf of fragments than is attainable with any but mortars. (Plate II).

The mobile trench mortar is a necessity because it can accomplish what no other weapon can. Its mobility enables it to keep a closer liaison with infantry than any other artillery. Its short range insures its employment well forward with the infantry. Its power against personnel, within its range, is 95 percent of the 6-inch howitzer, as the cone of fragments of the howitzer is such that about 45 percent of the metal goes directly into the ground. (See Plate II). Its weight is 10 percent of the 6-inch howitzer. Its cost to fire is about 5 percent of the 6-inch howitzer. The metal of its bomb is more efficiently distributed than that of a howitzer shell.

The trench mortar now actually possesses great advantages over any gun at present in existence. The tables show conclusively that trench artillery should be used whenever it is practicable to do so and that other artillery should not be used when the mission can be accomplished by trench artillery. The trench mortar is capable of greater development than any other gun. It is the purpose of this paper to determine what its future possibilities are and along what lines the development should take place in order to make a gun of the greatest usefulness in our Army.

The trench mortar is now a smooth bore gun using vaned projectiles. This at once gives it the advantage of simplicity of manufacture, both to the gun and its ammunition. No power is lost indeforming a rotating band or giving rotation to the bomb. The possibilities of vaned projectiles have not been deeply studied, but present indications are that they can be made to give great accuracy in addition to their other advantages.

The trench mortar, using high angle fire, can in most cases do without a recoil system.

The principle of propelling the bomb by utilizing the velocity of the powder gases instead of their pressure, originated with the smooth bore gun using vaned projectiles, and it gives greatest promise in a gun of this style. This advance developing out of trench artillery promises to place the new artillery in the same relation to the old that the steam turbine holds ~~to~~ with the reciprocating engine.

The future development of light mobile trench artillery may be considered under the following headings:

1 - The range of the gun.
2 - The weight of the gun.
3 - The type of bomb.
4 - Features contributing to certainty of action and convenience of service.
5 - The best organization of trench artillery for its development and tactical use.
6 - The coordination of trench artillery materiel and that of other branches of the service.

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

As the direct fire gun is the proper weapon for flat open country, so is the trench morter the weapon for rugged and wooded country. The original definition of the trench mortar might be changed so as to say that a trench mortar is a gun designed to throw a bomb containing a large explosive charge from a position with high angle defilade against a target similarly defiladed. The tactics of an army are determined by the terrain in which it is operating, and so is the range of the weapons employed. A flat open country is adaptable for the quick movements of large bodies to troops. The ground gives little aid for resistance. A mountainous country gives the greatest aid to resistance, but does not permit large troop movements and therefore is not the place where decisive battles are fought. The most stubborn resistance of the enemy is to be overcome in country of moderate roughness. Tactical necessity demands that the fighting take place from ridge to ridge, so that the main strength of the armies will be behind opposing ridges. A gun, which is to use indirect fire, must have as a minimum range that which will enable it to take cover behind one ridge and to fire upon targets over the next ridge. The minimum range will therefore be determined by the terrain of theater of operations. In most countries of moderate rugosity the distance between ridges averages one mile to a mile and a half. Thirty-five hundred yards may therefore be taken as the minimum range the mobile mortar must have in order to take part in the greatest number of actions.

For trench artillery to be of the greatest use in support of infantry it must be capable of going practically anywhere that infantry can go and at the same speed as the infantry. To accomplish this the weight will be limited by the following fundamentals:

1 - The maximum weight the average man can conveniently lift is 100 pounds.

2 - The maximum weight a man can conveniently carry over rough country is 75 pounds.

3 - The maximum weight a man can haul on a pneumatic-tired ball-bearing cart, over rough country, is about 130 pounds. (Based on [illegible] at Trench Artillery Center).

4 - The maximum number of men that can conveniently carry any one piece on a steep slope is four.

5 - The most convenient unit of men is eight.

It is presumed that the guns and ammunition will be carried as far forward as possible by motor trucks or horses, and that these means of transportation become impracticable the mortars and ammunition will be placed on hand carts hauled by the men. When the country becomes too rough for hand carts, the mortars and carts will be carried over these very difficult places. The weight thus becomes limited to about 600 pounds for the gun and 200 pounds for the cart or means of transportation. The weight of any one piece must not exceed 300 pounds and the bulkiest piece must be of such shape that it can be easily carried by four handles. There are very few places that the hand carts cannot be taken and the total weight might be made as high as 1,000 pounds. This weight could be carried by eight men making the first trip and four men returning for the remainder, or the gun squad might be temporarily increased in very difficult terrain. The large gun squad, however, becomes increasingly difficult to control, especially at night, and as the weight increases casualties become an increasing factor. It would be best to limit the weight to 800 pounds.

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

The power which the gun must have will depend upon the class of targets against which it is to be used. These targets in open warfare may consist of:

1 - Concealed machine gunners, trench artillery and automatic riflemen without shelter.

2 - Machine gunners and trench artillery in shell holes or light shelter.

3 - Machine gunners in concrete shelters.

For use against troops in the open the cast iron or cast iron shell overlaid with steel, used at high angles with instantaneous fuse, will be most useful.

With targets of the second or third class, an actual destruction of the shelter would in most cases require too long a time. The guns, therefore, should be supplied with smoke, incendiary and gas shells, which, in addition to the high explosive instantaneous shells, would be used to neutralize the machine guns while the infantry closed upon them.

As it is impracticable accurately to locate machine guns in woods and rough country, the mortars would be used to render a certain area untenable rather than to demolish a small target. A certain amount of dispersion of the shots would therefore be no disadvantage. The power of the battery must be such that all of a given area can be swept with fragments or placed in a smoke cloud before our mortars can be discovered and silenced by the enemy artillery. With the battery operating without the support of other artillery, this would limit the time of firing from one position to between five and ten minutes.

The conditions under which bombs explode vary to such an extent that it is difficult to make definite statements concerning them. Assume a bomb which has an effective radius of 100 feet from the point of burst. With such a bomb a minimum of 60 bombs would be required to cover a strip of ground one mile long and 200 feet wide, or 900 for one square mile of area.

Machine guns, to be effective, must be placed within 100 feet of the edge of a piece of thick woods. With such a bomb from 200 to 300 would be the minimum required to reduce a wooded strong point having three sides of a mile each. One hundred bombs can be fired by a battery of six guns in less than four minutes, so with such a bomb, the place could be prepared for the advance of the infantry with certainty in from five to ten minutes.

What should be the construction of a bomb to have an effective radius of 100 feet? To be effective a fragment should weigh at least .66 oz. (.024 lb.) and should have a velocity of 580 foot seconds. Assuming the average target presented by a man to have a width of eight inches, a circumference with a radius of 100 feet would contain 474 such targets. Four hundred and seventy-four fragments of .024 lb. would require a minimum of 11.376 pounds of metal to be contained in the walls of the bomb. Enough explosive would be required to give these fragments the necessary velocity, and the material and construction of the bomb should be such as to insure uniform fragments of the proper size.

It would seem from this, that to increase the range of the 6-inch Newton mortar, the weight of the bomb can be reduced considerably below 50 pounds and still leave sufficient power for it to be very effective against personnel.

The above data shows that the present mobile Newton gun has about one-half the range desired, that it can be increased in weight about 100 pounds without impairing its mobility, and that it has an ample margin of power.

The desired increase in range may be effected within the limits set forth by resorting to one or more of the following expedients:

1 - By wire winding the barrel so that it will stand greater pressures.

2 - By improving the ballistic coefficient of the bomb.

3 - By using a more progressive powder or by using the powder more efficiently.

4 - By reducing the weight of the bomb.

Certain other features of the gun, which should be improved, are:

1 - The powder charge and the bomb should be assembled as a complete unit.

2 - The fuse should come assembled ready to screw into the bomb.

3 - The ammunition should be weatherproof under all conditions.

The gun cannot be considered apart from the personnel that serves it. It is the gun and the personnel that make the artillery. If the potential possibilities for the future of trench artillery are to be realized, active work must be started at once and must be kept up until the efficiency of the gun has reached its limit. A place should be set apart for carrying on this work and for experimenting. A suitable personnel should be detailed to carry on the development with continuity; otherwise a valuable arm may be much delayed in entering our service. Such an arm is bound to appear as all the trend of tactics and ordnance engineering clearly point to it. It is a question as to whether our Army shall be among the first to have it or whether we shall wait and adopt it from some other Army.

The logical place for such development to go on is at a Center devoted to trench artillery. Such a Center would be the gathering place of all ideas and action in trench artillery and it should have the facilities for experimental work of all kinds. It should have a range suitable for the solving of a great variety of tactical problems with actual firing. It should be garrisoned with sufficient trench artillery troops and troops of other arms so that employment of trench artillery in conjunction with other arms can be practiced. Such a Center should be located where there are good transportation facilities, and near the engineering centers of the United States so that in its development there can be cooperation with the manufacturers, who will turn out the material on rush orders when it becomes needed.

In order that the spirit of progressiveness in trench artillery may be kept alive and that the work of the different units may be standardized and coordinated, it is essential that there be a head to all trench artillery activities and such should take form in a Chief of Trench Artillery.

Trench artillery is a special branch of the service. It is neither infantry, field artillery, nor heavy artillery. It does not trespass on the domain of any of these arms. It will in the future be the chief assistant to the attacking infantry, leaving the field and heavy artillery fire for counter battery work, for neutralizing fire and for the harassing of reserves. It is so distinct from any other arm of the service that it should be recognized and trained as a special arm. The work which it has ahead in the way of development will require the full time of especially qualified officers. The work which trench artillery will have to do in fighting calls for the highest type of training in the soldier who must be both an infantryman and an artilleryman.

The necessity for the organization of regiments of trench artillery to obtain the most effective use of the arm has become evident to all who have studied the subject and it need not be taken up here.

In connection with this subject it might be stated that the light trench artillery is the logical arm to use for gas projector attacks.

The idea of using hand carts as a means of transportation for other materiel than trench artillery is one worthy of consideration. A standard cart can be designed which would be equally suitable for being drawn by hand, motor, or horses. It could be equally well adapted for carrying small arms ammunition, machine guns, anti-tank guns and their ammunition, field artillery ammunition, rations, telephone equipment or a litter with patient. The carts can be of such a design that eight men can draw one with its load across country, and so that several can be connected for draft by horses or by a small tractor. A light tractor capable of going across country could draw a number of the carts anywhere at speeds up to twenty miles an hour.

RECOMMENDATION NO. III

CALIBER:

3. That pending further development the mobile 240 m/m mortar, as developed at the Trench Artillery Center, be used by the medium Trench Artillery, and that a recoil mortar of about this caliber be designed and adopted.

. . . . . .

The qualities which should be embodied in a weapon for medium Trench Artillery are:-

1 - It should be mobile enough to come to the support of infantry under favorable conditions of terrain.

2 - It should be equally useful in either stationary or mobile warfare.

3 - It should have a minimum range of 3,500 yards and as much over this as is consistent with its other qualities.

4 - It should be capable of being disassembled into parts, none of which are too bulky or large to be carried by four men.

5 - It must have the greatest simplicity consistent with its other qualities. Small loose parts must be eliminated.

6 - It must have rapidity of fire and be convenient to serve.

7 - It must be capable of being transported in the firing position, and where conditions do not permit this it must be capable of being fired as soon as assembled at its position without any preparation of the ground.

8 - It must have sufficient power to justify the effort expended in obtaining the above qualities.

The 240 m/m trench mortar is available in sufficient quantity to arm immediately the medium Trench Artillery of our army. It possesses, of the qualities mentioned above, Nos. 2, 4, 5, 6 and 8, and with the mobile platform also quality No. 7. It possesses all of these qualities in a greater degree than any similar mortar now available. Undoubtedly a bomb can be designed to give the necessary range and when mounted as recommended in paragraph 6 it will possess quality No. 1 outlined above.

. . . . . .

References:

Manual for Trench Artillery, Part IV "The 240 m/m Trench Mortar".

Table of Comparative Data on Various Trench Mortars.

Istruzione sul Servizio delle Bombarde.

German Artillery Materiel, Part II, Trench Artillery.

MOBILE 240 m/m TRENCH MORTAR, MODEL 1916.

DESCRIPTION OF MATERIEL

The Piece.

The piece is divided into three parts: The mortar proper, the carriage, and the metal bed and platform.

The Mortar Proper.

The main parts of the mortar proper are (a) the barrel, a steel tube slightly thinner at the muzzle than near the breech, with a smooth bore of 240.3 m/m (9.45 inches) and octogonal in shape at the breech end; (b) the breech, a steel plug bored out to form a chamber for the charge.

The front end of the breech is threaded externally and screwed into the breech end of the barrel. The rear end is provdded with trunnions. The breech is slotted to receive a steel breech block raised or lowered by hand in a plane perpendicular to the axis of the bore by means of a handle at the top, and held up or down by a safety latch. A hole is bored through the breech block and tapped to receive the firing mechanism.

Around the barrel, slightly below the middle, is bolted an elevating hand carrying an elevating and clamping mechanism consisting of a shaft with two pinions and two cranks, and a spindle with a hand-wheel for clamping the mortar in elevation. The transportation collars (near the breech and muzzle), with rings to receive porter bars, are bolted around the barrel. A groove is cut into the top of the barrel, midway between breech and muzzle, for the quadrant and above this is a support screwed underneath the barrel to hold the goniometer mirror. Aiming lines are cut on top of the breech and muzzle ends of the barrel.

The Carriage.

The steel carriage is designed to permit firing themortar between 45 degrees and 75 degrees elevation. At the center of the bottom plate is

a hole which fits over the pivot of the bed. To the underside of the bottom plate are rivetted two segments, forming the upper racer which rests and slides on the racer of the bed. These segments carry lugs which engage under the locking ring on the bed, thus joining the bottom plate at the rear. A steel covering plate is secured to the carriage on each side to protect the lower racers.

When in position, the mortar trunnions are held in the trunnion beds, on the side plates, by cap squares operated by levers on the outside of the beds. Stops are fitted to limit the movement of the levers. The side-plates, braced by a plate at their front ends, are each provided, front and rear, with sockets to receive socket bars. The elevating pinions engage in two racks at the top of the side plates and the clamping spindle slides in curved slots immediately below the racks.

The Metal Bed.

The steel bed, rectangular in shape, consists of a floor plate to the center of which is rivetted a pivot, the pintle center of the piece. Under the floor plate are rivetted six flanges, two overlapping the front and rear and the other four fitting between the upper sleepers of the platform. On the floor plate is a circular racer on which the carriage slides, the locking ring with which the lugs of the carriage engage, and a metal ring graduated in grades, which in conjunction with an index mark on the carriage is used for giving direction to the piece. The locking ring is cut away for mounting and dismounting the carriage, an arrow head being chiselled at the left front so that when the index on the carriage is opposite the arrow the carriage can be lowered into position. The bed is fitted with four sockets and tenangle irons, the latter for securing the bed to the upper platform.

The Metal Platform.

The rectangular steel bed, with the five timbers that fit in between the six steel flanges of the bed, is attached to the platform by a right-angled brace at the front and rear. The front brace is fourteen inches high and extends across the entire width of the platform which is four feet wide. The rear brace is the same heighth but the three reinforcing arms extend back along the platform twenty-four inches. In addition to the front and rear braces each of the five timbers are held in place by angle iron, 3" x 3", which run perpendicular to the axis of the gun.

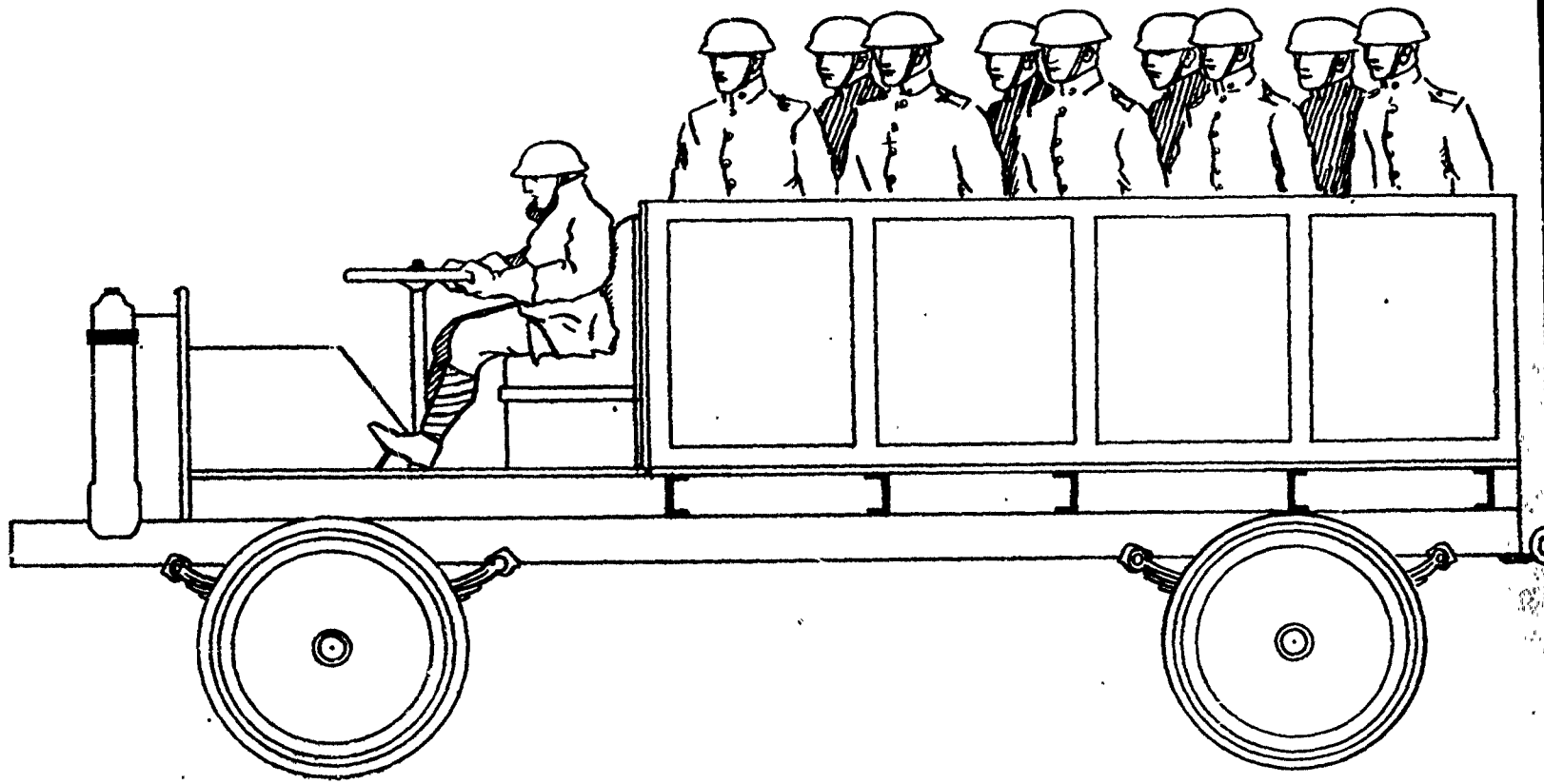
When this mortar is fired the estimated pressure on the base of the force of the explosion is one hundred and forty tons. A single sheet of metal strong enough to withstand the shock would not have the resiliency required. There are therefore two separate platforms seven inches long, by four feet one and one-half inches wide. The upper and lower platforms are separated by six channel irons running longthwise. These channels form five compartments into which are bolted five timbers. This combination of steel and wood resulting in the great rigidity of the platform, together with elasticity.

To the bottom of the lower platform four V shaped spades ten inches long are rivetted at an angle of one hundred and five degrees. The foremost spade is eight inches from the front edge of the platform and the four spades are each two feet apart.

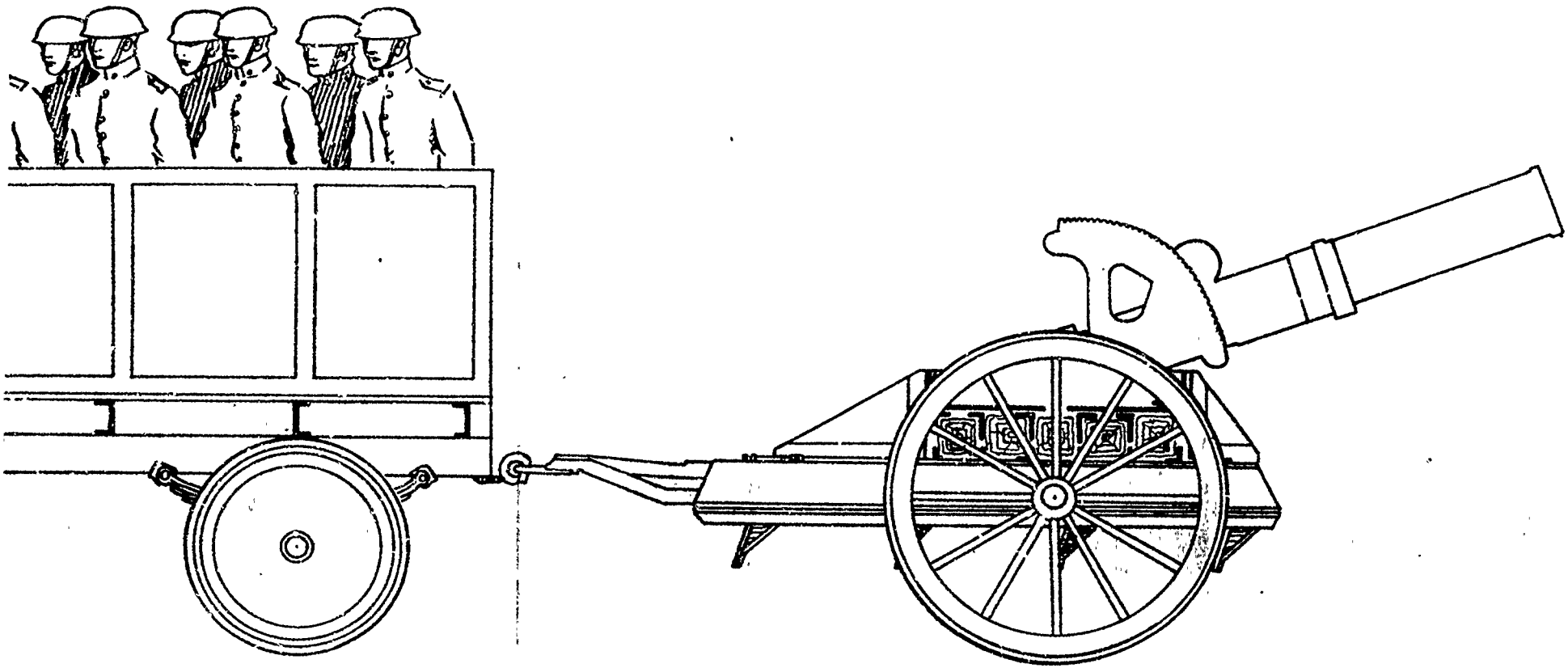
An axle is rivetted to each side of the platform for the wheels and the platform with the entire mortar can be hauled by a truck or a tractor.

The platform is put in the firing position by simply lifting the rear end until the front edge rests on the ground and the wheels are then slipped off and platform allowed to rest on the ground.

The force of the first sh t is sufficient to drive the spade into the ground. The entire weight of the mortar and platform is 4,939 pounds. Ten men can handle both the platform and the ammunition.



Mobile 240mm Trench Mortar Model 1918.



9mm. Trench Mortar Model 1918.

RECOMMENDATION NO. IV.

MOUNTS:

4. That pending further development a one-piece bed with spades, as developed at the Trench Artillery Center, be the mount used by light Trench Artillery.

. . . . . .

A mount for light Trench Artillery should have the following qualifications:

1 - It must be light in weight.

2 - It must be capable of easy transportation or carrying by ten men.

3 - It must enable the mortar to be changed from the travelling to the firing position in a minimum of time.

4 - It should be as simple as is consistent with the other necessary qualities.

5 - It should require a minimum preparation of the ground for firing.

The mounts for light Trench Artillery, which are now available and which have these characteristics in the greatest degree, are:

The Mobile 6-inch Newton Trench Mortar, Model 1918.
The 150 m/m Fabry Trench Mortar.
The 76 m/m and the 16 c/m Minenwerfer.

The last three named have recoil systems; the Newton has not. There is at present no mount for a trench mortar enabling the mortars to be fired directly from a wheeled carriage, and were such a mount provided it is possible that it would have a weight inconsistent with great mobility. Whether the mount has a recoil system or not, it is

necessary that either spades be provided or else that the bearing surface be dug into the ground, to hold it in place during firing. The present bed for the mobile 6-inch Newton mortar weighs 381 pounds and is one piece without any loose parts. It has proven satisfactory during all experimental shooting with it. The mortar can be removed from the hand cart, assembled and laid in about three minutes, which is about as quickly as any piece can be laid unless it fires directly from the wheels. The present bed was designed to be made from such material as could be easily obtained during the war, and experiments indicate that a yet lighter and more efficient bed can be made.

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RECOMMENDATION NO. V.

MOUNTS:

5. That a recoil caterpillar mount be developed for medium trench Artillery and that pending the availability of this mount the one-piece direct-thrust mount, developed at the Trench Artillery Center, be used by medium Trench Artillery.

. . . . . .

The mount for medium Trench Artillery should embody the following features:

1 - It should enable the mortar to be transported in the firing position on all terrain passable for wheeled or caterpillar vehicles, and when so carried should enable the mortar to fire while in the transport position.

2 - It should be capable of being disassembled so that no part is too heavy or bulky to be carried by four men, so that the mortar can be taken and set up for firing where vehicle transportation is impossible.

3 - It should have no small or loose parts.

4 - It should be capable of being assembled and disassembled with a minimum equipment of tools.

5 - It should enable the mortar to be fired from the ground with a minimum preparation of the ground.

6 - It should permit a maximum horizontal field of fire.

7 - It must permit easy and rapid service of the piece.

Such a mount will make the medium caliber mortar equally useful in mobile or stationary warfare. With the development of range it will enable the mortar, wherever the terrain is suitable, to keep close enough to moving infantry to support it either in an advance or rear guard action. It will enable the mortar to be set up for firing independently of its method of transportation, when used in stationary warfare.

How can such a mount be attained? The medium caliber trench mortar has a barrel which, for its power, is extremely light. This barrel can be mounted in a sleeve and provided with cylinders to give a long recoil, and the whole fired on a structure which can either be placed on the ground for firing or which can be transported on and fired from a universal caterpillar chassis as described in paragraph 11.

It will take some time to develop a satisfactory mount as described. In the meantime the 240 mortar can be mounted on a direct-thrust trailer mount as developed at the Trench Artillery Center. This mount should be constructed with trailer wheels capable of carrying the load at the maximum speed of a truck. Caterpillar treads can be provided as for the 155 G.P.F., which will enable the mortar to be hauled across country by caterpillar, horse or man draft. The under part of the platform can be assembled with bolts (instead of rivets as in experimental model) so as to permit dismassembling for carrying through trenches. Such a mount will make the mortar semi-mobile so that upon favorable ground it can be fired in about three minutes after arrival (assembled) and can be removed in about one-half hour.

Where the ground is rocky, from two to four hours would be required to prepare a bed for this platform.

It will be at once recognized that this mortar, with either the one-piece direct-thrust mount recommended for the present or the caterpillar mount recommended for the future, will be most efficient as a roving gun.

. . . . . .

Reference:

Manual for Trench Artillery, Part IV, 240 m/m Trench Mortar.

Description of the Mobile 240 m/m Trench Mortar.

RECOMMENDATION NO. VI.

MOUNTS:

6. That the mounts for medium weapons have traversing mechanism. This question for light weapons should be further studied.

. . . . . .

Without a traversing mechanism the mortar must be reemplaced for each target. It is essential that the horizontal field of fire be sufficient to allow for the adjustment of the gun on one target. Such an amount of traverse does not generally allow for a transfer of fire to another target at a great angle from the first. This lack of flexibility of fire reduces the usefulness of the gun on the offensive and renders it practically useless on the defensive, as it can be rushed from the flanks before it can be relaid.

The deflection scale of the 240 mortar is graduated for all-round fire and the deflection scale of the 6-inch mortar is graduated to 45 degrees each side of the axis of the platform. However, with the platform constructed as at present, very few shots can be fired at angles greater than 15 degrees from the axis of the platform. This is due to the construction of the platform and can be remedied.

While the question of traverse is important in the medium mortar, which is too heavy to be readily lifted and reemplaced, it is not so important in the light mortar which can be easily handled. The feature would, however, be a very desirable one in the light mortar and should be introduced if it is possible to do it without sacrificing more important features.

RECOMMENDATION NO. VII.

METHODS OF TRANSPORT:

7. That light weapons be transported on a universal hand cart appropriate also for carrying bombs, grenades, machine guns and their ammunition, 37 m/m guns and their ammunition, small arms ammunition, a litter with patient, rations, water tanks, field telephone switchboards and equipment, and indeed everything for which a light hand cart is needed.

. . . . . .

There is in use in the army a great variety of carts, each designed for a certain limited purpose on the spur of the moment when it was decided to put into service the particular material carried. Very often a particular cart is not specially suited to the use for which designed, and more often still is wholly unsuited to any other use. The cost and confusion of manufacture and supply of this great variety is bad enough in itself, but the worst feature is lack of availability at the front. A standard cart, designed after considering essentials in design for the several uses mentioned above, would result in more often having carts available at the front and the benefits, simplicity of quantity production among others, would justify such effort to get that standard cart.

RECOMMENDATION NO. VIII.

METHODS OF TRANSPORT:

8. That this universal hand cart be adaptable for draft by man power across country and for draft in tandem by animal power or by motor-cycle or truck on roads.

. . . . . .

The prime reason for having a hand cart for Trench Artillery is to enable the materiel to be taken over terrain by man power when that terrain is too difficult for motor transport and when no roads are available. They, therefore, must be equipped for man draft. Also for rapid changes of light units over more or less extended distances the carts and their loads must be linked together to make an appropriate draft load for a motor vehicle or an animal. This universality need entail little more than the addition of a draft pintle in addition to what would be required on a hand cart to be drawn by man power.

RECOMMENDATION NO. IX.

METHODS OF TRANSPORT:

9. That standard 4-wheel drive 2-wheel steer 3-ton truck with standard cargo bodies be provided for transporting personnel, materiel and ammunition of light Trench Artillery over long distances and for administrative and tactical use in the supply of ammunition during stationary warfare.

. . . . . .

A 4-wheel drive 2-wheel steer standard cargo body truck is recommended for the reason that those three features have been found desirable for Trench Artillery. A 3-ton truck, rather than one of another capacity, is recommended for the reason that it will take the personnel and materiel of a single light mortar as contemplated in this paper and will waste but a few pounds carrying capacity. Inasmuch as this cargo body is also appropriate for carrying ammunition and the ammunition body is inappropriate for a number of uses intended, a truck with ammunition body as we now know it is not desired.

R E C O M M E N D A T I O N N O . X .

METHODS OF TRANSPORT:

10. That for the immediate future trucks of Recommendation No. 9 be used to tow the mobile 240 m/m materiel mentioned in Recommendation No. 5.

. . . . . .

Actual experience has shown that the truck mentioned will handle the materiel mentioned. This materiel, i. e. one-piece 240 m/m platform, is so far superior to the old mentioned platform of the French that there is no comparison. It enables a high-power weapon to be put into action within three minutes after arriving at the position and while the need of it still exists. These facts are mentioned at this point of the discussion for the reason that the materiel and methods of transport are mutually dependent, and because pending development of other materiel existing trucks will haul the one-piece platform and also the ammunition.

RECOMMENDATION NO. XI.

METHODS OF TRANSPORT:

11. That a universal cater illar chassis with power unit capable of serving as a travelling and firing platform for the 240 m/m medium materiel mentioned in Recommendation No. 5 be designed and adopted. This chassis should be of [illegible] design [illegible] interchangeably mounted [illegible] field gun [illegible].

. . . . . .

At this time definite statement cannot be made as to what our next enemy will have in the way of mobile heavy artillery, but we can recognize the probability that he will have it. If he has it we also must have it if we hope for success. If he has none of it, then ours will give us an immense advantage, so that ours will be necessary or advantageous according to the equipment of our opponent.

What form this materiel will take is the next question. As far as the weapon itself is concerned, a heavy direct-fire long range gun can accomplish many of the missions, but always at great money cost, man power cost, time and auxiliary equipment cost. For the other missions high angle fire will be necessary anyhow except in the few cases where the fighting is on an unlimited flat plane. The fact scarcely needs substantiation here that for a definite amount of destructive power a mortar has advantages over a gun for the following reasons:

(a) Lightness of materiel.

(b) Low first cost of materiel.

(c) Low upkeep cost of materiel.

(d) Low cost of ammunition.

(e) Simplicity of manufacture of materiel, as regards time and monopolizing of mechanics and manufacturing plants.

The above are enough to make thinking gun enthusiasts consider the mortar as a field weapon, but the crux of the whole situation is that a mortar of a certain high power can be had where it is needed when it is needed, i. e. in rear and close to advancing combat infantry, while a gun of the same high power, even though it were the suitable weapon for the mission, cannot be on the spot. It therefore seems advisable to take the more appropriate weapon, which is also the more easily transported weapon, and devise means to insure its availability. The caterpillar tractor as a travelling and firing platform has been considered long and well in connection with other devices and seems to be the best solution of the problem.

The universal feature advocated making this chassis suitable also for mounting field guns, tank bodies and perhaps other things, is merely an extension of standardization in an attempt to lessen the number of types of carriers which at best, in an army having our complexity and thoroughness, will be great.

It will be recalled that the "Roving Battery" of this war was of great value, but that to get the requisite power such weapons as the 8-inch howitzer was used for this purpose and entailed much time, labor and cost. This 240 m/m recoil mortar on this caterpillar mount gives greater promise for successful economical use in roving batteries than does any other type designed or projected.

RECOMMENDATION NO. XII.

METHODS OF TRANSPORT:

12. That there be developed an appropriate trailer (possibly caterpillar) for carrying ammunition of all caliber and personnel.

. . . . . .

Foreign governments, it will be noted, make extensive use of trailers and our own government uses them only to a limited extent. In designing a trench or tractor to carry one load and to trail another equal load it is quite evident that power must be added. Aside from saving 50 percent of the chauffeurs, the principle seems good for the reason that there will be a big reserve of power for the few abnormally difficult places. Moreover, valuable motor power is not lying idle while a trailer is being loaded and unloaded. This trailer, too, may be almost universal because the many special compartment vehicles provided for this war are unnecessary refinements.

RECOMMENDATION NO. XIII.

KIND AND PROPORTION OF AMMUNITION:

13. That the present charges and fuses be continued in service pending the development of better charges and fuses.

. . . . . .

The present ammunition is the result of considerable study and development, but is yet imperfect in many particulars. The alterations and modifications hereafter proposed are generally of minor importance and with a view to mechanically perfecting a good but unfinished material.

R E C O M M E N D A T I O N N O . X I V .

KIND AND PROPORTION OF AMMUNITION:

14. That there be designed and adopted a fuse which is essentially delay, but which may be easily converted into an instantaneous fuse by the removal or alteration of an external delay element. This fuse may well be universal for all calibers of Trench Artillery.

. . . . . .

The present fuse for the 6-inch Newton is an example, but requires too much assembling for satisfactory service outside of ~~s~~stabilized trench fighting. A combination of this idea of delay and instantaneous elements changeable in a fuse with the more perfect mechanism of the French P.R. fuse as used in the 240 trench mortar can be developed. Considering the labor and expense involved in fuses it is deemed advisable to design and adopt one fuse now which can be made universal in our Trench Artillery service.

It will be noted that the Germans used time fuses in nearly all of their bombs, and to great advantage. This involves refinement and expense to which our Allies did not look with favor - but was this sound? The problem is far less complex for Trench Artillery than for the long range high maximum ordinate trajectory of the seacoast mortar. Such a fuse will be particularly useful where the trenches are only temporary and the fire action fleeting, as in war of movement, and it is thought advisable to look more carefully into the question of providing a time fuse.

R E C O M M E N D A T I O N N O . X V .

KINDS AND PROPORTION OF AMMUNITION:

15. That for all calibers the charge be weatherproof.

. . . . . .

This requirement was not important when the fighting was all in well-built trenches. It is a fundamental requirement now. The brass case of the 240 m/m mortar is satisfactory. The charge for the 6-inch Newton can be made weatherproof by providing a container around the tail, this container to be torn off by the gunner while loading the piece. Also, we have in mind the Brandt bomb and the method now used to protect the charge from the weather, i. e. a paper composition shot-gun cartridge which is inserted in a cylindrical place for it. This cylinder is perforated and the gas pressure perforates the paper container at these points and permits the gases to escape into the gas chamber behind the bomb and to give impulse to the latter.

R E C O M M E N D A T I O N N O . X V I .

KIND AND PROPORTION OF AMMUNITION:

16. That for all calibers the charge be supplied in complete units of the heaviest charge, lower charges being obtained by the removal of increments.

. . . . . .

This arrangement is advisable as it simplifies the supply of charges in weatherproof containers. With the small powder charges used by the Trench Artillery, increments rejected are not of material size or value. The French authorities propose to reduce the number of charges for the 150 m/m Fabry from four to two. It is believed that our recommended action is superior to the proposed French simplification.

RECOMMENDATION NO. XVII.

GAS AND INCENDIARY AMMUNITION:

17. That the light weapon be the standard gas weapon and that an appropriate gas bomb be developed.

. . . . . .

The high carrying capacity of the Trench Artillery bomb, the rapid rate of fire of the new 6-inch Newton, and the increased range and ballistic properties it possesses recommends it as the standard weapon for gas. It is not proper for our country to be asked to maintain a 4-inch Stokes mortar for gas alone when a 6-inch Newton can do everything that a 4-inch Stokes can, and in addition is available for destructive fighting. Furthermore, the guns not required for gas will constitute a good reserve. The French authorities plan to use their 150 Fabry for gas. The firing of gas shells is an artillery problem. The organization of Trench Artillery will be very good for gas attacks especially since the positions are close to the front infantry units. Since there is no gas shell at all now for the 6-inch Newton, one ought to be developed along new Trench Artillery ideas with stream line bomb that would be nearly silent in flight.

RECOMMENDATION NO. XVIII.

[redacted]:

18. That incendiary and smoke bombs be developed for the light mortar.

. . . . . .

There are occasions when a secure concrete machine-gun emplacement might be difficult for any kind of artillery to destroy, partly because of its strength and partly because its exact location may not be accurately known to us. Moreover, even small depressions a relatively short distance from the point of impact of large caliber H. E. shell give a remarkably large amount of protection. In such cases as these we can save much life, ammunition and time if we blind a weak enemy by smoke and proceed to the assault, or if we force a strong [redacted] by the use of incendiary bombs. There are few classes of shelters which the latter will fail to make untenable.

In this, as in other cases where the opposing lines are close together and where we cannot afford to endanger our own forces by the dispersion of long range fire, the mortar, already there, is the appropriate weapon and it is for this reason that it is suggested as the standard incendiary and smoke, as well as gas, weapon.

RECOMMENDATION NO. 414.

[illegible]:

1s. That for light [illegible] artillery ammunition be manufactured in the following percentages:

H. E.	80%
Gas	10%
Smoke	5%
Incendiary	5%

. . . . . .

This is a schedule for manufacturing. In any particular action only one kind of ammunition, or possibly two, would be likely to be required. Knowing the plans, only that ammunition would be drawn that was called for. If a gas attack were planned, mostly gas shells would be provided; if neutralizing fire were called for, mostly smoke with some gas; or if the target were personnel in holes, probably incendiary and gas would be combined. The proportion recommended is for a manufacturing schedule until further study shows that a different proportion is desirable.

[redacted]

[redacted]:

30. That for the present only, H. E. bombs be supplied for medium French Artillery and that a gas bomb for this caliber be studied.

. . . . . .

The rate of fire is necessarily slow and, although local concentration could be obtained, the medium weapons are not recommended for other than H. E. destructive work. It is to be borne in mind that the medium bomb with its high carrying capacity may be of considerable value with certain gases, mustard gas in particular, in obtaining local concentrations and that at times it is advantageous to mix gas and H. E. bombs, but this should be further studied before the adoption of a definite manufacturing program.

RECOMMENDATION NO. XXI.

[illegible] PROBLEM OF [illegible]:

21. That pending further development present types of bombs be continued in service.

. . . . . .

The present bombs are the result of experience and are reasonably satisfactory except that improvements should continue. These improvements for the 6-inch Newton are:-

(a) Nose to be pointed instead of flat.

(b) Length of bomb to be better proportioned to the caliber.

(c) Base of bomb to taper in accordance with air resistance.

(d) Metal of tail to be better distributed.

(e) Weight to be reduced.

These improvements for the 240 m/m are:-

(a) Shape to be improved.

(b) Weight to be reduced.

(c) Shell to be stronger.

The Brandt (stream line) bomb presents many needed improvements. A 60 m/m Brandt bomb is shown in an accompanying picture of the experimental French 60 m/m mortar.

RECOMMENDATION NO. XVII.

[illegible]:

28. That the study of rotated bombs (now in its infancy) be exhaustively pursued.

. . . . . .

When elongated projectiles were adopted it became necessary to prevent tumbling. This could be done either by inserting rifling or by a tail. Stream line bombs with low velocity carry very well and are practically soundless. The smooth bore permits a comparatively high muzzle velocity with relatively low chamber and bore pressure. These features have never been developed and offer wonderful possibilities.

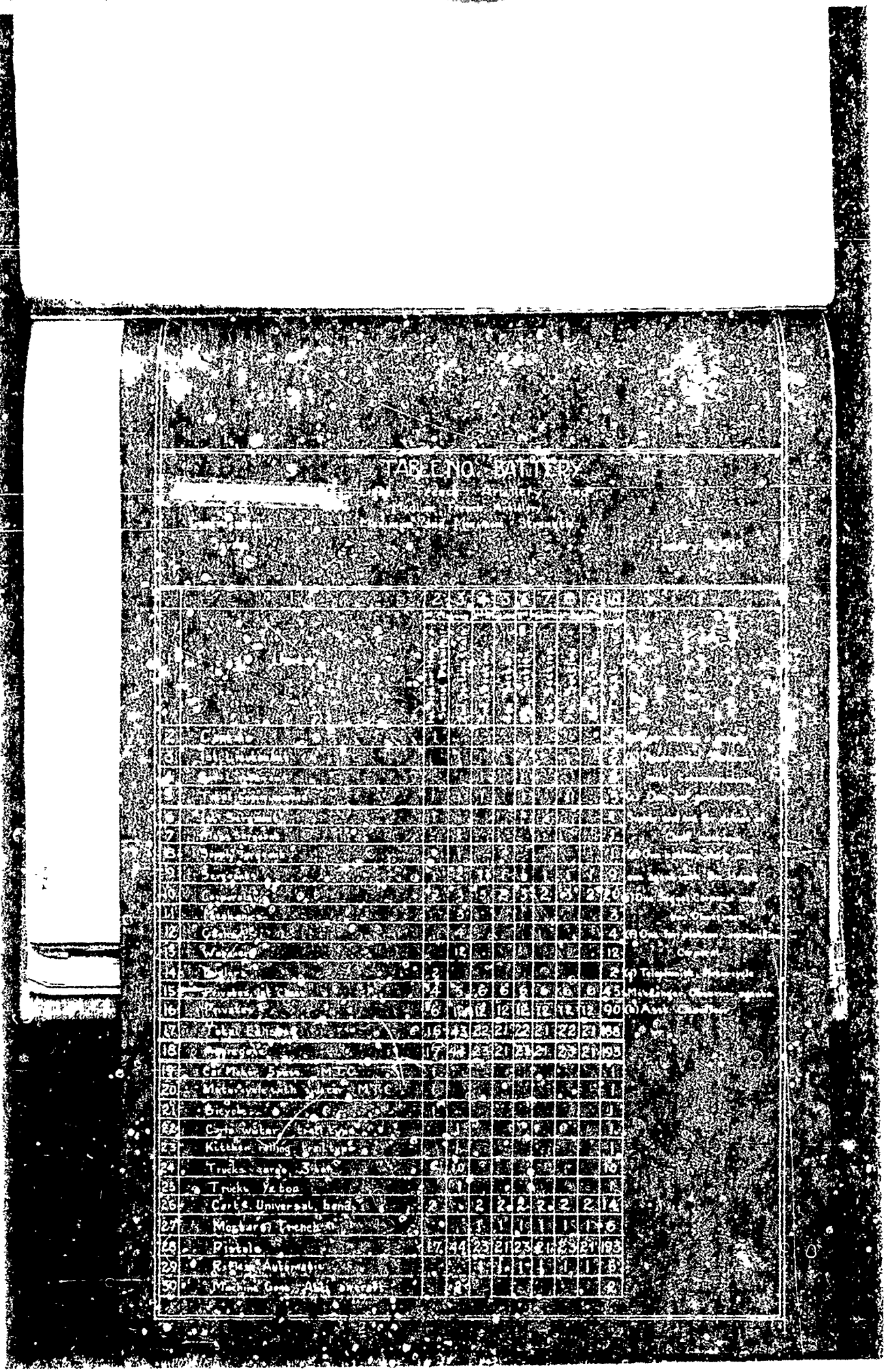
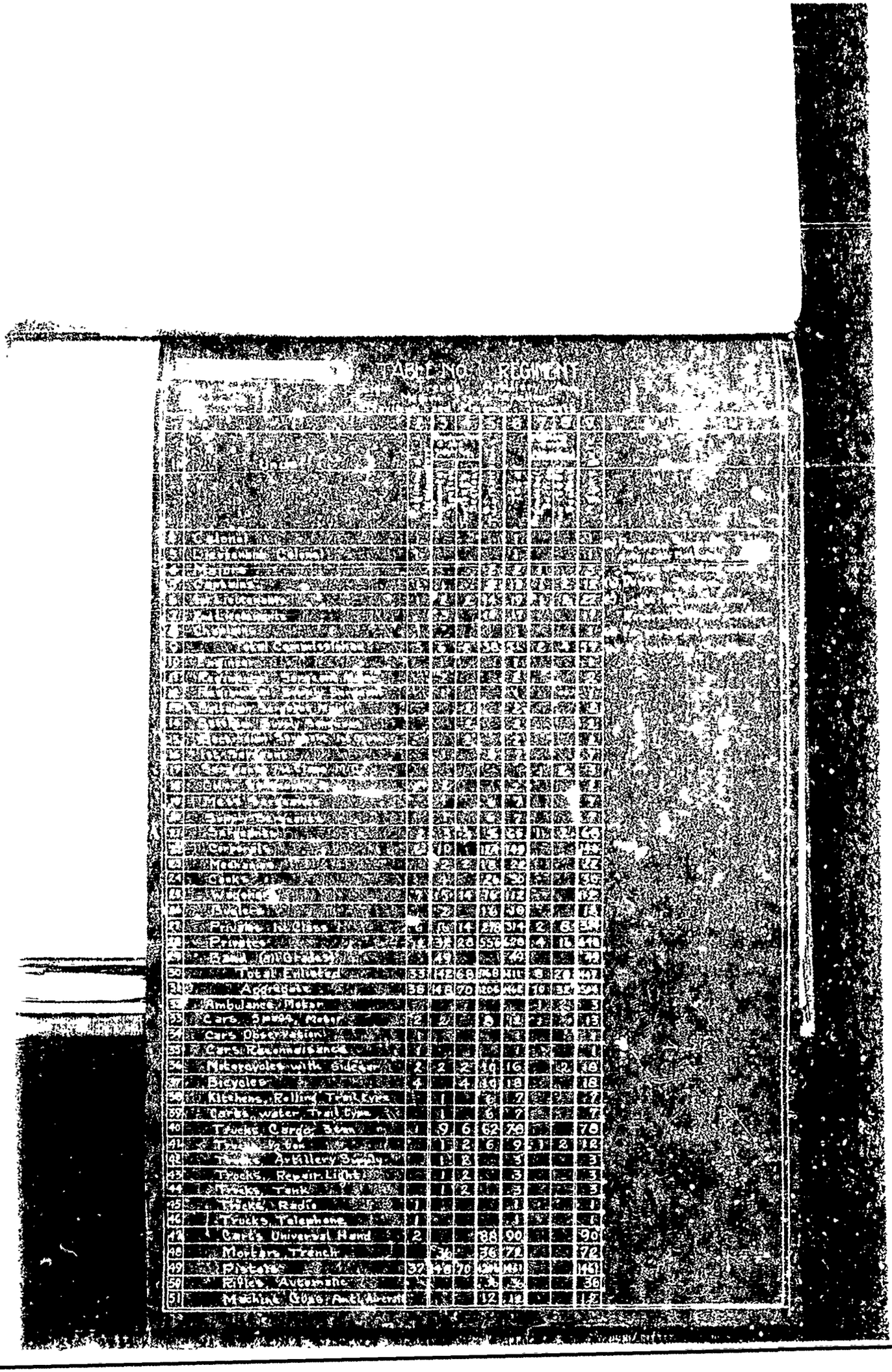


TABLE No. BATTALION

[illegible]

	Item	2	3	4	5	6	7	8	Remarks
1–20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
21	Privates	[illegible]	[illegible]	14	[illegible]	270	[illegible]	[illegible]	
22	Total Enlisted	[illegible]	[illegible]	31	[illegible]	[illegible]	[illegible]	[illegible]	
23	Aggregate	193	[illegible]	[illegible]	[illegible]	603	[illegible]	[illegible]	
24	Ambulance, Motor						1	[illegible]	
25	Cars, Motor, 5-Passenger	1	1		3	[illegible]		[illegible]	
26	Motorcycles with sidecar	1	3	1	3	5		6	
27	Bicycles	1	2	2	5	5		5	
28	Carts, water, trailer type	1			3	[illegible]		[illegible]	
29	Kitchens, rolling, trailer type	1			3	[illegible]		3	
30	Trucks, cargo, 3-ton	16		[illegible]	30	31		31	
31	Trucks, 1/2 ton	1		[illegible]	3	3	1	4	
32	Trucks, Artillery Supply O.D.			1					
33	Trucks, Repair, Light			1					
34	Trucks, tank			1					
35	Carts, Universal, Hand	44	2		42	44		44	
36	Machetes, hand	6			10	18		18	
37	Pistols	193	24	35	579	643		603	
38	Rifles, Automatic	6			18	18		18	
39	[illegible]	2			3	3		6	



Recommendation No. [illegible].

[illegible].

2d. That there be eight [illegible] regiments, each regiment to have two battalions, each battalion to have three batteries. See attached tables of organization.

. . . . . .

In the war in which we have just been engaged [illegible] not have regimental organization for French Artillery, primarily because we copied the organization used by our Allies before they had determined what is the best organization. As a result of this experience France adopted regimental organization as the only means by which the tactics and materiel of a new branch could be systematically and economically developed. Our own authorities were very slow to change, but the opinion which was almost universal among those who had seriously studied the question eventually caused General Headquarters to recommend regimental organization by cable dated November 10, 1918.

The need for a regimental organization for French Artillery is little different from what it is for other branches save that, in this early stage of development from every angle, it is slightly more imperative for French Artillery than for the older well established branches.

The proper composition of the regiment depends in great part upon the composition of a division. This is especially true of light French Artillery, which will operate in close support of infantry. The division of the future will probably have infantry as follows:

Division (1 Brigade (1 Regiment (1 Battalion
(1 Battalion
(1 Battalion
(1 Regiment - Same
(1 Brigade - Same
(Other Troops.

The figures "2" and "3" recur and to give the greatest flexibility to a regiment of Trench Artillery these numbers should appear. The regiment recommended has two battalions of three combat batteries each, and the reasons are apparent. For instance, assume the entire division engaged on a light enterprise where one regiment of Trench Artillery will suffice for support. If the tactical situation demands, a battalion can be temporarily attached to a brigade or even to a particular regiment of that brigade. On the other hand, assume the entire division engaged in a more difficult enterprise requiring two regiments of supporting Trench Artillery. In this case a regiment could be attached to support each infantry brigade and if further particularization seemed necessary a battalion could be attached to each regiment. Still further, a battery could be tolled off to support each infantry battalion. Thus it is seen that the regiment proposed has the maximum of flexibility for such conditions as may occur.

Early in November a table of organization was submitted calling for a regiment of three battalions of two combat batteries each, but this was not in accordance with the views of Trench Artillery. It was submitted "By Order".

The attached tables, it is thought, present fewer bad points than any others yet submitted. The basic idea is to have the desired mobility and active regimental control save in the rare cases where the mission properly calls for less French Artillery than a regiment, and for these cases to make the battalion such in equipment and training that it can accomplish the duty assigned.

RECOMMENDATION NO. XXIV.

ORGANIZATION:

24. That during the development and instruction of personnel, and pending the development and supply of improved appropriate materiel, all Trench Artillery be Army Artillery.

. . . . . .

The desirability of having a combat division complete in itself is recognized. Further, when the light Trench Artillery is developed, armed and trained as contemplated in this paper, it will have the mobility of infantry and, when other branches learn its effectiveness and worth, will be a primary consideration in the formation of plans for every action. That indicates that eventually it may properly become an organic part of a division. But, until that point is reached, until the materiel is developed and the personnel trained, and until the infantry itself realizes the indispensability of Trench Artillery, it is far better, and even necessary, that it be Army Artillery and grouped under the control of those who have its development at heart.

RECOMMENDATION NO. XXV.

ORGANIZATION:

25. That in an army there be provided five regiments of Trench Artillery as follows:

1 Regiment of medium Trench Artillery.

4 Regiments of light Trench Artillery.

. . . . . .

This recommendation is made on a basis of an army of approximately 500,000 men in which, in order to get something tangible upon which to work, three corps of six divisions are assumed. An old organization on this basis had

3 Corps battalions of 4 batteries each. . 12 batteries

18 Divisional batteries. . . . . 18 batteries

Total for this army . . . . 30 batteries

The Trench Artillery here recommended is 5 regiments of 6 combat batteries each - 30 batteries - so that in the quantity there is no change. With the present organization, where so much of the capability was wasted, this quantity was not large enough, as is conclusively shown by the extra units which the French borrowed for action sectors. But with its designation and concentration as a part of "Army Artillery" it is expected that the increased efficiency will counteract the present lack of quantity.

A study of French and Italian armies, and also a study of such data on the Germanic armies as are available, show that from two to two and one-half percent of the total combatant forces are Trench Artillery, and it will be noted that the strength here proposed does not differ greatly from those percentages. These facts have been valuable guides in this recommendation.

RECOMMENDATION NO. XXVI.

ORGANIZATION:

26. That the Trench Artillery of Recommendation No. 25 be the peace-time Regular Army strength of Trench Artillery and that it be immediately provided to the end that proper instruction and development may proceed.

. . . . . .

The peace-time organization of the Regular Army is the primary source of trained men for the more important assignments in any expansion and to act as instructors for the personnel of Reserve organizations in training. The amount here recommended for the permanent Trench Artillery strength of the Regular Army is considered as the minimum with which it will be possible to develop this branch and to disseminate knowledge of its use.

RECOMMENDATION NO. XXVII.

ORGANIZATION:

27. That Trench Artillery as mentioned in Recommendation No. 25 be organized and trained for each army called for, or to be called for, in first or other Reserves.

. . . . . .

This recommendation scarcely needs discussion for the reason that its intent is merely to provide for each army of whatever nature the very moderate amount of Trench Artillery recommended for the Regular Army.

RECOMMENDATION NO. XXVIII.

ORGANIZATION:

28. That a reserve of 20% of the commissioned strength and 10% of the enlisted strength of the Trench Artillery of the Reserve Armies mentioned in Recommendation No. 27 be trained to insure that the organization of each Reserve Army be at all times intact and ready for mobilization.

. . . . . .

It is assumed that attempt will be made to each Reserve organization enrolled to appropriate war strength at all times. For many reasons, such as reaching a certain age, establishing dependency which will excuse from military service, migration and deaths, many trained officers and enlisted men will become unavailable upon mobilization. This reserve of officers in particular is considered as essential if we are to avoid long training periods at a time when every mobilized man may be needed for combat. This seems to be most modest precaution made necessary because any probable enemy most probably will have taken the same precaution.

RECOMMENDATION NO. XXIX.

ORGANIZATION:

29. That, to insure continuity of policy, energetic systematic development, and to fix responsibility for these advances and the efficiency of Trench Artillery, the office of Chief of Trench Artillery is created.

. . . . . .

Trench Artillery is a new arm and it is not widely understood in our Army. This lack of understanding is so widespread that when our Army is changed from a war to a peace footing there is a grave danger that Trench Artillery will cease to exist unless it is represented in the council when this change is made. If without a representative it can hardly continue its existence, how will it be able without such a representative to develop to the limit of its possibilities or even attain its maximum possible efficiency with its present materiel? Trench Artillery is small in numbers. Higher commanding officers, even though interested in Trench Artillery, are not able to give to this arm the attention it requires, because its need in the matter of attention is out of all proportion to its numerical strength. Trench Artillery is such an arm that its officers must be specialists, and an officer who has not specialized in this arm is not fitted to command it, or develop it. The officers who command Trench Artillery must give their full time to the study of it.

In the training of Trench Artillery units there must be uniformity.

In the development of Trench Artillery material and tactics there must be a definite policy outlined and followed.

Some person or collection of persons must be responsible for these two things. A collection of persons has the disadvantage of slowness of action, and the functioning of the body is disturbed by the absence of any one member. Experience has proven the advantage of fixing such a responsibility upon one person.

Trench Artillery requires a Chief at Washington for the following purposes:-

1 - To advise the General Staff on matters pertaining to Trench Artillery.

2 - To see that Trench Artillery is properly represented and employed in any activity in which the Army may take part.

3 - To arrange for the execution of all orders pertaining to Trench Artillery.

4 - To insure uniformity of training among the different Trench Artillery units.

5 - To establish a continuous policy of development of Trench Artillery and to see that this policy is carried out.

6 - To insure that the training and development of Trench Artillery is pursued in accordance with the need of the Army as a whole.

7 - To provide some one to whom Trench Artillery commanders can appeal for decisions, and be sure that these decisions are uniform for all Trench Artillery and in accordance with the general policy of development.

8 - To keep in touch with similar developments in foreign armies to the end that our materiel training and tactics will be able at least to hold their own when pitted against these foreign armies.

RECOMMENDATION NO. XXX.

ORGANIZATION:

30. That, to insure proper coordination and concurrent development with Infantry, Field Artillery, Heavy Artillery and other line and staff branches, the Chief of Trench Artillery report to and operate directly under the Chief of Staff, U. S. Army.

. . . . . .

Trench Artillery is neither Field Artillery, Heavy Artillery nor Infantry. It does not trespass onthe domain of any of these arms. It has not the universal application of Field Artillery or Heavy Artillery. It is much more closely related to Infantry than either. It is necessary that it be trained as a distinct arm. It should, therefore, be directly under the commander of all of the arms rather than attached to any one arm. It must cooperate with Field Artillery and it must cooperate with Infantry. It cannot be said that it pertains to one more than to another. In an attack it will take part in the artillery preparation. During the attack it will advance with the Infantry, and possibly even with the Cavalry or Tanks. The Trench Artillery commander must, therefore, be intimately associated with the commanders of each of these arms. It is even more important, therefore, that the Chief of Trench Artillery be associated with all of the arms rather than with any one of them.

While it is essential that Trench Artillery be trained as a distinct arm, it is not considered advisable at this time to make it a distinct arm to the extent of commissioning officers in it. The officers who are working with this arm should be detailed to work with it for a number of years, because it requires a special training. The matter of making it a separate arm can well be held in abeyance until it is seen what development it makes and what is the trend in all of the arms.

If the Chief of Trench Artillery (whether he be such in fact only or whether he be officially recognized as such) is a subsidiary office under the Chief of Artillery (either field or coast) his communications with other arms and staff corps must be through the office of that chief. Such communications must be slower than direct communication with the other departments, and is bound to have some degree of formality which does not always permit of the complete understanding which can result from an informal verbal conference. The liaison with the artillery would be stronger than the liaison with the infantry. The best interest of the Army as a whole will be served if the Trench Artillery is on an equivalent footing with the other arms and consequently equally related to all of them rather than to any one.

RECOMMENDATION NO. XXXI.

TRENCH ARTILLERY CENTER:

31. That, in order to make development possible and to insure uniformity in this development and in instruction, a permanent Trench Artillery Center be established in the United States.

. . . . . .

In order that the potential possibilities of Trench Artillery may be realized, it is necessary that a definite policy of development be outlined and that someone be placed in charge of this development. It is next necessary that the proper equipment for pursuing this development be provided.

The best possible equipment for developing this arm is a Trench Artillery Center. Such a Center should be provided with all the necessary personnel and equipment for experimenting with and testing materiel and for developing the tactical side of the arm. In connection with this research and experimental department should be a School for officers and enlisted specialists. In connection with the tactical department would be the organization and training of Trench Artillery units. There should be an equipment department for maintaining the equipment of old units and for the initial equipment of new units. In times of training of reserves or threatened hostilities the Trench Artillery Center should become the mobilization and training center of all Trench Artillery units, and to render this effective all

the materiel necessary to equip the prospective reserves should be kept in store at the Center, so that upon mobilization training can commence at once without awaiting the shipment of material from some ordnance depot.

The equipment for such a Center should include:-

A range for Trench Artillery and small arms.

Ample ground for maneuvering.

Experimental machine shops.

Ballistic laboratory equipment.

School buildings.

Quarters for troops.

Warehouses.

Railroad facilities.

The Ordnance Department should establish at the Center their principal officers for the construction of Trench Artillery materiel in order that there be complete cooperation with the line. They should conduct all tests of Trench Artillery materiel at the Center and Trench Artillery officers should be present at the tests.

The machine shops would be for the purpose of making repairs to maintain materiel (artillery, motor transport, and signal) and to make experimental work possible without the delays due to shipments and the letting of contracts.

The ballistic laboratory equipment, while primarily for tests, would be equally important as an instructional feature.

The initial buildings need not be elaborate and can be supplied as needed in accordance with the growth of the place.

The railroad facilities are essential for troop movements and supplies.

Equally important with the material is the personnel to be stationed at the Center. There should be representatives of the Ordnance Department, Signal and Engineer Corps, of the Chemical Warfare Service and the Quartermaster Corps.

There should be a suitable force of machinists, draftsmen and laborers assigned to the Center as a Headquarters Company in order that the details may be permanent and that units stationed at the Center may not be diverted from their military duties.

The maintenance of such a Center would cost no more than any army post or posts of equal size. It has the extreme advantage of concentrating all Trench Artillery activities at oneplace, where all officers may be kept in touch with developments and where there may be perfect coordination between Trench Artillery and the staff departments.

RECOMMENDATION NO. XXII.

TRENCH ARTILLERY CENTER:

32. That a Board of Officers be at once appointed to select a suitable site and to recommend an appropriate layout of this permanent Trench Artillery Center conforming to what actual experience has shown to be sound.

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In the selection of a site for a Trench Artillery Center the following qualifications in the order stated should govern:

1 - Suitable Trench Artillery range and maneuvering ground.

2 - Central location with regard to War Department and manufacturing industries.

3 - Transportation facilities.

A range for Trench Artillery, which is to be used for the practical instruction of troops, should include the right to fire service ammunition from practically any point on a tract of varied ground about three by six miles. This does not necessarily mean that the entire tract need be uninhabited. On a tract of varied ground of this size there will probably be several locations for good tactical problems, and the intervening ground need not be disturbed.

The object of a large range is to permit organizations to utilize their service ammunition for the solution of tactical problems, rather than merely for practice in the service of the piece. The size and

character of the range should be such that a new location can be provided for each problem fired by any one organization so that the training will not lead to fixed methods. To this end the range should include mountainous country as well as flat, so that instruction may be given in taking advantage of the terrain, remembering that Trench Artillery is an arm for indirect fire.

Arrangement should be made so that maneuvers may be conducted in the country adjoining the range. Thus in their preliminary training troops will be kept off the range, and can be given their advanced training with ammunition on unknown ground.

Such a range will not be so difficult to obtain in a desirable locality as the specifications would imply. The selection of it will require a careful reconnaissance of the ground by experienced officers and a tactful and personal contact with the inhabitants to gain their cooperation and prevent numerous restrictions which would lessen its value.

The Center must include a School for officers and enlisted specialists. They should have the opportunity of visiting the ~~munitions~~ factories where Trench Artillery material is made. Officers should maintain liaison with the manufacturers who in wartime will make the Trench Artillery materiel. During development constant consultation with manufacturers will be needed in order that development may take place and follow standard manufacturing methods.

Organizations will be sent to the Center for training. In time of mobilization all Trench Artillery units of the eastern United States

should be sent to the Center for final training before joining their army. During a war, replacements of officers and men should be trained at the Center. While it is desirable that the supply departments and shops be right on the railroad, it is not essential that the training department be directly on the railroad.

A Trench Artillery Center will be a permanent establishment. It should, therefore, be carefully selected on the basis of the qualifications mentioned above. The site should be selected and the plans drawn up by trench artillerymen in consultation with the various staff corps. The board should, therefore, be given the necessary authority for travel and consultation.

RECOMMENDATION NO. XXXIII.

FRENCH ARTILLERY CENTER:

33. That, in order that the development made to date be not lost to the service and that progress may continue uninterruptedly, the French Artillery Center, American E. F., be at once moved to the United States and put into operation pending the establishment of the permanent French Artillery Center mentioned in Recommendation No. 31.

. . . . . .

There is now in existence in the American E. F. a French Artillery Center, which was established in accordance with the outline given in remarks on Recommendation Nos. 31 and 32. This Center is a complete entity and has the experienced personnel and the necessary records to be moved as a unit and commence functioning at once. So moved, it would form the nucleus of French Artillery in our new Army. It has taken over a year to build up this Center and train the personnel. The officers of the Center have already outlined a plan for the future development of French Artillery. They have been in constant touch with all of our French Artillery units, which have had experience at the front, and have been in constant liaison with the French French Artillery.

They have made visits to the various fronts and to the French and Italian French Artillery Centers. They have witnessed experimental demonstrations of new British, Italian and French materiel, and have visited the principal French and Italian factories where the French

Artillery material is safe. In a like manner the enlisted personnel have been gaining experience for over a year. The Center has already made improvements in material, which improvements, however, were limited in extent by the lack of resources with the war. The personnel is ready to take up this work where it was stopped. If the Center is disbanded much of this will be lost, and there will be a break in the continuity of the work, which will require a long time to make up. If a Center is started with a new personnel, it will be impossible for that personnel to attain the practical qualifications that have been collected by an intimate association with the principal [illegible] artilleries during the war. If a branch in Artillery is to remain in our Army it is recommended that there be retained the one made during the war rather than one which must begin anew.

PART III

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TRENCH ARTILLERY MATERIEL

of

EUROPEAN ARMIES.

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Transmitting from A-G-O. No. 8779. (F.D.C.) January 2, 1919.

Memorandum concerning the organization of the office of the Inspector of Barbarieb.

The office of the Inspector of Instruction controls the following:

(a) The School of the Soldier. (
(b) The Aspirants' Section (
(c) The Mortar Service (

The Barbarieb School, up to the present date, has graduated from the Artillery Officers' Training School [illegible].

The elements needed were these:

(a) Line officers who had other qualities in artillery [illegible] from cavalry officers who are instructed in the school for special courses lasting 20 days each during the enlargement of mortar.

(b) Line officers [illegible] and field branches of the service furnished with proper certificates of study of which were instructed in the courses for student officers (lasting first for three months and later varying from 4 to 6 months) in order to make them aspirants so that after a month of practical service with the mobilized batteries they became 2nd Lieutenants.

In addition to this the school provided for;

(c) Perfecting the professional culture and the practical knowledge group commanders and commanders of mortar batteries by means of completion of courses lasting 20 days and taking place every month.

(d) Instructing in the service an employment of mortars those artillery officers coming from courses of the Military Academy, in consequence of which it was determined to do away with the courses of study in the mobilized units.

The normal duties of the school in addition to this are;

(e) Formation of new detachments.

(f) Construction of equipments.

(g) The administration, testing and the supply of material to mobilized batteries.

(h) Instruction and constitution of sections for Stokes hand grenades.

(i) Instruction on constitution of batteries of small calibre of 37 m.

Moreover a directorate of courses, a group of instruction, a mobilization office, an office for material, 2 testing commissions - 1 for bombs and mortars and the other for Stokes hand Grenades and the subsidiary infantry material, - an historical section and a workshop for the repair of material are attached to the school for the purpose of carrying out the duties of the school.

The experiment section has as its duty the study of new material, the execution of experimental firing and compilation of various instructions pertaining to bombarding for the determination of range-tables.

This also is divided in to 2 branches as follows:

Experiment section for artillery for bombs and mortars.

Infantry experiment section for Stokes hand grenades and other materials.

The Stores serves as a recruiting center for all the bombardier personnel; matriculation is administered here; it provided for the revision and control of all the accounts in money and material of all the mortar units.

It provides for the preparatory instruction of personnel and troops before they are assigned to mobilized units.

Office of the Prospector of Bombardiers.

PROGRAMME

for Course of Instruction for Bombardier Officers.

FOREWORD.

Up to the present time the School for bombardiers has accordingly had alone all the duties pertaining to the recruiting of new officers whose specialty is bombarding as well as instruction for service in the same of officers who were to pass gradually from other specialties of artillery or cavalry.

Since the Ministry of War determined in July of the present year that the function of recruiting officers should be given to the Military Academy of Turia for bombardier specialists also and that the School should help only in completing the instruction of officers of a new category with a course intended to be developed at Lucciuolo before they should be destined to service in detachments, the courses which will be given from now on in the school for Bombardiers are the following:

1. Course of application for the specialty of bombarding for 2nd lieutenants of Artillery of new nomination proceeding from the Military Academy.

2. Normal Courses for instruction in the bombarding service for officers coming from other organizations or arms of the service.

3. Course of completion for commanders of groups and bombarding batteries.

The particular scope which is proposed for each course and the respective materials of instruction are here indicated in a summary manner and separately for each single course.

July 1918.

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COURSE OF INITIATION FOR BOMBARDING SERVICE FOR 2ND LIEUTENANTS OF NEW NOMINATION COMING FROM THE MILITARY ACADEMY.

Length of course 30 to 40 days.

Scope of course:

To furnish to artillery officers of new nomination all the special knowledge necessary to place them in a position to give useful service to bombarding batteries and sustain in their minds that high offensive spirit which ought to be one of the essential characteristics of a bombardier officer.

Maximum Program:

(a) The present day combat mortar (its origin, development, actual employment in bombarding, offensive and defensive.)

(b) Trench materiel used today (mortars, bombs, hand grenades). Detail description of Italian materials and observations on the materials in use by foreign armies (France, England, Austria, Germany).

(c) Handling, aiming and shooting of mortars (preliminary exercises and exercises of effective fire with mortars of various calibres).

(d) Choice and organization of positions for bombardment. General criticism, successive operations, practical construction of ambushes.

(e) Conferences of an educative character. General duties of an officer in the war of today. Particual duties subaltern. Means for maintaining the offensive spirit of troops in trench warfare at its heigth, coupling of energy with loving care of soldier; rigorous justice in command; continous interests for the soldiers of the personnel. Organization spirit. (Esprit de Corps).

(f) Conferences relative to the administration of detachments.

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NORMAL COURSES

Length of Courses: 20 days.

Scope of Course:

To prepare good commanders of groups and mortar batteries from officers coming from other specialities of artillery or cavalry.

Maximum Program:

(a) Tactics and organization. Characteristics of the present day battle. Generic criticisms on the employment of various arms. Duties confided to the artillery in general and to bombardment in particular. Historical glance at the development of the bombardiers specialty and its actual organic construction.

(b) Materials and munitions of the bombardiers work.

(c) Ambushes for mortar batteries.

(d) Handling, aiming and firing of mortars.

(e) Various conferences and exercises on technical arguments (telegraphy and telephoney, aeronautics, photo-electric service, observation and topographical reliefs.)

(f) Exercises in firing.

(g) Varied conferences on military culture and of an educated character.

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COURSE OF COMPLETION

Length of course: 20 days.

Scope of Course:

To perfect the technical - professional ability of bombardier officers (commanders of groups, senior captains, commanders of batteries or senior lieutenants), to keep them in touch with innovations in study concerning material and augment the tactical knowledge and employment thereof.

Maximum program:

(a) Conferences of a tactical character on the employment of various arms.

(b) Conferences on material under experiment or which is being studied.

(c) Liaison service, employment of means of organization.

(d) Constructive criticism of bombarding materials.

(e) Employment of mortars.

(f) Conferences on the types of testing the individual trench material.

(g) Exercises and experiments in firing.

(h) Visits to the repair shops and factories producing War material.

(i) Conferences on military subjects of major interests at the present time.

INSTRUCTION FOR OFFICERS OF DISPOSABLE SECTIONS,

Of a continuative character

Scope of the course:

To maintain the attitude of disposable officers of various grades which constitute the source of supplementary officers alive and efficient in order to send them to detachments removed from the zone of operations.

Maximum program:

(a) Practical conferences and instruction on material in use.

(b) Conferences on tactics and organizations.

(c) Observations on fortifications and works of the battlefield.

(d) Observations, choice of positions, orientation, map reading.

(e) Practical employment of sighting instruments (compass and goniometer) applications to the terrain.

(f) Employment of artillery and mortars.

(g) Models of bahavior.

(h) Various regulations.

(i) Employment of gas and means of defense.

OPINION OF COMMANDANT SCHNEIDER, FRENCH ARMY,
COMMANDANT, FRENCH TRENCH ARTILLERY CENTER, BAR-SUR-SEINE, FRANCE.

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If we review the materials actually existing, we remark:

1 - The 58 No. 2:

Is a gun unrefined, simple and light, but its range is small. The rate of fire unsatisfactory and impossible to maintain at a high rate on account of the heating of the barrel.

This mortar was improvised at the beginning of the war and was just risen. It has always been the policy not to improve the gun, improvements being made only on the bombs.

2 - The 150-T, Model 1916:

It is complicated gun, frail, poorly constructed and without precision. Nevertheless this gun has some very good theoretical qualities, viz:- low pressure in the long barrel from which there is little noise and no flash on the firing of the shots.

3 - The 150-T, Model 1917 (Fabry):

Is an excellent gun as to ballistic qualities, but;

(a) Is incomplete as regards construction. The apparatus for elevating and traversing are not mechanically sound.

(b) The barrel is a little too short.

(c) The method for laying the gun in direction by means of the siege goniometer and mirror is not practical for open warfare.

(d) Some parts are too heavy, viz:- platform.

(e) The system of traction is not developed. The gun is poorly balanced on the axle.

(f) The lack of blocking device when rolling on roads or fields causes vibrations of the barrel and cradle and wear in the recoil system and carriage.

(g) The extracting system for the cartridge cases is not satisfactory.

(h) The firing system is poorly designed. The lanyards wearing out very quickly.

(i) Makes lots of smoke.

(g) Change the packing of the powder and mark the number of the charge on the outside.

(h) Reduce, if possible, the number of the charges to two instead of four.

(i) Improve the means of traction.

CONDITIONS TO REALIZE IN A NEW MATERIAL

The idea "Materiel" must answer to the following conditions;

(a) Power:

(1) The trench for it will be of concrete construction. The projectile must be able to destroy it. It will then be necessary to have bombs contain from to 6 to 10 kg. of explosive.

(2) Eliminate in the bombs all the causes for duds. The greater the range the deeper will be the penetration of the bomb.

(3) To increase to the maximum the front of attack provide a large number of bombs. The surface destroyed is ir proportion to the power of the bombs.

(b) Speed of Fire:

Minimum number of shots 125 to 180 per hour. The service of the piece must be simple enough to permit this speed to be maintained for periods of 4 to 5 hours.

(c) Ballistic Properties:

(1) The maximum range of 3000 meters, which allows:-

(a) A large field of action in deflection and in depth.

(b) The installing of the materiel near the narrow guage tracks and far enough from the tender spots of the infantry orgaizations.

(c) To put it out of range of the German minenwerfers.

(2) Precisions of the same order as the precision of the 155 m/m guns of the H. F. A.

(3) High angle fire.

(4) To decrease the chance of detection by the enemy have the powder smokeless, flashless and noiseless. For this purpose it will be necessary to use long barrel with low pressure. To conciliate the use of powders burning at high pressure and prepulsion of low pressure projectiles it will be necessary to use the principle of the diaphragm and consequently to retain the loading of the bomb by the muzzle.

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4 - The 240 - T:

Is a very interesting gun as regards effect, but:

(a) Is not precise enough.

(b) Fires too slowly.

(c) Very tiresome to serve.

(d) Plarform too heavy and too cumbersome.

(e) Bomb with very bad ballistic coefficient, too frail and too heavy.

(f) Incomplete combustion of the charge.

(g) Too long to install.

MATERIAL TO DEVELOP, TO REDUCE AND TO SUPPRESS

It would be justifiable to do away with the 240-T and 150-T, Model 1916. The 58-T No. 2 ought to be retained on account of its rusticity, simplicity and number that can be put into use.

150-T, Model 1917 (Fabry) must be developed.

DESIRABLE CHANGES

58-T

Improve the platform and the elevating system. Increase the range of the bombs by the use of hollow stem tailsm which at the same time would decrease the chances of heating the barrel.

150-T, Model 1917 (Fabry):

(a) Make use of helicoidal thread for the elevating and traversing devices which would make the control easy, precise and with small resistance.

(b) Lighten the platform.

(c) Use for traversing of a collimatour similar to that of a 75 m/m gun, or of a panoramic sight.

(d) Modify the extracting system by using a double hook extractor.

(e) Increase the range to 2500 or 3000 meters.

(f) Modify the chemical composition of the propelling charge in order to decrease smoke.

)5) Two calibers - 150 and 240.

(d) Mechanical Proprieties:

(1) The material must not be complicated, nor frail, nor intricate in construction.

(2) The material must be light or at least able to be dis-mounted in elements of a maximum weight of 150 kg. The total weight for the heavier caliber must not be over 900 kg. so as to allow traction by two horses.

(3) Use of the recoil system to prevent the necessity of heavy and cumbersome platforms.

(4) Use of endless screws for all the control ling apparatus.

(5) Rapid and easy emplacing of guns.

PROJECTILES

58-T - Hollow stem bombs preferable of about 30 kg. weight.

240-T - 50 kilo bombs with thick walls and cellular tail.

150-T 1917 - Bomb is good and to be retained.

Do away systematically with crucial type of vanes.

Develop long range stream line bomb.

Gas projectiles to be developed.

The trench artillery projectile, on account of its large capacity and instantaneous burst, is an ideal gas projectile.

Incandiary and gas producing projectiles to be designed and developed.

CHARGES.

Use on all guns brass cartridge case.

Improve bursting charge to have less smoke.

Generalize the use of the diaphragm.

FUSES.

Retain the RY fuse and develop the ITR delay. Keep the PR with or without delay.

Generalize the use of mellenite relays to insure the explosion of elongated projectiles.

Generalize the constant density loading as in the 150-T, 1917.

R. G. A.
4th Division.

The report herewith inclosed on the use made by the 4th Army of the 1st Groupment of the 175 Trench Artillery regiment in the offensive operations of November 1-3 and in the detailed operations which preceded it is forwarded to the General Commanding the R.G.A. This report was compiled by Captain d'Aillieres of the staff of the 5th Division of the R.G.A. on his return from being attached to the 4th Army.

This groupment had been specially trained at Bar-sur-Seine for the War of movement. G.H.Q. had given instructions to the group of armies of the center that it should be used in a similar manner to the way it had been instructed. Nevertheless, of the 4 groups engaged two only were effectively used from the 1st to the 3rd of November as heavy accompanying artillery and the two other groups took part only in small operations, the rapid retreat of the enemy having made unnecessary the use of the infantry divicions to which they were attached.

As had been foreseen the results obtained were very conclusive.

The differenct objectives upon which the 150 mortars fired were without exception completely and rapidly destroyed and the infantry was able to go forward without difficulty.

These results are due to the characteristics of the trench artillery employed;

1st - Great accuracy and strength of the Mod.1917 mortars; the great material and moral effect of its projectiles although its weight (17 kilograms) is 2½ times less than that of the 150 short.

2nd - The great facility of handling a battery of 150. The guns and the O. P. are always very near together and communication is thereby rendered easy.

3rd - Great mobility of the 150 whose carts can go a nywhere that a machine gun cart can go.

4th - Intimate cooperation between the infantry and trench artillery resulting from the east with which liaison is ma ntained between them on the ground.

The action of the trench artillery dim shed the losses of the infantry and raised the morale without any doubt and the losses of the trench artillery during its accompanying action proper were rather small (half of the losses were due to one unlocky shot; a shell hitting a box of greandes and disabling 30 men).

The trench artillery was wisely employed; it was not considered as an infantry gun but as real accompanying artillery and the greatest initiative was left to the group commander.

Some important lessons can be learned from this first trial.

1st - The accompanying unit should be the four piece battery which alone is both mobile and powerful.

2nd - The sections armed with infantry weapons have been of great use in protecting the batteries and assisting in their movements.

3rd - The cart of the 150 has proved to be much superior to that of the 50 which is too heavy and too cumbersome.

4th - The ammunition supply of the group should be improved eigher by means of caterpillars or by an increase in the number of horses. It should not be remarked that the transportation of 100 or 120 - 15- m/m bombs which is about the capacity of a 75 m/m caisson can be effected by obly 6 horses.

The new method of using trench artillery has proved its wocht. If the hostilities keep on the use of Trench Artillery should be more general and the infantry should be made acquainted with its capabilities. The term "Trench Artillery" should disappear and in its place should be substituted "Accompanying Artillery" or "Exploitation Artillery"; both these latter names fit closer the new rule which the Trench Artillery is called upon to play under present conditions.

If the gouprs had had better facilities at their disposal and if there had been caterpillars for their ammunication supply the results would have been still more satisfactory; those obtained are excellent at least according to the opinions of the battaion commanders of the 86 and 408ther Infantyr Regiments.

Signed: Colonel Raybal,
Comm din. 4th Division R.G.A.

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R. G. A.
4th Division

6th November 1918

Report of the operations of the 2nd Group 176 Regiment of Artillery placed at the disposal of the 120th Division (9th Corps)

1 Map Enclosed

The 2nd Group arrived in the sector on the 30th of October.

The 31st of October was passed in reconnaissances of crossings of the Aisne, future battery positions and starting positions; 900 bombs were brought to Vrisy during the night of 30-31

The situation of the infantry was the following:

We had gained a footing on the right bank of the Aisne occupied Torron, Vandy and le Pinot. The few crossings of the Aisne were under the intense and precise fire of the enemy artillery. Two foot bridges and a dam half destroyed were the only means of getting the guns and ammunition accross.

The plan of operation for the Trench Artillery was as follows:

One Battery (4 - 150 Fabry Mortars) was to be placed at the disposition of each battalion (3 battalions were to attack). The days preceding the attack were to be used in getting as much as possible of the ammunition over to the raght bank of the Aisne.

The group commander was to stay at Division Headquarters.

The Battery Commanders were to stay with the battalion commanders acting however on their own initiative (see the attached order).

The line of advance and the eventual battery positions were determined upon in advance by consulting the Plan Directeur and Aerial photographs; the axis of liaison as well as the axis of movement of courier posts were pbicked out for each intermediate position.

As the number of bombs at the disposal of the group was very limited the Trench Artillery was not to take part in the artillery preparation but was to be reserved exclusively to help the infantry in its advance.

The ammunition supply during the action was to be made by means of ammunition wagons which assembled at Vrizy were to cross the Aisne as soon as possible.

The commander of the 2nd Group was informed on the 31st of October at 18 hours that the attack was to take place next morning at 5:45.

On account of the need for haste and the small means at the disposal of the group (12 carts per battery) each battery was ordered to put in line only two 150 mortars (4 carts) and 160 bombs (8 carts), The 4th battery (240 long) was ordered to assign a section armed with infantry wagons (machine gunners andV.B.) to each firing battery in addition to a group of scouts provided with tools to prepare the way for the advance.

All the batteries were at the assembling places and ready to take part in the action on the 1st of November at 4 hours.

6th Battery

The 1st of November;

Assemble at 500 meters from the first line south of Macquart Farm. The infantry advanced and gained a foot hold on the southern slopes of Hill No. 170.

At 6 hours the battery started forward, traversed Terron under the fire of the enemy machine gunners on Hill No. 170 and took position 400 meters southwest of Hill No. 170 and 200 meters from our line of machine gunners

At 9 hours it was readh to go into action.

After firing 80 bombs in the ravine and on the slopes of la Wacquerie the infantry advanced and occupied the crest. During the firing 8 enemy machine gunners surrendered and a machine gun was put out of action. The battery commander who was advancing with the infantry captured 7 Germans, one of whom was a candidate for commission and who had in his possession secret documents whichwere immediately sent to the corps.

At 17 hours 15, 48 more bombs were fired to permit the infantry to go forward on the plateau.

The 2nd of November:

During the night the battery was resupplied with ammunition. The ammunition wagons having crossed the Aisne came right up to the positions. A total of 210 bombs were brought to the line.

The battery commander's P.C. was on Hill No. 170. 40 bombs were fired on a 75 m/m minenwerfer which was bothering the infantry. The infantry moved forward and occupied the bottom of the raving.

The battery moved forward and took position 200 meters south of Hill No. 170.

At 16 hours 60 bombs were fired on machine guns situated between Hill No. 202 and in la Wacquerie Farm. The infantry moved forward and took positions 300 meterd from the road southeast of Alleux and which passes by Hill No. 202.

The 3rd of November.

The attack was recommenced at 10 a.m. 80 bombs were fired on a trench on Hill 202. Excellent results were obtained as was proved by an examination of the position afterwards (corpses, broken equipment). The infantry occupied Hill 202 and advanced.

As the last bomb was fired at 10 a.m. the battery resumed its advance at 10:07 and proceeded along the axis of march. It took position at its last objective and to assist in the capture of Alleux.

Alleux was taken without its assistance; the battery continued its advance but contact with the enemy having been lost the group was taken back out of action.

5th and 7th Batteries.

The 1st of November;

They were assembled between the Croix-de-Boham and the Croix-de-Chalaila, after having suffered considerable losses furing the crossing of the Aisne.

The assembling point was heavily fired upon and many men and horses were killed or wounded.

The 5th battery opened fire at 7 hours on the Malva Farm which was holding out against our attacks. As soon as the last bomb was fired the Infantry occupied the position and established itself along Malva Brook The Battery remained in readiness and continued to suffer severe losses.

The 7ther Battery was in readiness on the ridge west of Calandres Farm; not having any information on the situation the battery commander went along the first line and saw an enemy machine gun being placed in position. A few bombs were sufficient to put the enemy to flight.

During the entire morning the battery was under heavy fire and suffered very serious losses.

At 12 hours the group commender having no information concerning his units came out and set up his P.C. at Vrezy and took direct commandof the two batteries (5th and 7th) which were badly used up; he consolidated them and placed the consolidated battery at the disposal of the battalion on the right keeping liaison with the batta ion on the left.

At 12:40 the battery was ready to operate.

At 13 hours the Germans counterattacked and advanced norhhwest of Hill 193 and the battery position was swept by the enemy infantry fire. The situation was quite critical and the guns were moved and placed in position more to the left on the road passing the Croix-de-la-Chaliala and were ready to fire on the ravine southwest of hill 193 and in the woods each of Malva Farm.

The 2nd of November:

The Infantry resumed its advance in the morning, but was checked by enemy machine guns on hill 203.

The battery moved forward under hostile fire, crossed Malva Brook and took position at the Fontaine des Calandres right in the first line. The bombs were carried by hand for 500 meters for the ground had been made impassable by two days of rain and the ammunition carts could not advance further.

At 11 hours the battery was ready to fire.

From 11:30 to 11:45 30 bombs were fired on Hill 203 which was immediately occupied by the Infantry.

From 13 hours to 13:30 90 bombs were fired on the Northern slopes of Hill 203 which were full of machine guns; this permitted the infantry to keep possession of the crest.

In the evening the ammunition supply was replenished by means of carts from the battery which were filled up at an ammunition wagon which had been brought up to near our first starting position.

The 3rd of November:

80 bombs were fired before 10 hours on enemy machine guns in position at the Northwest corner of Vandy Woods south of Quartro-Vents.

An examination later showed good results were obtained (broken equipment etc) the infantry lost contact with the enemy and the battery was taken back out of action.

	LOSSES	
	Men	Horses
Killed	12	16
Wounded and evacuated	36	6
Wounded not evacuated	6	9

To this figure must be added two officers wounded one of whom was evacuated. In addition 1 ammunition wagon and 6 carts were completely destroyed.

Signed: Colonel Raynal
Commanding 4th Division, R.G.A.

R.G.A.
4th Division

6 November 1918

Report on the use of the Groups of 175th Regiment of Trench Artillery placed at the disposal of the Fourth Army.

See inclosed file.

Four groups of the 175th Regiment took part in the attack of the 1st of November and in the advance which followed it.

A detailed report shows what use was made of the 4th and 5th groups in the Division on the south (Axis of attack - south-noth). Its use was very limited for the preogress of the infantry depended only on the foreseen retreat of the enemy.

Two groups (2nd and 3rd) occupied a sector of Vouziers and were to take part in the infantry advance (axis of attack - west-east).

On the 5th of November the third grup continued its advance; it was in the region of Chatillon-sur-Bar and the detailed report of its opperations had not been finished.

The report of the operations of the 2nd group is attached to the folder.

CONCLUSIONS:

The use of the 2nd group in particular conformed absolutely to the principles laid down (Order No. 8345 of the 120th Division dated 30 Oct. 1918.) In spite of the great difficulties of the ground little time left to the group commander to make his plans and the inevitable difficulties of a first trial the trench artillery gave its assistance very efficiently so and in such mannser as to provoke general enthusiasm from the infantry (4o8 and 86th divisions)

The small numver of bombs at the disposal of the 4th Army prevented the trench artillery from taking part in the preparation for the attack. This is a serious mistake; it should take on important part in this.

The artillery preparation during the present operations is very short; it is made without any previous adjustment and often at night and by units which usually have arrived at the last moment.

It is difficult for our artillery to fire on objectives near our infantry especially as the positions of our first lines is often badly known.

At all events it is certain that the ground immdiately is front of our infantry is fired on very little or not at all.

If any defenders remain there they are able to hold up the attack.

This is what happened to the 9th Corps in the sector of the 40th Division and especially in that of the 42nd Division in front of Chestres. (In the woods 500 meters east of Chestres the enemy had organized very strong center of resistance which stopped our advance. It can be stated that not shot fell on these defenses). On the contrary the trench artillery, if it arrives two or three days before the preparation can easily fire very closely in front of the infantry being along side the latter and having complete knowledge of the ground and of the position of our lines. (No abnormal short has been noticed with the 150 Fabry).

To sum up, the trench artillery can be used to fire on the zone immediately in front of our line of departure up to 500 or 600 meters ahead of our Infantry.

It may be estimated that 2500 bombs for a division front will be sufficient for this mission.

During the Advance the trench artillery is the only artillery which having been able to cross the Aisne during the first 2 days gave efficient suppot to the infantry (communication with the left bank of the Aisne was almost continually interrupted).

Each battery had its zone of action (Italian Front). This zone was made necessary on account of the nature of the ground which was wooded and hilly. The group commander retained throughout his own initiative and if necessary was able to concentrate all his batteries on the zone objective.

The axis of advance and of liaison were the same; they had been established in advance and battery positions as well with the aid of Plan Directeurs and Aerial Photographs.

The order to fire was given by the battery commander after consultation with the battalion commander. The Duration of the Fire alone was indicated the infantry by the battery commander who regulated his ammunition expenditure according to the importance of the objectives.

In most cases 10 to 15 minutes firing was sufficient the infantry moved forward as soon as the fire had lasted the time fixed upon and cpantred the objectives.

All the missions which presented themselves were filled by the firing of a very small number of bombs (40 to 80). There were no group objectives; only battery objectives.

The batteries as they were organized were obliged to step after 3 days advance. 1 group for each 2 battalions engaged in the attack would be necessary to assure the relief of the personnel and to keep 1 or 2 units in reserve. These units would be engaged in the most favorable sectors, particularly those where the advance is the most rapid, that is to any where the units engaged most quickly become tired out,

The most important idfficulty which remains to be solved is that of the supply of ammunition.

The material on the other hand is quite easily transported and has given entire satisfaction.

Colonel Raynal,
Commanding 4th Division R.C.A.

120th Division
Staff
3rd Bureau

G. H. Q.
30th October, 1 9 1 8 .

NOTE ON FABRY TRENCH ARTILLERY

The 150 Fabry Material is particularly well suited for the accompaniment of Infantry in wooded country. Its ammunition must not be used up by making it take part in the artillery preparation.

A group of Fabry Trench Mortars consists of three batteries.

A battery in the field consists of four pieces - (8 small carts and 6 ammunition carts each carrying twenty bombs).

The battery is provided with a machine gun section (6 carts).

The horse-drawn carts can go anywhere that the machine gun carts can go.

The missions of the Fabry Trench Mortar are as follows:

1st - To assist the Infantry in reducing local resistance, a strong points, machine gun nests, woods, villages, etc.

2nd - To fire on enemy troops who are being assembled, in a ravine or under the shelter of a counter-slope for a counter-attack.

b The commander of the Trench Artillery group remains with the commander of the Infantry Division or keeps close liaison with him.

The battery acts with each battalion. The battery commander keeps with the battalion commander but is not under his orders. The latter makes known the infantry's needs.

The Trench Artillery can protect the infantry by its fire or can remain ready limbered up, to fire on objectives which are out of range from its original positions.

For the operations under preparation the two right batteries limbered up and the left battery ready to immediately take under its fire the ravine between Hill No. 170 and the Plateau of la Wagnerie if the Infantry has any difficulty in getting across it.

In addition to its material effect the moral effect of the bombs on an enemy sheltered in the woods is considerable.

The greatest initiative will be left to the group commander regarding the use of his guns in action.

Signed: - (General Mordacq)
Commanding 120 th Division

A True Copy

Colonel Raynal
Commanding 4th Division R.G.A.

124.

Paper Prepared By

Capt. R? T? Pease, F. A., 316th Battery, Trench Ar'ty.

Dealing mostly with

Present 6-inch Newton Mortar and Equipment.

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Capt.Pease while stationed at the Trench Aetillery Center worked with authorities in experiments to improve the materiel and did valuable work. This paper is inserted as cumulative evidence of trend of thought in Trench Artillery.

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MORTAR ARTILLERY

Mortars, General:

Direct fire guns fire at angles up to about 15 degrees: Howitzers fire at angles up to about 45 degrees: while Mortars fire at angles above 45 degrees.

The maximum range for a given charge with any gun is attained when the gun is laid at an elevation of approximately 45 degrees with the horizontal. Howitzers and Mortars are the two types only, which can achieve this elevation. Direct fire guns cannot.

Mortars have one great superiority over any other type of artillery, namely:- high angle fire. A shot coming from the front can be stopped by a wall or embankment in front. A s ot falling from directly overhead requires overhead covering for protection, and overhead cover requires time, and such labor and materiel as compared to the requirements for the frontal protection only.

The angle of fall of projectiles from the direct fire guns is not over 20 degrees even at extreme ranges. An embankment or trench is, tyerefore-protection against such fire. The angle of fall of howitzers projectiles is limited to about 50 degrees. Steep hills or walls are therefore requiree to afford protection against the fire of these pieces. But the angle of fall of mortar projectiles is really limited only by the vertical. Against mortars, overhead protection must be provided.

Inversely, the mortar can fire from behind very steep cover such as is affordel by a trench, or a rock quarry or cliff, and is therefore safe from the direct fire of rifles, machine guns and most field artillery. It is also safe in such a position from frontal oversavation or from balloon observation.

The maximum effect of the burst of a projectile is normal to its longest diameter or in other words at right angles to its angle of fall. With a projectile falling vertically this would mean that effective fragments are thrown equally to the front and rear as well as to the sides and the effective area covered is a circle of a diameter equal to twice the effective burst radius of the shell. As the angle of fall is tilted, the rear portion toward the ground and the forward portion u upward so that the effective area covered becomes a narrow strip of a length equal to twice the effective burst radius of the shell.

The disadvantages of mortars lies in the fact that in their present state of development, their dispersion is somewhat greater than that of other types. As the guns and ammunition and more particularly as the projectiles themselves are improved, this disadvantage will be overcome.

Advantages of the 6 — inch Newton.

(a) High angle fire (See under Mortars, General).

(b) High Power. The 6-inch Newton bomb contains 10 pounds of high explosive, which makes it about equal in destruction to the 155 m/m shell which contains 12 pounds of high explosive and five times as powerful as the shell of the 75 m/m, which contains about 2 pounds H. E.

(c) Portability. The gun is readily disassembled into loads for carrying, in no case heavier than can be carried by four men. This fact enables it to be taken anywhere men can go on foot - through woods, shell holes, over logs and broken ground. This is a marked superiority over any other weapon of the same or approximate caliber.

Field artillery pieces of 75 m/m caliber or greater, and all other wheeled materiel may be blocked by a broken down culvert, trees thrown across the road, shell holes in either roads or fields, Such conditions present but slight obstacles to men on foot.

(d) Light weight as a whole. This quality permits transportation with a minimum of personnel - eight men only being required to carry one gun and equipment complete, exclusive of ammunition and platform.

(e) Simple construction and operation. There are no intricate parts to get out of order, and little special training is necessary to make efficient cannoneers. Recoil mechanism requires special training and care for their proper maintenance. And this weapon has none.

(f) Low cost. Both gun and projectile are cheap in comparison with other weapons of like power and effectiveness. The parts of the gun are few and of simple manufacture. The shell is of cast iron with comparatively little machine work required in its manufacture.

The above are all manifest advantages, and the six-inch Newton as a dstrictly trench weapon, is sufficient though far from perfect. As used in the trenches it is fired from a solidly built, heavy wooden platform, to which it is securely fastened. Such an emplacement requires time and considerable material in addition to the gun and its immediate accessories. Ordinarily in trench warfare time is not an important element and such construction can be carried out with due attention to details. The ammunition though heavy is transported by hand during whatever period is available for the purpose or until a sufficient accumulation for the "fixed shoot" has been obtained. The gun is left in place from day to day, and the fortification of the position improved as time goes on. In the meantime firing data for all possible targets within range of the piece are obtained, and the information checked and perfected. The gun is not provided with a sight. As used in a trench, a sight would be something of an anomaly, since a view of more than a year or two is not ordinarily obtainable. The piece is laid by sighting by eye over the barrel using as data a compass bearing or like information. The personnel of the battery consists of 172 men and the number of guns is 12. Each gun detachment consists of 8 men and an N.C.O. The rest of the personnel is employed as telephone operators, signal men, drivers, etc.

Thus is the gun and battery designed for trench warfare; and given sufficient time for preparation, the materiel and personnel are efficient and sufficient. But to go forward rapidly with infantry in an advance is something which such a battery finds almost impossible of accomplishment.

The following are some of

The Disadvantages of the 6-inch Newton as a Field Weapon

(a) Slow movement. All parts are carried by hand. The bed, weighing about 250 pounds is the heaviest part and is carried by four men. It is manifest that loads of such weight cannot be carried for more than a few hundred yards at a time without permitting the men to rest; and even while moving the progress is slow as compared with that of infantry in motion. It has been demonstrated a number of times in actual warfare that the 6-inch Newton cannot follow the infantry.

(b) Weak bed. The bed, as designed, is intended for firing from a solid platform. The bed is of wood and of a strength sufficient only for use of charges #1, #2, and #3. The maximum range obtainable with charge #3 is 760 yards, while the maximum with a charge #7 is 1800 yards. Charge #3 can be used to advantage in very few instances in Field Warfare. As an illustration of the weak character of the bed, the writer has personally seen 18 beds broken by firing charges #4 and #5 from an earth foundation.

(c) Short Range. The extreme range of the gun with the maximum charge and present type of projectile is 1800 yards. This is too short a range to make it an efficient Field Gun. Attacks naturally progress from ridge to ridge. Our line halts behind one ridge while the enemy retreats behind the next one. This is the logical and natural order of battle in the open, and the position of such ridges dictate, in general,

the position of the opposing forces. The distance between ridges varies in different localities and with various forms of topography. Over a large part of France the distance between ridges is from a mile to a mile and a half. Since it is necessary to reach from one side of one ridge to the enemy's side of the next, the range of a field piece for efficient work should not be less than 3000 yards, and should be as much more as can be obtained, with due regard to the other requirements of the service for which the gun is intended. Increased range means greater latitude in the choice of a position; decreases liability of detection by the enemy; lessesn the vulnerability of the battery position; adds to the safety of the line of communication and ammunition supply from the rear. Increased range is however not an unmixed benefit. Its disadvantages will be discussedlater in an attemp to fix upon a satisfactory range for this particular gun.

(d) No sight. A sight is an instrument attached to a gun barrel for the purpose, first, of pointing it quickly and accurately in a given direction; second, of maintaining its direction once it has been laid. Nearly all field pieces of the present day are equipped with sights. A gun without a sight may be laid, either by pointint it directly at the target, when the target can be seen, which is perhaps possibly in a small fraction of oner percent of all cases with a mortar; by sighting over the barrel and alying the piece by eye on a line determined by compass (usually a small hand compass is the only possible type for such use); or by laying by eye on a line determined by some more complicated surveying method on the ground. An error of two degrees in deflection would mean missing the target by 100 yards at a distance of 3000 yards. A man who can sight over a round, tapering gun barrel tilted at an angle of 45 degrees or more and approximate a line close than 2 degrees, is guided more by the Grace of Providence than by virtuxe of his own cunning.

The Newton Mortar, as a trench weapon is designed to be controlled in deflection from a fixed line, pre-determined and under the conditions for which design is securely anchored to the ground. Field weapons, from the very nature of the service they are to perform, cannot be fixed to the ground. They must be capable of being removed quickly, as well as being set up quickly. Because they are not anchored to the ground, field pieces are kicked backward or laterally or both, a certain distance at each shot. The amount of this displacement varies chiefly with the character of the ground onwhich they are set up. This displacement is more apt to be other than parallel to the line of fire, and therefore causes the gun to be deflected from the proper laying. The amount of such delfection cannot be seen by casual inspection of the piece. With a sight it is possible to bring the gun back quickly to its proper direction. Without a sight, a course may be adopted of hit or miss and hope for the best, or proceed anew with the above thumb-handed method of relaying.

(e) Method of Transporting ammunition. The bombs weight about 52 lbs. each. They are usually carried, one bomb per man on the shoulder. This is slow at best, and extravagant use of man power.

As at present organized, the personnel of the battery can carry forward the 12 guns and their accessories only. The ammunition must be brought up on a second trip. With 8 men per gun the loads are distributed as follows;- 4 men to the bed; 3 men to the barrel; 1 man to the pick and shovel and whatever other tools are carried.

(f) Method of Fixing Charges and Fuses. The charges are put up in small cloth bags, an ounce of guncotton in one size of bag and one and one-quarter ounces of cordits in another size of bag. A #7 charge comprises 4 bags of guncotton and 4 bags of cordite. To fix these to the bomb they are slipped, or rather crammed, under some wires wound around the vanes of the bomb. This operation takes some time, it being necessary to handle 8 separate pieces. After this manipulation is completed an igniter, consisting of 2 pieces is snapped into a recess in the tail. Ten operations to prepare the charge.

Preparation of the fuse and exploder requires handling 4 more pieces, in addition to unscrewing the traveling cap from the nose of the bomb. Little need to be said concerning the fuse, as the new American fuse obviates most of these operations.

In view of the above considerations, the 6-inch Mortar is an impossible weapon for field warfare conditions. It remains, therefore, to see what can be done to overcome its deficiencies without destroying its evident superior qualities. Its greatest superiority rests in its comparative light weight and its capacity for being dissembled into a number of comparatively small loads. Its light weight is due largely to its lack of recoil system of heavy traverse mechanism. The 150 m/m Fabry mortar, of virtually the same caliber has both a recoil system and a carriage bearing a screw traversing mechanism. This mortar weighs about 450 pounds. The parts are, moreover, more bulky than is the case with the Newton. It cannot be taken over logs, through shell holes, or into places necessitating handling about. The Newton can be made superior to the Fabry for field service, and can still be used as a trench mortar which is almost beyond the capacity of the Fabry.

The following improvements are taken up in the same order as the deficiencies listed above.

Changes to Make the 6 - inch Newton a Field Mortar.

(a) Cart Mount. A cart has been designed, using two standard, ball-bearing, penumatic, motorcycle wheels, and a very light simple frame and pole. This cart will carry one mortar complete, including bed, barrel, pick, shovel, and a number of sandbags. To the front end of the pole is attached a shot prolong and crossbars for hauling by hand. Trials have shown that 4 men can take this entire equipment across plowed ground and up moderate slopes. On steep slopes it is necessary to double up. The crews of 2 carts working together take each cart forward separately. On roads or on firm grass ground four men will march steadily at a rate of from 2 to 2½ miles per hour. The arrangement is such that the entire equipment can be lifted off the cart quickly without undoing fastening of any kind. When an

(d) Sight. The barrel of the gun is at present so constructed that as it is traversed it rolls, and the amount of deflection is measured by the amount of the roll. This renders the barrel unsuitable for mounting a sight since the sight, attached to the barrel as it must be, would roll with it and so cause the plane of sight to lie on an angle with the plane of fire instead of lying parallel to it. The gun for use with a sight must be constructed to prevent the barrel rolling. A barrel and base has been redesigned which accomplishes this. The stud on the lower breech end, which causes the roll, is omitted, while two studs in a horizontal plane are added to the breech. These studs travel in a horizontal groove in the base block. The design provided for traversing only 20 degrees each side of the center line instead of 50 degrees, since the entire bed may be easily shifted if a greater change of deflection is necessary. This is done after the manner of shifting the trail of a field piece. It is contemplated using the U. S. 1917 panoramic sight, though any other similar sight would answer the purpose as well. The sight bracket, attached to the barrel, would be constructed to receive the type of sight adopted.

(e) Transporting Ammunition. A cart identical with the gun cart described under (a) is used for the transportation of ammunition. A steel caisson chest has been designed to fit this cart to make gun and caisson carts interchangeable. This caisson chest accomodates 8 bombs together with 8 charges and fuses complete. A spade and a tarpaulin are also carried. The weight of the caisson chest is about 50 pounds; 8 rounds at 52 pounds each, 416 pounds; 8 charges and fuses about 5 pounds; tarpaulin and spade about 15 pounds; or a total of about 486 pounds. This is about the same load as the gun cart carries. Four men draw one caisson. In this manner a squad of 8 men can bring up one gun complete together with 8 rounds of ammunition, where formerly they could bring forward the gun only. Four men can bring forward 8 rounds of ammunition, where formerly they brought forward only 4 rounds. Moreover, the entire equipment is transported more rapidly and with much less fatigue to the personnel.

There is always a point in battle beyond which ammunition above a certain weight cannot be taken. In other words, the heavier the ammunition the longer range required. With its present range the 6-inch ammunition is too heavy. It cannot be taken as far forward as it is necessary to place the gun. The 6-inch Brandt bomb weighs 37 pounds as against 52 for the present type. Using Brandt bombs the weight per caisson is reduced about 120 pounds. The effectiveness of this bomb is only slightly less than that of the present type. By thus reducing the weight of the ammunition it can be taken farther forward. By increasing the range the gun can be placed farther back. In other words, the point can be found where the gun and ammunition can be brought together.

(f) Charges. It is necessary to make the charges easier of preparation if quick action is to be obtained in firing. With the Brandt type of bomb, having a long tapering tail, this can be accomplished by using two charges; one of guncotton and one of cordite, each charge being on a single strip of cloth of the same material as the present bags. Each

strip would be so constructed as to be wrapped tight, once about the taper of the bomb, and fastened with a small hook. No. 1 charge would be made up of enough guncotton for a range of 2000 yards, while #2 charge would contain enough cordite to obtain the maximum charge for the gun. If another type of bomb is to be used, some other method than the present one can be devised to simplify the fixing of charges. As stated before, the new American fuse enables the fuse to be fixed in one operation.

(g) Organization. In field warfare it is usually imperative to get into position quickly, hit hard, and often to get out as quickly before the enemy has a chance to hit back. The light hand carts permit of reaching the position quickly and of leaving it quickly, while the character of the steel bed permits the gun being put into action without delay. It remains to provide sufficient ammunition to make the action thoroughly effective. Eight rounds per gun can be fires in less than one minute of time. With 12 guns and 1 caisson of 8 rounds per gun, the maximum effective effort of the battery isrepresented by 96 rounds. nIt should be noted that the personnel of the firing battery can bring forward at a time no more than this amount of ammunition. If 6 guns only are used, the other 6 gun crews and 6 carts [redacted] are avilable for transporting ammunition. In other words, 6 guns with 3 caissons with 8 rounds per gun may be brought up one time. Effective strength of the battery is, therefore, increased to 144 rounds, and the time required to fire the entire amount is lengthened to about 3 minutes. If it should be necessary to put 12 guns in action for a period of one minute only 2 batteries should be used. There is much greater certainty of getting 6 guns into action than of getting in 12. There is also a greater probability of having a reserve of ammunition on hand for emergencies after the first of the action. Moreover, a 12-gun battery is unwieldy, and ordinarily must be handled as 2 or more platoons in action, which makes for disconcerted action.

The tables of organization at present call for 96 men in addition to the N. C. O's. in the firing battery. With 6 guns and 4 carts per gun, or 24 carts, this allows of 4 men per cart. As above stated, 4 men per cart can take the battery equipment and ammunitiin forward under most conditions. However, the extraordinary conditions are the ones to be provided for in war. Such considerations indicste the advisability of providing six men per cart rather than 4 ment. Six men can move the load more rapidly than 4 and obviously with less fatigue and therefore can continue going for a longer period. This is very important in cases where a long haul is inevitable. It is never advisable when it can be avoided to put fatigued men directly into action. On the other hand there will be few occasions in field warfare where men can rest before goinyg into action. Therefore, whatever will mitigate their fatigue in coming up to the position, deserves considerations. Their certainty of getting forward is greatly increased with 6 men rather than 4 per cart, especially in the event of casualties. It is therefore advisable to increase the strength of the 6-inch battery by two men per cart or a total of 48 men.

The battery has fire officers. Acting as a 6-gun unit, the officers may be assigned to the following duties;- Battery Commander, Executive, Assistant to Executive, Liaison Officer, and Train Officer. If 12 guns are used, necessitating division of the battery into 2 platoons, 2 or more executives are required with consequent disconcerting influence. The battery , to develop its greatest efficienty, should be handles as a single unit, and not as a number of small detachments. The various duties of officers are then divded amon them, each officer being placed in the position he can best fill, instead of fulfilling all duties in a smaller unit.

Tactical Considerations.

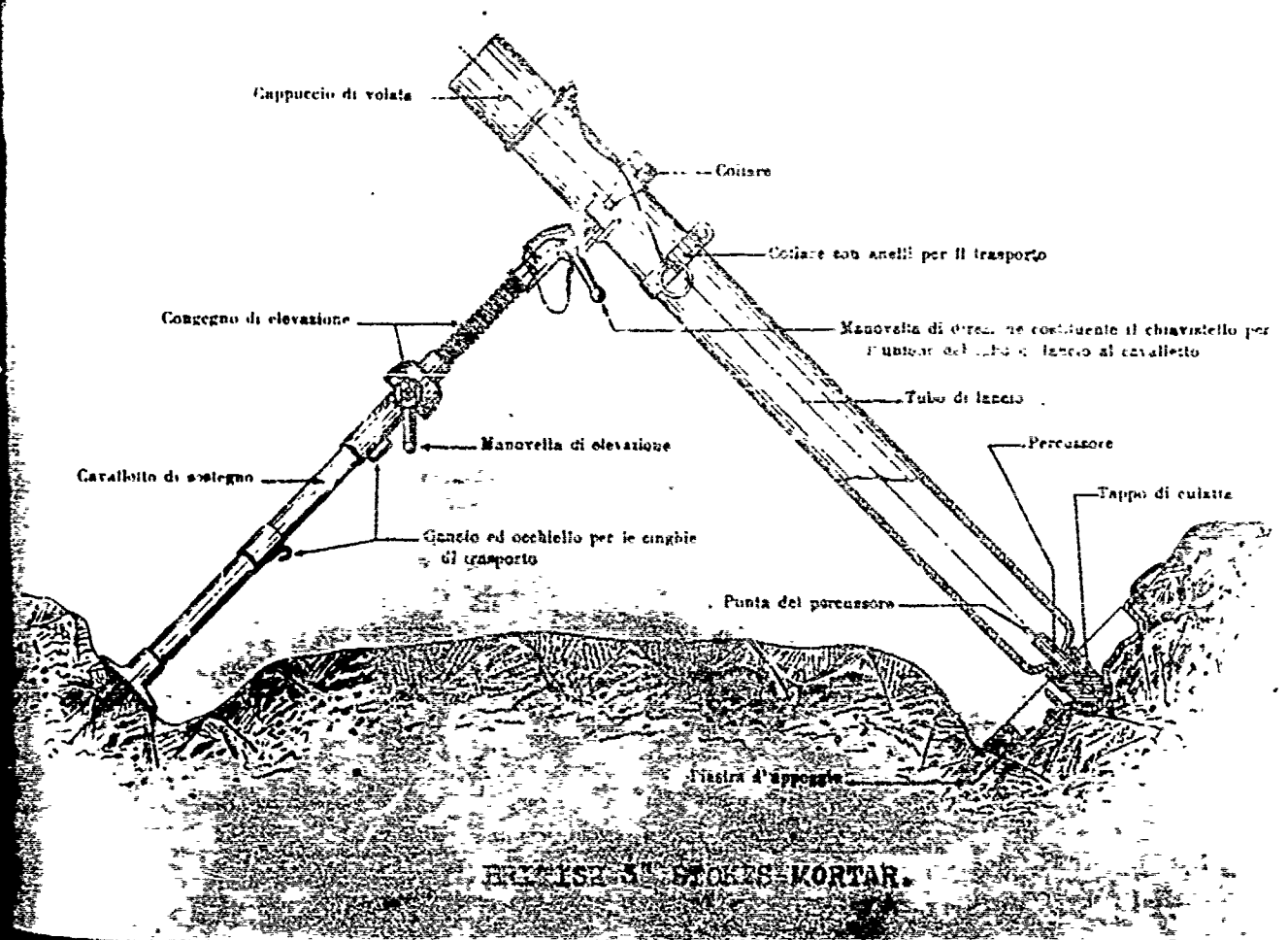
A 6-inch battery is equipped with 9 ordnance trucks of 2 tons capacity each. These trucks have a speed of 15 miles per hour, and will probably average 10 miles per hour on an open road. The entire personnel of the firing battery , together with the special detail, and 6 guns with caissons, carts and 24 rounds of ammunition per gun can be transported at one time on these trucks. Equipped thus, and with the light hand carts for use away from the road, such a battery becomes the most mobile artillery yet devised. Actual experiment has shown that a battery can debark from the trucks with full equipment, and be readu to move out on foot with the carts within 5 minutes after halting the truck train. Re-embarking on the truck requires scarcely more than debarking. Under trench warfare conditions it is usually possible to bring the trucks up within 2 kilometers of a position. Under field warfare conditions it is possible often to approach much closer to the position.

Because of their comparatively short range, Mortar Artillery must follow much closer behind the Infantry than is the case with the longer range artillery. If the Infantry is halted by machinegun nests, wire or strong points, it is the function of the mortars to clear the way. The 6-inch mortars are effective against any but the strongest shelters and emplacements. They are also effective against tanks. A single bomb, falling within one motor of a tank, will disable it. Because of the heavy charge of H.E. the moral effect of these bombs on personnel is very great. An instataneous fuse is used for cutting wire, and for use against personnel. The penetration with this fuse is slight. A delay fuse is also used which permits penetration and forms a crater about 4 meters across and 1.5 meters deep. This fuse is used with good effect against earthworks. Though not at present so used, these bombs might also be loaded to great advantage with gas.

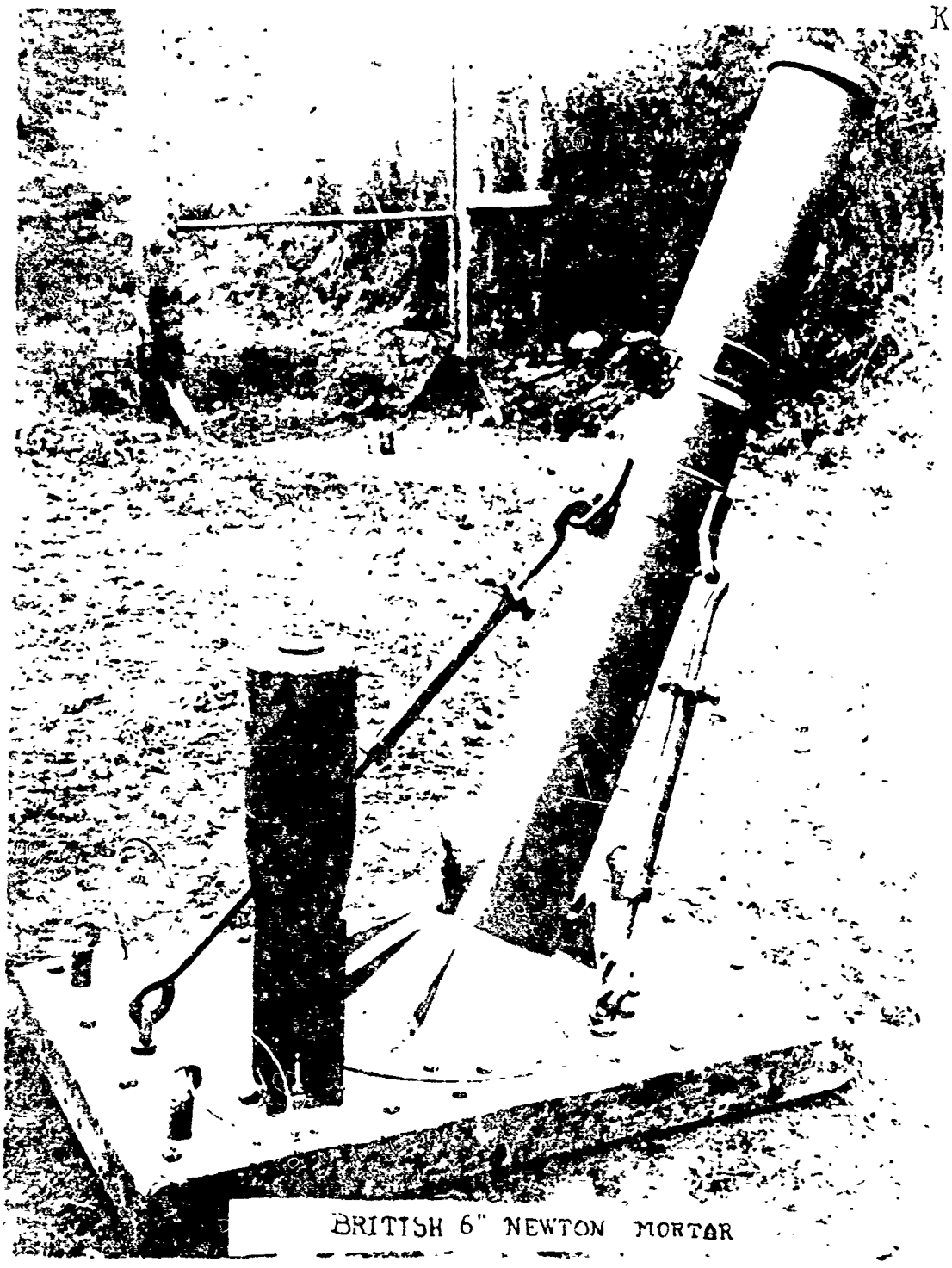
At Chateau-Theirrey the Infantry was held up by machine gun nests, It was found possible for the Infantry to pass around these, and they were left for the slow moving mortar batteries to destroy after the infantry had gone on. With truly mobile mortars it would have been able to eliminate such obstacles at once with fewer casualties to the Infantry.

To make an opening in a strong defensive position a concentration of Artillery is necessary. Six guns or even 12 guns are not sufficient to effect an opening large enough to permit of any considerable Infantry attack. The Mortar Artillery should be so organized that a heavy concentration on a considerable front is possible. Mortars can breach wire, destroy machine gun emplacements and trenches more cheaply and quickly than any other type of gun. In the open they are tremendously effective against personnel. All of these uses require concentration of many guns. This concentration can be accomplished by organizing mortar batteries into regiments of at least 6 batteries each. One such regiment of 6-inch mortars per Division, together with the longer ranged artillery which the Division now had, would better enable the Divisional Commander to meet all contingencies within the scope of his authority. Regiments of heavier mortars would be directly under the Army or Corps Commander. Or all regiments of Mortar Artillery might be directly under the Army or Corps Commanders.

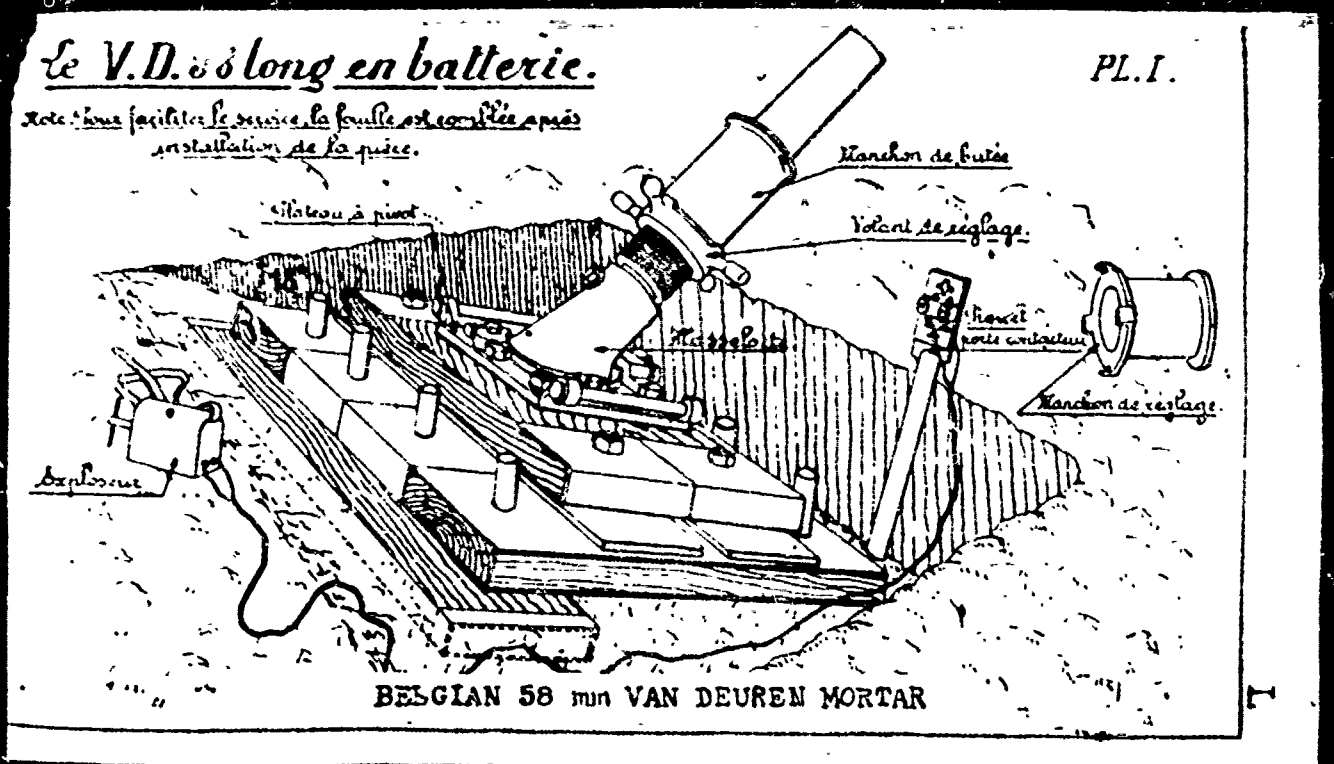
Each particular type of weapon has its own specific uses. The short range mortar cannot take the place of the longer range field guns any more than the field gun can take the place of the still longer range railroad gun. Each has its place; each has functions which the other cannot perform. The developed Mortar Artillery, as outlined above, can be assigned to missions which no other type of artillery can so well accomplish. It has functions which no other can usurp. It remains to develop it so that it can best fulfill those functions.

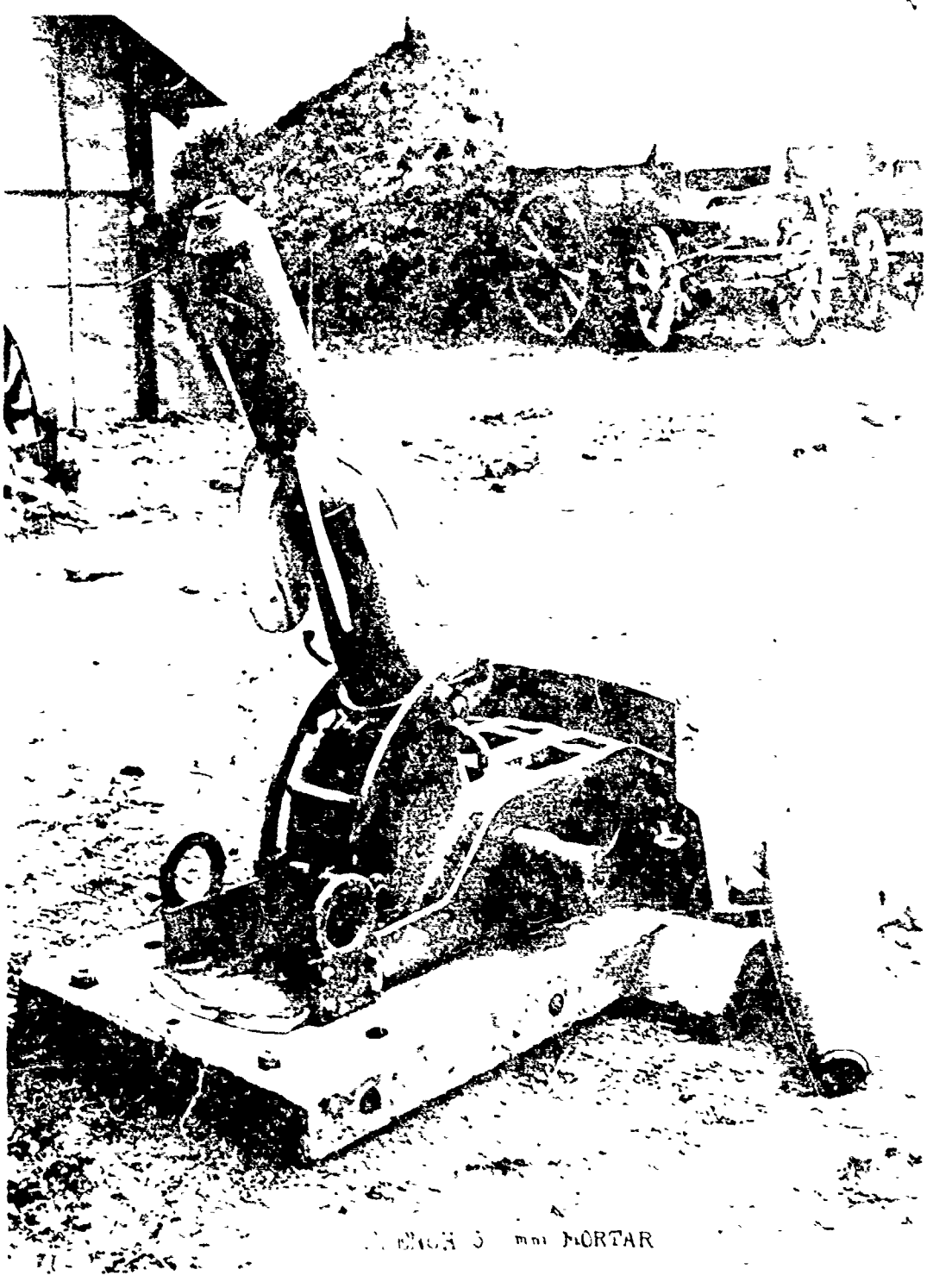


BRITISH STORES MORTAR.



BRITISH 6" NEWTON MORTAR


Le V.D. 58 long en batterie.
PL.I.
Note: Une facilité le service, la fouille est complétée après installation de la pièce.
Manchon de butée
Volant de réglage.
Affût-berceau à pivot
Chevalet porte contrepoids
Manchon de réglage
Semelle
Vérin
BELGIAN 58 mm VAN DEUREN MORTAR

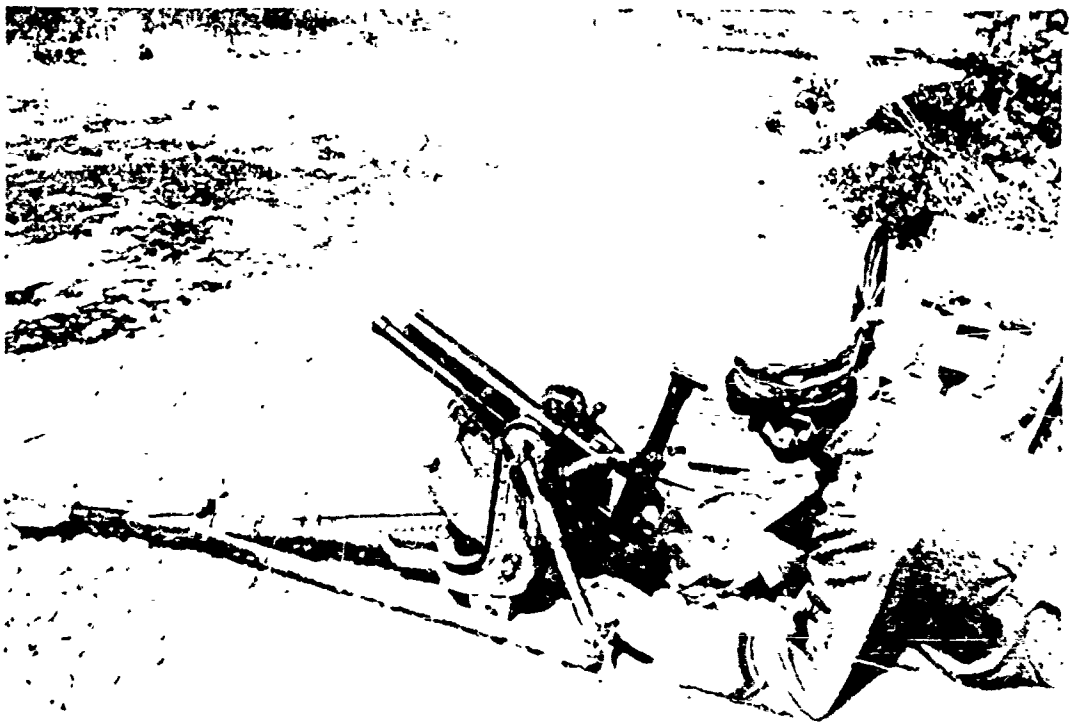


81mm MORTAR

BEAM 240 mm MORTAR

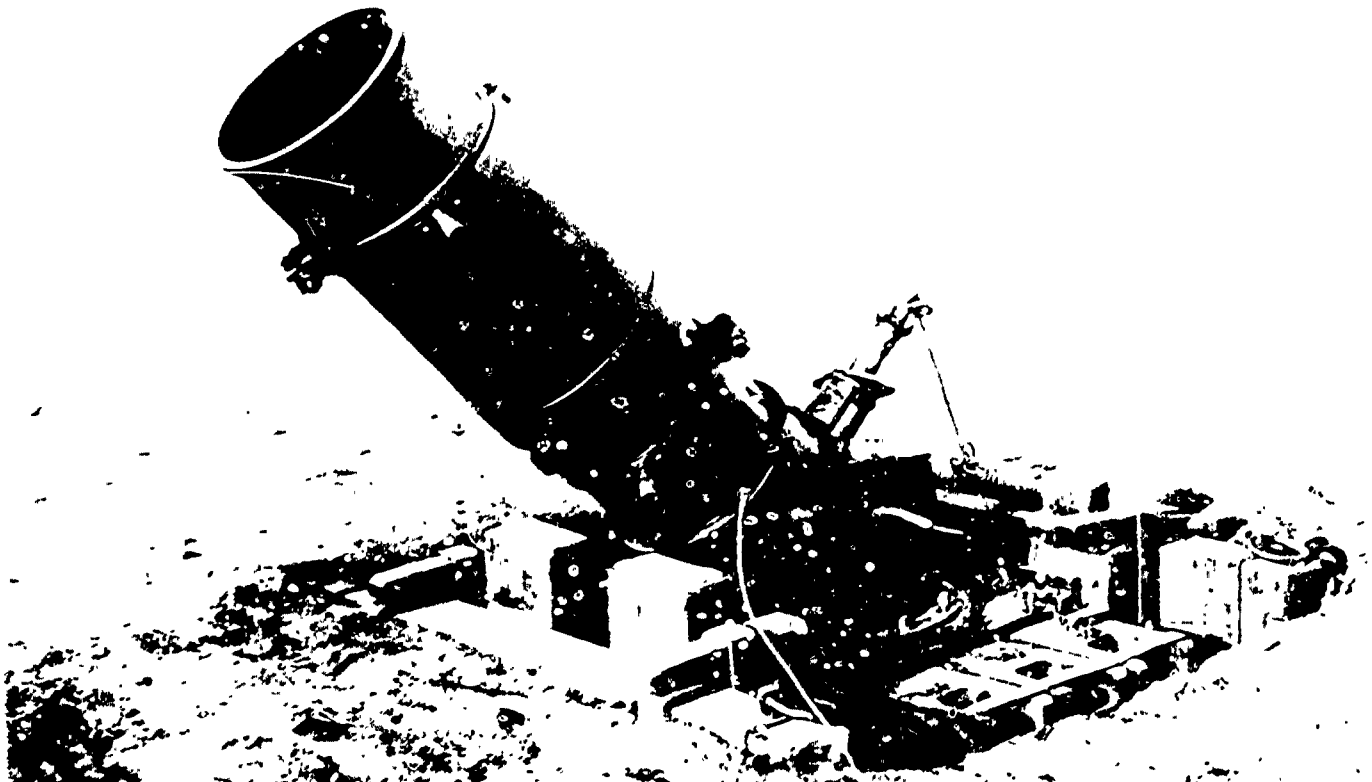
ITALIAN 37 mm GUN

ITALIAN 37 mm GUN

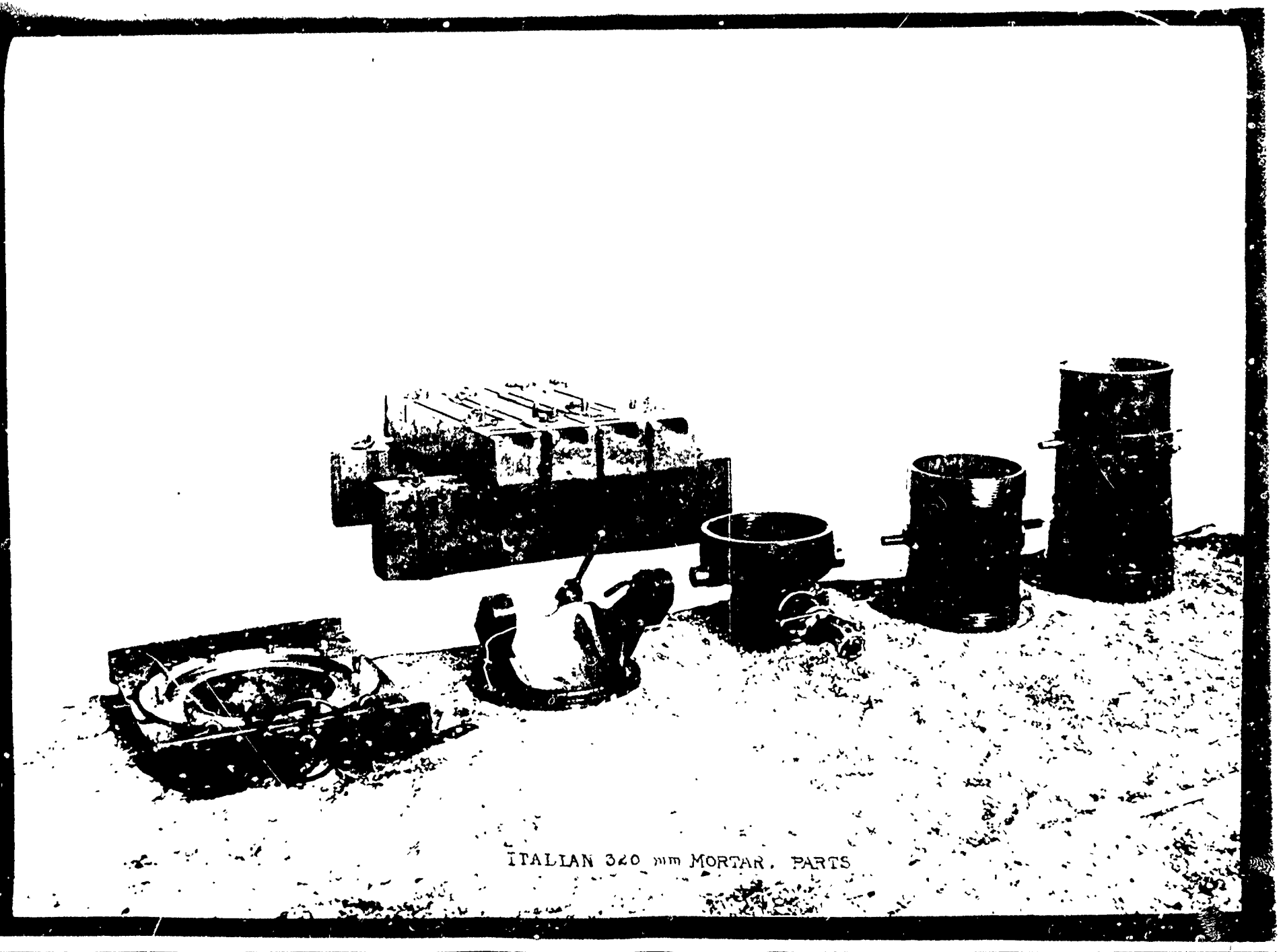


F 8 7

ITALIAN 37 mm GUN



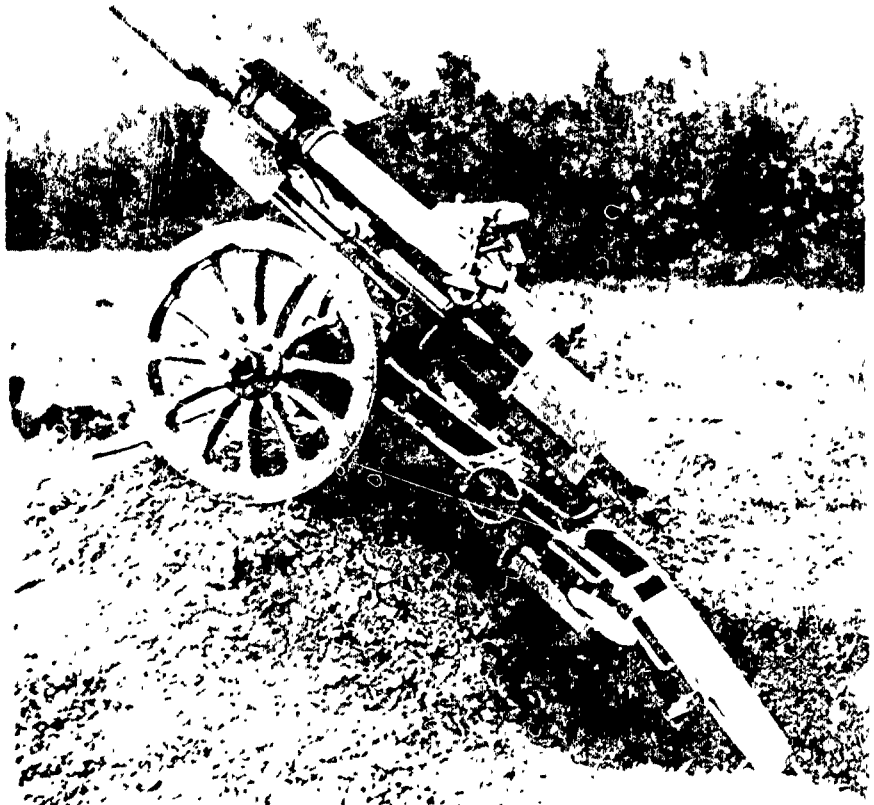
ITALIAN 32[illegible] mm MORTAR



ITALIAN 320 mm MORTAR. PARTS

ITALIAN 320 mm MORTAR, MULE TRANSPORT.

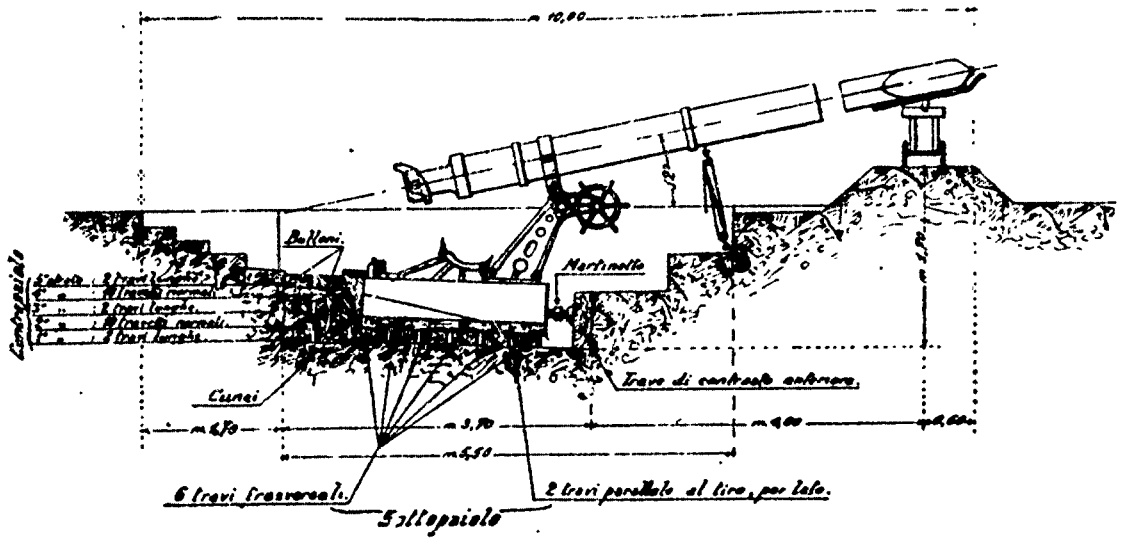
ITALIAN 320 mm MORTAR SOLDIER TRANSPORT



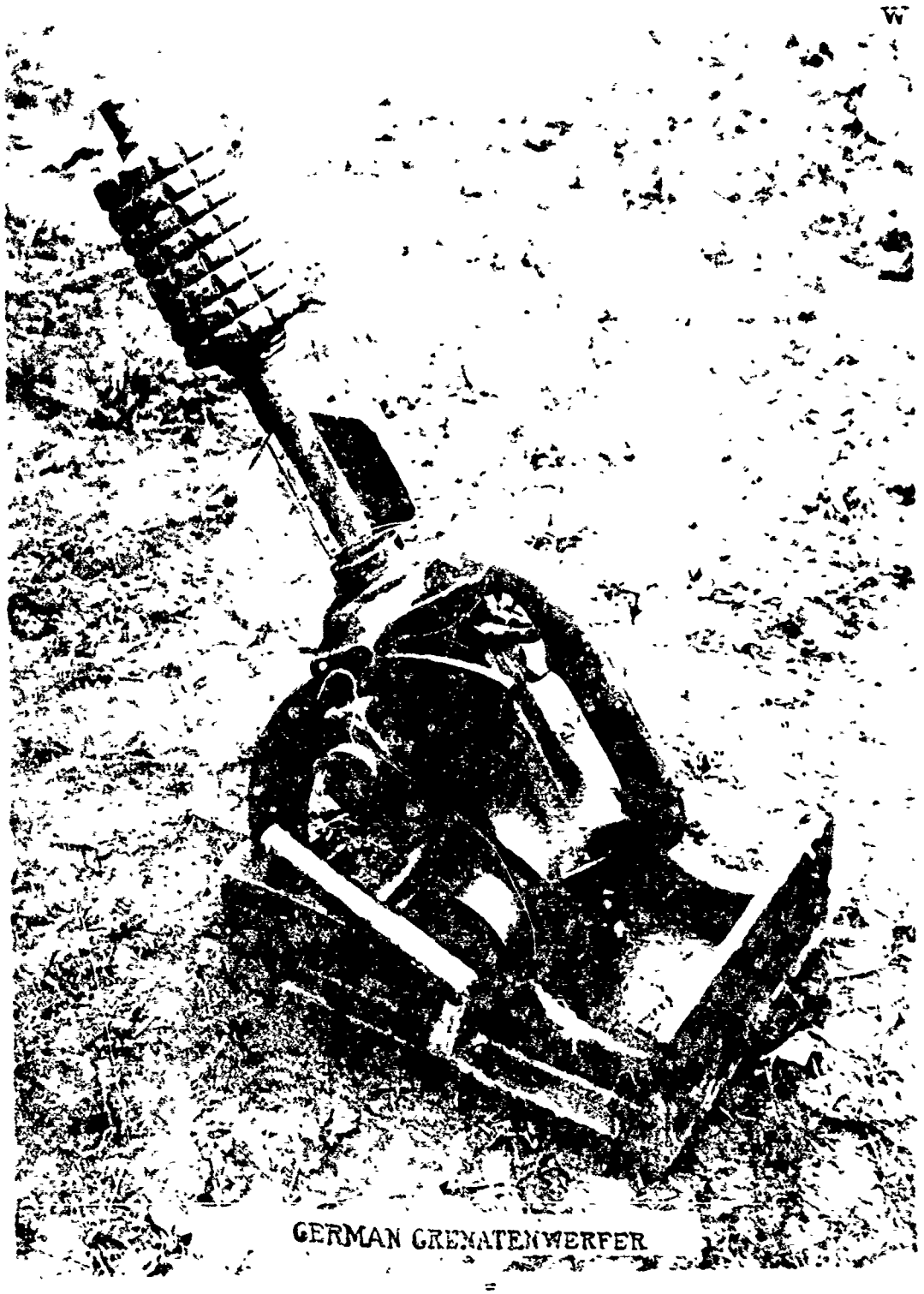
ITALIAN 65 mm MOUNTAIN GUN, BOND IN PLACE

ITALIAN 65 mm MOUNTAIN GUN ADAPTED FOR MORTAR BOMB

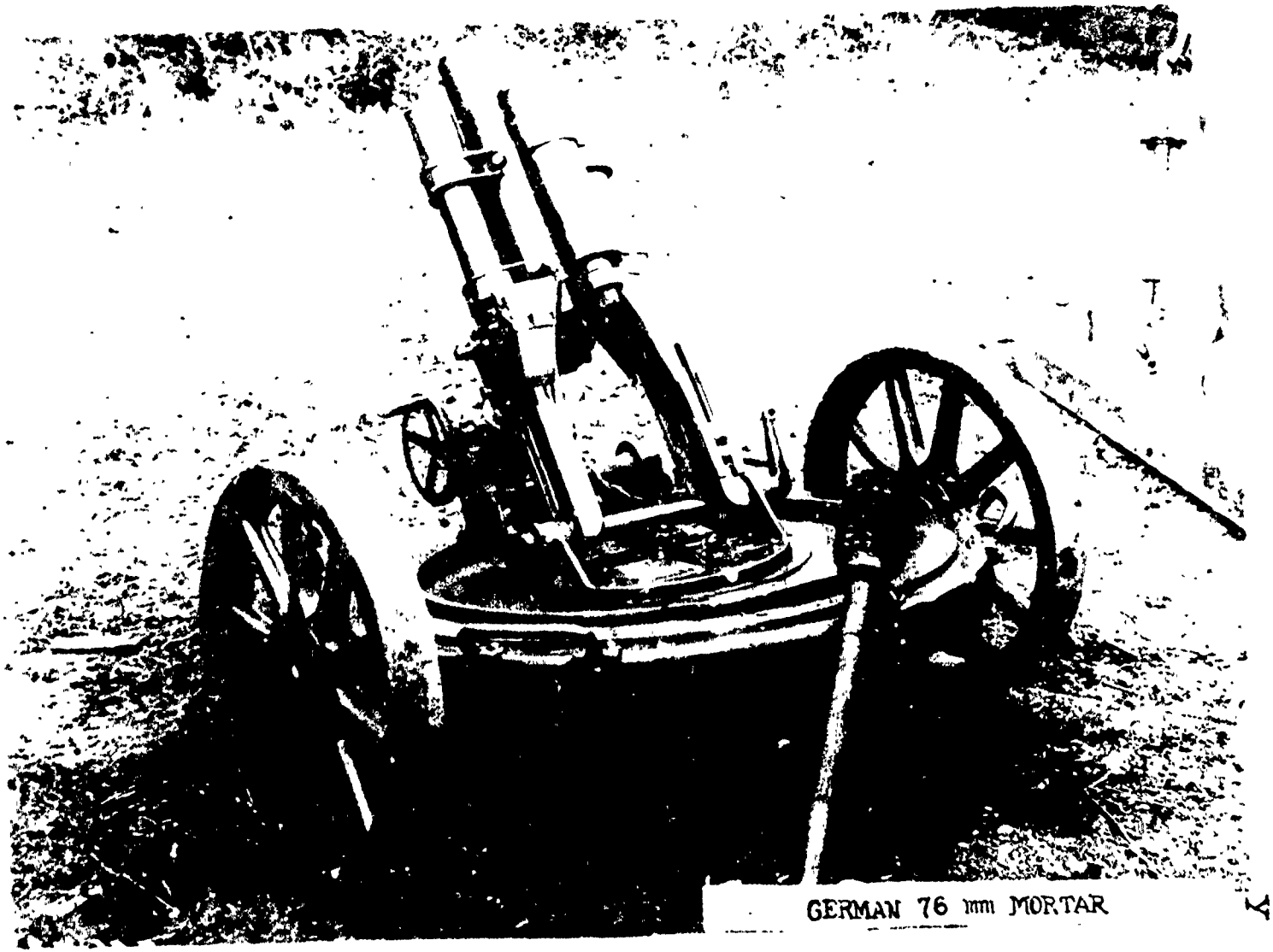
Bombarda da 420 in batteria.
Vista schematica di fianco e sezione.



ITALIAN 400 mm MORTAR



GERMAN GRENATENWERFER

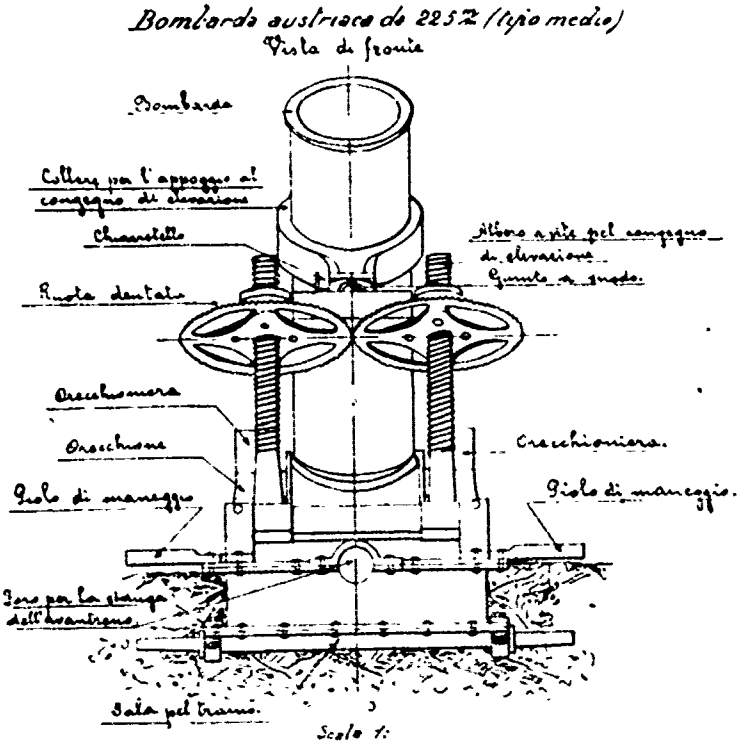


GERMAN 76 mm MORTAR

Z

buste manovelle per eseguire gli spostamenti in direzione e per il trasporto;

b) due fiancate formate da un blocco di ferro fuso a base rettangolare, fissate alla piattaforma con bolloni e munite superiormente di orecchioniera e sopra-orecchione;

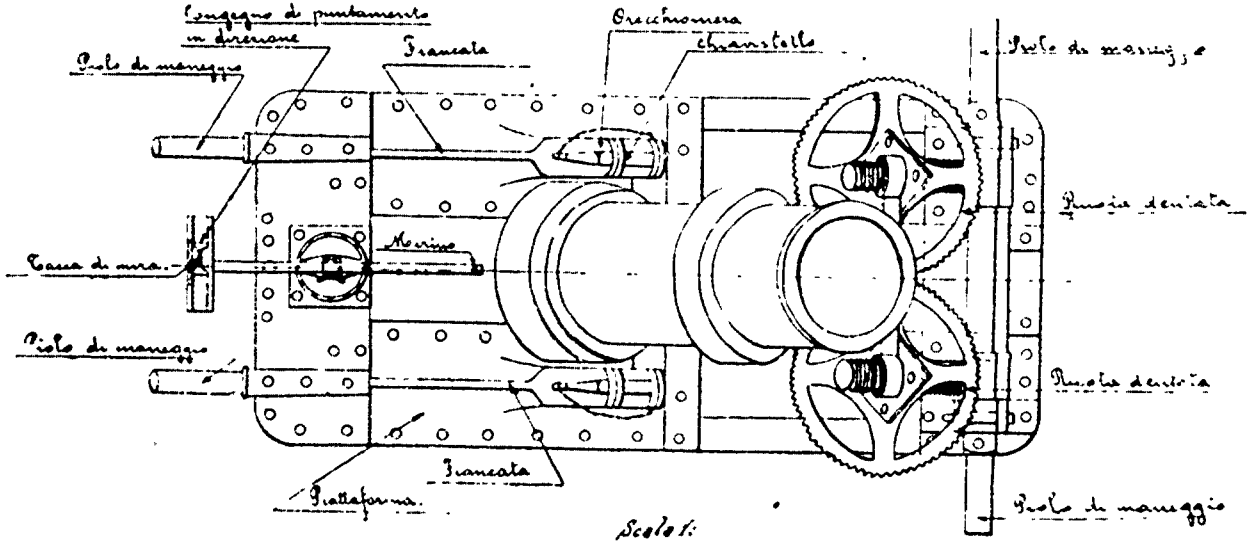


AUSTRIAN 225 mm MORTAR, FRONT VIEW

c) il congegno di elevazione costituito da due alberi a vite montati su di una sbarra colle estremità foggiate a perno, poggiate in due appositi supporti fermati alla piattaforma; sui due alberi sono calettate due ruote di maneggio, sui cui mozzo è montato un braccio con giunto a snodo per l'appoggio del collare anteriore

Bombarda austriaca da 225 m/m (tipo medio)

Vista in pianta



Scala 1:

AUSTRIAN 225 mm MORTAR, TOP VIEW

A

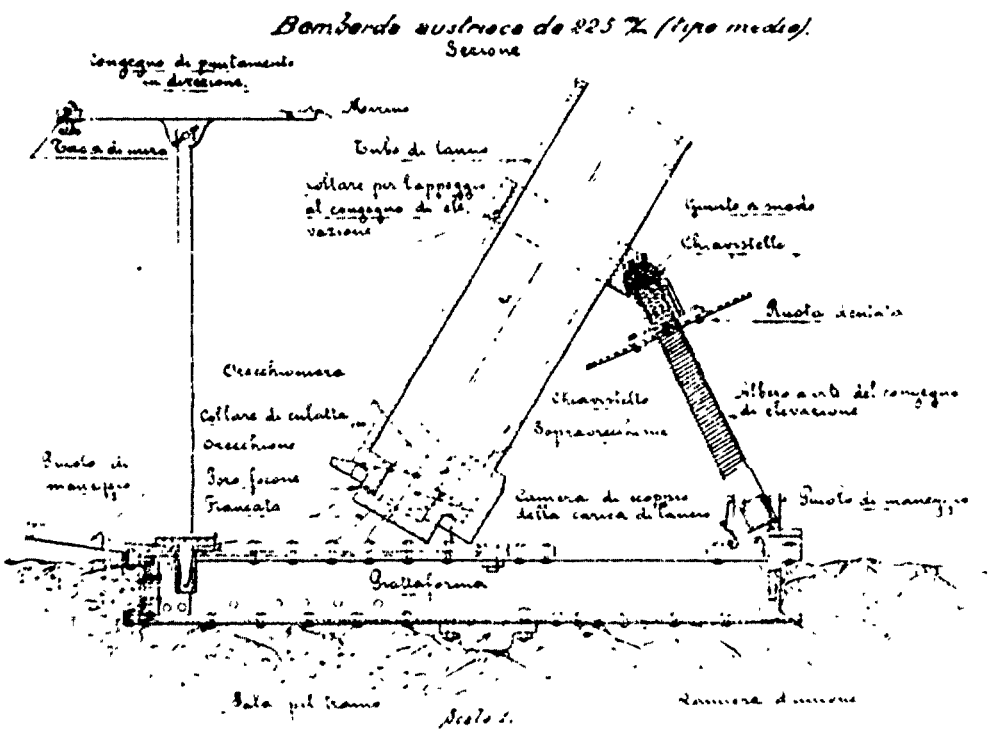


Fig. 61

AUSTRIAN 225 mm MORTAR, SIDE VIEW

BB

Translation from A-2-c. No. 2909. (J.R.R.) January 25 1919.

(From the "Appendix to Instructions on the Handling of Mortars," issued by the Commander of the Mortar School of the Royal Italian Army.)

Page No. 207.

Part IV.

ENEMY MATERIEL

297. Foreword. It is useful that the personnel of the bombardier detachments know the different materiels of the trench artillery used by the enemy, especially because the circumstances of the war may give rise to the opportunity of rapidly employing the material which, in some circumstances, the enemy may abandon in positions which we have conquered.

The materiels discussed in this part of "Appendix" are not all those employed by the Austrians. The School will in the future continue to divide the subject under separate headings; for the present only that material is discussed which is most frequently employed by the enemy upon which the School has made studies and experiments and upon which instructions have been given to the mortar corps personnel.

Chapter XV.

DUMMY RIFLE GRENADES

298. Dummy Rifle Grenades of 292 m/m (51). These are constituted of a cylindrical iron tromblon closed at the posterior end. Externally near the muzzle, are soldered 3 small pins diametrically perforated, to which are bound with twine the keys of the percussion charges of the projectile.

The tromblon is 1.22 m. long and 292 m/m in calibre, the walls are 12 m/m in thickness and it weighs 120 kg.

299. The projectile (seen in cross section in figures 51 and from the side and bottom in figures 52 and 53) is a wooden barrel surrounded with iron at the extremeties in the form of a cylinder capped by a truncated cone, the walls of which are about 40 m/m thick. The staves of the barrel are fixed on the inside by means of screws attaching them to a cylinder of metal. The dummy rifle g made is traversed longitudinally by an iron tube which serves to give passage to the fuse which ignites the charge. This tube has at the extremety two screw-threaded dies and thus functions as a bolt in connection with the cylindrical part of the projectile and its truncated-cone cap which is also of wood; this latter is furnished with 3 spark connections with relative detonators and 2 screw eyes to which are attached an iron wire handle serving as a means of transporting the grenade and of controlling it when it is introduced into the trunion.

The cylindrical portio. of the projectile contains a sheet iron cylinder in which the explosive charge is held. This cylinder has along its diameter an aperture also guarded with sheet iron, for the passage of the iron tube mentioned above. The external base of the barrel is covered by a plate of iron.

300. Each of the 3 spark plugs (or spark connections) is made of the following parts: (a) a small iron tube (Fig. 54 and 55), of about 12 m/m in diameter which traverses the cover of the projectile and serves to contain the small tube which carried the detonator, capsule and fuse; (b) A small tube of brass which is introduced in the upper extremety of the preceding and fixed with pressure screws threads; the upper part of this little tube is threaded and in the lower part it is furnished with the spark capsule of the fuse; (c) a striker (Fig. 55), formed by a brass bar with a ring and a point, a steel spring with a brass ferrule which serves to compress the spring and fix the striker in a little brass tube, and by a key which maintains the striker arm and is tied with a cord to one of the pins on the muzzle of the tromblon; (d) a fuse with a detonator whose combustion is about 10 seconds and which is fixed to the upper capsule by a small, narrow-necked tube; (e) a detonator formed bya sheet iron box containing 1/2 kg. of pertite with a small tube inside which serves to contain the lower extremity of the fuse with the detonator; this sheet iron box is closed at the top by an iron stirrup.

301. The projectile weighs 50 kg. and contains 13 kg. of explosive (chlorate of potassium). The charge consists of small sacks of black powder weighing from 250 to 500 grams.

302. Operation. The grenade is inserted about 2/3 the length of the tromblon which is given a convenient direction and inclination; at the bottom of the same, against one of the lateral sides, is placed the discharge; on the posterior side a fuse 1.50 m. is introduced into the longitudinal tube of the grenade; to the lower extremity of the fuze is applied a detonating capsule and the fuse is tied by a string to the die at the base of the grenade in such a manner that the capsule is placed opposite the base itself, thus taking care that in introducing the grenade into the tromblon the capsule does not strike against the breech and produce a premature ignition of the charge; the grenade is introduced into the tromblon, letting it slide gently while controlling it with the handle and arranging it in such a way that the capsule of the fuse falls near the explosive charge; the strikers are armed by compressing a spring and closing it with the key, and the little tubes bearing the strikers are screwed tight with caution; the cords connection the rings of the strikers to the posts on the muzzle are tied stongly but in such a way that there will be no tension; finally, the fuse is lighted and the assistants are dispersed. As the grenade leaves the muzzle, the keys of the strikers held by the string are automatically extracted and the striker, thus liberated hits the capsule and causes the ignition of the fuse of the grenade.

303. Experiments made by the School of Susegana (June 1917). Inclined at 55 degrees and with an explosive charge of 500 gr. a range of 300 and 330 m. was attained with 2 grenades respectively; traverse about 10 m.

Effects. On compact, gravelly ground the gravel was thrown about for a radius of 4 m. which visible traces of calcination. It appears that the grenade resists the shock of falling very well, even on very hard ground.

304. Dummy Rifle Grenades of 390 m/m. This grenade is similar to the preceding one, differing from it only by its greater calibre and its weight; this latter is 145 kg.

305. The projectile has the same composition as that of 292 m/m, weighs 97 kg. and contains 30 kg. of explosive. The sheet iron box containing the explosive, occupied, however, the whole cavity of the grenade, reaching as far as the cover in such a way that the detonators are surrounded by it; each of these contains 1 kg. of pertite. It is shot with a charge of black powder weighing from 1 to 1½ kg.

306. Experiments Made by the School of Susegana. (July 1917). With an explosive charge of 1 kg. formed by 2 coupled charges of 500 grams each, and inclined at an angle of 55 degrees, a range of 330 meters was attained.

Effects. On a grassy field with a gravelly sub-soil about 5 c/m from the top, the earth was scattered for a radius of about 7 m. with visible traces of calcination of stones and metallic ships of the projectile, for more than 300 meters.

#307. Employment of Dummy rifle Grenades without Tromblon. The Grenade of each of the preceding types may be employed without tromblon by means of making it roll down hill. The ignition of the same is prepared as follows: To a Bickford fuse (1 on the second) a detonating capsule (at least a No. 6) is applied and this is introduced into one of the small spark plugs of the grenade and is fixed there with little pieces of wood (or other waste material); then the fuse is attached to the cover of the grenade to prevent it from expiring while rolling. Thus prepared, the fuse is ignited and is caused to roll, possible for the first two or three meters by means of a machine arranged as an inclined plane by means of planks of wood. For greater assurance that it will function, the fuse with the capsule may also be applied to the 2 other tubes of the spark plug.

308. Advice for the verification and easy employment of captured material:

(a) Be sure that the tromblon is in a good state of preservation (that there are not dents in it, which if they are towards the muzzle and of small dimensions, may be eliminated with a hammer or file); (b) proceed at once to the cleaning and oiling of the interior of the tube and then keep the mouth of the same closed with a cover of sheet iron of impermeable cardboard or other similar material; (c) be sure that the little tubes carrying the strikers are quite firm and well fixed in the irbn tube of the spark plugs; (d) be usre that the strikers function well; (e) examine the state of preservation of the explosive charge and of the fuse, the latter of which also controls the velocity of combustion; (f) before charging the piece, grease

the tromblon and the grenade; (c) arm the strikers by introducing the keys 2/3 of the way only in order to facilitate their issue at the moment of firing; (d) place all three of the strikers of the grenade in position, or at least 2, in order that the fuse may not fail to ignite; (e) if the grenade does not issue from the tromblon, wait at least 5 minutes in addition to the time calculated for the combustion of the fuse before approaching the piece, for sometimes the fuse does not function with the desired speed; untie the cords of the strikers from the posts on the muzzle, take out the firing pins, cautiously unscrewing the respective tubes and extract the grenade from the tromblon by means of the attached handle; change the ignition fuse of the explosive charge and recharge the piece according to given instructions.

In operations which take place about a loaded piece it is necessary that those engaged in the work should keep as much as possible out of the line of projection of the grenade for the purpose of eliminating or diminishing eventual mishaps.

CHAPTER XVI
60 m/m Winged Grenade.

309. Powder winged grenades of 60 m/m are composed of three parts: (a) the winged grenade properly so called; (b) the cartridge; (c) the base.

Weight without base 17.5 kg. It comes within the category of small trench arms - grenades - employed by the infantry itself.

In Fig. 56, 57, 58, the grenade is represented in longitudinal cross section ready for firing.

310. The winged grenade properly so called is composed of a steel cylinder 37 m/m long and 45 m/m in diameter at the middle.

The upper part of the same, formed like a cup, has a diameter of 60 m/m for a length of 10 c/m and internally it is furnished with a hole about 60 m/m deep, 37 m/m in diameter, which forms the placing and chamber of the explosive charge; on this cup there is placed a hollow shaft of the bomb as in the 70 V.D. mortar.

The bottom of the cup, formed by a threaded plug, has a little hole in the middle to allow the point of the striker to pass. This is composed of a little bar of iron 15 c/m long, of an external diameter about 10 m/m sliding in a cylindrical cavity in the middle part of the grenade. Between a little projection in this cavity and the head of the striker there is arranged about the latter a strong spiral spring normally half compressed; the bar of the striker is furnished with a hole which serves to allow the striker to be pressed down (when the spring is entirely pressed), with a subjoined iron across a longitudinal breech of the bomb itself, 40 m/m away - and opened in the middle posterior portion thereof.

The grenade has another transversal aperture in which a safety pin is introduced with a safety key traversing even the handle of the striker in order to keep it armed.

The lower portion of the grenade has a hole about 30 m/m in diameter through which passes the bearing bolt which serves to fasten it to the carriage.

In the forward oblique portion of the grenade it will be noted 2 other bearings with holes through which passes a pivot (with pressure screw threads, operated by a handle) which glides in 2 sections controlled by the carriage, permitting it to be fixed at the desired inclination.

311. The carriage is composed of a block of fused cast-iron and comprises a plate which forms the base, and 2 flanges (on longitudinal projection). The base is 30.5 c/m long and 24 c/m wide. The flanges are 25.5 c/m high; these have 2 sections which control and in which slips the elevation pivot; these sections are graduated from 30 to 85 degrees. On the right flange 2 pins are fastened on the inside for the purpose of supporting a sighting instrument. On the lower part of the flanges there are, moreover, holes for the passage of the bearing bolt. Toward the front, the base has a hole giving passage to a screw by means of which the grenade is fixed to the foundation; in addition it is furnished with a brass shield upon which are indicated the various ranges and angles of inclination.

312. The carriage with the grenade lowered may easily be carried on the shoulder by means of appropriate shoulder rests.

313. The foundations received by the school and which serve for this type of grenade are formed by a block of wood of a medium thickness of 15 c/m with a rectangular base 100 x 26 c/m. Above it has 2 inclined planes; upon one of these the grenade is fixed by means of a plate with screws which is introduced into the forward aperture of the base of the piece.

314. The projectile (Fig. 59 used with this grenade is a bomb formed of 2 parts; the body and the shaft. The body of the bomb is piriforme, made of cast iron with pre-established fracture, 4 m/m thick at the hollow places and 6 m/m thick at the raised places, containing explosive and sometimes small lead bullets; at the top there is a hole into which the fuse is screwed and this latter is provided with a security cap which should be taken off before firing.

The shaft is made of an iron tube 50 m/m in diameter and 2 m/m thick; above is closed by a plug screwed internally into the body of the bomb. Four sheet iron wings are fixed to the shaft by means of screws.

The bomb weighs 4 kg.; the internal charge is similar to ammonal and weighs 510 grams; the detonator is composed of 45 grams of pertite.

315. The percussion fuse is shown in Fig. 60; the following points will be noted: (a) a hollow cylinder of hardened lead, threaded at the top in order that it may be screwed to the bomb, and at the bottom so that it may be attached to the receptacle containing the detonator; (b) a brass plug which closes the above mentioned cylinder at the top; (c) a striker screwed into the plug itself and furnished with a screw which, during the trajectory, completely screws up in such a way that its point is brought into the in-

terior; (2) a small hollow cylinder made of heavy brass and containing the capsule which slides in a hole. Be cylinder and is held in place by a spiral spring.

When the projectile falls, the small brass cylinder containing the capsule, overcoming the resistance of the spring, hits against the striker, thereby causing the ignition of the capsule, the flame of which causes the detonator to function, which in turn causes the detonator of perite to explode.

316. The explosive charge is made up of 40 grams of loose powder contained in a paraffined pasteboard cartridge to which a capsule is applied on the outside so that when the striker hits, it causes the explosive charge to ignite.

317. Each case of bombs contains 6 bombs, and 6 cartridges contained in the shaft of each bomb.

318. Operation. The foundation should be fixed in the direction desired and the grenade attached; a convenient degree of inclination is given; then the striker is armed introducing the safety pin to which the safety key is quickly applied. The explosive charge is placed in the cup of the grenade and the shaft is attached to the bomb from which the cowl covering the fuse should first be removed; then the safety key of the safety pin is taken out, and by means of string this latter is removed, thus causing the striker to fly loose.

319. Experiments made by the School of Gaseous (July 1917). With a normal explosive charge and with an inclination of 45 degrees, 6 discharges were made successively obtaining ranges 450, 432, 425 m. respectively. The bombs were very stable in trajectory; maximum traverse 10 meters. The winged grenade attains a noteable speed in flight. The grenades exploded on compact, gravelly ground and made holes about 1.20 by 0.40 meters.

320. Range table attached to the shield at the base of the carriage.

Inclination (Degrees)	Range	Correction for 1 Degree
45	440	2
50	436	5
55	410	7
60	376	9
65	332	10
70	280	15
75	205	15
80	129	15
85	58	--

321. Advice for the verification and quick use of material:

(a) Be sure that the grenade properly so called is in a good state of conservation especially as regard the cup and the carriage which should not have any splits.

(b) Be sure that the striker spring is in good condition, pressing upon the striker with the attached iron with which every winged bomb is furnished or with any other useful implement.

(c) If the safety pin is lost, substitute for it a nail of proper size bent into a hook to which to attach the strip.

(d) Follow out the operations indicated in paragraph 316, bearing in mind that the cartridge should be completely pressed down into the cavity of the cup of the primer.

(e) If there is a misfire take out the bomb and the cartridge, re-arm the striker, recharge the piece and discharge the striker the second time. In case of another misfire change the explosive charge.

(f) After 5 or 6 shots clean the cup, greasing the external surface to prevent rust and for the purpose of facilitating passage of the shaft.

CHAPTER XVII.
225 m/m Mortars.

322. Austrian mortars of 225 m/m caliber operating with powder are of 3 types, differentiated solely by the length of the barrel; they are:

The short mortar whose barrel is 0.80 m. long.
The medium mortar whose barrel is 0.94 m. long.
The long mortar whose barrel is 1.10 m. long.

Fig. 61, 62 and 63 represent the medium mortar in cross section from the top and from the front.

323. The mortar properly so called is made of a steel tube 225 m/m in caliber and 14 m/m in thickness. The breech forms a single piece with the barrel and has a discharge chamber, cylindrical in form with external diameter of 14 c/m and whose height is 8 c/m and which is furnished with a priming hole.

About 50 c/m from the breech a strong collar of iron is screwed into the barrel as a support for the elevating apparatus; another thick collar is forged on the breech and provided with 2 flanges for the purpose of mounting the mortar on the carriage.

324. The carriage is composed of the following parts: (a) a rectangular platform 1.40 m. long and 0.67 m. broad, composed longitudinally of 4 C irons and transversly of 4 C irons united above by a plate 1 c/m in thickness which constitutes the base of the ground support; at the 4 angles of the platform strong iron pins are fastened to which are attached, by means of sleeves, strong handles for placing the piece in position and for transporting it; (b) two flanks formed by ~~knits~~ a block of cast iron with rectangular basis, fixed to the platform by bolts and provided above with a bearing and bearing cap; (c) the elevation device is composed of 2 screws mounted upon a bar with its extremeties working on a pivot, placed in 2 supports attached to the platform; upon the 2 screws are placed 2 controlling wheels by the movement of which is raised an arm with a loose jointure for the support of the anterior collar of the barrel; the 2 wheels are toothed and mesh in such a way that if only one is touched both revolve about the 2 screws raising the above-mentioned arm and thus varying the inclination of the mortar; (d) the aiming apparatus is composed of an iron tube

movable on its diameter, about 1 m. high, fixed vertically on the rear portion of the platform; to the top of this is fixed an arm terminating at one end with a sighting notch sliding on a graduated rule, and at the other with a front sight.

The carriage, by means of an axis fixed upon the platform, may be mounted upon 2 wooden wheels with iron tires for the purpose of transport and may be moved on level ground by 4 men. For the short mortar the length of the axle is 1.00 m. and for the medium and long mortar 1.10 m; these latter have larger wheels. These two types may also be moved by means of suitable limbers to which 6 horses may be attached and upon which the caissons may also be placed.

325. The projectile for the mortars of 225 caliber are of 2 types: (a) the bomb 78 c/m in length (Fig. 64 and 65), made of a cylindrical iron tube 1 c/m thick and reinforced by 2 or 3 rings which are partly forced on and partly provided for by lathe turnings; to the upper part of the cylinder there is screwed a spherical cap to which is attached the ignition plug; to the posterior end there is screwed a base 2 c/m in thickness with a ring of leather or other analogous material containing a hole for the charging of the bomb and closed with a screw plug; when charged the projectile weighs 76 kg. and contains about 2[illegible] kg. of high explosive (Ammonal type); (b) a bomb of 50 c/m in length (Fig. 66 and 67) similar to the preceding but with only 2 rings for reinforcing and centering and with walls 2 c/m thick. When charged the bomb weighs 65 kg. and contains 12 kg. of the same explosive.

326. The system of ignition is that of percussion in the short bombs, and in part, in the long ones also, and partly by time for these latter.

327. The percussion type is composed of the fuse and the detonator (Fig. 58).

The fuse, of the Lenz type, screws into the proper mouth piece (fastened in the ogive of the bomb) after the small screw plug which closes it has been removed. The parts of the fuse are as follows (Fig. 68):

(a) A brass plug (1) the lower portion of which is provided with screw threads in order to allow it to be screwed into the mouth piece of the spherical ogive of the bomb; above it is screwed a brass cylindro-conical container (2) with 2 openings (3 and 4); in correspondence with one of these (4) a small spring (5) is fastened internally.

(b) A striker (6), the pointed shaft of which slides in a small hollow brass cylinder which contains the capsule (7) (8); between the capsule and the point of the striker (6) there is arranged a small spiral spring (9) and between the head of the striker and the upper part of the cylinder (7) there is, in a position of security a small fork (10) placed in correspondence with the opening (4) of the container (2).

(c) A sheet iron cowl (11) which almost entirely covers the container (2); upon the same there is placed a flat spring (12) with a hook (13) which, across an opening (14) of the cowl itself, hooks it to the container (2) screws the opening (3) of the latter; the cowl also encloses the security fork (10) pushing back the spring of the same (5); between the conical head of the container (2) and that of the cowl (11) there is placed a half compressed spiral spring (15) which serves to raise the cowl.

(d) A protracting bonnet (16) which prevents the unhooking of the flat spring (12); this bonnet is removed by turning a metal thimble (17).

Another type of fuse instead of having the bonnet (16) has a security ring on the cowl (11) with a key which traverses both of them.

On firing, the cowl (11) by inertia previously liberated from the bonnet or the safety ring, presses harder on the cylindro-conical container (2); the flat spring (12) unhooks and the cowl, by means of the spiral spring (15) snaps away, then the safety fork (10), pushed by the flat spring (5) also disattaches itself.

On striking the ground the heavy cylinder (7) bearing the capsule compresses the spiral spring (9) through inertia, strikes violently against the point of the striker causing the ignition of the capsule, the flame of which passes through the hole of the plug (1) and is communicated to the detonator.

If the bomb falls with the ogive upright the striker is brought into violent contact with the capsule; in any case, given the form of the head of the striker and the terminal part of the cylinder bearing the capsule, given the play existing between these 2 parts and given finally the conical form of the surfaces to which these same apply, the functioning of the percussion will succeed because the explosion takes place even at the minimum angles of fall.

The detonator of the explosive charge is made up of 220 grams of pertite with a charge that functions through the flaming of the capsule of the fuse; it is contained in a cylindrical tube screwed into the spherical head of the bomb.

328. The time fuse connection (Fig. 69) is contained in a steel tube made up of segments screwed together, each of which contains an intermediate plug pierced in the center. It is closed below by a brass plug, it is about 40 c/m long having medium diameter of 38 m/m; at the top this tube has a threaded collar which screws into the spherical head of the bomb.

The fuse is made up of a striking mass in a cylindrical form (1) weighing [illegible] provided with a striker; it is held in a position of security by a screw plug (2) which ought to be taken out only immediately before firing, and 2 spiral springs (3 and 4). The screw plug (2) is protected by a bonnet of sheet metal closed by a lead seal and paraffined paper; on firing the striking mass remains behind and, overcoming the resistance of the springs causes the striker to hit against a capsule (3) placed in one of the plugs (6) of the tube. The ignition of the capsule

ignites the fuse 26 c/m long which is provided with a rapid-burning wick. The burning of the fuse explodes the detonator of fulminate of mercury placed in a powder box containing black powder. Hereupon follows the explosion of the detonator composed of 4 cartridges of pertite weighing 200 grams, and this causes the bomb to explode.

329. The explosive charges are of two types:

(a) Of black powder; 220 grams, contained in a small sack (fig. 70) with a wooden disc whose diameter is equal to that of the discharge chamber of the mortar.

(b) Of Ballistite; 136 grams in five discs united to a disc of cardboard by a coupling.

330. Each case contains a bomb, a percussion fuse for bombs of this type, a charge of black powder or ballistite and a tube of fulminate.

331. Each piece is provided with a hood for the muzzle and a hair brush.

332. This material is handled as follows: when the mortar is placed in position it is pointed in the proper direction and the platform may even be sunk 15 c/m;in the discharge chamber is put the charge, taking care that the wooden or cardboard disc be turned towards the muzzle and the bomb is gently slid into the barrel after having been greased on the rings. Then the fuse is screwed to the bomb (percussion) after having removed the plug from the mouth-piece and the protecting bonnet or key from the fuse; if the time bomb is used, the security plug is removed, unscrewing it to the left.

Finally, when the operators have been dispersed the tube of fulminate is caused to function by means of a long string.

333. Experiments performed at Mortar School, (June, July, 1917).

(a) The medium mortar. With an explosive charge of black powder and an inclination of 45 degrees a range of 650 m. was obtained.

The bombs remain sufficiently stable in trajectory.

On compact gravelly ground the short bombs produced holes 70 x 250 c/m with vigorous scattering of very small chips and visible effects of calcination; the long bomb produced a hole 350 m/m in diameter at the surface and 200 at the base, 70 c/m deep. On meadow land a short bomb which had lost its fuse during flight, buried itself in the earth about 1 meter as did likewise another which burned slowly without exploding.

334. Observations for the verifications and quick usage of material.

(a) One must assure one's self that the trombion is in a good state of preservation (that there are no cracks or dents in it), and that the carriage is also in good condition.

(b) Clean and lubricate the piece and carefully wipe the discharge chamber: then cover the muzzle of the barrel with the proper bonnet or with other suitable cover.

(c) Test the condition of the explosive charge by firing several blanks.

(d) If the personnel is not acquainted with the use of fulminate of mercury tubes, substitute for these a Bickford fuse with a No. 6 detonator which must be introduced through the touch-hole into the discharge chamber before placing the explosive charge in position.

(e) Follow carefully all the operations indicated in paragraph 332;

(f) If the bomb does not leave the barrel wait at least 5 minutes in addition to the time calculated necessary for the ignition of the explosive charge; then change the tube or fuse mentioned in paragraph D and repeat the operation.

If no results are obtained this time, after the same lapse of time unscrew the fuse from the percussion bomb or screw up the safety plug of the time bomb; take the projectile out of the trombion, raising the rear portion of the platform, change the charge and recharge the piece according to instructions given.

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This report includes various blueprints and photographs which depict mortars in being during WWI.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

On March 22, 1919 (?) MG Ernest Hinds submitted this series of recommendations to the Chief of Staff, American Expeditionary Force on the suggested composition of the "New Artillery" which was neither heavy, field, or trench but preserved the best of trench artillery, through the use of mortars. Various comparisons with European mortars in use during WWI are indicated. The findings of the Trench or Mortar Board are complimentary to those of the Caliber Board which was also chaired by BG William I. Westervelt.

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