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ARTILLERY NOTES & GERMAN INSTRUCTIONS

418 Artillery Notes. No.1. Close Shooting in the Field.
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18 pdr. Correction Scale.

No.4. Artillery in Offensive Operations.

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Ausrustung des I.M.W. N/A. (Equipment of the Light Mine Throwers.)

Ausrustungsliste fur den leichten Minenwerfer N/A.

Tafeln zur Berichtigung der Tages und sonstigen Einflusse auf das Schiessen aus der Feldkanone 96 N/A. (Table to report the daily result of the Field Gun).

BRITISH & GERMAN GENERAL STAFF.

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AUSTRALIAN WAR RECORDS SECTION
CLASSIFICATION SUB-SECTION
C 39 / 1 / 22

# ARTILLERY NOTES.

*(Issued by the General Staff at General Headquarters.)*

## No. 1.—CLOSE SHOOTING IN THE FIELD.

This note supersedes the following previous publications:—

C.D.S. No. 30.—Close Shooting by Guns and Howitzers.
C.D.S. No. 31.—Notes on Registration of Artillery Targets.
C.D.L. No. 32.—Instruction for Calibration of Guns in the Field.

*All copies of the above should be destroyed.*

A.D.T. SERVICES D.H.Q.
No. 4148
AUST. W.R. RECORDS

*General Headquarters,*
*January,* 1916.

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Head-Quarters 10th Inf. Bde
A.I.F.

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*(Appendix to Artillery Notes, No. 1.)*

# SOME NOTES ON METEOROLOGICAL CONDITIONS WHICH AFFECT GUNNERY.

## BAROMETER.

The required value of the barometer reading can be obtained with sufficient accuracy from an Aneroid instrument, if this is set to agree with the properly corrected reading of a mercury barometer and checked by comparison from time to time.

The reading of the Mercury barometer with which the Aneroid should agree is not the reading for Mean Sea Level but the reading for the height at which the Aneroid is placed. This reading can be obtained by simple interpolation from the values for Sea Level and for 500 feet.

**Example.**

Aneroid at 340 feet.
Barometer at M.S.L. 29.87 inches.
„ 500 feet 29.31 „

Reading which Aneroid should give to be correct, $29.87 - \frac{340}{500} \times .56 = 29.49$ inches.

Aneroids can be set, if desired, by the Meteorological Officer at Hazebrouck and Querrieu or at the Meteorological Section, 2nd Echelon, G.H.Q.

## TEMPERATURE.

In the middle of the day, the temperature required for use in the range tables can be obtained with sufficient accuracy from a thermometer in a shady but not enclosed place, *e.g.*, a thermometer in the shade of a tree is good, but a thermometer hung close to the wall of a house is poor, and a thermometer hung in the sun is of course very bad. On a very hot sunny day the temperature even in the shade may be a little too high; but not more than 5° F. and usually much less.

In the early morning and at night, the temperature from a thermometer openly exposed will be sufficiently accurate if there is some wind and the sky is clouded over. But if it is nearly calm and the sky is clear, the thermometer will give a reading too low, frequently as much as 10° F. too low, because the air in the lower 200 feet or so of the atmosphere cools down exceptionally while the air above, through which the shell passes, remains at almost the same temperature which it had in the day.

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A good rough rule would be to take as the effective temperature at night, the day temperature diminished by $\frac{1}{3}$ of the fall of temperature.

**Example.**

Temperature in the day 70° F.
Temperature at night 46° F.
Effective temperature $70° \times \frac{1}{3} - 24° = 62°$

This applies to the ordinary cooling in clear comparatively calm weather. It does not apply if the fall of temperature is caused by a marked change of wind and weather.

## WIND.

On the average the wind increases from the ground upwards, rapidly at first and then slowly. With Westerly winds in summer the increase will be more rapid: with Easterly winds in summer the opposite effect occurs, and the wind at 6,000 feet may be light westerly, while the wind at the surface is light easterly.

In winter a North or North-West wind will increase upwards frequently more rapidly than the average.

It is practically impossible to compute the wind at 2,000 to 6,000 feet from observations of wind at the surface: because usually—

(1) The wind at the surface increases during the day and decreases during the night.
(2) The wind at 1,000 feet and above increases during the night and decreases during the day.
(3) The wind at the surface backs during the night and veers during the day, *e.g.*, a South-South-West wind tends to change to a South wind at night and to a South-West wind during the day.
(4) The wind at the surface depends very much upon the surroundings: if there are woods, houses, hills in the neighbourhood, the surface wind will be affected both in direction and in velocity, unless the place where it is observed is chosen with great care. On the other hand the wind above 1,000 feet is affected very little by the ordinary surface irregularities (though it may be affected considerably by a valley with comparatively steep sides).

All these variations in the surface wind are irregular and depend upon its strength; its actual direction and the state of the weather, *i.e.*, if sunny, or overcast, or wet.

Nobody, therefore, who has meteorological knowledge, tries the practically impossible task of deducing the upper wind directly from the surface wind. Either he makes direct observation of the upper wind or he draws a chart of presure distribution and uses a well established theoretical result to compute the wind in the upper air. Sometims the wind behaves badly but this is the exception and not the rule; usually the computed and actual winds ae in fairly good agreement. One exception occurs when the wind is light and the distribution of pressure not very well defined: then the errors in the computed wind which are negligible at higher velocities become comparable with the wind itself: fortunately, however, the light winds have the least effect upon a trajectory.

As showing the manner in which the velocity varies with height, the mean results for 80 Pilot Balloon Ascents made at G.H.Q. between June, 1915, and February, 1916, are here given. In the first column is given for comparison the velocity recorded by a fairly well exposed anemometer 45 feet above the ground.



### Wind Velocity in Feet per Second.

| By ANEMOMETER at | By PILOT BALLOON at | | | | | | |
|---|---|---|---|---|---|---|---|
| 45 feet. | 250 feet. | 1,000 feet. | 2,000 feet. | 3,000 feet. | 4,000 feet. | 5,000 feet. | 6,000 feet. |
| 9·5 | 18·0 | 21·3 | 23·8 | 25·4 | 26·4 | 26·7 | 27·3 |

It will be evident that if one used only the surface velocity in reckoning the effect of the wind on a projectile rising to 6,000 feet in the course of its flight, considerable errors would be introduced.

There is also a considerable change with height in the direction of the wind, and it is frequently as difficult to find the direction of the upper wind from the direction of the surface wind as in the case of velocity. On the average the wind veers two or three points in the first 1,000 feet and is afterwards more steady. A rough rule is to take the upper wind to be 2 points from the surface wind in the middle of the day, 3 points in the morning and afternoon and 4 points at night. If one faces the surface wind, the wind above will nearly always be blowing from one's right hand, *e.g.*, if the surface wind is S.W., the upper wind will usually be W.S.W. or W. The direction of the upper wind may also be computed theoretically with usually close approximation from the meteorological chart for the day.

Now when shooting with Medium or Heavy Howitzers the wind velocity and direction, which it is most important to judge correctly, is not so much that at the surface but that at the mean height of the trajectory which is more likely to be about the 2,000 feet mark. Above about 1,500 feet the wind is as a rule uniform in strength and direction over a large area, although the ground formations of different portions of that area may cause considerable variations of the surface velocity and direction.

With a view to assisting battery commanders who are constantly dealing with wind problems, the velocity and direction of wind will be computed twice daily, and the results sent as quickly as possible to all batteries in the area over which these observations will, as a general rule, be correct. There must, of course, be occasions when the weather does not follow normal procedure; these, however, cannot be legislated for.

It must, therefore, be understood that the communicated observations for wind in the upper atmosphere will appear to be at some variance with conditions obtaining locally, but, as has been explained in these notes, the surface conditions are not always a reliable guide to the conditions obtaining higher up.

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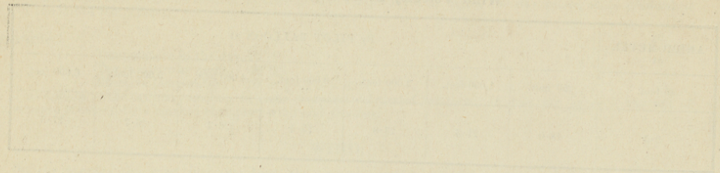

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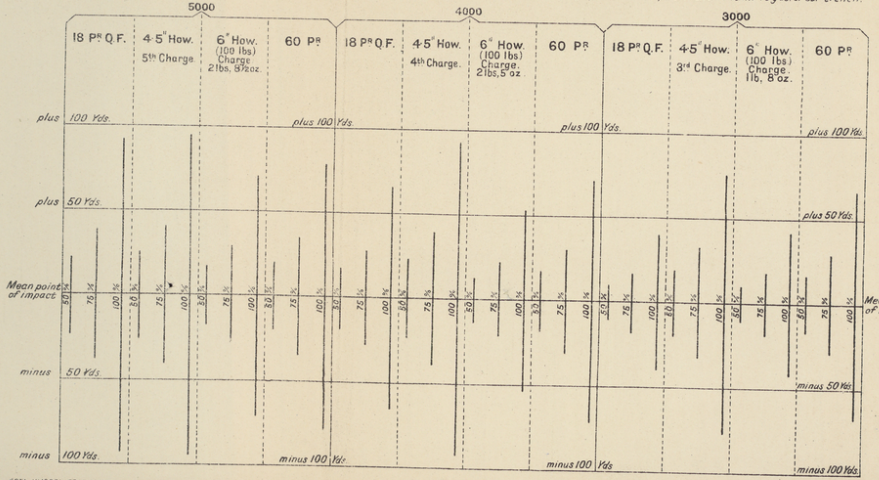
DIAGRAM SHEWING 50%, 75% & 100% LENGTH ZONES OF 18 Pr, 4·5" HOW. 6" HOW. & 60 Pr AT 5000, 4000 & 3000.

AN EXAMPLE ILLUSTRATES THE USE OF THIS.

*Our trenches are within 60 yds of the enemy's trenches. The range is 3000 yds. which of the above guns and howitzers could be employed without dropping shells into our own trench. Answer :- The 6" How. firing 1 lb. 8 oz. charge, should not put a shell within 18 yds of our trench.*





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# ARTILLERY NOTES.

*(Issued by the General Staff at General Headquarters.)*

## No. 1.—CLOSE SHOOTING IN THE FIELD.

1. The trench warfare in which the Army is now engaged very frequently necessitates the bombardment of an objective situated only a short distance from the line of trenches occupied by our own infantry. The problem, therefore, often arises as to whether it is safe, after ranging has been completed with due precautions, to continue fire on the objective without clearing our trenches, or whether there is a chance of some of our own shell falling into them.

2. The question of accuracy of fire has, therefore, become a matter of importance to a degree never contemplated in field warfare, or provided for. The object of these notes is to summarize in an easily accessible form such information as is required by artillery officers in order that they may obtain the greatest accuracy possible from their guns. But, before considering the various measures necessary with this object, it is essential that they should fully realize the limitations of their weapons in this respect. This is a matter which should be brought to the notice of commanders and others responsible for the organization of operations depending on artillery support.

### The error of the gun.

**The 50 per cent. zone.**

3. It is well known that if a series of rounds be fired from a gun at a fixed elevation, the shell will not all fall in exactly the same place, but the extent of the ground covered is rarely realized. This, of course, varies with different natures of guns and howitzers, and also at different ranges, and with different charges of any one howitzer or gun, and the actual figures are given in the range table of the gun concerned under the name of "the 50 per cent. zone."


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The 50 per cent. zone is the space in which 50 per cent. of the rounds fired at a given range should fall. If, then, this zone is, say, 50 yards long, at a certain range, half the number of shell fired in a series at that range should fall in a space of 50 yards, and if the mean of the rounds was exactly on the objective, 25 yards plus or minus should be the greatest distance from the objective of half of the shell fired.

**The 100 per cent. zone.**

4. It is, however, necessary to know where *all* the rounds may fall, and not only half of them, *i.e.*, to know the 100 per cent. zone. This zone is *four times* the length of the 50 per cent. zone, and in the above case it would therefore be 200 yards long, and we should be prepared for a shell falling either 100 yards over or 100 yards short.

5. But it must be borne in mind that these figures are arrived at under experimental conditions *i.e.*, wind less than 10 miles an hour and abnormal rounds omitted. Here, in the conditions of war, even such accuracy as is promised by the range tables will seldom be reached. Sights may shift, or be slightly out of adjustment; the layer may manipulate the gears incorrectly and so admit an error due to the play of the gears; or other mistakes may be made due to the personal factor. Some allowance should be made for these factors and in estimating the size of the 100 per cent. zone it is advisable, in order to obtain reasonable safety, to add some 10 per cent. to the figures obtained by multiplying the 50 per cent. zone by four.

6. To take a case. If the task of a 4·5-inch howitzer battery is to bombard a hostile line 100 yards in front of our own trenches, the commander must realize that if the range is 4,800 yards, at which the 50 per cent. zone is 45 yards, it will be quite possible for an occasional shell to drop in or behind our own trenches, even though the gun and the ammunition and the work of the gunners are in all respects correct. The question then arises how is the battery commander to carry out such a task without risk of hitting his own infantry, supposing it to be undesirable to withdraw the latter? There are two solutions.

7. One method is for the battery commander to range so that the mean point of impact instead of being at the target is so much beyond it that the shortest shell of the series will still be beyond our own trenches. In other words, so to range that the mean trajectory is sufficiently over the target to ensure the 100 per cent. zone being clear of our trenches. But it must be realized that this will involve a smaller percentage of hits.

8. The other method is to take advantage of the fact that the *breadth* zone is always much smaller than the *length* zone* and employ enfilade or oblique instead of frontal fire. Such fire on a long target will always give many more hits than frontal fire: in fact, the expenditure of ammunition should be only about one-seventh of that necessary to obtain the same effect with frontal fire. The longer the range of the gun the greater are the possibilities for enfilade fire, since the normal errors of the gun will provide the necessary searching effect, while

* The 50 per cent. zone of the 6-inch gun at 10,000 yards is 75 yards, while the breadth one is only 10½ yards.



the comparatively small breadth zone will ensure a large proportion of hits on the target. A study of the effect of wind on projectiles also shows that it is considerably less when the wind is across the range than when up or down it. The proportion varies with different guns and howitzers from $\frac{1}{2}$ to $\frac{1}{4}$, and it is therefore evident that the danger of inaccuracy due to wind is much less in enfilade than in frontal fire.

9. From the foregoing it is plain how the relative value of weapons for particular purposes may vary directly as their accuracy, as shown by their 50 per cent. zones in the range tables; and how necessary it therefore is that all those concerned with the preparation of plans of operations should have some idea as to what these values are.

10. The error of the gun dealt with above is a source of inaccuracy which cannot be eliminated. Many other factors affect the accuracy of the shooting, but these can be all allowed for and their effect therefore neutralized. These will now be dealt with in succession.

## Effect of weather.

11. The shooting of a gun is affected by variations of the following:—

(*a*) Height of barometer.
(*b*) Temperature of air.
(*c*) Temperature of charge.
(*d*) Strength and direction of wind.

Corrections for all these must be made if real accuracy is to be attained. They can be calculated from information given in the range tables or addenda to them, and since exact readings of (*a*), (*b*) and (*c*) can be obtained, they can be accurately allowed for. Wind is, however, seldom constant, either in velocity or direction: it is not easy to judge: and it varies at different heights above the ground level. The best approximation to its velocity and direction can generally be obtained from the R.F.C.

12. It is not only the shooting of the gun that is effected by the weather. The burning of the time fuzes, on which the effect of shrapnel fire, in particular, so greatly depends is seriously affected by damp. Our experience in Flanders last winter, as well as in South Africa, showed clearly how rapidly ammunition may deteriorate unless properly protected from the weather. Fuzes and tubes are especially susceptible to damp, and should not be exposed to its effects more than can possibly be avoided. Ammunition recesses if used must be properly constructed so as to protect their contents from the weather, and limbers and wagons must be kept closed.

13. As regards the number of shell to be fuzed, or the number of fuzes to be uncapped, this is a matter on which it is impossible to lay down definite rules, as the number must vary with the situation and the nature of the equipment. But it has been observed that the tendency, especially with inexperienced troops, is to fuze

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(or uncap) far more than is really necessary. This is a matter which commanders must watch closely, for it affects not only the accuracy, and therefore the effectiveness of our fire against the enemy, but also the safety of firing over our own infantry.

14. It is only by close supervision and minute attention to detail on the part of all concerned, that the ammunition can be kept in good condition during the weather for which we must be prepared.

## Effect of wear.

15. Erosion* of metal, caused by the heat of combustion of the charge, takes place at the commencement of the rifling. This allows the projectile to be rammed home a little further, thus increasing the air spacing for the charge. In consequence, the muzzle velocity falls off. The method of compensating for this is given under the heading of "calibration."

16. In an advanced state of wear shell will be unsteady in flight, and accuracy will be appreciably reduced. The capacity for close shooting, therefore, of guns that have become worn is affected, and this fact must not be forgotten when allotting guns to tasks demanding specially accurate shooting. In calculating the 100 per cent. zone, an allowance of 30 per cent. might be made for a gun approaching the condemning limits of wear.

17. When wear necessitates the replacement of guns it follows that the guns of a battery will show varying amounts of wear, and will not shoot alike. This will affect the shooting of the battery as a whole, and is another factor to be borne in mind when close shooting is required. This, again, can be compensated for by calibration.

18. The very short rounds of which there were many cases with the 4·7-inch Q.F. guns at one time were due, not to wear of the gun, such as is mentioned above, but to defective ammunition. Driving bands stripped and the shell turned over in flight.

## Effect of variation in ammunition.

### As regards cartridges.

19. Owing to small variations in manufacture, and in the quality of the ingredients of which cordite is composed, there may be differences in muzzle velocities given by different lots of cordite.

20. In order to compensate for this, charges for guns and howitzers are, where possible, adjusted, *i.e.*, when cartridges are made up from a lot which is known to give a velocity lower than the standard velocity, the necessary

* This erosion is more rapid with guns firing Mark I cordite than with those firing M.D., the heat of combustion of the former being considerably greater than that of the latter. Howitzers, in which the chamber pressures are comparatively low, wear much longer than guns.



addition is made to the normal weight of the charge, so as to ensure its giving the standard muzzle velocity. Similarly, when the lot of cordite being made up into cartridges is known to be high in velocity the necessary deduction is made. This fact is not generally known, and complaints have been made of charges being of different weights when this had been specially arranged in order to ensure their shooting alike.

Where cartridges are not marked A.C. (adjusted charge) various lots should be kept separate as far as possible.

### As regards weights of shell.

21. A decrease in weight of shell will increase the muzzle volocity, and so tend to increase the range; but at the same time the alteration of the ballistic coefficient will tend to shorten the range, and so nullify the effect of the higher muzzle velocity.

22. Small variations in weight of shell make very little difference in high velocity guns, but the difference is more marked in the case of howitzers, *e.g.*, with the 4·5-inch howitzer a difference of 10 ozs. in weight of the shell would alter the range by about 40 yards at 4,000 yards when using full charge: this is about the same as the 50 per cent. zone. It is, therefore, advisable that howitzer shell should be grouped according to weights.

## Registration of targets.

23. Registering is a term now applied to ranging by trial shots on various objects with a view to being able on some future occasion to open an immediate and effective fire on those points. As is well known, the range found at one time is not usually found correct on a subsequent occasion, even though all the variables dealt with in the preceding paragraphs have been eliminated as accurately as possible. The difference is due to what is generally termed the "error of the day," but might be more accurately described as the error of the moment, since on the same day temperature conditions and wind may easily vary sufficiently to alter the range with the 18-pr. as much as 200 yards at a range of 4,000. With the 4·5-inch howitzer such alteration would be less, but it is obvious that a couple of trial shots fired early in the day will not be sufficient to determine the "error of the day."

24. The record of registration of a target should contain the following:—

(i.) The range to it.
(ii.) The lateral angle to it measured in such way as has been found convenient.
(iii.) Corrector.

If variables have been correctly eliminated this record gives the range and line in normal atmospheric conditions* and in calm weather.

* The following are understood by the term "Normal":—Barometer 30". Temperature of air 60° F. Temperature of charge 60° F.

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When, however, shooting is to be carried out on such registration in conditions that are not normal, it is obvious that the only correction that will have to be applied to (ii.) is one for wind: other atmospheric conditions do not affect it.

Now a projectile is affected less by wind across the range than by one up and down it. It follows then that registration for line should be more reliable than it is for range and that, when shooting on registration, enfilade fire will probably give considerably better results than frontal.

25. A fairly good map of the country is available. For accurate shooting this should, however, be supplemented by information from the Topographical Section of the Royal Engineers, who can plot with great accuracy gun positions and various prominent points from which angles can be measured. If, therefore, a target is located on the map by the Royal Flying Corps, its range and bearing can be obtained by measurement and it should then be possible to bring a fairly accurate fire to bear on it, provided that the sighting of the guns has been correctly arranged by means of calibration.

## Calibration.

26. The term calibration has been generally understood to mean the process by which the muzzle velocities of guns can be calculated from the data obtained by actual shooting. Although, owing to the variables that have to be eliminated, the calculated muzzle velocities may not be absolutely accurate, nevertheless the results obtained give an excellent indication of the comparative shooting of guns one with another and with the map, and they are therefore of great value.

27. The following instructions should be of assistance for calibrating guns in the field:—

(*a*) Select a target about the centre of the arc of fire of the battery, and at a distance of about the average range at which the guns are used, and have its position accurately fixed on the map. If possible the target should be visible from an observing station.

(*b*) Choose a day on which the wind is steady and does not exceed 30 f.s.

(*c*) Note the following:—Barometer, air temperature (in the shade), wind*, charge temperature, lot of cordite.

(*d*) Fire a series of at least five rounds from each gun at the target.

(*e*) By means of the special calibration slide rules determine the M.V. of each gun.

28. The temperature of the charge varies very slowly for a sudden change of air temperature. It may, therefore, for practical purposes, be assumed that the charges will be at the average day and night temperature of the recess in which they are stored. If it is desired to measure the charge temperature more accurately, a clinical thermometer must be used.

* Best obtained from the R.F.C., *vide* para. 12.



29. The following example will illustrate the method of determining the M.V.:—

A 6-inch B.L.C. is fired at a target, distance 8,100 yards. Barometer 30·5″. Air temperature 40° F. Wind 20 f.s. against shell. Charge temperature 35° F.

As a result of the shooting it is found that the sight has to be set at 8,975 to hit target.

Using the battery rule first, and setting it for barometer, air temperature and wind, it will be found that opposite 8,100 yards is the corrected range 8,370.

Now taking the gun rule, and setting the corrected range 8,370 opposite 8,975 gun range, it will be found that under 35° F., the charge temperature, is the M.V. of the gun, viz.:—2,035 f.s. For purposes of record this M.V. should be painted on the gun.

30. Two slide rules are employed:—

The battery rule.
The gun rule.

31. *The battery rule* corrects for barometer, air temperature and wind.

To use this rule set the barometer reading opposite the air temperature on the slider. Move the cursor over the zero of the wind scale. Move the slider until the estimated wind velocity's component along the line of fire is under the cursor. The rule is then set.

Opposite the map distance on the rule can be read the corrected range to be ordered by the battery commander. This corrected range is compensated for barometer, air temperature and wind.

32. *The gun rule* corrects for charge temperature and the variation in the M.V. of the gun (as found in calibration) from the M.V. for which the sights are graduated.

To use this rule move the slider until the charge temperature is opposite the M.V. found by calibration. The rule is then set and should be clamped by the clamping screw.

Opposite the corrected range ordered by the battery commander will be found the "gun range" to be given to the gun. This gun range will therefore be the map distance corrected for:—

Barometer.
Air temperature.
Wind.
Charge temperature.
M.V. of gun as found by calibration.

This rule is used by the No. 1 at each gun. By means of it he converts the range ordered by the battery commander to "gun range" to be given to his gun.

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*(Appendix to Artillery Notes, No. 1.)*

# SOME NOTES ON METEOROLOGICAL CONDITIONS WHICH AFFECT GUNNERY.

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The reading of the Mercury barometer with which the Aneroid should agree is not the reading for Mean Sea Level but the reading for the height at which the Aneroid is placed. This reading can be obtained by simple interpolation from the values for Sea Level and for 500 feet.

**Example.**

Aneroid at 340 feet.
Barometer at M.S.L. 29.87 inches.
,, 500 feet 29.31 ,,

Reading which Aneroid should give to be correct, $29.87 - \frac{340}{500} \times .56 = 29.49$ inches.

Aneroids can be set, if desired, by the Meteorological Officer at Hazebrouck and Querrieu or at the Meteorological Section, 2nd Echelon, G.H.Q.

## TEMPERATURE.

In the middle of the day, the temperature required for use in the range tables can be obtained with sufficient accuracy from a thermometer in a shady but not enclosed place, *e.g.*, a thermometer in the shade of a tree is good, but a thermometer hung close to the wall of a house is poor, and a thermometer hung in the sun is of course very bad. On a very hot sunny day the temperature even in the shade may be a little too high; but not more than 5°F. and usually much less.

In the early morning and at night, the temperature from a thermometer openly exposed will be sufficiently accurate if there is some wind and the sky is clouded over. But if it is nearly calm and the sky is clear, the thermometer will give a reading too low, frequently as much as 10° F. too low, because the air in the lower 200 feet or so of the atmosphere cools down exceptionally while the air above, through which the shell passes, remains at almost the same temperature which it had in the day.

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A good rough rule would be to take as the effective temperature at night, the day temperature diminished by $\frac{1}{3}$ of the fall of temperature.

## Example.

| | |
|---|---|
| Temperature in the day | 70° F. |
| Temperature at night | 46° F. |
| Effective temperature | $70° - \frac{1}{3} \times 24° = 62°$ |

This applies to the ordinary cooling in clear comparatively calm weather. It does not apply if the fall of temperature is caused by a marked change of wind and weather.

## WIND.

On the average the wind increases from the ground upwards, rapidly at first and then slowly. With Westerly winds in summer the increase will be more rapid: with Easterly winds in summer the opposite effect occurs, and the wind at 6,000 feet may be light westerly, while the wind at the surface is light easterly.

In winter a North or North-West wind will increase upwards frequently more rapidly than the average.

It is practically impossible to compute the wind at 2,000 to 6,000 feet from observations of wind at the surface: because usually—

(1.) The wind at the surface increases during the day and decreases during the night.

(2.) The wind at 1,000 feet and above increases during the night and decreases during the day.

(3.) The wind at the surface backs during the night and veers during the day, *e.g.*, a South-South-West wind tends to change to a South wind at night and to a South-West wind during the day.

(4) The wind at the surface depends very much upon the surroundings: if there are woods' houses, hills in the neighbourhood, the surface wind will be affected both in direction and in velocity, unless the place where it is observed is chosen with great care. On the other hand the wind above 1,000 feet is affected very little by the ordinary surface irregularities (though it may be affected considerably by a valley with comparatively steep sides).

All these variations in the surface wind are irregular and depend upon its strength; its actual direction and the state of the weather, *i.e.*, if sunny, or overcast, or wet.

Nobody, therefore, who has meteorological knowledge, tries the practically impossible task of deducing the upper wind directly from the surface wind. Either he makes direct observation of the upper wind or he draws a chart of pressure distribution and uses a well established theoretical result to compute the wind in the upper air. Sometimes the wind behaves badly but this is the exception and not the rule; usually the computed and actual winds are in fairly good agreement. One exception occurs when the wind is light and the distribution of pressure not very well defined: then the errors in the computed wind which are negligible at higher velocities become comparable with the wind itself: fortunately, however, the light winds have the least effect upon a trajectory.

As showing the manner in which the velocity varies with height, the mean results for 80 Pilot Balloon Ascents made at G.H.Q. between June, 1915, and February, 1916, are here given. In the first column is given for comparison the velocity recorded by a fairly well exposed anemometer 45 feet above the ground.

### Wind Velocity in Feet per Second.

| By ANEMOMETER at | By PILOT BALLOON at | | | | | | |
|---|---|---|---|---|---|---|---|
| 45 feet. | 250 feet. | 1,000 feet. | 2,000 feet. | 3,000 feet. | 4,000 feet. | 5,000 feet. | 6,000 feet. |
| 9·5 | 18·0 | 21·3 | 23·8 | 25·4 | 26·4 | 26·7 | 27·3 |

It will be evident that if one used only the surface velocity in reckoning the effect of the wind on a projectile rising to 6,000 feet in the course of its flight, considerable errors would be introduced.

There is also a considerable change with height in the direction of the wind, and it is frequently as difficult to find the direction of the upper wind from the direction of the surface wind as in the case of velocity. On the average the wind veers two or three points in the first 1,000 feet and is afterwards more steady. A rough rule is to take the upper wind to be 2 points from the surface wind in the middle of the day, 3 points in the morning and afternoon and 4 points at night. If one faces the surface wind, the wind above will nearly always be blowing from one's right hand, *e.g.*, if the surface wind is S.W., the upper wind will usually be W.S.W. or W. The direction of the upper wind may also be computed theoretically with usually close approximation from the meteorological chart for the day.

Now when shooting with Medium or Heavy Howitzers the wind velocity and direction, which it is most important to judge correctly, is not so much that at the surface but that at the mean height of the trajectory which is more likely to be about the 2,000 feet mark. Above about 1,500 feet the wind is as a rule uniform in strength and direction over a large area, although the ground formations of different portions of that area may cause considerable variations of the surface velocity and direction.

With a view to assisting battery commanders who are constantly dealing with wind problems, the velocity and direction of wind will be computed twice daily, and the results sent as quickly as possible to all batteries in the area over which these observations will, as a general rule, be correct. There must, of course, be occasions when the weather does not follow normal procedure; these, however, cannot be legislated for.

It must, therefore, be understood that the communicated observations for wind in the upper atmosphere will appear to be at some variance with conditions obtaining locally, but, as has been explained in these notes, the surface conditions are not always a reliable guide to the conditions obtaining higher up.

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# ARTILLERY NOTES.

(Issued by the General Staff at General Headquarters).

## No. 1.—CLOSE SHOOTING IN THE FIELD.

1. The trench warfare in which the Army is now engaged very frequently necessitates the bombardment of an objective situated only a short distance from the line of trenches occupied by our own infantry. The problem, therefore, often arises as to whether it is safe, after ranging has been completed with due precautions, to continue fire on the objective without clearing our trenches, or whether there is a chance of some of our own shell falling into them.

2. The question of accuracy of fire has, therefore, become a matter of importance to a degree never contemplated in field warfare, or provided for. The object of these notes is to summarize in an easily accessible form such information as is required by artillery officers in order that they may obtain the greatest accuracy possible from their guns. But, before considering the various measures necessary with this object, it is essential that they should fully realize the limitations of their weapons in this respect. This is a matter which should be brought to the notice of commanders and others responsible for the organization of operations depending on artillery support.

### The Error of the Gun.

#### The 50 per cent. zone.

3. It is well known that if a series of rounds be fired from a gun at a fixed elevation, the shell will not all fall in exactly the same place, but the extent of the ground covered is rarely realized. This, of course, varies with different natures of guns and howitzers, and also at different ranges, and with different charges of any one howitzer or gun, and the actual figures are given in the range table of the gun concerned under the name of "the 50 per cent. zone."

The 50 per cent. zone is the space in which 50 per cent. of the rounds fired at a given range should fall. If, then, this zone is, say, 50 yards long, at a certain range, half the number of

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shell fired in a series at that range should fall in a space of 50 yards, and if the mean of the rounds was exactly on the objective, 25 yards plus or minus should be the greatest distance from the objective of half of the shell fired.

## The 100 per cent. zone.

4. It is, however, necessary to know where *all* the rounds may fall, and not only half of them, *i.e.*, to know the 100 per cent. zone. This zone is *four times* the length of the 50 per cent. zone, and in the above case it would therefore be 200 yards long, and we should be prepared for a shell falling either 100 yards over or 100 yards short.

5. But it must be borne in mind that these figures are arrived at under experimental conditions, *i.e.*, wind less than 10 miles an hour and abnormal rounds omitted. Here, in the conditions of war, even such accuracy as is promised by the range tables will seldom be reached. Sights may shift, or be slightly out of adjustment; the layer may manipulate the gears incorrectly and so admit an error due to the play of the gears; or other mistakes may be made due to the personal factor. Some allowance should be made for these factors and in estimating the size of the 100 per cent. zone it is advisable, in order to obtain reasonable safety, to add some 10 per cent. to the figures obtained by multiplying the 50 per cent. zone by four.

6. To take a case. If the task of a 4.5" howitzer battery is to bombard a hostile line 100 yards in front of our own trenches, the commander must realize that if the range is 4,800 yards, at which the 50 per cent. zone is 45 yards, it will be quite possible for an occasional shell to drop in or behind our own trenches, even though the gun and the ammunition and the work of the gunners are in all respects correct. The question then arises how is the battery commander to carry out such a task without risk of hitting his own infantry, supposing it to be undesirable to withdraw the latter? There are two solutions.

7. One method is for the battery commander to range so that the mean point of impact instead of being at the target is so much beyond it that the shortest shell of the series will still be beyond our own trenches. In other words, so to range that the mean trajectory is sufficiently over the target to ensure the 100 per cent. zone being clear of our trenches. But it must be realized that this will involve a smaller percentage of hits.

8. The other method is to take advantage of the fact that the *breadth* zone is always much smaller than the *length* zone* and employ enfilade or oblique instead of frontal fire. Such fire on a long target will always give many more hits than frontal fire; in fact, the expenditure of

* The 50 per cent. zone of the 6" gun at 10,000 yards is 75 yards, while the breadth zone is only 10½ yards.



ammunition should be only about one-seventh of that necessary to obtain the same effect with frontal fire. The longer the range of the gun the greater are the possibilities for enfilade fire, since the normal errors of the gun will provide the necessary searching effect, while the comparatively small breadth zone will ensure a large proportion of hits on the target. A study of the effect of wind on projectiles also shows that it is considerably less when the wind is across the range than when up or down it. The proportion varies with different guns and howitzers from ½ to ¼, and it is therefore evident that the danger of inaccuracy due to wind is much less in enfilade than in frontal fire.

9. From the foregoing, it is plain how the relative value of weapons for particular purposes may vary directly as their accuracy, as shown by their 50 per cent. zones in the range tables; and how necessary it therefore is that all those concerned with the preparation of plans of operations should have some idea as to what these values are.

10. The error of the gun dealt with above is a source of inaccuracy which cannot be eliminated. Many other factors affect the accuracy of the shooting, but these can be all allowed for and their effect therefore neutralized. These will now be dealt with in succession.

## Effect of Weather.

11. The shooting of a gun is affected by variations of the following:—

(*a*) Height of barometer.
(*b*) Temperature of air.
(*c*) Temperature of charge.
(*d*) Strength and direction of wind.

Corrections for all these must be made if real accuracy is to be attained. They can be calculated from information given in the range tables or addenda to them, and since exact readings of (*a*), (*b*) and (*c*) can be obtained, they can be accurately allowed for. Wind is, however, seldom constant, either in velocity or direction; it is not easy to judge; and it varies at different heights above the ground level. The best approximation to its velocity and direction can generally be obtained from the R.F.C.

12. It is not only the shooting of the gun that is affected by weather. The burning of the time fuzes, on which the effect of shrapnel fire, in particular, so greatly depends is seriously affected by damp. Our experience in Flanders last winter, as well as in South Africa, showed clearly how rapidly ammunition may deteriorate unless properly protected from the weather. Fuzes and tubes are especially susceptible to damp, and should not be exposed to its effects



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more than can possibly be avoided. Ammunition recesses if used must be properly constructed so as to protect their contents from the weather, and limbers and wagons must be kept closed.

13. As regards the number of shell to be fuzed, or the number of fuzes to be uncapped, this is a matter on which it is impossible to lay down definite rules, as the number must vary with the situation and the nature of the equipment. But it has been observed that the tendency, especially with inexperienced troops, is to fuze (or uncap) far more than is really necessary. This is a matter which commanders must watch closely, for it affects not only the accuracy, and therefore the effectiveness of our fire against the enemy, but also the safety of firing over our own infantry.

14. It is only by close supervision, and minute attention to detail on the part of all concerned, that the ammunition can be kept in good condition during the weather for which we must be prepared.

## Effect of Wear.

15. Erosion* of metal, caused by the heat of combustion of the charge, takes place at the commencement of the rifling. This allows the projectile to be rammed home a little further, thus increasing the air spacing for the charge. In consequence, the muzzle velocity falls off. The method of compensating for this is given under the heading of "calibration."

16. In an advanced state of wear shell will be unsteady in flight and accuracy will be appreciably reduced. The capacity for close shooting, therefore, of guns that have become worn is affected, and this fact must not be forgotten when allotting guns to tasks demanding specially accurate shooting. In calculating the 100 per cent. zone, an allowance of 30 per cent. might be made for a gun approaching the condemning limits of wear.

17. When wear necessitates the replacement of guns it follows that the guns of a battery will show varying amounts of wear, and will not shoot alike. This will affect the shooting of the battery as a whole, and is another factor to be borne in mind when close shooting is required. This, again, can be compensated for by calibration.

18. The very short rounds of which there were many cases with the 4.7" Q.F. guns at one time were due, not to wear of the gun, such as is mentioned above, but to defective ammunition. Driving bands stripped and the shell turned over in flight.

* This erosion is more rapid with guns firing Mark I. cordite than with those firing M.D., the heat of combustion of the former being considerably greater than that of the latter. Howitzers, in which the chamber pressures are comparatively low, wear much longer than guns.



## Effect of Variation in Ammunition.

### As regards cartridges.

19. Owing to small variations in manufacture, and in the quality of the ingredients of which cordite is composed, there may be differences in muzzle velocities given by different lots of cordite.

20. In order to compensate for this, charges for guns and howitzers are, where possible, adjusted, *i.e.*, when cartridges are made up from a lot which is known to give a velocity lower than the standard velocity, the necessary addition is made to the normal weight of the charge, so as to ensure its giving the standard muzzle velocity. Similarly, when the lot of cordite being made up into cartridges is known to be high in velocity the necessary deduction is made. This fact is not generally known, and complaints have been made of charges being of different weights, when this had been specially arranged in order to ensure their shooting alike.

Where cartridges are not marked A.C. (adjusted charge) various lots should be kept separate as far as possible.

### As regards weights of shell.

21. A decrease in weight of shell will increase the muzzle velocity, and so tend to increase the range; but at the same time the alteration of the ballistic co-efficient will tend to shorten the range, and so nullify the effect of the higher muzzle velocity.

22. Small variations in weight of shell make very little difference in high velocity guns, but the difference is more marked in the case of howitzers, *e.g.*, with the 4.5" howitzer a difference of 10 ozs. in weight of the shell would alter the range by about 40 yards at 4,000 yards when using full charge; this is about the same as the 50 per cent. zone. It is, therefore, advisable that howitzer shell should be grouped according to weights.

## Registration of Targets.

23. Registering is a term now applied to ranging by trial shots on various objects with a view to being able on some future occasion to open an immediate and effective fire on those points. As is well known, the range found at one time is not usually found correct on a subsequent occasion, even though all the variables dealt with in the preceding paragraphs have been eliminated as accurately as possible. The difference is due to what is generally termed the "error of the day," but might be more accurately described as the error of the moment, since on the same day temperature conditions and wind may easily vary sufficiently to alter the



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range with the 18-pr. as much as 200 yards at a range of 4,000. With the 4.5″ howitzer such alteration would be less, but it is obvious that a couple of trial shots fired early in the day will not be sufficient to determine the "error of the day."

24. The record of registration of a target should contain the following :—

(i.) The range to it.
(ii.) The lateral angle to it measured in such way as has been found convenient.
(iii.) Corrector.

If variables have been correctly eliminated this record gives the range and line in normal atmospheric conditions* and in calm weather.

When, however, shooting is to be carried out on such registration in conditions that are not normal, it is obvious that the only correction that will have to be applied to (ii.) is one for wind: other atmospheric conditions do not affect it.

Now a projectile is affected less by wind across the range than by one up and down it. It follows then that registration for line should be more reliable than it is for range, and that, when shooting on registration, enfilade fire will probably give considerably better results than frontal.

25. A fairly good map of the country is available. For accurate shooting this should, however, be supplemented by information from the Topographical Section of the Royal Engineers, who can plot with great accuracy gun positions and various prominent points from which angles can be measured. If, therefore, a target is located on the map by the Royal Flying Corps, its range and bearing can be obtained by measurement and it should then be possible to bring a fairly accurate fire to bear on it, provided that the sighting of the guns has been correctly arranged by means of calibration.

## Calibration.

26. The term calibration has been generally understood to mean the process by which the muzzle velocities of guns can be calculated from the data obtained by actual shooting. Although, owing to the variables that have to be eliminated, the calculated muzzle velocities may not be absolutely accurate, nevertheless the results obtained give an excellent indication of the comparative shooting of guns one with another and with the map, and they are therefore of great value.

* The following are understood by the term "Normal" :—Barometer 30″. Temperature of air 60° F. Temperature of charge 60° F.



27. The following instructions should be of assistance for calibrating guns in the field :—

(*a*) Select a target about the centre of the arc of fire of the battery, and at a distance of about the average range at which the guns are used, and have its position accurately fixed on the map. If possible the target should be visible from an observing station.

(*b*) Choose a day on which the wind is steady and does not exceed 30 f.s.

(*c*) Note the following :—Barometer, air temperature (in the shade), wind*, charge temperature, lot of cordite.

(*d*) Fire a series of at least five rounds from each gun at the target.

(*e*) By means of the special calibration slide rules determine the M.V. of each gun.

28. The temperature of the charge varies very slowly for a sudden change of air temperature. It may, therefore, for practical purposes, be assumed that the charges will be at the average day and night temperature of the recess in which they are stored. If it is desired to measure the charge temperature more accurately, a clinical thermometer must be used.

29. The following example will illustrate the method of determining the M.V. :—

A 6″ B.L.C. is fired at a target, distance 8,100 yards. Barometer 30.5″. Air temperature 40° F. Wind 20 f.s. against shell. Charge temperature 35° F.

As a result of the shooting it is found that the sight has to be set at 8,975 to hit target.

Using the battery rule first, and setting it for barometer, air temperature and wind, it will be found that opposite 8,100 yards is the corrected range 8,370.

Now taking the gun rule, and setting the corrected range 8,370 opposite 8,975 gun range it will be found that under 35° F., the charge temperature, is the M.V. of the gun, *viz.* :—2,035 f.s. For purposes of record this M.V. should be painted on the gun.

30. Two slide rules are employed :—

The battery rule.
The gun rule.

31. *The battery rule* corrects for barometer, air temperature and wind.

To use this rule set the barometer reading opposite the air temperature on the slider. Move the cursor over the zero of the wind scale. Move the slider until the estimated wind velocity's component along the line of fire is under the cursor. The rule is then set.

* Best obtained from the R.F.C., *vide* para. 12.



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Opposite the map distance on the rule can be read the corrected range to be ordered by the battery commander. This corrected range is compensated for barometer, air temperature and wind.

32. *The gun rule* corrects for charge temperature and the variation in the M.V. of the gun (as found in calibration) from the M.V. for which the sights are graduated.

To use this rule move the slider until the charge temperature is opposite the M.V. found by calibration. The rule is then set and should be clamped by the clamping screw.

Opposite the corrected range ordered by the battery commander will be found the "gun range" to be given to the gun. This gun range will therefore be the map distance corrected for:—

Barometer.
Air temperature.
Wind.
Charge temperature.
M.V. of gun as found by calibration.

This rule is used by the No. 1 at each gun. By means of it he converts the range ordered by the battery commander to "gun range" to be given to his gun.

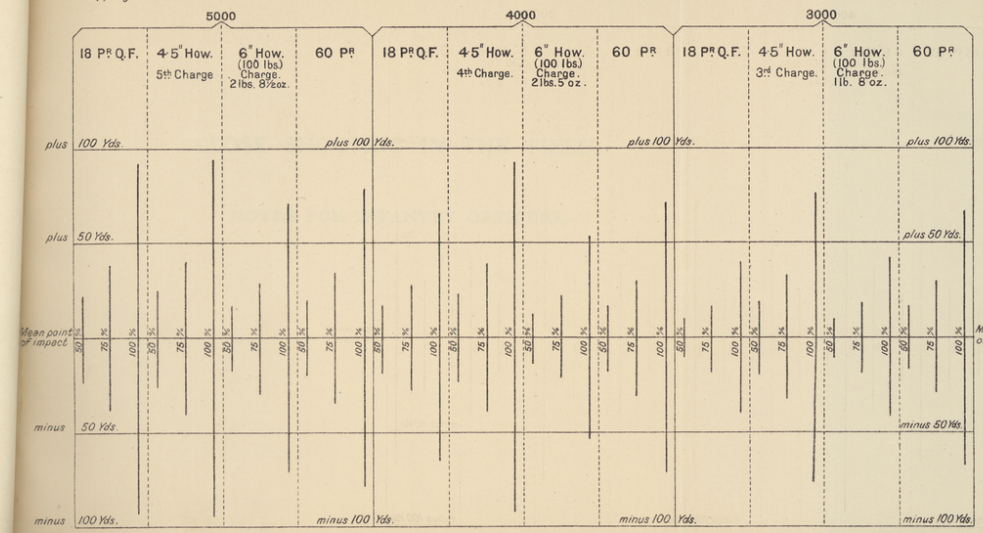


STATIONERY SERVICES PRESS A.—3/16—840—1000.

## DIAGRAM SHEWING 50%, 75% & 100%. LENGTH ZONES OF 18 Pr, 4·5" HOW. 6" HOW. & 60 Pr AT 5000, 4000 & 3000.

### AN EXAMPLE ILLUSTRATES THE USE OF THIS.

*Our trenches are within 60 yds of the enemy's trenches. The range is 3000 yds. which of the above guns and howitzers could be employed without dropping shells into our own trench? Answer:- The 6" How. Firing 1 lb. 8 oz. charge, should not put a shell within 18 yds. of our trench.*



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# CLOSE SHOOTING IN THE FIELD.

## NOTES FOR INFANTRY OFFICERS.

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# CLOSE SHOOTING IN THE FIELD.

## NOTES FOR INFANTRY OFFICERS.

### 1. The 100% Zone.

It is not generally realised that a number of rounds fired from one gun at the same elevation will not fall in the same spot, even though the service at the gun be in every respect correct. If a hundred rounds be fired at a certain elevation under experimental conditions, the pattern of the fall of the rounds will be a rectangle, the size of which varies with the gun or howitzer employed and the range. The length of this rectangle in the direction of the line of fire is called the 100% Length Zone and is invariably greater than its width at right angles to the line of fire, which is called the 100% Breadth Zone. For this reason the percentage of hits on a trench will be greater when it is fired at in enfilade than when frontally.

A typical diagram showing the pattern of the fall of 400 rounds is attached.

The 100% Length Zone is four times the length of the 50% Length Zone, and the 100% Breadth Zone is four times the breadth of the 50% Breadth Zone. Particulars of the 50% Length and Breadth Zones for the various ranges are given in the Range Tables for each gun.

### 2. The Mean Point of Impact.

The greater number of rounds fired at any given elevation fall near the centre of the rectangle, which is known as the "Mean Point of Impact." To obtain the best effect from a given number of rounds it is obvious that the mean point of impact should be on the target. Consequently when shooting frontally at an enemy front line trench at right angles to the line of fire, the best effect can only be obtained if about 40% of the rounds fall on our side of the enemy parapet. In many cases reports of "short shooting" received from our front trenches would not have been sent in if this fact were realised.

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### 3. Danger to our own Troops.

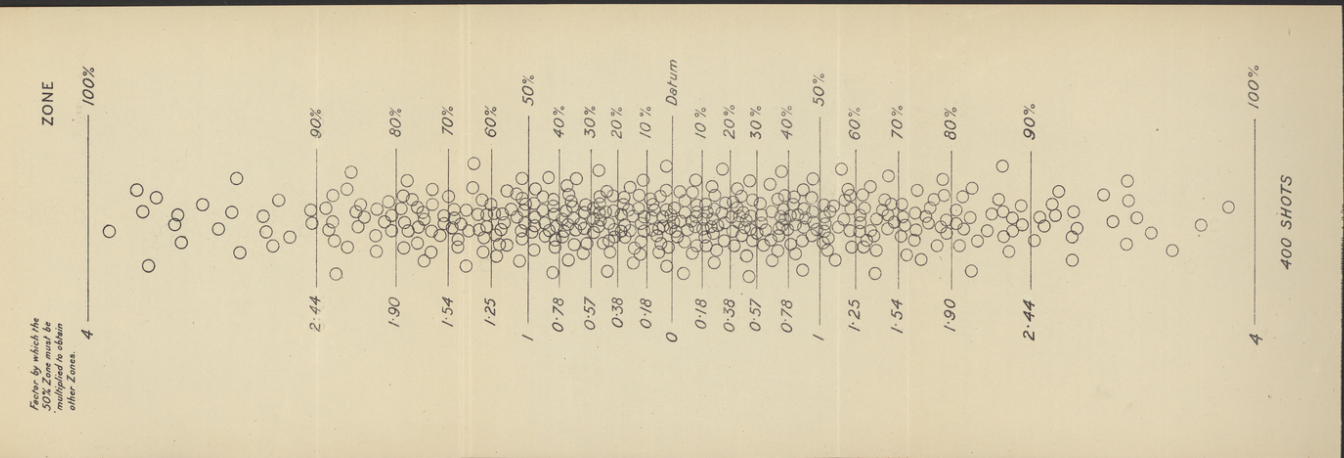
If the mean point of impact be on the enemy trench, some rounds may fall short of it by an amount equal to half the 100% Zone. This distance has to be taken into account when shooting over the heads of our own troops, and a margin of safety of 10% extra should be allowed for service conditions.

The Length of the 100% Zone of the :—

| | | | | |
|---|---|---|---|---|
| 18-pdr. Q.F. at | 3,000 | yards may be taken as | 140 | yards. |
| 4·5-in. Howr., | 3,000 | " " " | 140 | " |
| 6-in. Howr. " | 5,000 | " " " | 200 | " |
| 8-in. Howr. " | 7,000 | " " " | 280 | " |

The following paragraph is an extract from "Artillery Notes No. 4—Artillery in Offensive Operations" issued by the General Staff, February, 1917 :—

"The advisability of withdrawing infantry from their trenches during a bombardment must depend on the local conditions. If the trenches are good and the men keep down, they may be safer in the front trenches than crowded in support trenches which may be heavily shelled at times by the hostile artillery. If the distance between the opposing trenches is such that some rounds are likely to fall in or short of our trenches, then they must be cleared for the requisite time. The only alternative is to place the "mean point of impact" of the artillery fire beyond the target; this is unsound as it entails a much reduced chance of achieving the destruction required at a greatly increased cost of ammunition. In view of the consideration that the effect of a few of our own heavy shell dropping in a crowded trench, especially just prior to the assault, may prove a moral disaster, it will almost always be advisable to clear our trenches for the sake of an effective fire. The enemy is not likely to rush our trenches in any strength at such a time. It is the duty of the artillery commander to make these points clear to the General Officer Commanding; it is the latter's duty to decide. If trenches are to be cleared, it is important that ample notice should be given to the infantry in order that they may have time to make the necessary arrangements for temporary evacuation and for denying to the enemy any opportunity of coming forward out of his trenches to avoid the effects of artillery fire."

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CONFIDENTIAL.

[S.S. 139/3]

NOT TO BE TAKEN INTO THE FRONT TRENCHES.

# Artillery Notes.

(Issued by the General Staff at General Headquarters.)

## No. 3.—COUNTER-BATTERY WORK.

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## I.—The Importance of Counter-Battery Work.

1. During the course of the present war the importance of counter-battery work has become more and more accentuated. For just as artillery forms the main support of the offensive, so also is it the strongest weapon of the defence.

Destruction of the enemy's artillery is a most important factor of success, from both a moral and material aspect. Every hostile battery destroyed is one step gained, and destruction of the enemy's artillery must not be left to the eve of a battle, nor neglected till the enemy attacks.

The struggle against hostile artillery must therefore be the constant consideration of Commanders.

Counter-battery work is not a matter of spasmodic effort, but is a continuous operation depending for success on accuracy of fire, continuity of plan, unremitting study and firm control. Its conduct on these lines will alone meet the end in view, namely, the considerable if not total reduction at decisive moments of the volume of hostile artillery fire, whether in the form of preparation for an assault, counter-preparation to meet attack by our own troops, or barrages offensive and defensive.

Guns and howitzers of all calibres may be employed in counter-battery work, as on other tasks, according to the requirements of the tactical situation which alone can indicate the nature and volume of artillery fire to be devoted to each phase of artillery action.

## II.—Organisation and Command.

2. The General Officer Commanding Royal Artillery of the Army is charged with the co-ordination of all artillery action both in offence and defence, and he should pay special attention to counter-battery work.

Working in close touch with the General Staff he submits to the Army Commander his proposals as to the extent of the Corps counter-battery areas based on the artillery available with Corps, and the grouping of the hostile batteries; also as to any subsequent modifications necessitated by considerable movements of the enemy's artillery. It is his duty to ensure that hostile guns situated in the counter-battery area of one Corps, but firing on the front of another, are adequately dealt with, for it will seldom be found that the whole of the hostile artillery which fires on the infantry and guns of any particular Corps is situated within the counter-battery area of that Corps. He deals direct with the Corps Wing and Balloon Wing Commanders in all matters relating to the combined work of Artillery and Royal Flying Corps, and works in close touch with the General Staff (Intelligence) and Field Survey Company in all matters affecting artillery intelligence.

3. The General Officer Commanding Royal Artillery of the Corps is responsible in a similar manner to the Corps Commander, whose instructions he issues direct to the Corps Heavy Artillery and any Field Artillery directly under his command. He is, therefore, at all times responsible to the Corps Commander for the counter-battery work of the Corps. He deals direct with the Corps Squadron and Balloon Company Commanders in all matters connected with the combined work of the Artillery and Royal Flying Corps.



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The Corps and Balloon Wing Commanders are, however, the executive commanders of the Corps Squadrons and Balloon Companies respectively, and as such act as the technical advisers of General Officers Commanding Royal Artillery of Corps with whom they should be in closest touch.

The General Officer Commanding Royal Artillery of the Corps lays down the general counter-battery programme, both with regard to the destruction of the enemy's artillery, which must be systematically and persistently sought after, as well as for general neutralization which at times may become a matter of necessity, as for instance, at the moment of the infantry assault or in the face of a heavy hostile bombardment. This programme must include any share in counter-battery work that the Field Artillery may be called upon to take up.

4. Apart from such orders as may be issued by the Army as regards co-ordination of counter-battery work between neighbouring Corps, the General Officer Commanding Royal Artillery of the Corps must arrange with those of Corps on either flank for immediate assistance from their batteries whenever it becomes necessary to deal with artillery outside his Corps area which is punishing the infantry or impeding their advance.

He is further responsible to the Corps Commander for the allotment of ammunition and its proper expenditure to the best advantage. He exercises a constant control over the action of his counter-batteries, assuring himself by frequent visits to groups and batteries that fire is conducted on sound lines, that the means of observation and communication are both adequate and satisfactory and, by study of air photographs, that the fire is accurate and productive of results. During the actual course of a battle the General Officer Commanding Royal Artillery will seldom be able to pay such visits, as his time will be fully occupied at his headquarters.

5. The Brigadier-General Commanding Corps Heavy Artillery is the executive officer who issues the daily orders for counter-battery work, allots the actual batteries and arranges all details, for which purpose he may be assisted by a Staff Officer for Counter-Battery Work who is attached to the Artillery Staff of each Corps.

His orders will specify the tasks to be performed, the ammunition allotted and the aeroplanes to be placed at the disposal of batteries, in accordance with the directions of the General Officer Commanding Royal Artillery of the Corps.

He forwards daily to the General Officer Commanding Royal Artillery of the Corps. and to other offices, specified from time to time in higher orders, a report on the hostile artillery and the work of his counter-batteries. It is his duty to ensure that all information of immediate value is passed to the batteries concerned.

6. The object of this organisation, whatever its details may be, is to ensure a methodical and permanent system of counter-battery work which in the actual battle plays a capital rôle.

Particular care must be taken to ensure that the counter-battery action of the Artillery of the Corps shall not degenerate into the spasmodic fire of independent batteries dependent on the individual ideas and energy of their Commanders.



The assistance in counter-battery work that can be and is afforded by the Royal Flying Corps is beyond dispute. The closest personal touch between the Artillery and the Royal Flying Corps is a matter of the first importance. Difficulties and occasional failures will occur, but their recurrence can best be obviated by frequent interviews, both before and after work, between officers of the two arms concerned.

At the same time artillery must not look upon the aeroplane as an essential to successful fire, particularly as regards counter-battery work. Correct use of datum points, calibration, calculations for the error of the day, thorough and accurate intelligence as to hostile batteries and careful intersections of our own battery positions will, granted good gunnery, render it perfectly possible to deliver an effective fire on occasions when aeroplanes cannot work or are not available. On such occasions recourse may also be had to accurate instrumental observation from two stations, for which purpose it is not necessary that the target should be visible so long as the bursts of the shell can be observed. If a hostile battery has been accurately located by bearings, this method should give good results.

7. The system of communications for counter-battery work must be carefully studied if efficiency is to be ensured and waste of material avoided. Counter-battery formations should, as far as material allows, be in direct communication with similar formations on either flank, the Corps Squadron and Balloon Company, the Army Observation Section Posts, and with the Artillery of Divisions in the line. For without such communication quick transmission of information and orders is impossible and, consequently, rapid application of effective fire.

8. Three points of general application in connection with the organization of counter-battery work remain to be noted:—

(i.) The dividing lines for counter-battery work between formations, whatever their size, must always be regarded as elastic and arrangements must be made by Artillery Commanders concerned, in consultation with the Royal Flying Corps, for adequate overlap on either flank.

(ii.) It is to be clearly understood that whatever be the counter-battery programme ordered for any particular day, arrangements must be such that any hostile battery (not included in the programme) reported as active either from the air or from the ground can be immediately engaged.

(iii.) All means of observation must be fully considered and carefully organised. Observation from the air and the possibility of delivering an accurate though unobserved fire by means of calculations have perhaps tended to belittle the value of direct observation from the ground.

Whenever hostile batteries can be seen active from ground observing stations, they should be promptly engaged without waiting for other means of observation. Direct observation from the ground is particularly to be looked for when the progress of a battle brings possession of commanding ground with a good view of hostile territory hitherto unseen except from the air.



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## III.—The Allotment of Artillery.

9. While definite batteries must be detailed for normal counter-battery work falling within the scope of the Army or Corps programme, it is clear that the actual number of guns required will and must vary in accordance with the needs of the tactical situation.

It is the duty of the Army or Corps Commander, as the case may be, to lay down from time to time the amount of artillery to be devoted to the destruction or neutralization of the enemy's batteries.

But unless the counter-battery programme states what batteries are to be employed on this work and aims at avoiding unnecessary changes, within such limitations as can be foreseen, co-operation on the part of the Royal Flying Corps will be rendered far more difficult, and the great advantage that accrues from personal understanding between Royal Artillery and Royal Flying Corps officers will be largely sacrificed.

10. Howitzers and guns placed well forward must be included in the artillery detailed for counter-battery work and may be arranged in mixed or distinct groups, so long as the action of all batteries devoted to any one area is controlled by one authority.

Howitzers (8-inch and upward) are required for the work of destruction; guns play their part in neutralization. 6-inch howitzers are largely used for neutralization and are very effective. They are not really powerful enough to destroy long established and carefully constructed emplacements, but they are of great value in an advance when the enemy's guns are forced back into positions more or less hastily constructed.

A proportion of the Corps or Divisional Field Artillery can be usefully employed in the counter-battery work of the Corps. The employment of field howitzers for this service should be particularly considered in all artillery schemes, as these weapons are provided with gas shells.

Field guns (13 and 18-prs.) with their rapid rate of fire can give great assistance in neutralizing the nearer hostile batteries; their value in this respect is perhaps apt to be overlooked, owing chiefly to the fact that there are so many calls upon them in the actual battle.

## IV.—Locating and Recording the Positions of Hostile Batteries.

11. A methodical system of sifting, recording, and studying all information concerning hostile artillery from whatever source available, is essential to the quick and effective application of counter-battery fire.

The chief sources of information are:—

(*a.*) Observation Section Posts and Artillery Observing Stations (by means of cross-observation of flashes).

(*b.*) Royal Flying Corps (aeroplanes and balloons).

(*c.*) Sound Ranging Sections.

(*d.*) The study of maps and air photographs.



All information of immediate importance must be forwarded direct to Headquarters, Corps Heavy Artillery, while the co-ordinate positions and all available details are published periodically by the Army in the form of a map or list or both. This map or list forms the basis of the counter-battery programme ordered by the Army and Corps.

12. In every Counter-Battery Office a book* must be kept in which the record of every known hostile battery within the allotted area is entered from day to day until this battery is finally struck out as destroyed or as having moved to a new position. Air photographs of each position should be kept with the book. An enemy battery's record should include its calibre and co-ordinate position, its sector and periods of activity, the occasions on which it is engaged and by what weapons, the resulting damage inflicted, &c.

By this means it is possible to compile a list showing at a glance the positions and natures of hostile batteries that are known to fire on the various sectors of our line, while constant reference to this list and to the batteries' records will not only enable counter-battery fire to be directed from day to day on reasoned lines, but will build up a valuable store of knowledge on which to work in a battle.

13. The development of "Sound Ranging" greatly facilitates the work of recording hostile batteries, as by this means not only the location of a battery can be found during a period of definite activity, but also the actual target and, in favourable circumstances, the calibre may be ascertained. By the collation of a number of "Sound Ranging" reports it is therefore possible gradually to work out the arcs of fire of hostile batteries, and knowledge of this nature will obviously much facilitate counter-battery work, particularly during periods of trench warfare. By the same process any system of "dummy flashes" regularly used by the enemy should sooner or later be discovered.

Sound Ranging cannot be carried out during a continuous bombardment by our own batteries, but is feasible during hostile artillery activity when the total rate of fire does not exceed one round per second.

14. All our experience emphasizes the importance of air photography and of constant study of air photographs.

In the first place, these things are essential if no hostile battery is to escape punishment. It does not necessarily follow that a gun position is unoccupied because no flashes are seen to appear from it, while, on the other hand, both dummy flashes and blank charges may be used to simulate active batteries.

Again, it must not be assumed that because a battery is known to have moved or to have been destroyed its old position will not be subsequently repaired and re-occupied, nor, on the other hand, that a battery will move because it has been severely handled.

Careful comparison of photographs of various dates will greatly assist decision as to whether emplacements are occupied or not, attention being particularly paid to the marks made by tracks and the blast of guns and to the actual condition of the pits.

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* Specimen pages of a suitable "Counter-Battery Book" are inserted at the end of this pamphlet.



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Air photographs will also disclose the position of emplacements constructed for the support of the enemy's rearward lines of defence, and will thus enable a Commander to work out in advance his arrangements for counter-battery work in the future.

A tendency on the part of the enemy to camouflage a certain number of his battery positions has lately been remarked.

Constant photography of the areas likely to be occupied by hostile artillery is therefore called for at all times in the hope that new positions may be detected in the first stages of their construction before effective concealment has been attained.

Finally, air photographs will assist a Commander to appreciate the extent to which his counter-battery work is crowned by definite results.

15. Occasionally it may be necessary to induce the enemy to disclose the positions of his batteries at times when conditions are favourable for observation. This will particularly be the case just prior to active operations, or when by reason of bad weather or other circumstances, the hostile artillery has escaped observation for some considerable period. The object in view may be attained by means of "Chinese" attacks or even by a vigorous display of trench mortar activity; but action by artillery alone is unlikely to achieve the desired result

## V.—Principles of Action.

(Attention is called to "Co-operation of Aircraft with Artillery," issued by the General Staff, November, 1916).

16. The characteristics of counter-battery work are two-fold, destruction of hostile batteries as a daily task and neutralization on certain tactical occasions of all batteries which it has not been possible to destroy.

It is evident that destruction offers the most satisfactory means of reducing the hostile artillery to impotence. But since this ideal cannot be completely achieved, occasions will arise in all active operations when the infantry must be further protected against the enemy's guns by fire for neutralization.

The immediate object of all counter-battery work being to obtain maximum effect on hostile artillery, batteries specially detailed for this work must on principle be placed well forward, so that distant hostile batteries may be reached and also that full benefit may be reaped from enfilade fire.

### Destruction.

17. The howitzer is par excellence the counter-battery weapon for destructive purposes owing to the advantages it possesses over the gun in accuracy and its ability to deliver its shell at very steep angles of descent.



To ensure the destruction of a hostile battery, certain requirements must be met:—

(*a.*) It must be established that the position to be engaged is actully occupied.
(*b.*) Fire must be carefully controlled and observed, not only during ranging but also while firing for effect.
(*c.*) A sufficient quantity of ammunition must be devoted to the task in hand.

As regards (*b*), fire is only of value if it is accurate and this depends on control and observation. Both guns and howitzers have a tendency to lose exact range or line to a target from a variety of causes, even though ranging may have been satisfactorily accomplished.

18. If destruction is to be achieved with certainty, and if the tactical situation admits, it is desirable that observation should continue to the last in order that any subsequent inaccuracy of fire, beyond that due to the error of the piece, may be at once detected and corrected.

19. Touching the expenditure of ammunition, it is futile to attempt the destruction of a hostile battery with a small number of rounds. The following table may be taken as a general guide to the minimum number of rounds which under favourable conditions may be considered sufficient to destroy a battery, assuming frontal fire is employed:—

| | Rounds. |
|---|---|
| 6-inch howitzer .. .. .. .. .. .. | 200 |
| 8-inch „ .. .. .. .. .. .. | 150 |
| 9.2-inch „ .. .. .. .. .. .. | 100 |
| 12-inch „ .. .. .. .. .. .. | 50 |

If enfilade fire is used a less number should suffice.

Economy in ammunition is to be sought, not in withholding any of the amount required for a legitimate task, but by taking every precaution to ensure accuracy of fire and by avoiding the possibility of waste, due either to the engagement of a doubtful target or to the adoption of a policy of half-measures. If a hostile battery is to be destroyed, then fire should not cease till the result, as far as it is possible to tell, has been achieved.

20. Destruction, as already stated in a previous section, must be regarded as a continuous procedure. It is to be carried out at all times with relentless vigour, both during actual battles and in the intervals between them.

21. While anything in the nature of plastering an area with shells in the hope of destroying a scattered collection of hostile guns can only entail waste of ammunition, and is therefore to be deprecated, cases may occasionally arise when it may be justifiable to attempt the simultaneous destruction of a group of gun positions with certain strict provisos.



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The positions must, of course, be known to be occupied and must be contained within an area small and clearly defined by means of roads, tracks, streams, &c., so as to facilitate for the air observers the ranging of the various batteries to be employed on the task.

These batteries should consist of the heaviest and longest ranging weapons available so that full benefit may be reaped from the power of their shell and from enfilade fire. The area must be thoroughly covered with shell, fired on a simple and methodical plan.

22. Time is a factor of great importance in destructive work as regards the co-operation of the Royal Flying Corps, and every step that can be taken to expedite fire observed from the air is an emphatic gain.

With the slower firing howitzers the destruction of a hostile battery may be undertaken simultaneously by two batteries of the same group.

Arrangements having been carefully thought out beforehand, each of the two batteries should range one after the other. Fire for effect can then be carried out by rounds of battery fire at 2 seconds interval from each battery alternately on a signal from the aeroplane observer, who will send down the results in the usual manner.

The observer can call at any time for fire to be taken up by one of the batteries if he sees abnormal errors occurring.

Normally, however, destructive effect is under present conditions best assured by concentrating all the guns or howitzers of a battery on each emplacement of the hostile battery in turn; the order in which the emplacements are engaged being arranged beforehand.

23. In carrying out the work of destruction every endeavour should be made to exploit the use of oblique and enfilade fire, as in every case the breadth zone of a gun or howitzer is much less than its length zone, and the chances of obtaining direct hits are therefore greater as the obliquity of the line of fire to the target increases.

Known batteries must be definitely selected for an attack, in order of their importance and activity, both before and during active operations, and be notified in the daily programme of counter-battery work.

Pre-arranged shoots should be carried out as systematically as possible so as to admit of the maximum amount of aerial observation of fire for destruction.

Fire for destruction with aeroplane observation should, when possible, be followed from two ground observing stations, the observers being informed when the aeroplane observer gives "O.K." This procedure may assist to secure accurate fire at some future date when no aeroplane is available.

Aeroplane observation should, however, invariably be provided, if the tactical situation admits, in the case of fire for destruction when accurate observation from the ground is impossible.

24. Consideration must always be directed towards the selection of the most suitable weapon for destructive work in each instance. Apart from the question of oblique fire which has already been touched upon, it is obvious that the heaviest howitzer should preferably be employed when the protection of the target is known or reasonably believed to be of the strongest. Similarly, against a battery unprotected or



merely camouflaged, the field howitzer may prove a perfectly adequate weapon. Commanders should bear in mind that at times of abnormal artillery movement, such as must occur in the case of a hurried reinforcement on a large scale, or of a sudden retreat, there will be periods during which a number of hostile batteries will be little if at all protected. Under such circumstances full use can be made of the lighter forms of artillery for counter-battery work, so long as the protected and unprotected targets can be distinguished.

Shrapnel fire of field guns or 60-prs. can be usefully employed in conjunction with the actual work of destruction effected by heavy howitzers, with a view to inflicting loss on detachments that may be compelled to withdraw from their guns or at night, by bursts of fire at irregular intervals on personnel and horses sent up to move the damaged battery.

**Neutralization.**

25. The object of neutralization is to paralyse and blind those hostile batteries which have not been destroyed by a sudden and violent application of all available means. It will therefore be required both in offence and defence.

In the offensive, directly that the infantry leave their trenches they must be relieved as far as possible of the burden of the enemy's barrage, which may otherwise inflict considerable losses and even arrest their movement.

At this moment every available weapon must be employed against the hostile artillery and continue firing until the infantry is established in the position won. On every hostile battery known or suspected, and that is not at the moment subjected to destructive fire, fire must be opened of sufficient intensity to prevent the service of the guns. By cutting the batteries' communications and by engaging all known observing stations, the power of the hostile artillery will be still further reduced.

It is open to question whether hostile batteries definitely located just prior to an attack should be destroyed at once or not. Every battery that is destroyed is one less to reckon with on the day of attack. On the other hand, batteries that are severely shelled and not actually destroyed, may be induced to move to a new position and so be unlocated at the hour of assault. In this case it may be impossible either to destroy or even to neutralize them at the critical moment. These considerations must receive due weight in the artillery plan for an offensive operation.

26. In cases of preparation by the enemy for attack or counter-attack, and at other times when he subjects our infantry to a severe bombardment, the need of neutralizing fire will occur just as much as at the moment of our own assault. The infantry again must be relieved of the weight of the enemy's fire, and under such circumstances relief can only be immediately effected by a general neutralizing fire, which must for the time being take precedence over the pre-arranged destructive programme of the day.

27. In all schemes therefore of offence and defence regard must be had to the orders and arrangements necessary to produce effective neutralization, either at a pre-determined hour or at a moment's notice, as the case may be.



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Neutralization zones must be allotted to groups and batteries and, in considering action to meet attack or counter-attack by the enemy, the counter-battery programme must include a scheme of general neutralization to be executed, if required, by every available gun that can be spared for the purpose.

Hostile artillery reduced to silence by neutralization should be kept under intermittent fire by field or medium guns to prevent a recurrence of its activity.

The Royal Flying Corps play a direct and important part in neutralization. For while the enemy's ground observing stations and occasionally his balloons are the charge of the artillery, his aeroplanes and the majority of his balloons must be engaged by the Royal Flying Corps, who thus assist to deprive him of his means of observation.

Anti-aircraft guns must also take a vigorous share in denying to the enemy the benefits of aerial observation.

A thorough and detailed scheme is therefore essential to effective neutralization, and such a scheme can only be built up on knowledge. Hostile batteries will not be neutralized unless their whole history is studied from day to day with untiring energy. Further, to increase the chances of success, measures must be taken to arrange as far as possible for observation from the air and from the ground of the fire of neutralizing batteries.

28. As regards the method of fire to be employed, fire should be distributed over the whole target from the first round.

29. Gas shell may be profitably employed for neutralizing fire, provided that atmospheric conditions are favourable and that a sufficient quantity of such shell can be fired. For guidance as to the number of gas shell required (*see* "Instructions on the use of Lethal and Lachrymatory Shell" issued by the General Headquarters, under No. S.S. 134, Section 11).

30. The foregoing paragraphs deal chiefly with neutralization during the actual progress of a battle. But at other times the moral of a hostile battery may be considerably affected by the knowledge that it will be subjected to prompt and accurate neutralization whenever it opens fire.

It is therefore important that hostile batteries should be quickly engaged not only when their flashes are seen from aeroplanes, balloons or observing stations, but also when their activity is deduced from current reports. Such deductions should frequently prove correct if the records of hostile batteries are carefully kept on the lines laid down in Section IV. and if a quick and reliable system of transmitting reports of hostile artillery activity exists.





# COUNTER-BATTERY BOOK.



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## EXPLANATION.

The object of this book is to provide all Artillery Commanders who have counter-battery work to do with a detailed account of the situation in a portable form, and in one with which they will all be conversant, so that when Batteries or Groups are relieved the new Commander at once has a grasp of the Grouping and Activity of the Hostile Artillery.

As each book only contains 100 pages, it will be necessary for the larger formations to keep more than one book, and in order to derive the full benefit from the information supplied by the Army, the pages should be numbered consecutively, and the histories of all batteries entered, so that the number of the page corresponds with the number given to the Battery in the Active Hostile Battery List (A.H.B.).

In the case of a smaller formation such as a Group, one book would probably be sufficient if the pages were numbered and an ordinary index kept at the end of the book.

On each right hand page is a form to show the history of the Active Hostile Battery, while immediately opposite, on the left hand page, is an account of how that particular battery has been engaged by our Artillery.

By this means it can be at once seen—

(1.) How often a battery has been reported active.

(2.) By whom it has been reported (R.F.C.; Sound Ranging Section; Observing Station; Balloons; Corps Intelligence).

(3.) How often it has been engaged by our Artillery and the number of rounds expended.

(4.) How many photographs have been taken of the position and their dates.*

Order of accuracy:
- P. Correct to 20 yards.
- Q. „ 50 „
- R. „ 100 „

R.F.C. visibility:
- A. Each gun position seen.
- B. Battery position seen.
- C. General idea only.

* These should be kept in a properly indexed box, so that any photograph can be turned up at a moment's notice.



## INDEX.

In order to provide a connection between the Registered Number of the Batteries of the Active Hostile Battery List and the actual co-ordinates of the battery, a few pages, showing in outline ordinary map squares, are added at the end.

Upon these squared pages should be filled in the map square letters and numbers corresponding to the area for which the particular Group in question carries out the counter-battery work.

The number of the page containing the battery history should be inserted on the squared pages, in the approximate map position of the battery in question.



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| Engaged by. | Date. | Calibre. | Rounds. | Result. | Engaged by. | Date. | Calibre. | Rounds. | Result. |
|---|---|---|---|---|---|---|---|---|---|
| 96th S.B. .. | 16. 4. 16 | 6″ H. | 20 | Unknown. | | | | | |
| 103rd H.B.. | 22. 5. 16 | 60-pr. | 75 | Neutralized. | | | | | |
| 74th S.B. .. | 10. 11. 16 | 9·2″ | 30 | Bad. | | | | | |
| 74th S.B. | 11. 11. 16 | 9·2″ | 40 | Good. Appears knocked out on photo. | | | | | |
| 23rd S.B. .. | 11. 11. 16 | 9·2″ | 60 | | | | | | |
| 64th S.B. .. | 11. 11. 16 | 12″ | 25 | | | | | | |
| D./148 .. | 11. 11. 16 | 4·5″ | 100 | | | | | | |



| Position. | H 26, C 2834. | A.H.B. number. 1. |
|---|---|---|
| Other emplacements. | H 26, C 3240. | Calibre. 15-cm. H. or 10·5-cm. G. |
| | H 26, C 3748. | Accuracy. Ø.P. |
| | H 26, C 5053 | R.F.C. visibility. A. |

| Photo and date. | Target or arc. | R.F.C. | S.R.S. | O. | K.B.S. | VII Corps. | Remarks. |
|---|---|---|---|---|---|---|---|
| 11M550. 8. 4. 16.. | Hebuterne .. | 9. 4. 16 | 9. 4. 16 | 5. 5. 16 | 10. 11. 16 | 4. 5. 16 | Four heavily protected pits lying across a track, under which shelters connected by a gallery have been dug. |
| 11M551. 8. 4. 16.. | D 20d .. | 16. 4. 16 | 10. 4. 16 | 20. 5. 16 | | 16. 5. 16 | |
| 12L1070. 17. 8. 16.. | E 15c. . .. | 4. 5. 16 | 4. 5. 16 | 12. 7. 16 | | 22. 5. 16 | |
| 12L1660. 22. 10. 16.. | Pommier .. | 16. 5. 16 | 21. 5. 16 | 22. 11 16 | | 1. 7. 16 | |
| 13L337. 23. 11. 16.. | | 22. 5. 16 | 22. 5. 16 | | | 12. 7. 16 | |
| | | 1. 7. 16 | 5. 11. 16 | | | 10. 11. 16 | 5. 7. 16.—Light railway connected to position. Tracks shown in original photos are disappearing. |
| | | 12. 7. 16 | 10. 11. 16 | | | | |
| | | 10. 11. 16 | | | | | 10. 11. 16.— Later photos show that camouflage is more complete. |
| | | 11. 11. 16 | | | | | |
| | | 22. 11. 16 | | | | | Was not active between July and November. |



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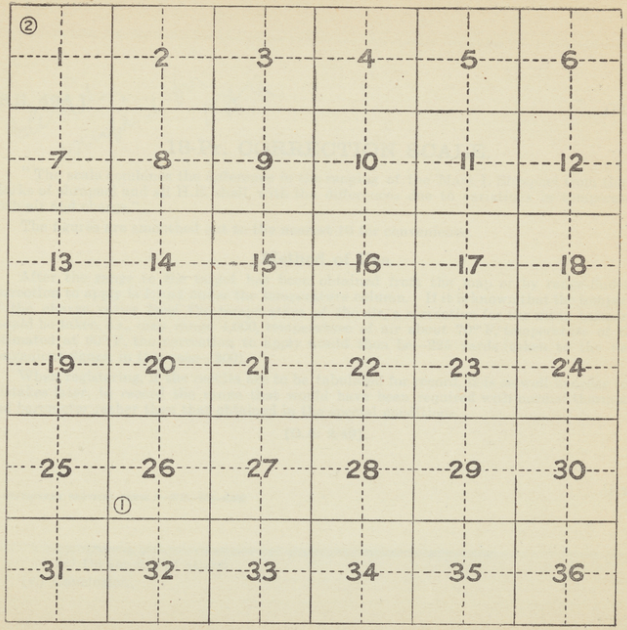
H.

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[S.S. 49A.]

O.B./364.

# 18-Pr. CORRECTION SCALE.

"The scale combines the difference in the ranging of the Mark I. Shrapnel from the other Marks of shrapnel and all H.E. shell, with the differences due to variations in temperature of both air and charge."

The figures are smoothed out to the nearest 10 for convenience.

## Method of Use.

After the range to the target has been obtained from the map or by range-finder, the correction to apply is found under the temperature column. If it is known that the temperature of the charge varies from the temperature of the air, a correction for the mean temperature should be taken, *i.e.*, map range 4,000, temperature of air about 70° F, temperature of charge estimated at 60° F, the correction to apply would then be—225 yards (taken to the nearest convenient figure, in this case—200).

When registering, if the results are to be tabulated for record, it is as well in order to save mistakes later, to record the range that would have been required with normal thermometer and barometer rather than that obtained in the special conditions.

**[O.A. 2/49].**

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[P.T.O.

(b) During periods immediately preceding offensive operations.
(c) On the day of attack.

(v.) Conclusion.

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## Range Tables—Corrections for Temperature, etc., when using Nitro-cellulose Charge.

| | Temperature, Fahr.— | | | | | | Barometer— | Wind— |
|---|---|---|---|---|---|---|---|---|
| | 30° | 40° | 50° | 60° | 70° | 80° | 1-inch fall | 30 F.S. against |
| 2,000 ... | —30 | —50 | —60 | —80 | —100 | —110 | —15 | +30 |
| 3,000 ... | —70 | —100 | —120 | —140 | —160 | —180 | —30 | +60 |
| 4,000 ... | —120 | —150 | —180 | —210 | —240 | —270 | —45 | +90 |
| 5,000 ... | —170 | —210 | —250 | —290 | —330 | —370 | —60 | +120 |
| 6,000 ... | —210 | —260 | —310 | —360 | —410 | —460 | —75 | +160 |
| 7,000 ... | —240 | —300 | —360 | —420 | —480 | —540 | —90 | +200 |

[P.T.O.

# Artillery Notes.

*(Issued by the General Staff at General Headquarters).*

## No. 3.—COUNTER-BATTERY WORK.

*NOTE.—Throughout this paper the term "heavy artillery" includes all artillery except divisional artillery and anti-aircraft guns.*

1. Counter-battery work is in many ways the most important, as it is certainly the most difficult, of the tasks of the artillery under present conditions. It has been steadily growing in importance and is now recognised as an essential element both in offensive operations and in the work of "holding the line." In consequence, the methods to be adopted have been the subject of much discussion, and various papers dealing with different aspects of the case have been circulated during the last year, including memoranda by responsible French Commanders, as well as translations of similar documents captured from the enemy. From our own experience, and from the material thus available, it is now possible to arrive at certain definite conclusions as to the methods to be followed in the improvement and development of counter-battery work in the future; and it is the object of this paper to place the principles thus established at the disposal of officers concerned in a convenient form.

2. The subject will be treated under the following heads:—

(i.) The location of hostile batteries.
(ii.) The allotment of guns for counter-battery work.
(iii.) The system of command.
(iv.) The plan of action:—
  *(a)* While holding the line.
  *(b)* During periods immediately preceding offensive operations.
  *(c)* On the day of attack.
(v.) Conclusion.

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## I. The Location of Hostile Batteries.

3. Owing to the great development in air reconnaissance during the last summer, there was at one time a tendency to depend *almost entirely* upon this for the location of the enemy's guns. The reports of air observers will probably always be the chief source of information regarding the German artillery positions, but in many parts of the line, owing to the facilities for concealment afforded by the nature of country, it is impossible to detect from the air the presence of a German battery until it opens fire. It is, therefore, absolutely necessary, while taking full advantage of the valuable help which can be rendered by aeroplane reconnaissance, to develop all other means available for locating the enemy's batteries.

4. Artillery officers and look-out men are trained "to detect readily the flashes of guns, the dust thrown up by their discharge and the other indications of the presence of a battery in action" (*Field Artillery Training, para. 155 (2)*); and the attention paid to such work in the artillery has in many cases met with marked success. But the increase in the artillery on both sides, and the elaboration of the systems of communication and of control of fire, have necessitated a similar extension of the system for locating the enemy's guns. A regular organization for this purpose has now been established in all Armies, so that it is not necessary to do more here than lay stress upon the two main principles which should govern the working of such an organization.

5. The first of these is that the fullest possible use should be made of all possible sources of information. These will include, in addition to the machinery belonging to the organization itself, all artillery observing stations, *whether belonging to units told off to counter-battery work or not: air photographs and the reports of the R.F.C.: kite balloons: and any system of "sound-ranging" or the like which may be installed in the area. The rapid and accurate collation of the information received from all these sources is a matter which will require careful arrangement, since the larger part of the evidence will be circumstantial and not direct. Even direct evidence of flashes may merely refer to dummy flashes or to guns run temporarily into dummy emplacements.

* It is important that these observing stations should be well organized and in lateral communication.



6. But, however well this work may be done, it will prove of no practical value, unless the primary object of the whole thing is kept constantly in view. This is the *silencing of the enemy's guns*. And since the enemy's guns can only be silenced by artillery fire, the main efforts of the system must be directed to giving to the artillery told off for counter-battery work just such information as they require, and with as little delay as possible. The organization of the system for locating the enemy's batteries must, therefore, depend upon the organization of the artillery for counter-battery work.

## II. The Allotment of Guns.

7. The necessity for devoting a considerable number of guns to counter-battery work has only recently been realized. There was at one time a tendency to look upon such work as outside the sphere of the field artillery, a matter which could be left entirely to the heavy artillery. But the destruction of the enemy's defences becomes day by day a more difficult task, and, therefore, tends more and more to absorb the whole time and ammunition of the heavy howitzers, leaving only the heavy guns for counter-battery work. It is not intended to suggest that heavy howitzers should not be used for the destruction of the enemy's guns when circumstances permit: opportunity should certainly be taken of lulls in the operations for this purpose. But, during attacks and the periods immediately preceding them, these howitzers will generally be fully occupied with their more legitimate work, and it is therefore on the heavy guns that the work of silencing the enemy's guns must chiefly fall. Under present conditions as regards relative strengths this is a task beyond their power, and the field artillery must therefore render all possible assistance.

8. It is true that a battery cannot be *permanently* silenced except by the destruction of its guns, and this may be beyond the power of field artillery; but the object in view may be attained by its *temporary* silencing or neutralization. However well entrenched a battery may be it will rarely be able to maintain effective fire "if subjected to an accurate, rapid and intense fire" (*Field Artillery Training, para. 223 (3)*) even of field guns, while a direct hit with a field howitzer shell is quite sufficient to put a gun out of action unless very heavily protected.

Both field guns and howitzers are undoubtedly limited in range, but it considerably lightens the task of the heavy artillery if it is relieved of the counter-battery work within the range of the field artillery: and in many cases it is possible for field artillery to neutralize batteries, the guns of which are out of its range, by attacking their observing stations.

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9. During the preparation and delivery of an attack the artillery of the divisions actually attacking will be fully occupied in the support of their own infantry*, and their attention should not be diverted to any other objects. But it may often be possible to utilise the artillery of the divisions in reserve. During intervening periods there are objections to keeping in action any portions of the artillery of divisions which are resting, since the fullest advantage should be taken of this period for training, and the paramount duty of the field guns of the divisions holding the line is to assist the infantry of their division in repelling any attacks that may be made. For this they must obviously be under the orders of the divisional artillery commander. But wherever the artillery available allows, field guns must also find a place in the counter-battery organization, while the bulk of the field howitzers, whose rôle does not include the repulse of an assault, should be utilized for counter-battery work.

## III. The System of Command.

10. It is generally agreed that all the artillery detailed for counter-battery work in any given area should be formed into a separate command for this purpose. But the size of the area with which such an organization should deal is a matter in which it is impossible to lay down hard and fast rules. In some cases, though these will be the exception, it may be possible for the counter-battery work to be done within the division. More generally the corps will be the unit, and in such cases the counter-battery group will work directly under the general officer commanding the artillery of the corps, although the executive command of the group should always be vested in an officer appointed for that purpose. This will normally be the officer commanding the heavy artillery of the corps. In other cases, especially those of pronounced salients or re-entrants in the line, the boundaries of corps areas may not be suitable as lines of demarkation between the zones of counter-battery groups, and in such cases better effect may be obtained by organizing the counter-battery work on broader lines than is possible within the limits of corps areas.

11. It is recognised that with the withdrawal of the control of counter-battery work from the formation holding the line, the difficulty of securing rapid and effective co-operation increases—and this applies in turn to the brigade, the division, and the corps. On the other hand,

* It must be recognised that it will rarely be possible in future to count on heavy guns for sweeping approaches and similar "barrage" work, and that this must therefore be undertaken by the field artillery.



hostile fire comes very largely from a flank, and the flashes of guns so employed are generally screened from view from the portion of the front opposite them. The full effect of the powerful weapons now available is also much discounted if their action is confined to too narrow a front, and the value of long range enfilade fire is lost.

12. This is a matter in which the local circumstances must be the decisive factor in each case. In the same army circumstances may render different courses advisable in different parts of the line. Generally speaking, however, it is advisable to organize the counter-battery work on a corps basis, provided that adequate measures are taken to ensure co-operation between corps. In all cases, however, the paramount consideration is that the organization adopted should be that best suited to accomplish the task in hand—*viz:* the silencing of the enemy's artillery.

## IV. The Plan of Action.

### (a) While holding the line.

13. During the periods which intervene between offensive operations ammunition will probably be limited. Such as is available should, however, be devoted to the systematic destruction of the hostile batteries, for the destruction of one is better than the registration of many.

This is a task for which heavy howitzers are pre-eminently suited on account of their range, accuracy and shell power. Accuracy is above all things necessary; and the whole object will be defeated unless success has been effected before darkness allows of a change of position. It is therefore not advisable to embark upon such an enterprise unless the circumstances are favourable, exact observation being an essential element of success. At the same time advantage should be taken of every favourable opportunity, and whenever a hostile battery is located it is the duty of the responsible artillery commander to think out a definite plan for its destruction, and to arrange every detail in advance so that it may be attacked directly the conditions are such as to promise successful results.

14. To destroy a battery that has been accurately located a considerable expenditure of ammunition is allowable provided continuous observation is possible. Very happy results have been obtained by combining the shrapnel fire of guns with the high explosive of howitzers. If the guns can get a surprise salvo into a previously registered target they may hope to cause casualties, and when the howitzers commence their destructive programme the shrapnel should be distributed in rear and on the flanks to catch the detachments if the latter are withdrawn.

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After such an attack fire should be kept up at intervals throughout the night as men and horses will probably be brought up to shift the guns.

15. During this period also special attention should be devoted to the discovery of the enemy's observing stations. As a general rule, however, these should not be interfered with unless our troops are suffering heavily owing to their existence, for no great results can be expected from their destruction at this time. On the other hand if the attack upon them is deferred until the day of an attack or the previous evening, and is then methodically conducted in accordance with carefully thought out plans, it may have very important results.

**(b) During periods immediately preceding offensive operations.**

16. The question of the extent to which hostile batteries should be attacked during the period* immediately preceding offensive operations is a difficult one. On the one hand this is the time when effective fire will give the greatest results, since it is too late for the replacement or repair of damaged material. On the other hand it must be remembered that the heavy howitzers—the most effective weapons for the purpose—will be much occupied with the destruction of the enemy's defences, and that the attack if ineffective will only result in a change of position. Generally speaking however, the enemy's guns should be attacked whenever there is a reasonable prospect of effecting their destruction: fire merely for neutralization should be avoided.

17. Several days† before the time fixed for the attack a deliberate effort should be made to induce the enemy's guns, and especially his "defence batteries," to open fire and so disclose their position. It is impossible to lay down any definite rules as to the methods by which this may best be effected, but it may be accepted that artillery action alone will be insufficient, and that variety is the soul of success. Every possible arrangement should of course be made to ensure full advantage being taken of the opportunity by all the means available for locating the hostile positions.

**(c) On the day of the attack.**

18. If the attack is not to be delivered until late in the day, all the time available previous to its delivery should be spent by the counter-batteries in verifying their registration of the hostile gun positions and, possibly, if time permits, in destroying some batteries.

* From three to four days to a week according to circumstances.
† So as to allow for unfavourable weather.



19. During the final bombardment and actual attack the most recent experience shows that an effective system is to attack all known German batteries (including their observing stations) *suspected of* being occupied, without waiting for them to be reported active. This will probably have the effect of driving the detachments into their dug-outs at any rate, and even if they man their guns again directly our infantry leave their trenches the few moments delay in opening fire may be invaluable.

20. Further, the plan of attack should ensure not only that no hostile battery, or even single gun, escapes attention, but also, as far as possible, that the different natures of guns are dealt with at the time when, according to their respective rôles, they are most likely to impede the progress of our infantry. Thus their howitzers cause most annoyance to our troops when forming for assault, and after the line has been captured: their field guns, especially those dispersed and dug in for the purpose, during the progress of the attack. It should also provide for the concentration of fire on to particularly obnoxious zones in accordance with the intelligence previously collected as described in Section I., and batteries must be ready to deal at once with any battery reported "active" by an aeroplane or balloon observer.

21. In order to avoid waste of ammunition on the one hand, or the possibility of guns re-opening unchecked on the other, aeroplane observers must devote their attention especially to reporting what batteries are active, and whether the fire directed upon them is effective in silencing them. They must be on the look out for the re-opening of fire by batteries which have been apparently mastered; and it is a wise precaution to give all such batteries an occasional short burst of fire whether reported active or not.

22. Even if only a section* is told off to each hostile gun position a very considerable number of guns will be required, but the necessity for allotting a sufficient force of artillery has already been referred to in Section II. It must be recognised that the enemy's artillery cannot be adequately dealt with unless enough guns are detailed for counter-battery work, and reserved for their special task.

* In some cases a single gun may possibly be sufficient.

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## V. Conclusion.

23. In the preceding paragraphs certain principles have been enunciated regarding the method of employment of the artillery in counter-battery work. In doing so there is no intention of cramping the initiative of those responsible for the control of the artillery fire, but rather to assist them by laying down difinite lines for their guidance, which will ensure their efforts being directed in accordance with a common plan. The details of the counter-battery work must always depend upon the local circumstances and the means available.

24. In conclusion there only remains to draw attention to the necessity for taking every precaution to ensure co-ordination of effort. The first essential is careful demarkation of the respective zones of action. But any arrangement of this sort must be an elastic one, since no arbitrary division can cover all cases that may arise. It is therefore next necessary to provide for direct communication between the groups organized for counter-battery work, and between the units employed on the same task on the same front. It is only thus that complete co-operation can be secured under, however, varying circumstances.

25. However carefully thought out such purely artillery arrangements may have been, it must always be remembered that in counter-battery work especially the direction of artillery fire must depend to a great extent on the reports of observers in the air. The closest co-operation and camaraderie between the artillery and the flying corps is therefore vital to success. The artillery programmes must be prepared by the officer in command of the counter-battery group in consultation with the commander of the squadron with which he is working, and it is of the greatest importance that after the observers come in, they should discuss the day's work, and everything connected with it, with the commanders of the batteries with which they have been working.

26. Finally, every precaution must be taken to avoid any tendency to detachment between the artillery employed on counter-battery work and the rest of the army. Whether the army is employed in offensive operations or merely "holding the line," the fortunes of the infantry must depend to great extent on the success or failure of the artillery in its struggle with the enemy's guns. No effort must therefore be spared towards reducing the loss from the enemy's gun fire, whether this is accomplished by the direct destruction of his batteries, or by their neutralization.

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# Artillery Notes.

(Issued by the General Staff at General Headquarters.)

## No. 4.—ARTILLERY IN OFFENSIVE OPERATIONS.

*General Headquarters,*
*April*, 1916.

AUSTRALIAN WAR MEMORIAL
PRINTED RECORDS
4-17636

(B199) 2,000 6/16 H&S 3401wo

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# ARTILLERY NOTES.

(Issued by the General Staff at General Headquarters.)

## No. 4.—ARTILLERY IN OFFENSIVE OPERATIONS.

*This note is supplementary to that on "Preparatory measures to be taken by Armies and Corps before undertaking offensive operations on a large scale."*


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## I.—The General Plan of Attack.

### 1. Duty of the Artillery Commander.

In all offensive operations it is the duty of the officer commanding the artillery of the force engaged, whether this is an infantry brigade with artillery attached, a division, a corps, or an army, to prepare an "artillery plan" as described in this paper. This plan will be based on, and supplementary to, the general plan of attack.

### 2. Selection of the front of attack.

Under present conditions, no offensive operation can be expected to achieve complete success unless both the preparation and support by the artillery are effective; and for this it is not enough that the requirements in guns and ammunition should have been correctly estimated and adequately provided. The first and most essential element of success is that the front selected for attack should admit of a full development of artillery fire, and of complete co-operation between the artillery and the infantry. It is only when the ground allows of artillery commanders—

(i.) Seeing clearly the enemy's defences, and also following the movements of the attacking infantry;
(ii.) Controlling the fire of their guns rapidly and effectively;

that the infantry can count on obtaining the full measure of support which artillery can render. For, however carefully thought out the arrangements for the control of both artillery fire and infantry movement may be, they are always liable to be thrown out of gear by some unexpected development.

It is, then, the first duty of the artillery commander to place before the general officer commanding the force full particulars as to how the ground affects the efficiency of the artillery preparation and support, so that the latter may give due weight to such considerations in selecting the front of attack. "An objective which may appear at first sight easy of access to the infantry, may prove in the end costly to attack, if it does not lend itself to the judicious application of artillery fire; and vice versa, localities which present difficulties to the infantry alone may, if it is possible to bring the converging fire of artillery to bear on them, be carried with comparatively little loss."

### 3. Estimate of guns and ammunition required.

The general plan of attack having been settled, it is the next duty of the artillery commander to prepare an estimate of the amount of artillery and of ammunition required for the operation. The first point to remember is that the *ammunition* required depends upon the work to be done, *i.e.*, upon the enemy's defences, more than on the number of guns available. The latter is, however, the governing factor as regards the *time* which will be required for the preparation, and has therefore an important bearing on the general plan of attack, for if surprise forms any part of the latter, it is essential that sufficient *fire units* should be available to allow of the different portions of the enemy's defences being bombarded simultaneously.



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The *nature of guns* required depends, like the ammunition, on the nature of the enemy's defences. There has sometimes been a tendency to think that nothing but the heaviest howitzers should be demanded on all occasions. A little consideration shows that even if the number of these natures available, and still more the amount of ammunition for them, were unlimited—conditions which are never likely to be fulfilled—questions connected with the supply of ammunition alone would necessitate economy in their use. In estimating requirements the heavier natures should only be detailed for tasks beyond the power of the lighter.

### 4. Reconnaissance.

An estimate of the guns and ammunition required can, therefore, only be made after thorough reconnaissance of the enemy's system of defence, including his trenches, machine-gun emplacements, observing stations, communication trenches, rear lines, strong points, wire, &c. This reconnaissance must include not only the examination of the ground from all possible points of view, but also the reports of air observers, and a very careful study of air photographs, and of all information available in the intelligence section. The latter should give the roads used by the enemy in bringing up reinforcements and supplies of ammunition and food, the places where they can best be blocked by artillery fire, and the forming-up places likely to be used for counter-attack. The number and nature of the guns which may be brought into play by the enemy is also an important factor, as it governs the requirements for counter-battery work.* It is important that the artillery commander should make this reconnaissance in company with the general staff of the formation, and that the fullest information regarding not only the enemy's defences but his habits should be obtained from both the artillery and the infantry holding the front.

## II.—The Artillery Plan.

### 5. Scope of the artillery plan.

The general plan of attack having been settled, and information having been received that the necessary guns and ammunition will be available for the operation, the artillery commander will make out his "Artillery Plan." This should be a comprehensive statement of the objects to be attained by the artillery, and the methods to be employed. It will give the organization of the artillery for the attack, the tasks and zones of the various commands, the arrangements for communications and for the co-operation of the Royal Flying Corps, the orders regarding the expenditure and supply of ammunition, and any other points regarding the action of the artillery which it is necessary to include. Its preparation will involve a consideration of all the various tasks of the artillery during the preparation and support of the attack, but care must be taken to avoid cramping the initiative of the subordinate artillery commanders by entering into details which are within their province.

* Counter-battery work has been dealt with in a separate note (No. 3 of this series).



### 6. Organization.

The organization of the artillery forms perhaps the most important part of the artillery plan. The principle that a divisional commander, to whom a definite objective is assigned, should have under his orders the artillery which is necessary to enable him to carry out his task, may often be inapplicable, as for instance where a corps attacks in depth and divisions succeed each other on the same front; for experience shows that any attempt to apply this principle of attack in depth to the artillery is foredoomed to failure. Now, more than ever, the guns form the "iron framework of the battle"; and all recent operations have proved the necessity for a carefully elaborated scheme for the employment of the whole of the artillery, involving a methodical allotment of tasks from the outset, and depending for its successful execution on an effective chain of artillery command.

### 7. Allotment of tasks.

The number and variety of the tasks which the artillery is called upon to perform necessitate very careful arrangement, if the different natures are to be employed to the fullest advantage. These tasks depend upon the enemy's defences, and must, therefore, vary with the nature and extent of these. The following principles will, however, generally apply.

(i.) The first task of the *field guns* is to cut the wire. During the preliminary bombardment they will also assist in destroying the enemy's defences wherever the nature of these renders them vulnerable to the high explosive shell of field guns, as, for instance, where they consist of breastworks. During this period, however, they will be chiefly employed in preventing the enemy repairing their wire, or the damage to their entrenchments. On the day of the attack they will cover the assault by their fire on the front of attack, as well as on the flanks; they will search the communication trenches; and will establish barrages to isolate the attack and stop any attempts at counter-attack.

(ii.) *The field howitzers* will be used for the destruction of the enemy's first line defences wherever this is within their power, and especially for blocking their communication trenches, both during the preliminary bombardment and on the day of attack.

Both field guns and howitzers will also be allotted to counter-battery work as described in the note on that subject (No. 3 of this series); and the introduction of gas shells for the latter (*see* Section VI.) may be expected to considerably enhance their value for this work.

(iii.) *The medium guns* (4·7-inch and 60-pr.) will be chiefly employed in counter-battery work, but may, in addition, be used for the bombardment of definite points in the enemy's defences, and for sweeping the more distant communication trenches and approaches generally with shrapnel. On the day of attack they will, however, probably be all required for counter-battery work.

(iv.) *The medium howitzers* (6-inch) have in the past been generally required to assist the divisional artillery in the destruction of the enemy's first line defences. The longer range of the new pattern (26-cwt.) howitzers has, however, greatly extended their sphere of usefulness.



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(v.) *The heavy howitzers* (8-inch and 9·2-inch) will be chiefly used for the destruction of the enemy's second line defences, and for specially strong points in the first line. During the preparatory period they will also assist in the counter-battery work by destroying such of the enemy's batteries as have been accurately located.

(vi.) *The heavy guns* (6-inch) will be used, both in the preliminary bombardment and on the day of attack, in sweeping distant approaches, bombarding headquarters, billets, &c., and in keeping the enemy's balloons at a distance. They will also be used to assist in the counter-battery work.

(vii.) *The very heavy howitzers* (12-inch and 15-inch), and the guns and howitzers *on railway mountings*, will be used for the bombardment of special points of tactical importance, or localities where it is known that there are very strong underground refuges requiring the heaviest shell for penetration.

## 8. Command.

Although, normally, divisional artillery will remain as heretofore, both tactically and administratively, under the orders of the divisional commander, the scheme of an attack may render it advisable for the corps commander to place the general officer commanding the artillery of the corps in executive command of the whole of the artillery supporting the attack.

In such cases the divisional artilleries will still remain under their artillery commanders, and there will rarely be any reason to interfere with their organization. During the ordinary work of "holding the line" it is often very convenient to substitute "groups" of various sizes, formed to fit the local circumstances, for the established brigades, and this may in many cases be advisable, although it has sometimes been carried to an extreme not warranted by circumstances. It must, however, be remembered that there is an inherent weakness in all such improvised organizations, and that this will probably not be apparent until the unforeseen occurs (as in offensive operations it inevitably will), and the necessity for unrehearsed action arises.

The guns and howitzers allotted to counter-battery work will form a separate command as described in the note on the subject (No. 3 of this series).

The medium howitzers when employed in the destruction of first line defences have usually been placed under divisional artillery commanders, but the increased range of the newer pattern may render it advisable to group them with the heavier natures which will normally form a separate command.

As regards the heaviest natures, and all on railway mountings, the small number available and the fact that the special tasks to which they will usually be allotted are only indirectly affected by the fluctuations of the fight, will often render it inadvisable to restrict their action in accordance with the narrow front of a corps. In such cases they may be retained under the direct control of the Major-General, Royal Artillery, of the army. When, however, they are used to supplement the work of the lighter natures, as for instance when 6-inch guns are used for counter-battery work, or when the 12-inch and 15-inch howitzers are employed to destroy extra strong points in the enemy's trench system, or to bombard villages close behind the line, they should usually be combined in the same command as the other guns or howitzers employed on the same task.



## 9. Co-ordination.

An important part of the artillery plan is the co-ordination of the different artillery commands. In a corps this will mean the several divisional artilleries and the heavy artillery; in an army the artillery of the different corps, and any heavy artillery which may be retained under the direct control of the Major-General, Royal Artillery, of the army. It will include the measures necessary to ensure co-operation and to avoid any possibility of misunderstanding as to their respective zones and tasks; it will provide for the possibility of bringing heavy concentrations of fire on to particular areas if required; for cases where the heavy artillery of one corps can with advantage engage targets in front of another; and also for the fullest possible use of enfilade fire, the value of which for technical as well as tactical reasons is explained in the note on "Close Shooting in the Field" (No. 1 of this series).

## 10. Air observation.

Under modern conditions a great deal of the work of the artillery must always depend upon the assistance of the Royal Flying Corps, although the actual requirements will vary according to the extent to which direct observation is possible. It is the duty of the artillery commander to formulate his demands in each case, and to include in his artillery plan the arrangements decided upon: in some cases the arrangement of the guns may be decided by the number of aeroplanes which can operate simultaneously upon the front of attack. It is essential that the observers allotted to artillery work should be placed at the entire disposal of the artillery during the period of registration, as well as for the actual bombardment: close personal touch between observers and battery commanders is the secret of success.

On the actual day of the attack, and during the subsequent days' fighting, the officer directly responsible for the counter-battery work in each corps must have an observer constantly in the air. This will require at least four machines in addition to those required as escort to prevent interference with the air-observers by hostile aeroplanes. A machine should also be at the disposal of the general officer commanding the artillery of the corps, ready to go up at once to obtain any special information he may require.

The Kite Balloon Sections will be allotted to artillery commands. The important point to bear in mind in connection with these is that for balloon observation an intimate knowledge of the country is the first element of success. Any change of area should therefore be avoided.

# III.—The Preliminary Arrangements.

## 11. Distribution.

A thorough understanding of the work to be done, and of the time at which it is to be done, is essential to the success of the artillery preparation and subsequent action. The work to be done must first be divided amongst the subordinate artillery commands, *e.g.*, in the case of a corps between the different divisional artilleries and the heavy artillery. These subordinate commanders then allot their tasks and zones to their brigades, and the brigade commanders to their batteries.



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Positions will have to be found for the large number of extra guns which will be required for an offensive operation of any size, as well as probably for many of those already in action, whose positions have been selected with a view to defence. Every effort should be made to place the artillery supporting the attack as far forward as possible, so as avoid any unnecessary changes of position during the course of operations, since these must always involve difficulties in connection with registration and ammunition supply. Every precaution must be taken to conceal the fact that new positions are being prepared.

The allotment of observing stations will generally be found a still more difficult problem, for the expansion required will be very great and fresh stations cannot be found in a hurry. The importance of a systematic selection and preparation of observing stations cannot be exaggerated.

### 12. Reconnaissance.

All the above require a very careful reconnaissance both of the enemy's position and of the ground available, and with this object it is of the greatest importance that the various artillery commanders should get into touch at the earliest possible moment with the commanders of the infantry whose attacks they are to prepare and support. Their reconnaissances must be made in conjunction with the infantry officers, and the latter must also examine the ground from the artillery observing stations. And this joint reconnaissance on the ground must be combined with a joint study of air photographs, and of all other information as to the enemy's defences in their common zones of action, as described in paragraph 4. It is only by such means that each arm can get to understand the requirements of the other.

### 13. Registration.

The value of exact and careful registration before a close and rapid bombardment is obvious. This registration, equally with the reconnaissance, must be carried out in close touch with the infantry as far as it is concerned with the enemy's defences; and this will ensure that the reconnaissance has resulted in a mutual understanding.

The longer the period over which the registration can be spread the better, and in this as in every other way possible artillery commanders must endeavour to avoid giving any indication to the enemy as regards the points of attack. The allotment of observing stations and of aeroplane observers during this period will require very careful attention. It must be remembered that even when direct observation is possible, the assistance of an air observer may often result in considerable saving in ammunition.

### 14. Protection.*

It is incumbent upon the artillery to take every possible precaution to prevent the enemy's fire from interfering with the execution of the task required of them. This involves making observing stations, battery commanders' posts, telephone dug-outs, and gun emplacements as far as possible shell-proof. During ordinary trench warfare observing parties can usually move if their station is shelled, and detachments can similarly be withdrawn from the guns; and it is therefore often forgotten that such procedure is incompatible with the support of an infantry attack, when the guns must be fought regardless of the enemy's fire. Unless proper protection has been provided for the observers as well as for the guns, the attempt to do so will only result in casualties to personnel and materiel, and consequent failure of the artillery to render the support to which the infantry are entitled.

* Details regarding the methods of protecting observing stations, gun emplacements, &c., are given in the note on "Artillery holding the line" (No. 7 of this series).



### 15. Ammunition Supply.

The arrangements for the supply of ammunition require very careful consideration, for it is of the first importance that nothing should interfere with the movements of the infantry. During the preliminary bombardment there will be considerable traffic connected with the moving up of the infantry, and it is therefore advisable to have the ammunition required for this bombardment with the guns previous to its commencement. But this is not the crux of the problem. The real difficulties will commence on the night after the attack. The roads will then be blocked with reinforcements, ammunition, and supplies going up for the infantry, and with ambulances coming back; and the great object is to avoid adding to the congestion during this period. Every artillery unit should therefore have with it on the morning of the assault, in addition to the full establishment in its echelons, whatever ammunition it is estimated will be spent on that and the following day. It is not necessary that all this ammunition should be actually with the guns,* but it must be so placed that it can be brought up to the guns without interfering with the traffic connected with the support of the infantry. The ammunition so "dumped" must be well protected from fire and weather.

### 16. Communications.†

Previous to an offensive operation it will be necessary to provide the requisite communications for a much larger force of artillery than will normally be engaged in holding the line, and this requires very careful organization under army and corps supervision. The actual communications to be established in each case must depend upon the organization of the artillery. They will include, in addition to the ordinary framework in the way of command posts and observing stations, the communications required by the higher artillery commanders. These latter will be laid by the signal service, but it is essential that such circuits should be kept quite distinct from the general system. The ordinary telephone exchanges, however useful during trench warfare, are quite unsuited for artillery fighting communications during offensive operations, when all the wires will be in use at the same time.

* It must however be remembered that in the case of heavy artillery the physical strain of working the guns is very severe, and that relief detachments should be able to rest, and not be employed on the heavy work of bringing up ammunition.

† Details regarding the methods of laying communications are given in the note on "Artillery holding the line" (No. 7 of this series.)



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It is impossible to take too many precautions to avoid the interruption of communication. In addition to protecting the telephone wires as far as this is possible, preparations must be made for the rapid opening of alternative means of communication. Visual signalling is the most important of these, and stations should be selected and established. Possible points in the enemy's lines should also be selected beforehand, so that, after the attack has succeeded, intermediate observers may know where to look for signals. The establishment of central stations from which messages can be sent on by telephone will prove of great assistance.

Short range wireless sets may sometimes be used where visual signalling is impossible, but in such cases reliance will usually have to be placed on orderlies, either on foot or on bicycle. Here, again, arrangements must be made in advance so that everyone may know what to do when the time comes.

## IV.—The Preparation of the Attack.

### 17. Object of the preliminary bombardment.

The preliminary bombardment is designed to achieve a certain purpose, namely, to enable the infantry to enter and penetrate the enemy's position: for this his works and the obstacles protecting them must be adequately destroyed, and his morale shaken. The extent of the ground to be bombarded will depend upon the objective assigned to the attack. It will in all cases include, in addition to the destruction of the enemy's front-line system on the front to be assaulted, the next line in rear, and all communication trenches leading from it towards the front line. Certain areas in rear may, however, be deliberately left untouched, while the communication trenches are heavily bombarded, with the object of inducing the enemy to use this ground for bringing up reinforcements: with the same object it is generally advisable not to shell reserve billets during this period. The trenches, both front-line and support, for several hundred yards to either flank, according to the lie of the ground and the trace of the works, must be dealt with as heavily and effectively as the front of attack itself, and all salients within 1,200 yards from which flanking fire could be brought to bear must receive drastic treatment.

### 18. Accuracy of fire.*

The proximity of the opposing lines, and the necessity for destroying definite points in the enemy's lines, demand a meticulous accuracy on the part of the artillery never previously contemplated. The various steps necessary to ensure this are detailed in the note on "Close shooting in the field," and in order to allow of attention to these it is advisable to arrange for periodical pauses in the bombardment. During these pauses the fire should be checked by a few rounds on calibration points, equipment carefully inspected, and any slight repairs effected. Such pauses also serve to clear the air for observing officers, besides steadying the nerves of all concerned. They can well be combined with the arrangements for deceiving the enemy referred to in paragraph 22.

* See the note on "Close shooting in the field" (No. 1 of this series).



But the possibility of danger to our own infantry has also to be considered. The advisability of withdrawing infantry from their trenches during a bombardment depends in each case on the local conditions. If the trenches are good, and *the men do not put their heads up*, they may be safer in the front trenches than crowded in support trenches, which are often heavily shelled directly our bombardment opens—the nearer they are to hostile infantry the safer they are from hostile shells. At the same time the effect of one of our own shell dropping in a crowded trench, or among men creeping forward during the final bombardment, may be disastrous. The "error of the gun" must be realized; and it must be remembered that any attempt to reduce the danger by establishing a "mean point of impact"* beyond the objective will seriously diminish the effect of the fire.

The duty of the artillery commander is to make these points clear to the general officer commanding; it is for the latter to decide whether the circumstances justify incurring the risks.

### 19. Forward guns.

In some cases guns dug in actually in, or close to, the front line trenches, may prove of great value for special purposes, such as for making a breach in the hostile parapets, or for knocking out machine guns. Provided time is available, experience shows that field guns can be got into almost any position, and that their fire at such short ranges produces a very marked effect. The methods to be employed will vary in every case, but a description of those employed on one occasion, when the conditions were particularly difficult, is given in Appendix B as an illustration of the way in which such a problem should be faced. The secret of success lies in the most careful attention to detail. Unless every possible precaution is taken the gun and detachment may both be placed *hors de combat* before they have effected their purpose. Although there is no doubt that their presence has a great moral effect, their use must not be overdone, and they should not open fire until just before the assault.

### 20. Night firing.

As the bombardment proceeds, it is very important that the enemy should be prevented from repairing the damage done to his trenches and wire entanglements. The duty of keeping these under fire will usually devolve upon the divisional artillery, but the infantry must be called upon to assist with rifle and machine-gun fire, especially at night. Night firing on the enemy's defences may also form part of the programme of bombardment with the object of shaking his morale; but this will require careful arrangement so as to avoid drawing fire when our own infantry are engaged in reliefs. Roads and approaches in rear of the enemy's position must, in any case, be subjected to artillery fire at night to prevent the bringing up of ammunition and supplies, and to cause casualties in reliefs. If this is carefully arranged, it may be expected to give important material as well as moral results. In view of the continuous nature of the work required of the artillery by these and other duties, it is essential to arrange that all ranks may get the requisite amount of sleep and rest.

* *See* the note on "Close shooting in the field." (No. 1 of this series).



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## 21. Duration of the bombardment.

The *time* required to destroy the obstacles depends upon their nature and extent, upon the number of fire units available, and upon the facilities for observation. If the fire is to be deliberately conducted with accurate observation, so that the full effect can be obtained, the time required can be calculated with considerable accuracy—with the one exception that, where air observation is required, all depends upon the weather. Shortening the period may give the advantage of surprise, and may prevent the enemy bringing up more artillery to meet the attack. On the other hand, it will entail a much heavier expenditure of ammunition of the heavier natures,* and a short bombardment, however intense, may not have the same effect on the enemy's morale as the protracted strain of some days' exposure to constant shell fire, particularly if during this period his communications are adequately blocked. Judging from the duration of the preliminary bombardments in the most important offensive operations during the past year† it cannot be said that the high road to success lies either in a short "hurricane" attack or in a protracted bombardment. The duration and character of the bombardment must primarily depend upon the strength of the enemy's works, and the artillery available for their attack, but many other factors must be considered by the general officer commanding the force, with whom the decision must rest. It is the duty of the artillery commander to place before him the technical considerations involved.

## 22. Character of the bombardment.

Whatever the decision on this point the programme of bombardment must be so arranged as to keep the enemy in uncertainty as to when the actual assault is coming. The German is accustomed to being drilled all his life. If, therefore, it is possible during the preliminary bombardment to drill him until he has become thoroughly accustomed to a certain procedure, and then, when the time comes, to adopt an entirely different one, there will be a very good chance of disorganizing his arrangements. Again, if he can be induced by a burst of intense fire followed by a "lift," to man his parapets, it should be possible to inflict serious losses by judiciously timed shrapnel fire; and by the repetition of such tactics it may be hoped to make him chary of leaving his shelters. Whether when the assault is actually to be delivered it should be preceded by a burst of fire of the greatest possible intensity is a matter on which there has been a gradual change of opinion. Under the present conditions of trench warfare such fire cannot be expected to cause any great effect, and it may just give the enemy the warning which he desires. The most important point is to avoid giving any indication of the intention to assault until the first line trenches have been gained. Generally speaking, therefore, it is better to keep up fire of a medium intensity up to the moment of assault, and then not to make any sudden pause or lift. In some cases success has followed an assault delivered during a period of absolute silence.

* Shortening the period will considerably reduce the amount of ammunition—chiefly field artillery—expended on preventing the repair of damaged works, and the bringing up of supplies and ammunition.

† *See* Appendix C.



## 23. Progress of the bombardment.

During the preliminary bombardment it is the duty of the artillery commander to watch closely the progress of the work of destruction, and to make any modifications in the allotment of guns and ammunition which he may consider necessary to ensure the completion of the work. To assist him in this, he must arrange for the effect of the fire on the enemy's works to be continually observed by artillery officers and aeroplane observers, and must also be in constant communication with the infantry commanders concerned. A careful comparison of successive aeroplane photographs will be found to afford valuable indications.

In some cases an attack must be launched at a pre-arranged time, whatever the cost, and the responsibility of the artillery commander is then limited to doing his best to have the preparation *as complete as possible* by that time. But when this is not the case, it is the duty of the artillery commander to inform the general officer commanding if he considers the attack should be deferred in order to allow of further artillery preparation. The completeness of such preparation must, however, always be a relative term, and many considerations other than the purely artillery one must influence the decision. It is a matter which most vitally affects the infantry, and it is one, therefore, on which the opinion of infantry officers must carry great weight.*

While, therefore, it is the duty of the commander of the artillery to keep the general officer commanding informed of the progress of the demolition, and to state whether he considers the attack should be postponed to allow of further bombardment, the decision as to the completion or otherwise of the artillery preparation must rest with the general officer commanding himself.

# V.—The Support of the Attack.

## 24. Covering the assault.

In trench warfare the arrangements for covering the actual assault are comparatively simple, for, owing to the proximity of the lines, the infantry will in most cases start from within assaulting distance. All that is required is that during the few minutes which will elapse while they are covering the short space between the respective lines, all points in the enemy's defences from which fire can be brought to bear are so smothered with shell as to render this impossible.† This will mean the whole front of the attack, and up to as much as 800 to 1,200 yards to either flank, according to the lie of the ground and the trace of the trenches. It is above all important that any suspected machine-gun emplacements, which have not been absolutely destroyed by the preliminary bombardment, should be subjected to constant fire, for one machine gun unattended to may jeopardize the success of the whole operation.

* Before the artillery attempt to cut wire, infantry patrols should be sent out to report on the nature and extent of the wire, looking especially for low trip wires where the grass is long. They should also report on the progress of the work of destruction.

† Except when this is purposely omitted in the hope of effecting a complete surprise—*vide* paragraph 22.



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## 25. Isolating the attack.

In addition to directly supporting the attack, it is the duty of the artillery to isolate it, and so allow the infantry to consolidate their position undisturbed. For this purpose, after the attack is launched, heavy fire must be kept up on the immediate flanks and on the areas in front. It is particularly important to prevent the enemy's bombers working along the trenches from the flanks, and field guns dug in at close range, as described in paragraph 19, have in some cases proved particularly effective for blocking these. Meanwhile the fire on the immediate front of attack must be gradually lifted. The "lifts" want careful timing, and should be very gradual, of the nature of a "creep" arranged to suit the pace at which the infantry are likely to make progress. Fire from medium howitzers can of course be kept up after that of the heavier natures, and from field howitzers later still, while that of field guns need not be lifted for a minute or two after the howitzers. Units must be told off to fire on all communication trenches, and other possible lines of approach, and on cross roads, and places where troops might be massed for counter-attack. It is especially important that arrangements should be made to cover the whole front of the new line during the night after the attack. For the second night these may have to be changed according to information obtained from observers and air photographs during the day.

## 26. Barrages.

The artillery must be prepared to make a barrage right across the front in case the enemy attempts a counter-attack in force, and batteries should be retained "in observation" for this purpose, and not employed on other tasks. Barrage fire must be very carefully regulated, and it must be realized that it is out of the question to keep it up for an indefinite length of time. Where the ground is under observation, it is not necessary to fire until the enemy is actually seen advancing; where the ground cannot be seen from the artillery observing station a slow rate of fire with occasional short rapid bursts at irregular intervals will probably have the desired effect. To attempt to keep up intense fire for any great length of time may only lead to the guns being short of ammunition at the moment when the attack actually comes.

## 27. Enfilade fire.

Enfilade fire is of particular value in the support of an infantry assault, not only on account of its great effect, but also because of the accuracy with which it can be used. If the guns placed in position for this purpose are anchored and registered accurately on the German front line when at extreme traverse, the fire can be brought back slowly as the infantry assault, by simple turns of the traversing wheel. Guns so placed can also be used to form a "cross-barrage," that is to say, one formed by guns firing at right angles to one another: whatever route is taken in the endeavour to pass through such a barrage, some of the fire must come in from a flank. It must be remembered, however, that enfilade fire must be used with caution in supporting an attack, for if it is extended over ground which the observing officer cannot see, there may be danger of hitting bodies of our own infantry beyond those which the guns are supporting.



## 28. Advance of the artillery.

If the object of the attack is to reach the enemy's second line, it is necessary that special arrangements should be made for supporting the further movement of the infantry. Where artillery can advance by daylight, guns must be pushed forward for this purpose, supported by the fire of those remaining in action. The units to be pushed forward must be told off beforehand, so as to allow of their making every possible preparation* for surmounting the difficulties they will meet with. The probable order of advance should also be made out, and the responsibility for commencing the movement clearly defined. Positions and observing stations must be reconnoitred and allotted, and it may sometimes be possible to prepare emplacements, but these must be carefully concealed. Sections or single guns may sometimes be employed in this way when it would be impossible to send forward a complete battery, the section commander being placed under the orders of the commander of the battalion he is supporting.

Field howitzers are especially useful for the close support of the infantry, as they can be placed under cover in positions where field guns could not clear the crest, but it will often be necessary to move forward the medium guns and howitzers of the heavy artillery as well.

Often, however, the country will not allow of guns being moved forward by daylight. In such cases the guns required to support the advance to the second line must be dug in beforehand in or near our front line. If these guns do not open fire until the infantry have reached their first objective, it is quite possible that they will be able to maintain their position.

In the case of a corps attacking on a narrow front, with two divisions in front line and one division in reserve, it would be a suitable arrangement to use the artillery of the reserve division for this purpose. This latter division would then have the support of its own artillery for the attack of the enemy's second line.

## 29. Co-operation with the infantry.

The necessity of maintaining the closest possible touch with the infantry throughout the preliminary arrangements and the artillery preparation of the attack has been already insisted upon. In the support of the attack this close co-operation becomes still more essential, and at the same time far more difficult. Information as to the progress of the attack coming through infantry brigade and divisional headquarters will rarely reach artillery commanders in time to be of use. At the same time to enable the infantry to succeed the continued support of the artillery is required, and this can only be given if the artillery are continually in touch with their progress and can direct fire at once on any points which are impeding their advance.† It is, therefore, incumbent on the artillery to take every possible step to maintain this touch, and the result of experience shows that the following arrangements are generally the most satisfactory.

* This will include making exits from positions, improving roads, preparing portable bridges, and arranging for the carriage of the tools and materials required for the preparation of the new positions. For the latter purpose ordinary netting is easily carried and will be found very useful for temporary screens.

† Cases have indeed occurred where the obstacle to advance has been the fire of our own artillery, when owing to the completeness of the artillery preparation the attack has been carried through with a rapidity never contemplated.



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### 30. Position of artillery commanders.

In the first place the artillery command posts must be carefully selected. Those of the commanders of the artillery of corps and divisions will usually be with the commanders of the formations to which they belong. In cases where a corps commander decides to place the whole of the artillery of the corps under the executive command of the general officer commanding the artillery of the corps, it will be the duty of the latter to maintain the closest touch with the commander of the attacking infantry, and the posts of divisional artillery commanders will be placed where they can best control their commands.

The work of the heavy artillery is so intimately connected with that of the divisional artillery that it is advisable wherever possible to establish the command posts of heavy artillery commanders in the closest proximity to those of divisional artillery. This is also the best way to ensure the heavy artillery commanders being kept informed of the movements of the infantry.

Although field artillery brigade commanders will be in many cases at first with infantry brigadiers, experience shows that any attempt on their part to move forward with the latter only leads to the interruption of their communications with their batteries. Their place is where they can best control the fire of their batteries.

Battery commanders must be where they can best see the general situation. Once the attack has been launched this changes so rapidly that there is often no time to receive orders from higher commanders, and they must be prepared to act instantaneously on their own initiative, of course informing their brigade commander of the action taken.

### 31. Observing and liaison officers.

Both brigade and battery commanders will require the assistance of "observing officers" and "liaison officers." The primary duty of the former is to observe the fire of their units, of the latter to maintain touch between the infantry and the artillery supporting them, and to call for artillery support as desired by the infantry commander to whom they are attached. Both classes will require their own means of communication, and forward observing officers must be provided with personnel and equipment to allow of their moving their positions.* Artillery brigade commanders will invariably attach a "liaison officer" to the headquarters of any infantry brigade whose attack they are supporting. This officer must be a man of experience and resource.

Each battery commander will usually have a "forward observing officer" to observe the fire from a forward position, to keep him informed of the general situation, and to send back all information possible.

* The following has been found a suitable party :—

| | | |
|---|---|---|
| 1 officer. | 2 telephones. | 2 periscopes. |
| 1 non-commissioned officer. | 2 small reels of D. 1 cable. | Visual signalling apparatus. |
| 2 telephonists. | | |



In selecting their position these officers must remember that their business is to assist their battery commanders—not to join in the infantry fight—and that their information is of no use unless they can get it back in time. Their best position will usually be the farthest point forward to which good communication has been opened up; normally battalion headquarters. Probable observing stations in the enemy's lines will also have been previously determined and allotted, and sections from these to points in the second line made from the map to test their field of view; and these will be occupied by forward observing officers as soon as the progress of the attack permits.

But as a general rule, by far the best, quickest and most accurate information has been obtained from intermediate observing stations, so placed as to be far enough removed from the turmoil of the attack, and yet sufficiently far forward to command a clear view of the ground over which it is to take place. Where ground allows, one such observing station (at least) should be established by each brigade. As explained in paragraph 2, the possibility of obtaining such observing stations is a point of first importance in forming the original plan of attack.

### 32. Time Table.

Circumstances may, however, necessitate the attack being carried out where facilities for observation are bad; and although various means, such as rockets, flares, flags, &c., have been tried for indicating the progress of the infantry in such cases, none have so far proved entirely successful. It is often, therefore, necessary to have recourse to a "time table," and it is then the duty of the artillery commander to draw this up. No definite rules for this can be given, except that it is necessary always to work to a "zero" which can be changed up to the last moment. An example of a time-table actually used in a recent operation is given in Appendix D, but this must be taken as a guide only, since circumstances will be different in every case. It must always be remembered, too, that the time-table depends on the movements of the infantry, and that whatever care is taken in its preparation it can hardly be expected that their movements will be so regular as to agree throughout with any forecast. A time-table has often worked well during the very early phases after the assault, but the time must come when it can no longer be followed, and all ranks must be prepared for this. It is important that infantry officers should be acquainted with the time-table.

## VI.—Gas and Smoke.

### 33. Use of gas and smoke.

Gas and smoke may be used in different ways in an attack. In some cases gas clouds are projected from cylinders, in others smoke and gas bombs may be fired from trench mortars, or gas shells fired by the artillery. Any one of these different methods may be resorted to, or they may be used in combination, but since gas and smoke bombs do not form part of the equipment of the trench mortars manned by the artillery, it is with the gas shells only that the artillery is directly concerned. The use of gas and smoke



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in other forms, however, may effect the action of the artillery, and must therefore be referred to here. The first point to remember is that owing to the possibility of the use of gas or smoke having to be abandoned *at the last moment* on account of changes in the weather, no abatement in the thoroughness of the artillery preparation should be made on account of the fact that the use of these aids forms part of the general plan of attack. They will only affect the action of the artillery on the day of attack.

### 34. Combination of artillery fire with gas or smoke.

The idea that high explosive shell should not be used against those parts of the enemy's line on which a gas attack is directed, for fear of dispersing the gas, may be dismissed. Far from reducing the effect of the gas, shells bursting among it may be expected to increase it by forming eddies which will allow of the gas sinking into the enemy's trenches, dug-outs, &c. There is, therefore, no reason to reduce the H.E. fire of the artillery on account of the use of gas. Shrapnel fire may also be expected to be very effective in combination with smoke and gas, as these will probably cause the enemy to man his parapets, and in some cases to come out into the open.

The use of smoke, however, adds to the difficulties of the attacking artillery, since it interferes with observation of fire, and also of the progress of their infantry. When smoke is used on the front of attack, the artillery must therefore work to a time-table, the disadvantages of which have already been pointed out in para. 32.

As regards effect on the enemy's artillery, it is impossible to interfere with their ability to "barrage" our front line trenches, but the smoke will prevent their knowing the time and point of attack, and therefore will interfere with their power to concentrate upon it. It will also interfere with their power to bring fire on our infantry once they are through the front line barrage, as it will conceal their progress from the enemy's observers.

### 35. Description of gas shell.

It is, however, in the use of *gas shell* that the artillery is chiefly concerned.

The body of these shell is filled with a chemical liquid (S.K.) which is scattered over the ground as soon as the shell bursts, and then slowly vapourises. The vapour produces intense irritation of the eyes and respiratory organs. It is not poisonous, but those handling the shell, especially in the case of one showing a suspicion of leakage, should be provided with protective goggles, and should at all costs avoid rubbing their eyes with their hands.

The bursting charge is only sufficient to open the shell, so that the penetrative effect of the splinters is very much less than with the ordinary shell.

### 36. Action of gas shell.

The vapour of S.K. is seven times heavier than air, and will therefore remain close to the ground, filling trenches, dug-outs, cellars, covered gun emplacements, woods and hollows. The radius of action of this type of shell depends almost entirely on atmospheric conditions, especially wind.



The shells will produce their minimum effect—

When there is a strong wind blowing.
During heavy rain (light rain is no serious disadvantage).
When the temperature is low, near freeziug point.

The most favourable circumstances for use are when there is—

A total absence of wind, o a light breeze preferably blowing towards the enemy.
Great humidity of the atmosphere; the more saturated the atmosphere the more marked will be the result.

The effect is particularly marked in valleys, or small woods, and in forests the shells may be employed even when a strong wind is blowing outside.

In the open, on a damp and muggy day with little wind, the effect may last for six hours or more, whereas on a dry clear day, with a breeze, it will probably not persist for more than 30 minutes. In woods, buildings, or covered emplacements, the effect may be felt for as long as 24 hours.

### 37. Gas barrages.

Gas shells may be employed against a position which it is desired to deny to the enemy for a certain length of time, or to create a barrage through which the enemy's troops cannot pass. To get the best effect it is always advisable to select ground which favours the use of gas, such as for instance a valley, wood, or village. If a gas barrage has to be formed in the open it should have a depth of from 150 to 200 yards. It must always be borne in mind that the fire may have the effect of preventing our own troops from occupying the ground for some hours, or even, in some cases, of traversing it.

### 38. Counter-battery work.

The chief value of gas shells is, however, for counter-battery work, for which they possess certain decided advantages over the ordinary shell. The gas sinks into the dug-outs; it affects the whole of the personnel; and most important of all, it renders the position untenable for some time. Even if efficient protective masks are available, these will almost certainly considerably interfere with the service of the guns. Moreover, by taking advantage of the wind, effect may be obtained, even if the position of the guns has not been located with the accuracy that is required for obtaining direct hits on gun emplacements; and the effect will be most marked when the guns are concealed in woods, houses, &c., where they are least vulnerable to ordinary attack. Gas shell may also often be used with great advantage against artillery observing stations.



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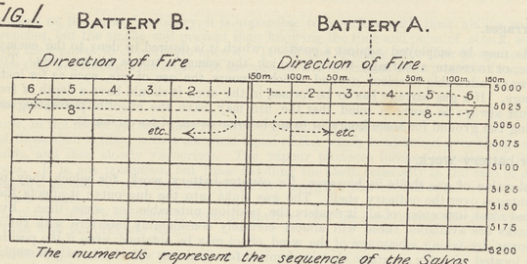
**39. Method of using gas shell.**

The quantity of vapour of S.K. necessary to produce an effective cloud can only be obtained by firing a large number of shell—with the 4·5-inch. cast-iron shell at least one round for every two yards of front. The fire should be rapid until the necessary cloud has been produced, after which a slow rate will be sufficient to maintain it. Even when the gas shell contain some smoke-producing substance, ranging should be carried out with the ordinary shell, so as to give the enemy no warning of what is coming. To cover a zone really efficiently the fire must be methodically distributed, and the following extract from a captured German document is a good example of how this may be done:—

* * * * * * *

"The four guns of a battery are so placed that with parallel lines of fire they will cover a front of 50 metres with their fire. A series of four rounds per 50 metres of front will be fired. The area to be covered is then searched in zones 50 metres wide and 25 metres deep, so that no gaps are left. The barrage should first of all be established along its whole width and the range should not be increased until this has been effected (see Fig. 1).

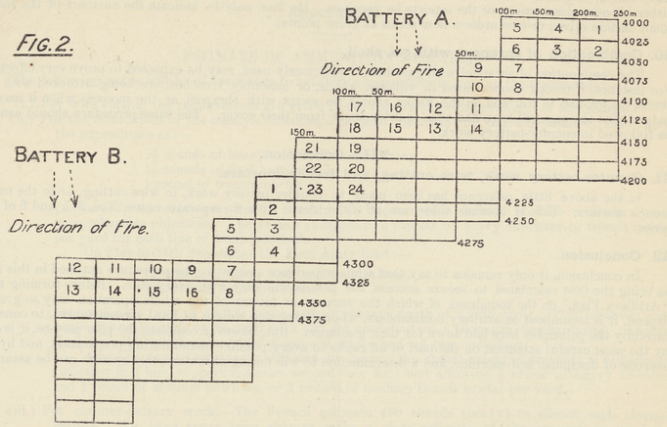
FIG. 1.




The numerals represent the sequence of the Salvos



FIG. 2.




The sequence in which salvos are fired will depend on the direction of the wind, the nature of the hostile positions included in the area to be shelled, and also on the intentions of our own troops. With a west wind, for instance, the salvos will begin from the west; if our infantry intends to advance later towards the area in question, our salvos will begin on the near edge of the area.



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Calculations should be indicated on a diagram, the width and depth of which are proportional to those of the target. Thus Fig. 2 represents a barrage fire against a ravine situated obliquely to the angle of fire.

In order to retain control of the fire, even during the procedure of searching, the artillery commander has a similar diagram, which enables him to change rapidly the method of searching in accordance with either his own observations or the reports he receives. He has only to indicate the numbers of the salvos (omit certain salvos or else order a new series at given points)."

### 40. Combination of shrapnel with gas shell.

The combination of shrapnel with gas shell, if judiciously used, may be expected to prove very effective. For instance, if troops concentrated in villages, woods, or assembly trenches, are being attacked with gas shells, the ground in rear and on the flanks should be swept with shrapnel at the moment when it may be judged that the gas will have had time to drive them from their cover. The same procedure should usually be followed in counter-battery work.

## VII.—Conclusion.

### 41. Counter-battery work, wire cutting, and trench mortars.

In the above little reference has been made to counter-battery work, to wire cutting, or to the use of trench mortars. This is because these are all fully dealt with in separate notes, Nos. 3, 5 and 6 of this series.

### 42. Conclusion.

In conclusion, it only remains to say that while experience points to the procedure outlined in this note as being the best calculated to secure success, the details will vary with every case. Before forming their "Artillery Plan," on the soundness of which the success or failure of the whole operation may so greatly depend, it is incumbent on artillery commanders, while giving due weight to local circumstances, to consider carefully the principles here laid down for their guidance. But, however complete the plan may be, it is only by the most careful attention on the part of all ranks to every possible detail during preparation, and by the exercise of discipline, self-sacrifice, and a determination to win during execution, that success can be assured.



## Appendix A.

### ESTIMATE OF AMMUNITION REQUIRED.

The following notes will be of assistance to artillery commanders in making their estimates :—

(i.) For wire cutting the requirements are given in the note on the subject (No. 5 of this series).

(ii.) For the destruction of the enemy's defences, a German memorandum, dated September, 1915, gives the expenditure at :—

$1\frac{1}{2}$ rounds of heavy and medium howitzer;
$1\frac{1}{2}$ rounds of field howitzer;
1 round of trench mortar;

per yard, for an attack on a limited front for the capture of a definite position without a more comprehensive objective. The French estimate is 3 rounds of heavy howitzer or trench mortar per yard for each line of front attacked.

On 21st to 24th September the First Army fired :—

$1\frac{1}{2}$ rounds of heavy and medium howitzer,
2 rounds of field howitzer,

per yard, on a front of 12,000 yards, and an average depth of 1,000 yards. This, however, only enabled strong points to be dealt with and did not admit of a thorough bombardment. At least double would have been required if gas and smoke had not been relied on.

A more accurate estimate is obtained by taking the actual extent of trenches *to be destroyed* (whether first line, support trenches, second line, &c.) and allowing $\frac{1}{3}$ round of heavy howitzer and 1 round of medium howitzer, or 2 rounds of medium trench mortar per yard.

(iii.) For counter-battery work.—The French estimate 400 rounds (heavy) to silence each German battery. We have never been able to make a close estimate of the amount required for counter-battery work, since it depends on the number of the enemy's batteries which may be "active," and the extent of their "activity," and on most of our front it is practically impossible to make any reliable estimate of the number of the enemy's guns. Experience however shows that a very fair approximation to the expenditure will be obtained by allowing 100 rounds per gun per day for all guns allotted to counter-battery work.



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(iv.) For the miscellaneous tasks of artillery our experience agrees very well with the French estimate of 150 to 200 rounds per gun per day. The following number of rounds can conveniently be fired :—

| | | |
|---|---|---|
| Field guns .. .. .. .. | 200 | rounds per gun per day. |
| Field and medium howitzers .. .. | 150 | " " |
| Heavy howitzers (8-inch and 9·2-inch) | 100 | " " |

On any one day the number of rounds from field guns and howitzers can be considerably increased.

---

## Appendix B.

### EXAMPLE OF THE EMPLOYMENT OF AN 18-PR. GUN IN A FRONT LINE TRENCH.

*Note.*

The following is only intended *as an example*. The particular method employed must vary with circumstances in each case. For instance, on one occasion, where a gun was placed between 150 and 200 yards from the German trenches, an ordinary canvas screen was put up just in front of the position selected. The Germans were allowed to get used to this, and a sandbag emplacement was then built behind it. When the time came for the gun to open fire the screen was not removed but the gun fired through it. In another case it was found when firing a registering round that the gun could not get at the German parapet without hitting our own. No gap in our parapet was however made as this might have invited attention and disclosed the presence of the gun, but on the day of the attack the infantry were cleared away from that portion of our trench, and the gun with its first two or three rounds breached our own parapet, and then dealt successfully with its target.

*Example.*

**Preparatory arrangements.**

The actual position was finally selected six days before the attack. It was not exposed to any hostile obse ving stations, or to flanking rifle or machine gun fire. Accurate measurements of the trench were taken, and a facsimile trench was dug at the battery wagon line.



In conjunction with an engineer officer, the form of emplacement was decided upon. The chief point consisted in the provision of a wooden box, with a sloping hinged front, which was to be built into the parapet. (*See* diagram.) The facsimile emplacement was prepared accordingly, the gun placed in it, and gun drill assiduously practised (including live shell practice) by the detachment, which was composed of volunteers. Gun and sights were carefully tested, and all ammunition to be used was tested for gauge in the bore to guard against jams.

As a canal had to be crossed to reach the position a pontoon raft was prepared to carry the gun, and a thorough reconnaissance of the whole route was made. A small stream which intervened was bridged, and ramps were cut on both banks of the canal.

When the gun position had been fixed definitely, a back angle was taken to an aiming point so that the gun could be laid before the box was opened.

**Occupation of the position.**

Two nights before the day of attack the gun was driven down to the canal bank, being halted whenever flares were fired. It was then manhandled and rafted across the canal, and carefully concealed on the further bank, with its ammunition placed in a dug-out. Infantry assisted in this.

Concurrently, the digging of the emplacement was commenced under R.E. supervision, Wheel tracks, a foot deep, were cut for the last 30 yards of the approach to the position to give better cover. Dug-outs were prepared and strengthened for the detachment and ammunition. The epaulment was completed during the following day.

The second and final stage was carried out on the night immediately preceding the attack.

Firstly, the wooden box was inserted into the parapet. To effect this the parapet had to be pulled down on a front of about 5 ft., and to cover this gap a canvas screen was erected in front. When placed in position the box was covered with sandbags and earth, and the parapet re-built round it.

The gun and ammunition were then brought up and placed in position. Three communication trenches had to be crossed, and planks were laid for this purpose. They were not filled in so that their use by infantry might not be obstructed. In bringing up the gun a canvas canopy was carried over it, and the detachment was trained to fall flat whenever a flare went up, dropping the canopy over the carriage to hide it.

**Action.**

The artillery fire attack opened at 5 a.m. Covered by a salvo from a trench mortar battery in action close by, the gun opened fire and fired its 100 rounds in 9 minutes. The range was 70 yards and the objective was to destroy a T-head and the knife-rest wire by it. The T-head appeared to be demolished with the 50th round, after which the fire was directed against the knife-rests of wire. The latter were extensively piled up, being taken in enfilade.



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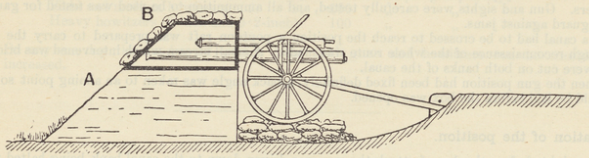
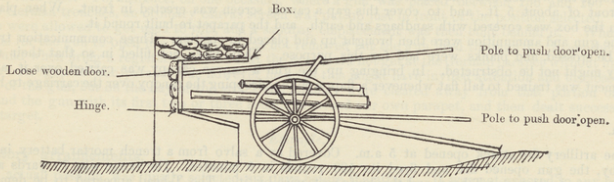
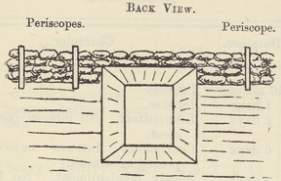
No casualties occurred during the firing, and, as soon as it was over, the detachment was withdrawn to cover in its dug-out. The gun was withdrawn on the night following the day of attack in a similar way and without loss.

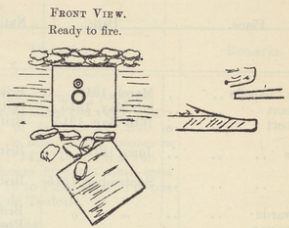



The thick lines indicate the wooden box in section as placed in the parapet.
At A were the hinges round which the front of the box, AB, swung when pushed from rear, the remainder of the box did not move.





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## Appendix C.

PARTICULARS OF PRINCIPAL BOMBARDMENTS.

| Place. | Date. | Nation. | Bombardment. | |
|---|---|---|---|---|
| | | | Duration. | Character. |
| Neuve Chapelle .. .. | March, 1915 .. | British | 40 minutes | Intense. |
| Festubert .. .. | 9th May, 1915 .. | British | 1 hour | Intense. |
| Festubert .. .. | 16th May, 1915 | British | 2 days | Intermittent. No intense bombardment. |
| Hooge .. .. .. | June, 1915 .. | British | 6 days | Continuous. Intense immediately preceding assault. |
| Loos .. .. .. | September, 1915 | British | 4 days | Steady bombardment. No intense bombardment. |
| Bellewarde .. .. | ,, ,, | British | 6 days | Intermittent. |
| Champagne .. .. | ,, , | French | 3 days | Steady bombardment. Not intense till moment of assault. |
| Vimy Ridge .. .. | ,, ,, | French | 5 days | Steady bombardment. Intense at moment of assault. |
| Frise .. .. .. | January, 1916 .. | German | 8 hours | Continuous |
| Vimy Ridge .. .. | ,, ,, .. | German | 4 hours | Very intense. |
| Verdun .. .. .. | February, 1916.. | German | 1 day | Very intense. |
| The Bluff.. .. .. | ,, ,, .. | British | 4 days | Surprise attack in early morning: artillery opened fire 3 minutes after assault. |



## Appendix D.

EXAMPLE OF A TIME TABLE.

LINE TO BE BROKEN THROUGH Q 2 TO V 6.

0—0.10.

| Guns. | From | To | Objective. | Remarks. |
|---|---|---|---|---|
| 1 gun—9·2-inch howitzer .. | 0.0 | 0.10 | Fme. Cour d'Avoue Q 9—Q 10. | |
| 35th heavy battery (one section). | 0.0 | 0.10 | Road from house 200 yards south-west of la Quinque Rue to Fme. de Bois, taking houses *en route* P 14, P 15, P 13, P 16. | |
| 35th heavy battery (one section). | 0.0 | 0.10 | From house 80 yards south-west of P 10 to Fme. Cour d'Avoue Fme. de Toulotte. | |
| 11—18-pr. batteries .. .. / 3—13-pr. batteries .. .. | 0.0 | 0.10 | Wire cutting. | |
| 1—15-pr. battery .. .. | 0.0 | 0.10 | Enfilading wire entanglements and trenches in S 21 a Q 2 to P 10. | |
| 2—15 pr. batteries .. .. | 0.0 | 0.10 | Enfilading wire entanglements and trenches in S 21 a Q 2 to R 7. | |



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01.0—0.40.

| Guns. | From | To | Objective. | Remarks. |
|---|---|---|---|---|
| 1 gun—9·2-inch howitzer .. | 0.10 | 0.40 | Fme. Cour d'Avoue and P 13 .. | Up till 0.45. |
| 1 gun—9·2-inch howitzer .. | 0.20 | 0.40 | Fme. du Bois R 8. | |
| 35th heavy battery (one section). | 0.10 | 0.40 | Road from house 200 yards south-west of la Quinque Rue to Fme. de Bois, taking house *en route* P 14, P 15, P 13, P 16. | |
| 35th heavy battery (one section). | 0.10 | 0.40 | From house 80 yards south-west of P 10 to Fme. Cour d' Avoue Fme. de Toulotte. | |
| 11—18-pr. batteries .. .. | 0.10 | 0.35 | Wire cutting. | |
| 3—13-pr. batteries .. .. | | | | |
| Ditto .. .. | 0.35 | 0.40 | Bombardment of trenches with alternate H.E. and shrapnel. | |
| 1—15-pr. battery .. .. | 0.10 | 0.40 | Enfilading wire entanglements and trenches in S 21 a Q 2 to P 10. | |
| 2—15-pr. batteries .. .. | 0.10 | 0.40 | Enfilading wire entanglements and trenches in S 21 a Q 2 to R 7. | |
| 4—6-inch howitzer batteries<br>4—5-inch howitzer batteries<br>1—4·5-inch howitzer battery<br>1—4·5-inch howitzer battery | 0.30 | 0.40 | Bombardment of trenches from Q 5 to V 6, which includes right flanks.<br>(From Divisional Artillery). | |



At 0.40 Infantry assault and push on to the line Fme. Cour d'Avoue—Fme. du Bois. It is assumed that the Infantry make good the line P 8, P 10, Q 12 and the road thence to le Tourelle at 1.15.

0.40—1.15.

| Guns. | From | To | Objective. | Remarks. |
|---|---|---|---|---|
| 1 gun—9·2-inch howitzer .. | 0.40 | 1.15 | Toulotte and post 200 yards south. | |
| 1 gun—9·2-inch howitzer .. | 0.45 | 1.15 | Orchard M 9. | |
| 35th heavy battery (one section). | 0.40 | 1. 0 | Barrage from house 200 yards S.W. of la Quinque Rue to Q 17. | |
| | 1. 0 | 1.15 | Fme. de Toulotte. | |
| 35th heavy battery (one section). | 0.40 | 1.15 | Barrage Rue de Marais from M 11 to M 19 and M. 20. | |
| 1—6-inch howitzer battery | 0.40 | 0.50 | Fme. Cour d'Avoue Q 9—Q 10. | |
| | 0.50 | 1. 5 | Moulin d'Eau P 15, P 12, P 13, P 14. | |
| 1—6-inch howitzer battery .. | 0.40 | 0.50 | Fme. du Bois R 8 and communication trench. | |
| | 0.50 | 1.15 | Fme. de Toulotte. | |
| 1—6-inch howitzer battery .. | 0.40 | .. | Trenches on right flank from Q 3 to P 4 and M 9, N 12, N 13, N 14. | |
| 1—6-inch howitzer battery .. | 0.40 | 0.50 | Between Fme. Cour D'Avoue and Fme. du Bois. | |
| | 0.50 | 1.15 | From P 18 to N 16 house and trenches. | |
| 1—5-inch howitzer brigade .. | 0.40 | .. | Trenches on right flank from Q 3 to P 4. | |
| 1—5-inch howitzer brigade .. | 0.40 | 1.00 | Trench R 8, R 9, R 11, R 12 and road from Q 14 to R 13. | |
| 1—4·5-inch battery .. .. | 0.40 | 1.00 | Communication trenches to Fme. du Bois, communication trenches to Fme. d'Avoue. | |
| 2—18-pr. brigades .. .. | 0.40 | 1.15 | La Quinque Rue—le Tourelle road. | |
| 1—18-pr. brigade .. .. | 0.40 | 1.10 | Watch left flank and barrage. | |
| 1—18-pr. brigade .. .. | 0.40 | 1.10 | Watch right flank and barrage. | |
| 3—13-pr. batteries .. .. | 0.40 | 1.00 | Barrage la Quinque Rue and Rue d'Ouvert if required. | |
| | 1.00 | 1.15 | Mobile reserve in the hands of G.O.C. 1st Division. | |
| 1—15-pr. brigade .. .. | 0.40 | 1.15 | Right flank. | |



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Further advance after 1.15, *i.e.*, the occupation of the line la Quinque Rue—le Tourelle.

| Guns. | From. | To. | Objectives. | Remarks. |
|---|---|---|---|---|
| 2 guns—9·2-inch howitzers.. | 1.15 | 1.45 | Points M 19, M 20, M 23, M 25, M 27, M 28 and Lorgies. | |
| 35th heavy battery (one section). 35th heavy battery (one section). | 1.15 | 1.45 | Lorgies, point 35 Rue du Marais, M 20, M 19. | |
| 1—6-inch howitzer battery.. | 1.15 | 1.35 | Rue du Marais M 9, M 10, M 11, M 12, M 13, M 14, M 15, M 16. | |
| 1—6-inch howitzer battery.. | 1.15 | 1.35 | N 17 to M 20—M 17 to M 25—M 27, 28. | |
| 1—6-inch howitzer battery.. | 1.15 | 1.45 | Lorgies points P 32, P 31 and P 28 | |
| 1—6-inch howitzer battery.. | 1.15 | 1.45 | Houses and trenches from P 18 to N 16. Trench N 26 to P 24. Points N 23 and N 21. Points N 29, N 30, between Rue du Marais and Lorgies. | Eventually Beau Puits. |
| 2—5-inch howitzer batteries.. | 1.15 | 1.30 | Trenches at N 6, N 9, N 10, N 11. Points M 9 and M 10. | |
| 1—1/3rd 4·5-inch batteries.. | 1.15 | .. | Under Infantry Brigadiers. | |
| 2—18-pr. brigades (25th and 39th). | 1.15 | .. | Under Infantry Brigadiers. | |
| 1—18-pr. brigade (26th) .. | 1.15 | .. | Lorgies, — *Pte.* Cauchiette and watch left flank. | |
| 1—15-pr. brigade .. .. | 1.15 | .. | Barrage from point N 11 south to L 12. | Deliberate unless rapid firing required. |
| 1—4·5-inch howitzer battery | 1.15 | .. | Junction of roads near P 14 .. | 2nd Divl. Artillery. |
| 1—18-pr. brigade .. .. | 1.15 | 1.35 | Barrage right flank if required .. | 2nd Divl. Artillery. |



# Artillery Notes.

(Issued by the General Staff at General Headquarters.)

## No. 5.—WIRE-CUTTING.

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# ARTILLERY NOTES.

(Issued by the General Staff at General Headquarters.)

## I.—WEAPONS FOR WIRE-CUTTING.

1. The weapons for wire-cutting are :—

Medium Trench Mortar.
18-pr. Q.F.
Howitzers.
60-pr. B.L.

In all cases close observation is essential to obtain good results.

### TRENCH MORTARS.

#### 2" Trench Mortar.

2. The 2" Trench Mortar with the Newton fuze has been found the most suitable mortar for wire-cutting, for the following reasons :—

(*a*) The bomb contains sufficient weight of metal to cut the wire.

(*b*) The H.E. charge is sufficient to drive the fragments at a high velocity through the wire.

(*c*) The bomb bursts immediately on impact, so the lateral effect is very great and the craters formed are small and shallow.



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## Effect with 2" Trench Mortar.

3. The following experiments have been carried out, which show the results that may be expected when using the 2-in. Mortar with Newton fuze:—

(*a*) The wire consisted of a mixture of English and French barbed wire, strung with the least possible tension from wooden pickets about 4 ft. high. Each bay was 12 sq. yds. with 12 strands to each bay. Forty rounds were fired, of which 30 fell in the wire itself, and 1,200 sq. yds. were cut sufficiently to allow the easy passage of infantry. This is at the rate of one round per 40 sq. yds.

(*b*) The target consisted of crinoline wire crossed by strands of barbed wire. Forty rounds were fired, of which 25 fell in the wire itself, completely demolishing an area of 600 sq. yds. This is at the rate of 1 round per 24 sq. yds. The range was about 333 yards and the conditions easy.

From these experiments it would appear that one round per 10 sq. yds. of barbed wire, and one round per 6 sq. yds. of loose wire, would be a generous allowance when estimating the amount of ammunition required to cut wire with the 2-in. Trench Mortar, using the 107 D.A. fuze, and allowing a factor of safety of 4 for difficult conditions of firing, observation, etc.

## Observation of Fire.

4. Observation of rounds against wire is difficult, and flank observation should invariably be employed if the best results are to be obtained.

Wind will be found to have considerable effect on 2-in. bombs, so that in windy weather very careful observation and ranging is necessary.

# III.—18-pr. Q.F.

## Range.

5. The best ranges for the 18-pr. are between 1,800 and 2,400 yards. Between 1,000 and 1,800 yards difficulties generally occur in clearing our own parapets, owing to the flat trajectory of the shell, and below 1,000 yards fuzes cannot be set to burn with sufficient regularity on account of its high velocity.



Wire can be cut up to about 3,500 yards, but more time and a considerable increase in the amount of ammuniiion are required. Above this range the shrapnel bullets have not sufficient remaining velocity to deal with wire effectively.

## Calibration.

6. Guns must be overhauled by the artificers and carefully calibrated before being used for wire-cutting.

## Platforms.

7. Good steady platforms are essential. The best platform has been found to consist of a foundation of brick, or sandbags with a covering of brick rubble, well pounded—wood is too springy. On chalky soil a special platform has been found unnecessary. A baulk of timber should be placed under the trail-eye and sandbags placed between the baulk and the spade. For accurate shooting the gun should recoil in prolongation of the trail, as jump and side-slip are then practically eliminated. To obtain this at the shorter ranges the trail should be raised and well supported in such a position that the gun has a little more than the correct elevation when it is in the travelling position. Steps for the trail can be cut to suit varying elevations if required. The traversing gear should be nearly at zero for the same reason.

## Anchoring.

8. With a good platform and the gun recoiling in prolongation of the trail, anchoring is often unnecessary—sandbags placed behind and in front of the wheels, and on the lower felloes between the spokes, will help to steady the gun.

If anchoring is necessary, a baulk of timber should be well dug in directly under the axle and secured; a rope being passed round it and round the trail as far forward as possible. The recoil of the carriage tightens up the rope. When a switch is required, it is only necessary to run up the gun, and the rope slacks off.

## Observation of Fire.

9. The observing officer should be as close as possible to the wire and his eye should be on a level with his task. It is generally advisable to have two observers—one close up and to a



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flank to observe for range and height of burst, one further in rear and directly opposite the wire to correct for line. This is especially desirable when firing at wire in enfilade. It may sometimes be necessary to make special arrangements for close observation, *e.g.*, by sapping forward and establishing an observing station.

Before guns attempt to cut wire, infantry patrols should be sent out to report on the nature and extent of the wire, looking especially for low trip wires where the grass is long. They should also report on the progress of destruction. In the case of distant hidden wire, it may be necessary to resort to air photographs to obtain this information.

## Ranging.

10.—It is generally agreed that shrapnel is the most efficient projectile, but everything depends upon bursting the shell in the right place. Each gun should be accurately ranged on the near edge of the entanglement and the shell should burst about four feet above the ground and as close to the wire as possible. A burst even five yards short has little effect.

Instead of using the corrector, the length of fuze should be given, and small alterations in the height of burst obtained by raising or lowering the angle of sight a few minutes. About 30 to 40 per cent. of the rounds should burst on graze.

A proportion of H.E. shell (about 5 per cent) mixed with the shrapnel is useful when the wire is fixed on iron posts.

## Method of Fire.

11.—When plenty of time is available, a good method is to begin with two or three guns per battery and note which gun settles down to steady shooting. Continue with that gun, relieving the detachments. A gap should be made through the wire and then enlarged.

When there is a large amount of wire to be cut, each gun should be ranged separately, and then fire continued with salvoes, gradually reducing the elevation as the guns get hot. Continual pauses must be made to let the guns cool down and to check the registration.



Once a battery has been detailed for wire-cutting, it should not be called upon to fire at other targets except in case of emergency. Night-firing, barrages, etc., should be carried out by other batteries.

## Ammunition.

12. The amount of ammunition required varies with the range and the depth and quality of the wire. A rough rule is to allow 1/3 the number of hundreds of yards in the range for each yard of front.

The ammunition required should be dumped beforehand as far as possible, so as to avoid throwing unnecessary strain on the personel of the battery.

Fuzes should be sorted into "lots." Fuzes vary, and occasionally a good "lot" will burn very regularly and allow of a reduction in the number of grazes expected.

# IV.—HOWITZERS.

High explosives from howitzers (4·5-in. and 6-in.) should be used in conjuction with the 18-prs., to scatter the posts and the wire when cut. Heavy howitzer (8-in. and 9·2-in. will cut a lot of wire, but unless a quick acting fuze is employed (such as No. 106), they are liable to create awkward obstacles, owing to the size of the craters.

# V.—60-pr.

Wire beyond the range of field guns may be cut by 60-prs., provided accurate observation is obtainable, but the amount of ammunition required is very large. H.E. may be employed, but only a small portion of rounds can be expected to burst in the wire. The difficulty with shrapnel at long ranges is the irregular burning of the time fuze (No. 85); but this may be improved by taking out the set-screw, loosening the nut, setting the fuze and then tightening up the nut again. The set-screw is then replaced.

A good steady platform is a necessity. The trail should be raised above the level of the bottom of the wheels and the carriage allowed to recoil through about 2 feet.



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# Artillery Notes.

(Issued by the General Staff at General Headquarters.)

## No. 6—TRENCH MORTARS.

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## I.—Employment of Trench Mortars.

### 1. Characteristics of the different natures.*

*Light trench mortars* (3-inch Stokes, 3·7-inch and 4-inch) are mobile and normally require no special emplacements, although these are an advantage when they can be prepared. Their effect against material is inconsiderable, but they are useful for engaging targets in the open, for minor retaliation, and for overwhelming the defence by rapid fire just previous to an assault. They are especially suitable for sending forward with the infantry in the assault, and it will usually be advisable to hold some of them in hand for this purpose.

*Medium trench mortars* (1½-inch and 2-inch) can be got into action anywhere in the trench area, but time is required to prepare emplacements and good platforms, which are necessary for accurate shooting, although they can be fired from temporary platforms with moderate accuracy for a limited number of rounds. Their chief uses are for cutting wire and for the destruction of the enemy's defences, for both of which the 2-inch is especially effective. They are unfitted by their own weight and the weight of their ammunition to accompany infantry in the actual assault, though they will move forward in support as soon as possible.

*Heavy trench mortars* can be brought into action only in the neighbourhood of roads, railways, or specially prepared approaches. They have a longer range than the medium mortars, and their material and moral effect is very great. They would generally be used for the bombardment of strong tactical points.

### 2. Organization and command.

All trench mortars are organized in 4-gun batteries. The light are manned by the infantry and form an integral part of infantry brigades. The medium and heavy are manned by the artillery, and form an integral part of the divisional artillery. When attached to infantry brigades, however, these batteries will come under the command of infantry brigadiers for all tactical purposes.

* Tables giving particulars of the different natures of trench mortars and of their ammunition are given in the Appendix.



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A captain is attached to divisional artillery headquarters for trench mortars. His duties include the following :—

(i.) Supervision of the medium and heavy trench mortar batteries of the division as regards the care and provision of equipment, and the provision of a trained reserve of personnel.
(ii.) Advising infantry brigadiers on technical matters regarding the light batteries if required.
(iii.) Commanding any special concentration of trench mortar batteries within the division.

He will also assist when required in the preparation of offensive and defensive schemes, selection of positions and observing stations, allotment of zones and tasks, and in supervising the supply of ammunition.

### 3. Use in holding the line.

In normal trench warfare the rôle of trench mortars is to harass the enemy by engaging living targets where opportunity offers, to destroy defensive works and obstacles within the limit of the range of the mortars, and to prevent new works being carried out. This will be done in co-operation with the artillery and infantry using the other trench weapons. Schemes will be carefully thought out, in order that the best use may be made of the different weapons employed, and some definite result obtained, *e.g.*, a minor operation may be carried out with a view to drawing the fire of the enemy's trench mortars and so locating their position. In the case of minor hostile attacks they can be used to drive the enemy from any small sections of our trenches into which they may have obtained a footing, and also to bombard important points in rear and on the flanks of the enemy, thus isolating him while he is dealt with by our own infantry and bombers.

### 4. Use in defence.

The question of a hostile attack in force must also be carefully considered, and definite orders issued as to the action of the mortars in this case. Generally speaking, the Stokes mortar, owing to its rapid rate of fire, will engage the enemy's front trenches, sap heads, important communication centres, and trenches or other points at which he is likely to concentrate, by this means isolating any troops that may emerge from the trenches for the attack. Medium mortars, on the other hand, owing to their slow rate of fire, will help little in breaking down the actual assault, and if they are kept in too forward positions they run a great risk of being captured in the first rush. They should, therefore, when not taken forward for special purposes, be kept in permanent emplacements covering our own first and second line fire trenches. From these positions it will generally be possible also to cover the hostile front and intervening ground, and so engage the enemy during his assault. Should the enemy get a footing in our trenches, the mortars will be of great value in preventing him consolidating his position and in supporting our counter-attack.

### 5. Use in attack.

Although the light batteries form integral parts of infantry brigades, and work directly under the orders of infantry brigadiers, it may in some cases be advisable to mass them for special purposes. In any case their



employment must be combined with that of the other natures and with the rest of the artillery, for the best results can only be obtained when all natures are employed according to their respective powers and limitations to assist in the preparation and support of the infantry attack.

The organization and distribution, and the allotment of tasks and zones (especially to the medium and heavy batteries), will therefore form part of the "Artillery Plan" described in the note on "Artillery in offensive operations" (No. 4 of this series).

*Light batteries.*

The light mortars will as a general rule take little or no part in the preliminary bombardment, but a portion will be used to harass the enemy in the final stage of the bombardment, for which their rapidity of fire renders them particularly effective, and to engage concentrations of troops, or troops driven into the open. The remainder will be held in readiness to go forward, following close in rear of the assaulting infantry to afford them support where necessary. As much ammunition as possible will be taken forward actually with the mortars, and careful preparation must be made for their further supply. This supply will necessarily be by hand.

*Medium and heavy batteries.**

The heavy mortars will be used during the preliminary bombardment, in which the very great destructive effect of their heavy bombs should be particularly effective against any strong points within the limits of their range. The medium should deal with all ordinary defences which they can reach, thus releasing howitzers for engaging targets at longer ranges. They are particularly valuable for wire-cutting, and may often be used for this and for the destruction of the enemy's defences, where for any reason, such as trees, these cannot be reached by ordinary artillery. Owing to the violence of their explosive effect, it will rarely be possible to employ heavy trench mortars to support the advance of the infantry, but it may often be possible to use the medium natures for this purpose, if emplacements can be prepared close behind our front-line trenches. These positions will not be occupied previous to the commencement of operations, and must be carefully concealed until the last moment.

On account of their weight, and the weight of the bombs, medium mortars cannot be expected to accompany the infantry during the assault, but a proportion will be told off to support the infantry when the position is gained. These mortars will be carried forward at the first opportunity, and will either be brought into action at once in the captured position, or collected at some central point in that line, from which they may be sent to the support of any point where further advance is held up. The exact moment at which the mortars will move forward can only be decided on by the battery commander at the time, but it is important that the infantry should receive their support as soon as possible.

*Advance in support of attack.*

In all cases of moving trench mortars forward in support of an attack, careful preparation must be made beforehand, as regards :—

(*a.*) Ammunition supply ;
(*b.*) The line of the advance ;
(*c.*) The point to make for.

* In the case of a bombardment extending over several days it may be advisable to defer opening fire with the trench mortars until the last day so as to avoid the risk of their being destroyed by the enemy's artillery.



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Both (*b*) and (*c*) must be known to every man in the battery, as any one of them may have to carry on in the event of officers and non-commissioned officers becoming casualties. These points must also be known to the infantry whose attack is being supported, so that they may know where to find the mortars in the event of their support being required. It must be remembered that in an advance trench battery communications will probably be cut. The support which the mortars can give to the infantry will therefore depend entirely for its efficiency on the initiative displayed by the officers, non-commissioned officers and men of the batteries, who will be called upon to work without orders from above. The divisional mortar officer will make arrangements for the collection of any mortars which are not required to take part in the advance, and for their subsequent movement and distribution.

## II.—Selection, Preparation, and Occupation of Positions.

### 6. Selection of positions.

The battery commander will receive orders as to the extent of the enemy's front to be covered, or the targets to be engaged by his battery, and also as to the area in which the battery will operate. In the case of heavy and medium mortars, these orders will normally be given by the divisional trench mortar officer; light mortar batteries will receive them from the infantry brigade to which they belong. On receipt of these orders, the battery commander will make as thorough a reconnaissance as time permits of the ground and of the enemy's defences. The use of trench maps and air photographs will be of great assistance in this reconnaissance.

### 7.—Positions for holding the line.

For normal trench warfare permanent positions will be chosen with a view to their defensive properties. They should be carefully protected and concealed from aircraft observation, and should enable effective fire—both enfilade and cross-fire where possible—to be brought on to such of our trenches as will probably be first occupied in the event of a successful hostile attack. It may also be advisable to place some mortars to cover our support and communication trenches. The trench mortars will then be able to support our counter-attack effectively, and to harass the enemy while he is attempting to consolidate his gains. These positions must not be so far forward that they are liable to be captured in the early stages of a hostile attack. More advanced positions should also be chosen and prepared, but should not be permanently occupied.

Observing stations will be selected so that from the different stations the whole of the enemy's front covered can be well observed. The exact position and the extent of front that can be observed from each will be noted on a map.

### 8.—Positions for offensive operations.

For offensive operations positions must be selected according to the tasks to which the mortars are allotted, and must be carefully concealed and protected. Their preparation will entail much time and labour, and they



should be reconnoitred, and, as far as possible, prepared beforehand. These positions should be so arranged that if a certain extent of front is to be engaged the mortars will cover with their fire the whole of this front. If single targets are to be engaged, the emplacements should allow of fire being brought to bear on as large an arc as possible on either flank of the allotted target. The arcs of fire of two or more mortars should, when possible, overlap at any specially important points in the enemy's line to enable concentrated fire to be directed on those points if necessary.

Positions should be sufficiently far forward to allow of points in rear of the enemy's first line being engaged without change of position, but must be so situated that the firing of the mortars will not interfere with the movement of troops in the trenches. Opportunities for enfilade and cross-fire must be sought, and the subsequent advance in support of the infantry must always be kept in view. At least one alternative emplacement for each mortar should be selected, and the exact position of all emplacements be entered on a map. A sketch of an actual position of a trench mortar battery (trenches slightly altered) is given in the Appendix. This is a good example of how mortars should be situated, and the use of enfilade and cross-fire.

### 9. Battery Headquarters.

Each battery must have a headquarters in the trenches; this should be placed in a central position in communication with battalion headquarters, and the position made known to all infantry officers in the sector. The infantry trench commander and the trench mortar officer on duty in the trenches must each know at all times where the other is to be found.

### 10. Mortar emplacements.

The exact type of emplacement and the position of dug-outs, &c., cannot with advantage be stereotyped as much will depend upon local conditions. The following principles must, however, be adhered to:—

Steady platforms are a matter of great importance, especially with medium and heavy mortars. The beds should be placed so that when centrally fixed the mortars cover the targets to be engaged, or the centre of the portion of the enemy's front allotted to each.

Protection must be as thorough as possible. Overhead cover, concrete if obtainable, gives security to the detachment, and adds greatly to efficient service. Cover from aircraft observation must be provided. Deep emplacements give better security, but revetting will then be necessary. With trenches 6 feet deep or more, cross-shoring is necessary in addition to revetment. The better the protection the fewer will be the casualties, and a grave responsibility rests upon battery commanders to see that the fullest possible protection is provided for all under their command.

Emplacements should not be larger than is necessary for the service of the gun. It should be possible to fire the mortar from under cover.

The line of fire must clear the parapet at the lowest angle of elevation.

Ammunition stores must be protected by a traverse from the mortar.

Emplacements must be drained.



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Alternative emplacements will be made for each mortar as soon as possible after the battery is in action. Spare mortar beds will be kept in these emplacements to enable mortars which have to change position to open fire from the alternative emplacements without delay.

Diagrams of standard emplacements and platforms are given in the Appendix.

### 11. Communications.

Telephone communication will be established between observing stations and mortar emplacements, the wires being well buried to afford protection from splinters and bullets. Communication will also be established with the officer under whose orders the battery commander is working.

But although the telephone is the normal method of communication, the wires are specially liable to be cut. Opportunities for visual signalling should therefore be fully exploited, and provision must also be made for messages to be carried by orderly. Whatever precautions are taken, the circulation of orders among trench mortars will always be difficult and, at times of sudden emergency, very precarious. All ranks must, therefore, be fully informed of the situation, actual or likely to arise, and must consider beforehand what action should be taken in an emergency, such as—

Gas attack on the front,
Sudden hostile bombardment,
Mine explosion,
Trenches rushed.

The course to be taken depends in almost every case upon the action of the infantry. A close understanding must be come to with the infantry and common action decided upon beforehand.

### 12. Ammunition Supply.

It will be necessary to have a considerable store of ammunition always at each mortar position; and ammunition dugouts must also be of such a size that a considerable extra quantity of ammunition can be stored in them when required for offensive operations. Arrangements must also be made for a further supply to be stored at points further to the rear, preferably in dugouts near the entrance to communication trenches. Such reserve stores will save great labour when a bombardment is in progress and large quantities of ammunition are required.

The supply of ammunition to the mortars must be carefully organized, special fatigue parties being detailed for the work (probably supplied by infantry units), and the communications to be used carefully reconnoitred. Important communication trenches should be avoided, as these will certainly be blocked by troops when active operations are in progress; they are also subject to the enemy's "barrage fire."



## III.—Gunnery.

### 13. Laying out lines of fire.

Lines of fire may be laid out in the following ways:—

(*a.*) By directing the sighting line of the periscope on to the target, or on to some point in line with it.
(*b.*) By measuring the angle from an aiming point to the target, and laying the dial sight, set at this angle, on the aiming point.
(*c.*) By taking the compass bearing off a map or on the ground, and placing the centre of the bed on this line.

When the correct line has been found aiming posts are planted in line with the axis of the mortar. An aiming point is picked up in line with the sighting line of the periscope, or the periscope is laid on the aiming posts.

If the dial sight is used, the angle from the aiming point is noted, and the sight is laid on this aiming point from round to round.

Subsequent corrections are given in degrees of the traversing gear.

### 14. Ranging.

Ranging consists in finding by trial shots—

(*a.*) The elevation;
(*b.*) The line;
(*c.*) The length of fuze.

(*a.*) *Elevation.*—The target must always be bracketed, bold corrections being made until a bracket is established. A "short bracket" of 10 yards should be obtained and verified, and fire for effect may then be proceeded with at the longer range, or the mean of the bracket.

Example:—

| No. of round. | Range. | |
|---|---|---|
| 1 | 280 yards | Long bracket. |
| 2 | 240 „ | |
| 3 | 260 „ | Short bracket. |
| 4 | 250 „ | |
| 5 | 255 „ | Target. |



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(*b.*) *Line.*—Corrections for line are given in degrees after each round, as required—

| | | | | | |
|---|---|---|---|---|---|
| 1 | degree | equals | 1½ | yards at a range of | 100 yards. |
| 1 | „ | | 5 | „ „ | 300 „ |
| 1 | „ | | 8 | „ „ | 500 „ |

If the line is very erratic from round to round it is probable that the platform is at fault, and a new platform is the only remedy.

It must be remembered that, even under perfect conditions, the pattern made by a number of rounds fired at the same elevation is an elongated one. Consequently when the range and line have been correctly found, subsequent corrections should not be made on the observation of single rounds, but on groups of three or four rounds. If the range is correct, a proportion of rounds will fall short of the target.

(*c.*) *Length of fuze.*—Ranging will normally be carried out with fuzes set to burst on graze. The settings for this are given on the range card. When ranging is completed, bursts in air will be obtained by shortening the fuze setting, or delay action by lengthening the setting. Air bursts 15 feet or less above the parapet are most effective against troops. *High air bursts are a waste of ammunition.*

For wire-cutting direct action fuzes will be used; the bombs then burst directly they strike the ground, and no crater is formed.

## 15. Causes affecting accuracy of fire.

The following causes affect the accuracy of shooting:—

Variable weight of projectiles. To obtain uniform results, projectiles must be weighed and grouped according to their weights.
Temperature of the charge. The higher the temperature the more powerful the charge.
Variation of size of chamber. If the shell is not properly rammed home, it will not travel so far.
Force and direction of the wind.
The bed not level. The projectile will incline to the lower side.
The bed not firm and evenly supported.

Full details as to the measures to be taken to ensure the greatest possible accuracy are given in the note on "Close shooting in the Field" (No. 1 of this series). Although these apply particularly to ordinary guns and howitzers, a study of this note will be found of great value to trench mortar officers.



## 16. Registration.

A clear systematic record must be kept of all registrations, showing:—

The number and position of the emplacement.
The target, described with reference to the map, or by its generally accepted name.
The elevation.
The line.
The length of fuze.

This record must be handed over to an incoming battery. In addition, each emplacement should have a range card of its special targets, and this must be kept up to date.

To avoid disclosing the position of the trench mortars, registration should be carried out under cover of artillery fire. This may be either howitzer fire on points near those on which the mortars are being registered, or shrapnel fire on those portions of the enemy's trenches from which the position of the mortars could be detected. A combination of both may often be advisable.

Where a large number of trench mortars are to be employed in an offensive operation, the fact that such a concentration has taken place must be concealed up to the last moment. Some previous registration, however, is absolutely necessary if the fire is to be accurate and the desired effect obtained on the enemy's trenches or wire. By a careful study of aeroplane photographs, registration on one target may be used as a basis for calculating the line and range to other targets, and in this and every other possible way registration must be reduced to a minimum. Every precaution must also be taken to conceal what is being done. Not more than two or three mortars should be firing at the same time; those firing should be some distance apart; the fire should be slow and desultory, and should be covered by artillery fire as above.

## 17. Methods of engaging objectives.

Accuracy of fire is always of the utmost importance, and all fire must be observed, since, however carefully a target has been registered, slight corrections will almost always be required.

Observation from trenches is generally difficult, since in many sectors nothing can be seen except the enemy's parapet and wire. Battery commanders will, therefore, get into touch with artillery observing officers, who, from their observing stations, are often able to assist trench mortar officers in observing their fire.

Firing salvos from two or more mortars has great moral effect, and the bombs cannot be dodged as is the case when single rounds are fired. This system also renders the mortars less liable to be located by the enemy. When a considerable number of rounds have been fired from one emplacement, it is advisable to remove the mortar at once to an alternative emplacement, for if the enemy has located the position heavy retaliation may be expected.

No more ammunition than is required to achieve the object in view will be used for any definite task, since the supply to the mortars will always be difficult owing to the great labour involved in bringing up the ammunition by hand.



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## IV.—Conclusion.

### 18. Gas and smoke.

In the above no reference has been made to the use of trench mortars for gas or smoke, since this does not as a rule form part of the work of the ordinary trench mortars which fire H.E. bombs. A trench mortar, the 4-inch Stokes, which does not fire H.E., has been specially provided for firing gas and smoke bombs, and instructions for its use will be issued as required.

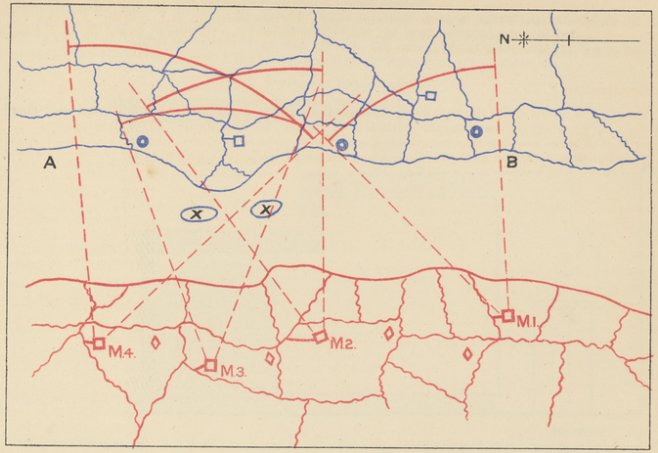
### 19. Conclusion.

These notes are based on the best experience so far available and must be carefully studied. There is, however, no intention of cramping the initiative of trench mortar officers. New developments in the employment of these weapons may be expected, and officers must be prepared to make such modifications in the procedure here described as circumstances may render advisable from time to time.



## Appendix A.

### TYPE OF TRENCH MORTAR BATTERY POSITION.




*Enemy's line*
*British line*
*Mortar emplacements—*
*British* M1.
*Enemy's*
*Enemy's Machine Guns*
*Arcs of fire of Mortars thus*
*Alternative emplacements*

*The extent of front to be covered by the Battery is from A to B, but concentrated fire is required on the salient and craters X X.*

*The mortars are so placed that each mortar except M1 can cover the salient, and that all mortars enfilade either portions of the enemy front line or communication trenches, while the fire of M4, 3, and 2, can be crossed if necessary.*

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## Appendix B.

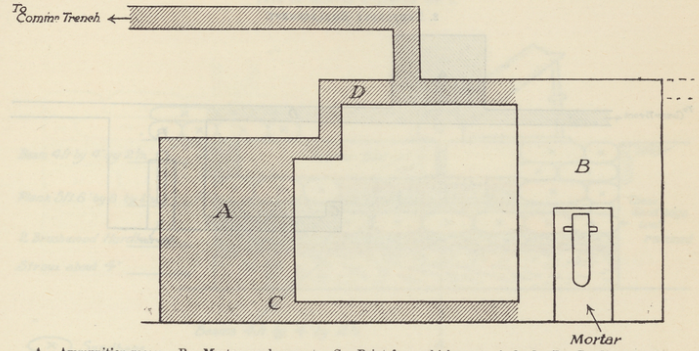
### TYPES OF MORTAR EMPLACEMENTS.

Dimensions of emplacements depend on the depth of the trenches.

Emplacements must be as small as possible while allowing (*a*) the mortar its full "field of fire," (*b*) the efficient service of the mortar If emplacements are too large valuable cover is lost.

They will be as deep as the nature of ground permits, but care must be taken that the bombs will clear the parapet when the mortar is laid at the lowest angle of elevation (*i.e.*, extreme range).

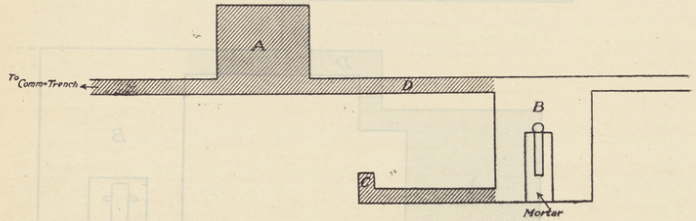
1. PERMANENT EMPLACEMENT.




A.—Ammunition recess. B.—Mortar emplacement. C.—Point from which mortar is fired. D.—Loading trench.

Overhead cover.

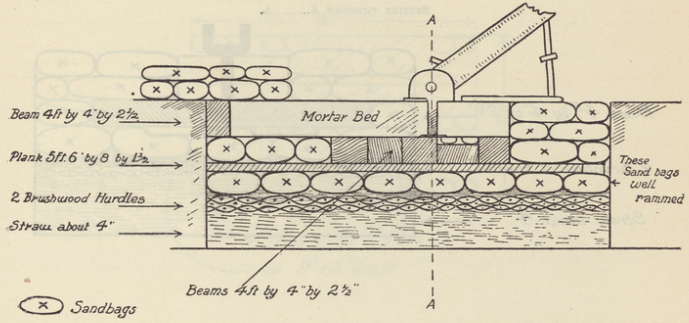
2. Temporary Emplacement.






## Appendix C.

Type of Mortar Platform No. 1.
For marshy ground.



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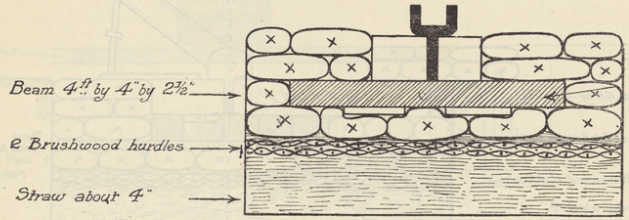
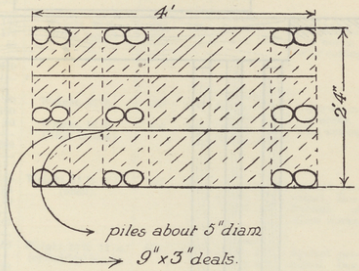
SECTION THROUGH A.....A.






TYPE OF MORTAR PLATFORM. NO. 2.

PLAN.



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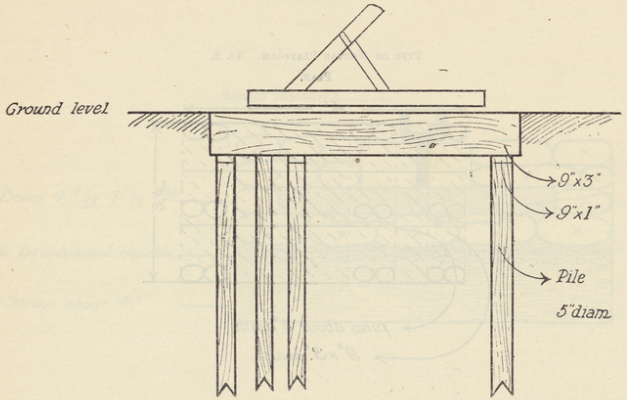
SECTION.




The piles are driven in vertically a maximum distance of 4', the distance depending on state of ground and resistance offered. The tops are then cut off level.



## Appendix D.

DETAILS OF TRENCH MORTARS.

| Class. | Type. | Weight for transport.* | Projectile. | Range Max. | Range Min. | Effect. | Uses. | Extreme rate of firing. Average conditions. | — |
|---|---|---|---|---|---|---|---|---|---|
| | | lb. | | yds. | yds. | | | | |
| Heavy | 240 mm. | Mortar ... ... 485<br>Mounting ... 425<br>Platform ... 569<br>7 Sleepers each 130<br>Sundries ... 190<br>Total ... 2,519 | Weight, 192 lb. (Aerial torpedo type.) | 1,100 | 600 | *Crater.* Depth, 10 ft. Width, 24 ft. | Destruction of works. | One round in six minutes. | For hand transport barrows are provided, for mortar, mounting and platform. |
| Medium. | 2-in. | Mortar ... 105<br>Bed ... ... 175<br>Elevating stand 50<br>Total ... 320 | Weight, 60 lb. (Stick bomb). | 500 | 100 | *Crater.* Depth, 5 ft. Width 14 ft. | Destruction of works. Wire cutting | One round in 2 minutes. | |
| | 1½-in. | Mortar... ... 90<br>Mounting ... 120<br>Tray ... ... 50<br>Total ... 260 | Weight, 33 lb.<br>Weight, 18 lb. (Stick bombs). | 290<br>500 | 100<br>200 | *Craters.* Depth, 3½ ft. Width, 7 ft.<br>Depth, 2 ft. Width, 4 ft. | Destruction of works. Wire cutting | One round per minute. | |
| Light | 4-in. | Mortar ... 53<br>Spade ... ... 34<br>Elevating stand 20<br>Total ... 107 | Weight, 11 lb. 9 oz. (shell). | 600 | 100 | *Crater.* Depth, 2 ft. Width, 4ft. | Against personnel. Destruction of minor works. | Two rounds per minute. | |
| | 3-in. Stokes. | Mortar and elevating stand. 56<br>Base-plate ... 28<br>Total ... 84 | Weight, 10 lb 11 oz. (cylindrical bomb). | 430 | 170 | *Crater.* Depth, 2 ft. Width, 4 ft. | Against personnel. Destruction of minor works. | 25 rounds per minute. | |
| | 3·7-in. | Mortar... ... 27<br>Elevating stand 20<br>Total ... 47 | Weight, 4½ lb. (tin canister). | 340 | 40 | Shrapnel | | Three rounds per minute. | |

* Weights do not include stores.



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## Appendix E.

DETAILS OF AMMUNITION.

| — | Weight of bomb. | Bursting charge. | Propelling charge. | Nature of fuze. | Method of firing. | Components of one round. |
|---|---|---|---|---|---|---|
| 240-m.m. | 192 lbs. | 99 lb. H.E. | 1·54 lb. of cordite. | Percussion. | Bickford fuze igniter lit by portfire. | Bomb.<br>Fuze.<br>Charge.<br>Igniter. |
| 2-inch | 50 lb. | 16 lb. H.E. | 1½, 2½, or 3½ oz. of cordite. | Time (No. 31A) or percussion | Rifle mechanism. | Bomb (50 lb.).<br>Tail with pin (10 lb.).<br>Fuze.<br>Exploder.<br>Charge—(one 1½ and two 1 oz. parts).<br>Special cartridge for firing mechanism. |
| 1¼-inch | 33 lb. stick bomb.<br>18 lb. stick bomb. | 4¾ lb. H.E.<br>2¾ lb. H.E. | 500 grains of of cordite. | Time No. 121 (mod.). | T friction tube | Bomb (33 or 18 lb.).<br>Fuze.<br>Gaine.<br>Charge.<br>T friction tube. |
| 4-inch | 11 lb. 9 oz. shell. | 2¾ lb. H.E. | 1, 2, 3, 4, 5 or 6 drams of guncotton. | Time No. 27. | Rifle mechanism. | Shell.<br>Fuze.<br>Charge (in 1 dram and 2 dram parts).<br>Special cartridge for firing mechanism. |
| 3-inch Stokes | 10 lb. 11 oz. cylindrical shell. | 2½ lb. H.E. | 12-bore ballistite cartridges, either 120 grains or 175 grains. | Time (pistol head). | Shell with cartridge inserted falling on to striker in the bore. | Bomb.<br>Fuze and Fuze-head detonator.<br>Cartridges—<br>1 long range.<br>1 short range. |
| 3·7 inch | 4½ lb.—Tin canister with shrapnel. | 15 oz. H.E. | Cartridge alone, or with ½, 1 or 1½ drams of guncotton yarn. | Time (Bickford and detonator). | Rifle mechanism. | Bomb.<br>Fuze and detonator.<br>Charge (in ½ dram parts).<br>Special cartridge for firing mechanism. |



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# Artillery Notes.

(ISSUED BY THE GENERAL STAFF AT GENERAL HEADQUARTERS.)

## No. 6—TRENCH MORTARS.

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## I.—Employment of Trench Mortars.

### 1. Characteristics of the different natures.*

*Light trench mortars* (3-inch Stokes, 3·7-inch and 4-inch) are mobile and normally require no special emplacements, although these are an advantage when they can be prepared. Their effect against material is inconsiderable, but they are useful for engaging targets in the open, for minor retaliation, and for overwhelming the defence by rapid fire just previous to an assault. They are especially suitable for sending forward with the infantry in the assault, and it will usually be advisable to hold some of them in hand for this purpose.

*Medium trench mortars* (1½-inch and 2-inch) can be got into action anywhere in the trench area, but time is required to prepare emplacements and good platforms, which are necessary for accurate shooting, although they can be fired from temporary platforms with moderate accuracy for a limited number of rounds. Their chief uses are for cutting wire and for the destruction of the enemy's defences, for both of which the 2-inch is especially effective. They are unfitted by their own weight and the weight of their ammunition to accompany infantry in the actual assault, though they will move forward in support as soon as possible.

*Heavy trench mortars* can be brought into action only in the neighbourhood of roads, railways, or specially prepared approaches. They have a longer range than the medium mortars, and their material and moral effect is very great. They would generally be used for the bombardment of strong tactical points.

### 2. Organization and command.

All trench mortars are organized in 4-gun batteries. The light are manned by the infantry and form an integral part of infantry brigades. The medium and heavy are manned by the artillery, and form an integral part of the divisional artillery. When attached to infantry brigades, however, these batteries will come under the command of infantry brigadiers for all tactical purposes.

* Tables giving particulars of the different natures of trench mortars and of their ammunition are given in the Appendix.



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A captain is attached to divisional artillery headquarters for trench mortars. His duties include the following:—

(i.) Supervision of the medium and heavy trench mortar batteries of the division as regards the care and provision of equipment, and the provision of a trained reserve of personnel.
(ii.) Advising infantry brigadiers on technical matters regarding the light batteries if required.
(iii.) Commanding any special concentration of trench mortar batteries within the division.

He will also assist when required in the preparation of offensive and defensive schemes, selection of positions and observing stations, allotment of zones and tasks, and in supervising the supply of ammunition.

### 3. Use in holding the line.

In normal trench warfare the rôle of trench mortars is to harass the enemy by engaging living targets where opportunity offers, to destroy defensive works and obstacles within the limit of the range of the mortars, and to prevent new works being carried out. This will be done in co-operation with the artillery and infantry using the other trench weapons. Schemes will be carefully thought out, in order that the best use may be made of the different weapons employed, and some definite result obtained, *e.g.*, a minor operation may be carried out with a view to drawing the fire of the enemy's trench mortars and so locating their position. In the case of minor hostile attacks they can be used to drive the enemy from any small sections of our trenches into which they may have obtained a footing, and also to bombard important points in rear and on the flanks of the enemy, thus isolating him while he is dealt with by our own infantry and bombers.

### 4. Use in defence.

The question of a hostile attack in force must also be carefully considered, and definite orders issued as to the action of the mortars in this case. Generally speaking, the Stokes mortar, owing to its rapid rate of fire, will engage the enemy's front trenches, sap heads, important communication centres, and trenches or other points at which he is likely to concentrate, by this means isolating any troops that may emerge from the trenches for the attack. Medium mortars, on the other hand, owing to their slow rate of fire, will help little in breaking down the actual assault, and if they are kept in too forward positions they run a great risk of being captured in the first rush. They should, therefore, when not taken forward for special purposes, be kept in permanent emplacements covering our own first and second line fire trenches. From these positions it will generally be possible also to cover the hostile front and intervening ground, and so engage the enemy during his assault. Should the enemy get a footing in our trenches, the mortars will be of great value in preventing him consolidating his position and in supporting our counter-attack.

### 5. Use in attack.

Although the light batteries form integral parts of infantry brigades, and work directly under the orders of infantry brigadiers, it may in some cases be advisable to mass them for special purposes. In any case their



employment must be combined with that of the other natures and with the rest of the artillery, for the best results can only be obtained when all natures are employed according to their respective powers and limitations to assist in the preparation and support of the infantry attack.

The organization and distribution, and the allotment of tasks and zones (especially to the medium and heavy batteries), will therefore form part of the "Artillery Plan" described in the note on "Artillery in offensive operations" (No. 4 of this series).

*Light batteries.*

The light mortars will as a general rule take little or no part in the preliminary bombardment, but a portion will be used to harass the enemy in the final stage of the bombardment, for which their rapidity of fire renders them particularly effective, and to engage concentrations of troops, or troops driven into the open. The remainder will be held in readiness to go forward, following close in rear of the assaulting infantry to afford them support where necessary. As much ammunition as possible will be taken forward actually with the mortars, and careful preparation must be made for their further supply. This supply will necessarily be by hand.

*Medium and heavy batteries.**

The heavy mortars will be used during the preliminary bombardment, in which the very great destructive effect of their heavy bombs should be particularly effective against any strong points within the limits of their range. The medium should deal with all ordinary defences which they can reach, thus releasing howitzers for engaging targets at longer ranges. They are particularly valuable for wire-cutting, and may often be used for this and for the destruction of the enemy's defences, where for any reason, such as trees, these cannot be reached by ordinary artillery. Owing to the violence of their explosive effect, it will rarely be possible to employ heavy trench mortars to support the advance of the infantry, but it may often be possible to use the medium natures for this purpose, if emplacements can be prepared close behind our front-line trenches. These positions will not be occupied previous to the commencement of operations, and must be carefully concealed until the last moment.

On account of their weight, and the weight of the bombs, medium mortars cannot be expected to accompany the infantry during the assault, but a proportion will be told off to support the infantry when the position is gained. These mortars will be carried forward at the first opportunity, and will either be brought into action at once in the captured position, or collected at some central point in that line, from which they may be sent to the support of any point where further advance is held up. The exact moment at which the mortars will move forward can only be decided on by the battery commander at the time, but it is important that the infantry should receive their support as soon as possible.

*Advance in support of attack.*

In all cases of moving trench mortars forward in support of an attack, careful preparation must be made beforehand, as regards:—

(*a.*) Ammunition supply;
(*b.*) The line of the advance;
(*c.*) The point to make for.

* In the case of a bombardment extending over several days it may be advisable to defer opening fire with the trench mortars until the last day so as to avoid the risk of their being destroyed by the enemy's artillery.



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Both (*b*) and (*c*) must be known to every man in the battery, as any one of them may have to carry on in the event of officers and non-commissioned officers becoming casualties. These points must also be known to the infantry whose attack is being supported, so that they may know where to find the mortars in the event of their support being required. It must be remembered that in an advance trench battery communications will probably be cut. The support which the mortars can give to the infantry will therefore depend entirely for its efficiency on the initiative displayed by the officers, non-commissioned officers and men of the batteries, who will be called upon to work without orders from above. The divisional mortar officer will make arrangements for the collection of any mortars which are not required to take part in the advance, and for their subsequent movement and distribution.

## II.—Selection, Preparation, and Occupation of Positions.

### 6. Selection of positions.

The battery commander will receive orders as to the extent of the enemy's front to be covered, or the targets to be engaged by his battery, and also as to the area in which the battery will operate. In the case of heavy and medium mortars, these orders will normally be given by the divisional trench mortar officer; light mortar batteries will receive them from the infantry brigade to which they belong. On receipt of these orders, the battery commander will make as thorough a reconnaissance as time permits of the ground and of the enemy's defences. The use of trench maps and air photographs will be of great assistance in this reconnaissance.

### 7.—Positions for holding the line.

For normal trench warfare permanent positions will be chosen with a view to their defensive properties. They should be carefully protected and concealed from aircraft observation, and should enable effective fire—both enfilade and cross-fire where possible—to be brought on to such of our trenches as will probably be first occupied in the event of a successful hostile attack. It may also be advisable to place some mortars to cover our support and communication trenches. The trench mortars will then be able to support our counter-attack effectively, and to harass the enemy while he is attempting to consolidate his gains. These positions must not be so far forward that they are liable to be captured in the early stages of a hostile attack. More advanced positions should also be chosen and prepared, but should not be permanently occupied.

Observing stations will be selected so that from the different stations the whole of the enemy's front covered can be well observed. The exact position and the extent of front that can be observed from each will be noted on a map.

### 8.—Positions for offensive operations.

For offensive operations positions must be selected according to the tasks to which the mortars are allotted, and must be carefully concealed and protected. Their preparation will entail much time and labour, and they



should be reconnoitred, and, as far as possible, prepared beforehand. These positions should be so arranged that if a certain extent of front is to be engaged the mortars will cover with their fire the whole of this front. If single targets are to be engaged, the emplacements should allow of fire being brought to bear on as large an arc as possible on either flank of the allotted target. The arcs of fire of two or more mortars should, when possible, overlap at any specially important points in the enemy's line to enable concentrated fire to be directed on those points if necessary.

Positions should be sufficiently far forward to allow of points in rear of the enemy's first line being engaged without change of position, but must be so situated that the firing of the mortars will not interfere with the movement of troops in the trenches. Opportunities for enfilade and cross-fire must be sought, and the subsequent advance in support of the infantry must always be kept in view. At least one alternative emplacement for each mortar should be selected, and the exact position of all emplacements be entered on a map. A sketch of an actual position of a trench mortar battery (trenches slightly altered) is given in the Appendix. This is a good example of how mortars should be situated, and the use of enfilade and cross-fire.

### 9. Battery Headquarters.

Each battery must have a headquarters in the trenches; this should be placed in a central position in communication with battalion headquarters, and the position made known to all infantry officers in the sector. The infantry trench commander and the trench mortar officer on duty in the trenches must each know at all times where the other is to be found.

### 10. Mortar emplacements.

The exact type of emplacement and the position of dug-outs, &c., cannot with advantage be stereotyped as much will depend upon local conditions. The following principles must, however, be adhered to:—

Steady platforms are a matter of great importance, especially with medium and heavy mortars. The beds should be placed so that when centrally fixed the mortars cover the targets to be engaged, or the centre of the portion of the enemy's front allotted to each.

Protection must be as thorough as possible. Overhead cover, concrete if obtainable, gives security to the detachment, and adds greatly to efficient service. Cover from aircraft observation must be provided. Deep emplacements give better security, but revetting will then be necessary. With trenches 6 feet deep or more, cross-shoring is necessary in addition to revetment. The better the protection the fewer will be the casualties, and a grave responsibility rests upon battery commanders to see that the fullest possible protection is provided for all under their command.

Emplacements should not be larger than is necessary for the service of the gun. It should be possible to fire the mortar from under cover.

The line of fire must clear the parapet at the lowest angle of elevation.

Ammunition stores must be protected by a traverse from the mortar.

Emplacements must be drained.



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Alternative emplacements will be made for each mortar as soon as possible after the battery is in action. Spare mortar beds will be kept in these emplacements to enable mortars which have to change position to open fire from the alternative emplacements without delay.

Diagrams of standard emplacements and platforms are given in the Appendix.

## 11. Communications.

Telephone communication will be established between observing stations and mortar emplacements, the wires being well buried to afford protection from splinters and bullets. Communication will also be established with the officer under whose orders the battery commander is working.

But although the telephone is the normal method of communication, the wires are specially liable to be cut. Opportunities for visual signalling should therefore be fully exploited, and provision must also be made for messages to be carried by orderly. Whatever precautions are taken, the circulation of orders among trench mortars will always be difficult and, at times of sudden emergency, very precarious. All ranks must, therefore, be fully informed of the situation, actual or likely to arise, and must consider beforehand what action should be taken in an emergency, such as—

Gas attack on the front,
Sudden hostile bombardment,
Mine explosion,
Trenches rushed.

The course to be taken depends in almost every case upon the action of the infantry. A close understanding must be come to with the infantry and common action decided upon beforehand.

## 12. Ammunition Supply.

It will be necessary to have a considerable store of ammunition always at each mortar position; and ammunition dugouts must also be of such a size that a considerable extra quantity of ammunition can be stored in them when required for offensive operations. Arrangements must also be made for a further supply to be stored at points further to the rear, preferably in dugouts near the entrance to communication trenches. Such reserve stores will save great labour when a bombardment is in progress and large quantities of ammunition are required.

The supply of ammunition to the mortars must be carefully organized, special fatigue parties being detailed for the work (probably supplied by infantry units), and the communications to be used carefully reconnoitred. Important communication trenches should be avoided, as these will certainly be blocked by troops when active operations are in progress; they are also subject to the enemy's "barrage fire."



# III.—Gunnery.

## 13. Laying out lines of fire.

Lines of fire may be laid out in the following ways:—

(*a.*) By directing the sighting line of the periscope on to the target, or on to some point in line with it.
(*b.*) By measuring the angle from an aiming point to the target, and laying the dial sight, set at this angle, on the aiming point.
(*c.*) By taking the compass bearing off a map or on the ground, and placing the centre of the bed on this line.

When the correct line has been found aiming posts are planted in line with the axis of the mortar. An aiming point is picked up in line with the sighting line of the periscope, or the periscope is laid on the aiming posts.

If the dial sight is used, the angle from the aiming point is noted, and the sight is laid on this aiming point from round to round.

Subsequent corrections are given in degrees of the traversing gear.

## 14. Ranging.

Ranging consists in finding by trial shots—

(*a.*) The elevation;
(*b.*) The line;
(*c.*) The length of fuze.

(*a.*) *Elevation.*—The target must always be bracketed, bold corrections being made until a bracket is established. A "short bracket" of 10 yards should be obtained and verified, and fire for effect may then be proceeded with at the longer range, or the mean of the bracket.

Example:—

| No. of round. | Range. | |
|---|---|---|
| 1 | 280 yards | Long |
| 2 | 240 „ | bracket. |
| 3 | 260 „ | Short |
| 4 | 250 „ | bracket. |
| 5 | 255 „ | Target. |



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(*b.*) *Line.*—Corrections for line are given in degrees after each round, as required—

| | | | | | |
|---|---|---|---|---|---|
| 1 | degree | equals | 1½ | yards at a range of | 100 yards. |
| 1 | ,, | | 5 | ,, ,, | 300 ,, |
| 1 | ,, | | 8 | ,, ,, | 500 ,, |

If the line is very erratic from round to round it is probable that the platform is at fault, and a new platform is the only remedy.

It must be remembered that, even under perfect conditions, the pattern made by a number of rounds fired at the same elevation is an elongated one. Consequently when the range and line have been correctly found, subsequent corrections should not be made on the observation of single rounds, but on groups of three or four rounds. If the range is correct, a proportion of rounds will fall short of the target.

(*c.*) *Length of fuze.*—Ranging will normally be carried out with fuzes set to burst on graze. The settings for this are given on the range card. When ranging is completed, bursts in air will be obtained by shortening the fuze setting, or delay action by lengthening the setting. Air bursts 15 feet or less above the parapet are most effective against troops. *High air bursts are a waste of ammunition.*

For wire-cutting direct action fuzes will be used; the bombs then burst directly they strike the ground, and no crater is formed.

## 15. Causes affecting accuracy of fire.

The following causes affect the accuracy of shooting:—

Variable weight of projectiles. To obtain uniform results, projectiles must be weighed and grouped according to their weights.
Temperature of the charge. The higher the temperature the more powerful the charge.
Variation of size of chamber. If the shell is not properly rammed home, it will not travel so far.
Force and direction of the wind.
The bed not level. The projectile will incline to the lower side.
The bed not firm and evenly supported.

Full details as to the measures to be taken to ensure the greatest possible accuracy are given in the note on "Close shooting in the Field" (No. 1 of this series). Although these apply particularly to ordinary guns and howitzers, a study of this note will be found of great value to trench mortar officers.



## 16. Registration.

A clear systematic record must be kept of all registrations, showing:—

The number and position of the emplacement.
The target, described with reference to the map, or by its generally accepted name.
The elevation.
The line.
The length of fuze.

This record must be handed over to an incoming battery. In addition, each emplacement should have a range card of its special targets, and this must be kept up to date.

To avoid disclosing the position of the trench mortars, registration should be carried out under cover of artillery fire. This may be either howitzer fire on points near those on which the mortars are being registered, or shrapnel fire on those portions of the enemy's trenches from which the position of the mortars could be detected. A combination of both may often be advisable.

Where a large number of trench mortars are to be employed in an offensive operation, the fact that such a concentration has taken place must be concealed up to the last moment. Some previous registration, however, is absolutely necessary if the fire is to be accurate and the desired effect obtained on the enemy's trenches or wire. By a careful study of aeroplane photographs, registration on one target may be used as a basis for calculating the line and range to other targets, and in this and every other possible way registration must be reduced to a minimum. Every precaution must also be taken to conceal what is being done. Not more than two or three mortars should be firing at the same time; those firing should be some distance apart; the fire should be slow and desultory, and should be covered by artillery fire as above.

## 17. Methods of engaging objectives.

Accuracy of fire is always of the utmost importance, and all fire must be observed, since, however carefully a target has been registered, slight corrections will almost always be required.

Observation from trenches is generally difficult, since in many sectors nothing can be seen except the enemy's parapet and wire. Battery commanders will, therefore, get into touch with artillery observing officers, who, from their observing stations, are often able to assist trench mortar officers in observing their fire.

Firing salvos from two or more mortars has great moral effect, and the bombs cannot be dodged as is the case when single rounds are fired. This system also renders the mortars less liable to be located by the enemy. When a considerable number of rounds have been fired from one emplacement, it is advisable to remove the mortar at once to an alternative emplacement, for if the enemy has located the position heavy retaliation may be expected.

No more ammunition than is required to achieve the object in view will be used for any definite task, since the supply to the mortars will always be difficult owing to the great labour involved in bringing up the ammunition by hand.



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## IV.—Conclusion.

### 18. Gas and smoke.

In the above no reference has been made to the use of trench mortars for gas or smoke, since this does not as a rule form part of the work of the ordinary trench mortars which fire H.E. bombs. A trench mortar, the 4-inch Stokes, which does not fire H.E., has been specially provided for firing gas and smoke bombs, and instructions for its use will be issued as required.

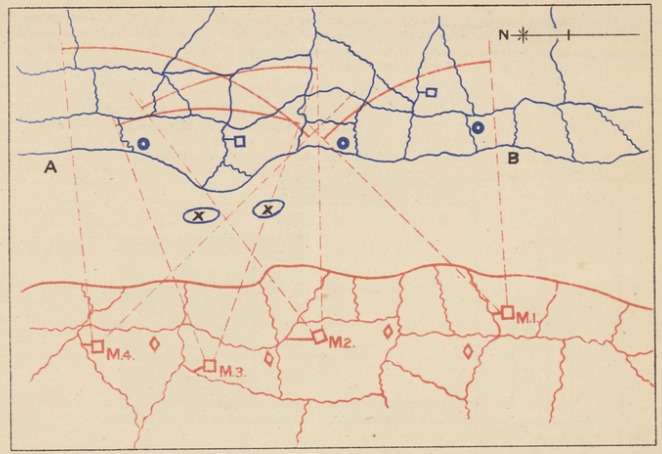
### 19. Conclusion.

These notes are based on the best experience so far available and must be carefully studied. There is, however, no intention of cramping the initiative of trench mortar officers. New developments in the employment of these weapons may be expected, and officers must be prepared to make such modifications in the procedure here described as circumstances may render advisable from time to time.



## Appendix A.

### TYPE OF TRENCH MORTAR BATTERY POSITION.




*Enemy's line*
*British line*
*Mortar emplacements—*
*British* M1.
*Enemy's*
*Enemy's Machine Guns*
*Arcs of fire of Mortars thus*
*Alternative emplacements*

*The extent of front to be covered by the Battery is from A to B, but concentrated fire is required on the salient and craters X X.*

*The mortars are so placed that each mortar except M1 can cover the salient, and that all mortars enfilade either portions of the enemy front line or communication trenches, while the fire of M4, 3, and 2, can be crossed if necessary.*

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## Appendix B.

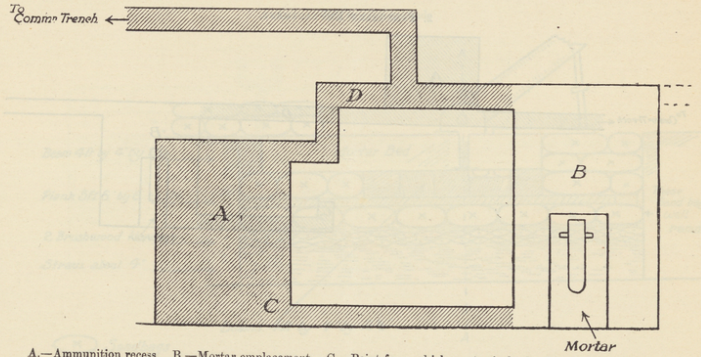
### TYPES OF MORTAR EMPLACEMENTS.

Dimensions of emplacements depend on the depth of the trenches.

Emplacements must be as small as possible while allowing (*a*) the mortar its full "field of fire," (*b*) the efficient service of the mortar If emplacements are too large valuable cover is lost.

They will be as deep as the nature of ground permits, but care must be taken that the bombs will clear the parapet when the mortar is laid at the lowest angle of elevation (*i.e.*, extreme range).

1. PERMANENT EMPLACEMENT.




A.—Ammunition recess. B.—Mortar emplacement. C.—Point from which mortar is fired. D.—Loading trench.

Overhead cover.



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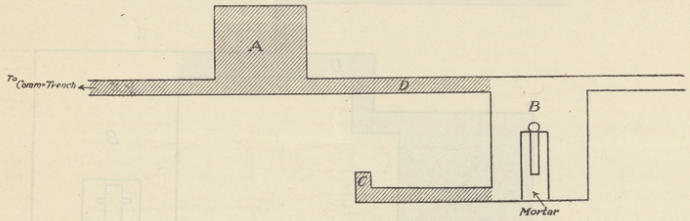
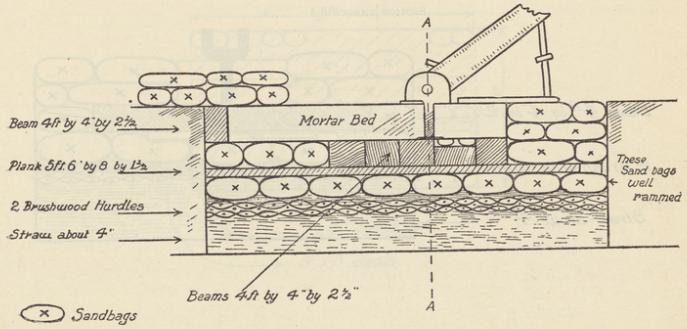
2. Temporary Emplacement.






## Appendix C.

Type of Mortar Platform No. 1.
For marshy ground.



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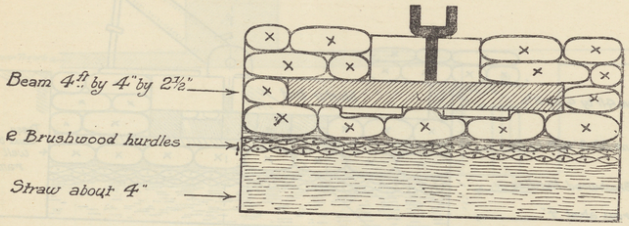
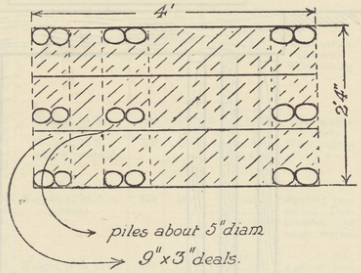
SECTION THROUGH A.....A.




TYPE OF MORTAR PLATFORM. NO. 2.

PLAN.



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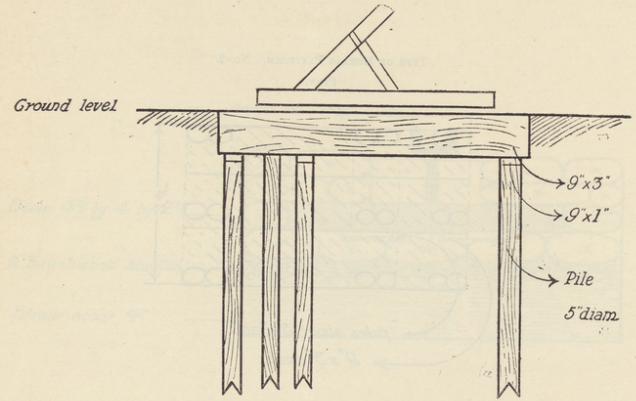
SECTION.




The piles are driven in vertically a maximum distance of 4', the distance depending on state of ground and resistance offered. The tops are then cut off level.



## Appendix D.

DETAILS OF TRENCH MORTARS.

| Class. | Type. | Weight for transport.* | Projectile. | Range Max. | Range Min. | Effect. | Uses. | Extreme rate of firing. Average conditions. | — |
|---|---|---|---|---|---|---|---|---|---|
| | | lb. | | yds. | yds | | | | |
| Heavy | 240 mm. | Mortar ... ... 485<br>Mounting ... 425<br>Platform ... 509<br>7 Sleepers each 130<br>Sundries ... 190<br>Total ... 2,519 | Weight, 192 lb. (Aerial torpedo type.) | 1,100 | 600 | *Crater.*<br>Depth, 10 ft.<br>Width, 24 ft. | Destruction of works. | One round in six minutes. | For hand transport barrows are provided, for mortar, mounting and platform. |
| Medium. | 2-in. | Mortar ... 105<br>Bed ... ... 175<br>Elevating stand 50<br>Total ... 320 | Weight, 60 lb. (Stick bomb). | 500 | 100 | *Crater.*<br>Depth, 5 ft.<br>Width 14 ft. | Destruction of works.<br>Wire cutting | One round in 2 minutes. | |
| | 1½-in. | Mortar... ... 90<br>Mounting ... 120<br>Tray ... ... 50<br>Total ... 260 | Weight, 33 lb.<br>Weight, 18 lb. (Stick bombs). | 290<br>500 | 100<br>200 | *Craters.*<br>Depth, 3½ ft.<br>Width, 7 ft.<br>Depth, 2 ft.<br>Width, 4 ft. | Destruction of works.<br>Wire cutting | One round per minute. | |
| | 4-in. | Mortar ... 53<br>Spade ... ... 34<br>Elevating stand 20<br>Total ... 107 | Weight, 11 lb. 9 oz. (shell). | 600 | 100 | *Crater.*<br>Depth, 2 ft.<br>Width, 4ft. | Against personnel. Destruction of minor works. | Two rounds per minute. | |
| Light | 3-in. Stokes. | Mortar and elevating stand. 56<br>Base-plate ... 28<br>Total ... 84 | Weight, 10 lb 11 oz. (cylindrical bomb). | 430 | 170 | *Crater.*<br>Depth, 2 ft.<br>Width, 4 ft. | Against personnel. Destruction of minor works. | 25 rounds per minute. | |
| | 3·7-in. | Mortar... ... 27<br>Elevating stand 20<br>Total ... 47 | Weight, 4½ lb. (tin canister). | 340 | 40 | Shrapnel | | Three rounds per minute. | |

* Weights do not include stores.



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4-17638

## Appendix E.

DETAILS OF AMMUNITION.

| —— | Weight of bomb. | Bursting charge. | Propelling charge. | Nature of fuze. | Method of firing. | Components of one round. |
|---|---|---|---|---|---|---|
| 240-m.m. | 192 lbs. | 99 lb. H.E. | 1·54 lb. of cordite. | Percussion. | Bickford fuze igniter lit by portfire. | Bomb.<br>Fuze.<br>Charge.<br>Igniter. |
| 2-inch | 50 lb. | 16 lb. H.E. | 1½, 2½, or 3½ oz. of cordite. | Time (No. 31A) or percussion | Rifle mechanism. | Bomb (50 lb.).<br>Tail with pin (10 lb.).<br>Fuze.<br>Exploder.<br>Charge—(one 1½ and two 1 oz. parts).<br>Special cartridge for firing mechanism. |
| 1¼-inch | 33 lb. stick bomb.<br>18 lb. stick bomb. | 4¾ lb. H.E.<br>2¾ lb. H.E. | 500 grains of of cordite. | Time No. 121 (mod.). | T friction tube | Bomb (33 or 18 lb.).<br>Fuze.<br>Gaine.<br>Charge.<br>T friction tube. |
| 4-inch | 11 lb. 9 oz. shell. | 2¾ lb. H.E. | 1, 2, 3, 4, 5 or 6 drams of guncotton. | Time No. 27. | Rifle mechanism. | Shell.<br>Fuze.<br>Charge (in 1 dram and 2 dram parts).<br>Special cartridge for firing mechanism. |
| 3-inch Stokes | 10 lb. 11 oz. cylindrical shell. | 2½ lb. H.E. | 12-bore ballistite cartridges, either 120 grains or 175 grains. | Time (pistol head). | Shell with cartridge inserted falling on to striker in the bore. | Bomb.<br>Fuze and Fuze-head detonator.<br>Cartridges—<br>1 long range.<br>1 short range. |
| 3·7 inch | 4½ lb.—Tin canister with shrapnel. | 15 oz. H.E. | Cartridge alone, or with ½, 1 or 1½ drams of guncotton yarn. | Time (Bickford and detonator). | Rifle mechanism. | Bomb.<br>Fuze and detonator.<br>Charge (in ½ dram parts).<br>Special cartridge for firing mechanism. |



Equipment of the
Light Mine Throwers.

## l. m. w. 23. II/A

Königl. Preuss. Minenwerfer-Komp. 41 * 4

AUSTRALIAN WAR MEMORIAL
PRINTED RECORDS
4-17639

2. Aufl. 1000 Angefertigt März 1916

Graph. Anstalt der Kb. M.- u. M.-F.

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TO BE RETURNED

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## Appendix E.

DETAILS OF AMMUNITION.

| —— | Weight of bomb. | Bursting charge. | Propelling charge. | Nature of fuze. | Method of firing. | Components of one round. |
|---|---|---|---|---|---|---|
| 240-m.m. | 192 lbs. | 99 lb. H.E. | 1·54 lb. of cordite. | Percussion. | | |
| 2-inch | 50 lb. | 16 lb. H.E. | 1½, 2½, or 3½ oz. of cordite. | Time (No. 31A) or percussion | | |
| 1¼-inch | 33 lb. stick bomb.<br>18 lb. stick bomb. | 4¾ lb. H.E.<br>2¾ lb. H.E. | 500 grains of of cordite. | Time No. 121 (mod.). | | Charge.<br>T friction tube. |
| 4-inch | 11 lb. 9 oz. shell. | 2¾ lb. H.E. | 1, 2, 3, 4, 5 or 6 drams of guncotton. | Time No. 27. | Rifle mechanism. | Shell.<br>Fuze.<br>Charge (in 1 dram and 2 dram parts).<br>Special cartridge for firing mechanism. |
| 3-inch Stokes | 10 lb. 11 oz. cylindrical shell. | 2½ lb. H.E. | 12-bore ballistite cartridges, either 120 grains or 175 grains. | Time (pistol head). | Shell with cartridge inserted falling on to striker in the bore. | Bomb.<br>Fuze and Fuze-head detonator.<br>Cartridges—<br>1 long range.<br>1 short range. |
| 3·7 inch | 4½ lb.—Tin canister with shrapnel. | 15 oz. H.E. | Cartridge alone, or with ½, 1 or 1½ drams of guncotton yarn. | Time (Bickford and detonator). | Rifle mechanism. | Bomb.<br>Fuze and detonator.<br>Charge (in ½ dram parts).<br>Special cartridge for firing mechanism. |



# Ausrüstung

des

# l. M. W. n/A

Königl. Preuss. Minenwerfer-Komp. 41

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| | | | | | | |
|---|---|---|---|---|---|---|
| 3·7 inch | 4½ lb.—Tin canister with shrapnel. | 15 oz. H.E. | Cartridge alone, or with ½, 1 or 1½ drams of guncotton yarn. | Time (Bickford and detonator). | Rifle mechanism. | Bomb.<br>Fuze and detonator.<br>Charge (in ½ dram parts).<br>Special cartridge for firing mechanism. |

20

## A) im Zubehörkasten.

I. Einlage (oben) Nr. 241

| Fach | | Nummer |
|---|---|---|
| a) | 2 kurze Abzugsschnüre | 224 |
| | 1 lange Abzugschnur | 226 |
| b) | 1 Schlüssel zum Geschoß | 192 |
| | 2 Zünderstellstifte | 191 |
| c) | 1 Hammer, darunter | 181 |
| | 2 Durchschläge | 179 |

| Nummer | | |
|---|---|---|
| 173 | 1 | Kneifzange |
| 173a | 1 | Kombinationszange |
| 174 | 1 | verstellbarer Schlüssel |

| Nummer | | |
|---|---|---|
| 176 | 1 | Flachmeißel |
| 177 | 1 | Kreuzmeißel |
| 180 | 1 | Schlüssel zur Bremseinrichtung |
| 182 | 1 | Heft zum Schraubenzieher |
| 187 | 1 | Rundfeile mit Heft |
| 190 | 1 | Entlader |
| 227 | 1 | Oelspritzkanne |
| 228 | 1 | Glycerinmischungskanne |
| 247 | 1 | Ansetzer mit Gummikopf |
| | 1 | kompl. Visier |

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| | | | | | | |
|---|---|---|---|---|---|---|
| 3·7 inch | 4½ lb.—Tin canister with shrapnel. | 15 oz. H.E. | Cartridge alone, or with ½, 1 or 1½ drams of guncotton yarn. | Time (Bickford and detonator). | Rifle mechanism. | Bomb.<br>Fuze and detonator.<br>Charge (in ½ dram parts).<br>Special cartridge for firing mechanism. |

20

## A) im Zubehörkasten.

II. Einlage (unten) Nr. 242

| Fach | | Nummer |
|---|---|---|
| d) | 2 Federsplinte | 56 |
| | 4 Federn zum Rücklaufmesser | 152 |
| | 4 Oeler | 163 |
| e) | 2 Schlüsselbolzen für Tragestangen | 166 |
| | 2 Vorstecker für Räder | 212 |
| f) | 2 Schräubchen für Filzwischer | 149 |
| | 2 Schräubchen mit Muttern | 150 |
| | 2 Sicherungsschräubchen | 148a |
| | 4 Schräubchen z. Ledermanschette | 140 |
| g) | 1 Blechbüchse enthaltend: | 239 |
| | 2 Ledermanschetten | 48 |
| | 2 Talkumpackungen | 52 |
| h) | 1 äußere Vorholfeder | 31 |
| | 1 innere Vorholfeder | 32 |
| | 1 Aufsteckrohr | 189 |
| | 5 Bogen Schmirgelleinen | |
| i) | 1 Schlagbolzenschraube | 17 |
| | 1 Schlagbolzen | 18 |
| | 1 Feder dazu | 20 |

| Nummer | | |
|---|---|---|
| 9 | 2 | Federbolzen zum Abzugshebel |
| 10 | 2 | Federhülsen zum Hammer |
| 11 | 3 | Federn zur Federhülse zum Hammer |
| 12 | 2 | Federhülsen zum Abzugshebel |
| 13 | 2 | Federn zur Federhülse zum Abzugshebel |
| 14 | 2 | Federn zum Federbolzen |
| 18 | 2 | Schlagbolzen |
| 20 | 3 | Schlagbolzenfedern |
| 21 | 1 | Sicherungsscheibe |

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| Nummer | | |
|---|---|---|
| 22 | 1 | Sicherungsschraube |
| 38a | 4 | Lederringe |
| 53 | 4 | Dichtungsringe, Kupfer |
| 54 | | Füllochschraube mit Bolzen |
| 57 | 2 | Sicherungsschräubchen für Kolbenring und Lagerring |
| 81 | 2 | Libellen für Visier |
| 162 | 2 | Stauffserbuchsen |
| 170 | 1 | Steckschlüssel |
| 171 | 1 | Füllstück |

| Nummer | | |
|---|---|---|
| 172 | 1 | Füllstück (flach) |
| 175 | 1 | Schlüssel zum Visier |
| 178 | 1 | kleiner Schraubenzieher |
| 183 | 1 | Kaliberring |
| 185 | 1 | Kupferdorn |
| 186 | 1 | Flachfeile |
| 188 | 1 | Halbrundfeile |
| 194 | 1 | großer Schraubenzieher |
| 230 | 1 | Fettbüchse |
| | 1 | kg Putzwolle |

| | | | | | | |
|---|---|---|---|---|---|---|
| 3·7 inch | 4½ lb.—Tin canister with shrapnel. | 15 oz. H.E. | Cartridge alone, or with ½, 1 or 1½ drams of guncotton yarn. | Time (Bickford and detonator). | Rifle mechanism. | Bomb. Fuze and detonator. Charge (in ½ dram parts). Special cartridge for firing mechanism. |

20

## B) am Minenwerfer

| | | |
|---|---|---|
| Nr. 168/169 | 2 | Tragestangen |
| „ 220 | 1 | Wischer zum Rohr |
| „ 245 | 1 | Zuggurt |
| „ 229 | 1 | Mündungskappe |
| „ 204 | 1 | Vorhängeschloß zum Zubehörkasten |
| „ 270 | 1 | Geschützüberzug |
| „ 271 | 1 | Kette dazu |
| „ 272 | 1 | Vorhängeschloß zur Kette |
| | 2 | Räder mit Vorstecker |

10

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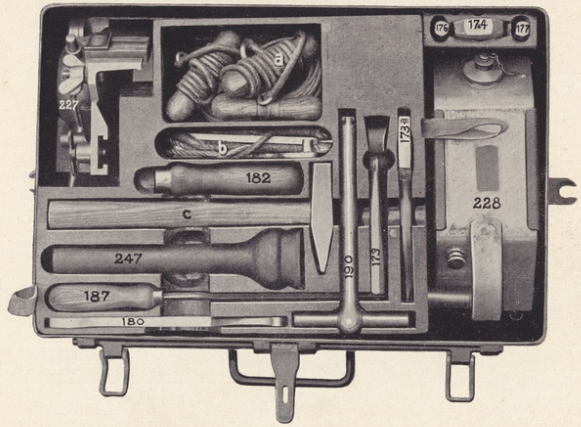
| | | | | | | |
|---|---|---|---|---|---|---|
| 3·7 inch | 4½ lb.—Tin canister with shrapnel. | 15 oz. H.E. | Cartridge alone, or with ½, 1 or 1½ drams of guncotton yarn. | Time (Bickford and detonator). | Rifle mechanism. | Bomb.<br>Fuze and detonator.<br>Charge (in ½ dram parts).<br>Special cartridge for firing mechanism. |

20

## Oberer Einsatz.

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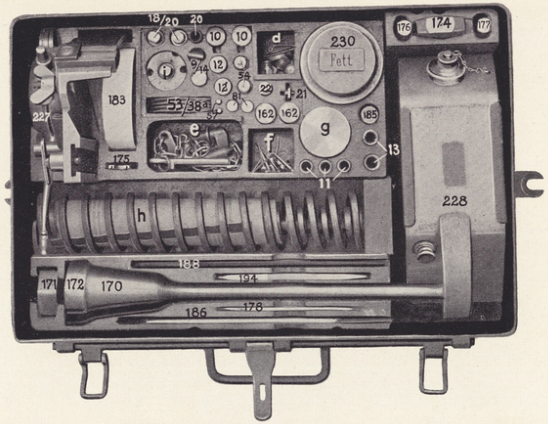
| | | | | | | |
|---|---|---|---|---|---|---|
| 3·7 inch | 4½ lb.—Tin canister with shrapnel. | 15 oz. H.E. | Cartridge alone, or with ½, 1 or 1½ drams of guncotton yarn. | Time (Bickford and detonator). | Rifle mechanism. | Bomb.<br>Fuze and detonator.<br>Charge (in ½ dram parts).<br>Special cartridge for firing mechanism. |

20

## Unterer Einsatz.

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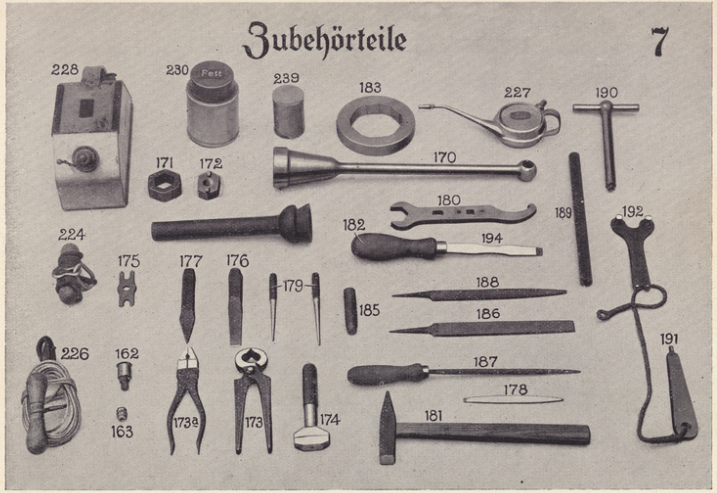
| | | | | | | |
|---|---|---|---|---|---|---|
| 3·7 inch | 4½ lb.—Tin canister with shrapnel. | 15 oz. H.E. | Cartridge alone, or with ½, 1 or 1½ drams of guncotton yarn. | Time (Bickford and detonator). | Rifle mechanism. | Bomb.<br>Fuze and detonator.<br>Charge (in ½ dram parts).<br>Special cartridge for firing mechanism. |



# Zubehörteile



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| | | | | | | |
|---|---|---|---|---|---|---|
| 3·7 inch | 4½ | canister with shrapnel. | | Cartridge alone, or with ½, 1 or 1½ drams of guncotton yarn. | Time (Bickford and detonator). | Rifle mechanism. | Bomb.<br>Fuze and detonator.<br>Charge (in ½ dram parts).<br>Special cartridge for firing mechanism. |

20

Nur für den Dienstgebrauch bestimmt.

Equipment List for the Light Mine Throwers n/A.

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| | | | | | | |
|---|---|---|---|---|---|---|
| 3·7 inch | 4½ lb. — 4 in canister with shrapnel. | 10 oz. H.E. | Cartridge alone, or with ½, 1 or 1½ drams of guncotton yarn. | Time (Bickford and detonator). | Rifle mechanism. | Bomb.<br>Fuze and detonator.<br>Charge (in ½ dram parts).<br>Special cartridge for firing mechanism. |



# Ausrüstungsliste

für den

# leichten Minenwerfer n/A.

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| | | | | | | |
|---|---|---|---|---|---|---|
| 3·7 inch | 4½ lb.—Tin canister with shrapnel. | 15 oz. H.E. | Cartridge alone, or with ½, 1 or 1½ drams of guncotton yarn. | Time (Bickford and detonator). | Rifle mechanism. | Bomb.<br>Fuze and detonator.<br>Charge (in ½ dram parts).<br>Special cartridge for firing mechanism. |





## Unterbringung des Zubehörs.

### A. Im Zubehörkasten.

#### I. Einsatz (oben) Nr. 241.

| Fach | | Nummer |
|---|---|---|
| a) | 2 kurze Abzugsschnüre | 224 |
| | 1 lange Abzugsschnur, 10 m lang | 226 |
| | 1 lange Abzugsschnur, 5 m lang | |
| b) | 1 Schlüssel zum Geschoß mit Schnur | 192 |
| | 2 Zünderstellstifte mit Schnur | 191 |
| c) | 1 Hammer, darunter | 181 |
| | 2 Durchschläge | 179 |

| Nummer | |
|---|---|
| 173. | 1 Kneifzange. |
| 173a. | 1 Kombinationszange. |

| Nummer | |
|---|---|
| 174. | 1 verstellbarer Schlüssel. |
| 176. | 1 Flachmeißel. |
| 177. | 1 Kreuzmeißel. |
| 180. | 1 Schlüssel zur Bremseinrichtung. |
| 182. | 1 Heft zum Schraubenzieher. |
| 187. | 1 Rundfeile mit Heft. |
| 190. | 1 Entlader. |
| 227. | 1 Ölspritzkanne mit Inhalt. |
| 228. | 1 Glyzerinmischungskanne mit Inhalt. |
| 247. | 1 Ansetzer mit Gummikopf. |
| | 1 kompl. Visier. |

Anm.: Die Nummern beziehen sich auf den »Anhang zum Vorentwurf für den leichten Minenwerfer n/A.«.



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| | | | | | | |
|---|---|---|---|---|---|---|
| 3·7 inch | 4½ lb.—Tin canister with shrapnel. | 15 oz. H.E. | Cartridge alone, or with ¾, 1 or 1½ drams of guncotton yarn. | Time (Bickford and detonator). | Rifle mechanism. | Bomb.<br>Fuze and detonator.<br>Charge (in ½ dram parts).<br>Special cartridge for firing mechanism. |





## II. Einsatz (unten) Nr. 242.

| Fach | | Nummer |
|---|---|---|
| d) | 2 Federsplinte zur Kolbenstange | 56 |
| | 4 Federn zum Rücklaufmesser | 152 |
| | 4 Öler | 163 |
| e) | 2 Schlüsselbolzen für Tragestangen | 166 |
| | 2 Vorstecker für Räder mit Riemen | 212 / 212a |
| f) | 2 Schräubchen für Filzwischer | 149 |
| | 2 Schräubchen mit Muttern | 150 |
| | 2 Sicherungsschräubchen | 148a |
| | 4 Schräubchen zur Ledermanschette | 140 |
| g) | 1 Blechbüchse enthaltend: | 239 |
| | 2 Ledermanschetten | 48 |
| | 2 Talkumpackungen | 52 |
| h) | 1 äußere Vorholfeder | 31 |
| | 1 innere Vorholfeder | 32 |
| | 1 Aufsteckrohr | 189 |
| | 5 Bogen Schmirgelleinen | |

| Fach | | Nummer |
|---|---|---|
| i) | 1 Schlagbolzenschraube | 17c |
| | 1 Schlagbolzen | 18e |
| | 1 Feder dazu | 20d |
| | 1 Gewindering | 18f |

| Nummer | |
|---|---|
| 9. | 2 Federbolzen zum Abzugshebel. |
| 10. | 2 Federhülsen zum Hammer. |
| 11. | 3 Federn zur Federhülse zum Hammer. |
| 12. | 2 Federhülsen zum Abzugshebel. |
| 13. | 2 Federn zur Federhülse zum Abzugshebel. |
| 14. | 2 Federn zum Federbolzen. |
| 18c. | 2 Schlagbolzen. |
| 20d. | 3 Schlagbolzenfedern. |
| 21e. | 1 Sicherungsscheibe. |
| 22d. | 1 Sicherungsschraube. |
| 38a. | 4 Lederringe. |
| 53. | 4 Dichtungsringe, Kupfer. |
| 54. | 2 Füllochschrauben mit Bolzen. |
| 57. | 2 Sicherungsschräubchen für Kolbenring und Lagerring. |

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| Nummer | |
|---|---|
| 81. | 2 Libellen für Visier. |
| 162. | 2 Staufferbuchsen. |
| 170. | 1 Steckschlüssel. |
| 171. | 1 Füllstück. |
| 172a. | 1 Füllstück (flach). |
| 175. | 1 Schlüssel zum Visier. |
| 178. | 1 kleiner Schraubenzieher. |
| 183. | 1 Kaliberring. |
| 185. | 1 Dorn. |
| 186. | 1 Flachfeile. gestrichen |
| 188. | 1 Halbrundfeile. |
| 194. | 1 großer Schraubenzieher. |
| 230. | 1 Fettbüchse mit Inhalt. |
| | 1 kg Putzwolle. |
| 227. | 1 Ölspritzkanne |
| 221. | 1 [illegible] Visier. |

Im Deckel.

244. 1 [illegible] mit Schießbuch u. Ersatzstift.



## B. Am Minenwerfer.

Nr. 168/169. 2 Tragestangen.
» 220. 1 Wischer zum Rohr, an [illegible] an der Wiege befestigt.
» 245. 1 Zuggurt am Rohr.
» 229. 1 Mündungskappe.
» 204. 1 Vorhängeschloß zum Zubehörkasten.
2 Räder mit Vorstecker.
» 226. 1 lg. Abzugsschnur 10 m lg. (Im Rohr untergebracht.)

| | | | | | | |
|---|---|---|---|---|---|---|
| 3·7 inch | 4½ lb.—Tin canister with shrapnel. | 15 oz. H.E. | Cartridge alone, or with ½, 1 or 1½ drams of guncotton yarn. | Time (Bickford and detonator). | Rifle mechanism. | Bomb. Fuze and detonator. Charge (in ½ dram parts). Special cartridge for firing mechanism. |



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| | | | | | | |
|---|---|---|---|---|---|---|
| 3·7 inch | 4½ lb.—Tin canister with shrapnel. | 15 oz. H.E. | Cartridge alone, or with ½, 1 or 1½ drams of guncotton yarn. | Time (Bickford and detonator). | Rifle mechanism. | Bomb.<br>Fuze and detonator.<br>Charge (in ½ dram parts).<br>Special cartridge for firing mechanism. |

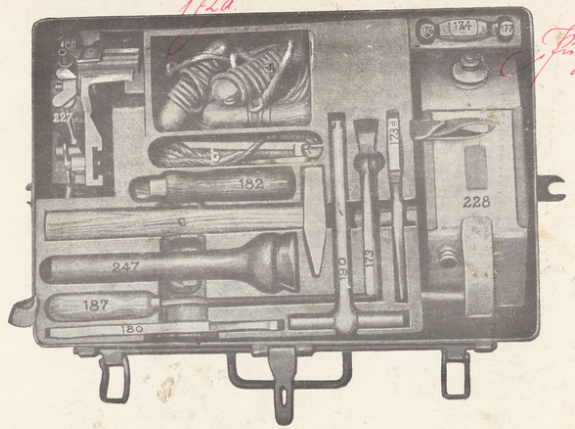




Oberer Einsatz.

1720.

Führerkoffer.

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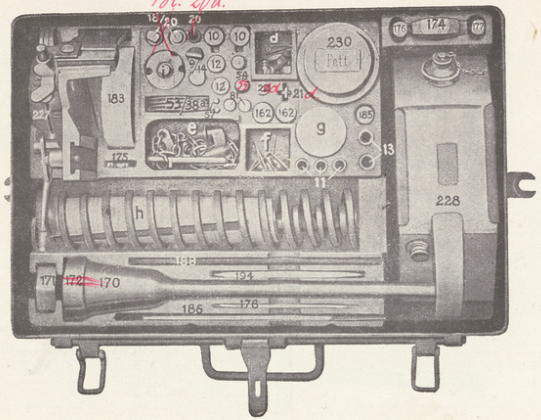
| | | | | | | |
|---|---|---|---|---|---|---|
| 3·7 inch | 4½ lb.—Tin canister with shrapnel. | 15 oz. H.E. | Cartridge alone, or with ½, 1 or 1½ drams of guncotton yarn. | Time (Bickford and detonator). | Rifle mechanism. | Bomb.<br>Fuze and detonator.<br>Charge (in ½ dram parts).<br>Special cartridge for firing mechanism. |





Unterer Einsatz.

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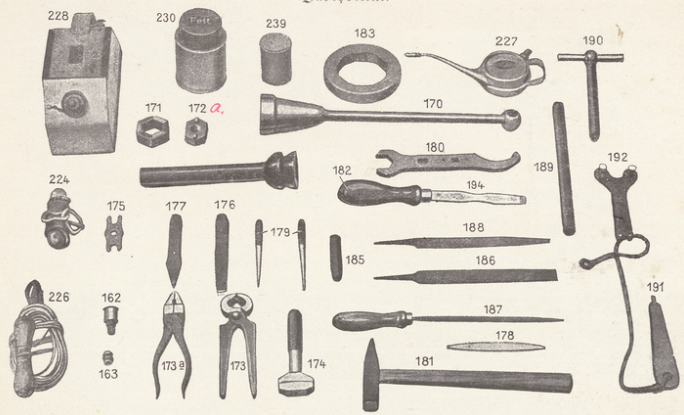
| | | | | | | |
|---|---|---|---|---|---|---|
| 3·7 inch | 4½ lb.—Tin canister with shrapnel. | 15 oz. H.E. | Cartridge alone, or with ½, 1 or 1½ drams of guncotton yarn. | Time (Bickford and detonator). | Rifle mechanism. | Bomb.<br>Fuze and detonator.<br>Charge (in ½ dram parts).<br>Special cartridge for firing mechanism. |





## Zubehörteile.




2333. 17. II.

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4-17640

| | | | | | | |
|---|---|---|---|---|---|---|
| 3·7 inch | 4½ lb.—Tin canister with shrapnel. | 15 oz. H.E. | Cartridge alone, or with ½ 1 or 1½ drams of guncotton yarn. | Time (Bickford and detonator). | Rifle mechanism. | Bomb.<br>Fuze and detonator.<br>Charge (in ½ dram parts).<br>Special cartridge for firing mechanism. |



1-1. 2-2. 3-0. 4-1.

Table to report the do
results of the Field-gun 96 n/A o

Kriegsministeriums gestattet.

AUSTRALIAN WAR RECORDS SECTION
CLASSIFICATION SUB-SECTION
757

# Berichtigung der Tages- und sonstigen Einflüsse auf das Schießen aus der Feldkanone 96 n/A.

mit normaler (großer) und kleiner Ladung.

(Berichtigungstafeln.)

AUST. WAR MEMORIAL
No. H168

Aufgestellt für das F. Schr. 96 n/A. und die K. Gr. 15 mit K. Z. 11 Gr. zu 6,85 kg; gilt auch als Anhalt für K. Gr. 14 und K. Gr. 15 mit / K. Z. 11 Gr. sowie mit /. F. K. Gr.

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17640

| | | | | | | |
|---|---|---|---|---|---|---|
| 3·7 inch | 4½ lb.—Tin canister with shrapnel. | 15 oz. H.E. | Cartridge alone, or with ½, 1 or 1½ drams of guncotton yarn. | Time (Bickford and detonator). | Rifle mechanism. | Bomb.<br>Fuze and detonator.<br>Charge (in ½ dram parts).<br>Special cartridge for firing mechanism. |



1—1 2—2 3—0 4—1.

Nur für den Dienstgebrauch bestimmt.

Veröffentlichungen aus dieser Vorschrift sind nur mit Genehmigung des Kriegsministeriums gestattet.

AUSTRALIAN WAR RECORDS SECTION
757

# Tafeln

zur

## Berichtigung der Tages- und sonstigen Einflüsse auf das Schießen aus der Feldkanone 96 n/A.

mit normaler (großer) und kleiner Ladung.

(Berichtigungstafeln.)

No. H168
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batterie, Vermessungsabteilung oder u. U. auch dem nächsten Schallmeßtrupp erfragt werden. Es ist der für die betreffende Höhenlage der Batterie geltende, nicht etwa der auf Meereshöhe reduzierte Barometerstand zu nehmen. (Ausdrücklich in diesem Sinne anzufordern!)

Aus Barometerstand und Lufttemperatur läßt sich nach Tafel I das Tagesluftgewicht für die Höhenlage der Batterie ermitteln.

Tafel II gibt die zu dem ermittelten Tagesluftgewicht gehörende Verbesserung der Entfernung. Bei Luftgewichten unter 1,22 kg für das Kubikmeter ist dabei an Entfernung abzubrechen, darüber zuzulegen.

## 3. Der Wind.

Dem Einfluß des gegenüber dem Bodenwind mit zunehmender Höhe nach Geschwindigkeit und Richtung sich ändernden Windes auf die Flugbahn kann in genauer und zugleich einfacher Weise nicht Rechnung getragen werden. Man erhält aber brauchbare Ergebnisse, wenn man Geschwindigkeit und Richtung des Windes in der »durchschnittlichen Geschoßflughöhe« berücksichtigt. Diese durchschnittlichen Geschoßflughöhen enthält die Spalte 2 der Tafel III. Am besten erfragt man Richtung und Geschwindigkeit des Windes für die durchschnittliche Geschoßflughöhe bei einer der in Ziffer 2 genannten Stellen. Sind von solchen Stellen keine Angaben zu erlangen, so müssen als Notbehelf die in der Anlage 1 (S. 31) zusammengestellten Regeln verwandt werden.

Tafel III gibt die Entfernungs-, Tafel V die Seitenverbesserungen, die notwendig sind, um den Windeinfluß möglichst auszuschalten. Es sind dabei nur drei Windgeschwindigkeiten von 6, 12 und 18 m/sec sowie vier Hauptrichtungen unterschieden, und letztgenannte durch die im Kopf und am Fuß der Tafeln eingezeichneten Pfeile sowie durch die Richtungszahlen (vgl. S. 29) bestimmt. Die Fahnen der Pfeile deuten in die Richtung, nach der der Wind geht.

## 4. Die besonderen Einflüsse.

a) Infolge verschiedener Pulvertemperaturen, Verlängerungen des Verbrennungsraums durch Abnutzung der Rohre, Verschiedenheiten in der Pulverlieferung treten



Unterschiede in der Tagesanfangsgeschwindigkeit gegenüber der schußtafelmäßigen Anfangsgeschwindigkeit auf. Die rechnerische Ermittelung der Tagesanfangsgeschwindigkeit ist ziemlich unsicher und findet daher nur in Ausnahmefällen (vgl. S. 33) statt. Besser ist es, die besondern Einflüsse zusammen durch einen kurzen Schießversuch zu ermitteln. Man wählt hierzu ein gut beobachtungsfähiges Hilfsziel mit genau bekannter Entfernung und bestimmt unter Ausschaltung der Einflüsse des Tagesluftgewichtes und des Windes nach den Tafeln II, III und V die für die erste Richtung erforderliche Aufsatzstellung (Entfernung und Seite). Nunmehr erfolgt das geschützweise Einschießen nach dem Hilfsziel. Der Unterschied zwischen der erschossenen und der für die erste Richtung ermittelten Entfernung wird den besonderen Einflüssen, also in erster Linie dem Unterschied der tatsächlichen Anfangsgeschwindigkeit gegenüber der schußtafelmäßigen Anfangsgeschwindigkeit zur Last gelegt und dient zur Ermittelung der zutreffenden Spalte der Tafel IV. Nach der so ermittelten Spalte des einzelnen Geschützes kann dann die für ein anderes Ziel zur Ausschaltung der besonderen Einflüsse erforderliche Korrektur wiederum aus Tafel IV abgelesen werden.

Ein Erschießen der Spalten für alle Geschütze ist nur bei der erstmaligen Anwendung des Verfahrens, ferner nach größerem Munitionsverbrauch, bei besonders auffälligem Verhalten einzelner Geschütze erforderlich. Im übrigen genügt es, bei weiterem Schießen nur die Spalte für ein Geschütz zu erschießen und nach dem Ergebnis die Spalten der übrigen Geschütze unter Berücksichtigung der einmal ermittelten Unterschiede festzustellen. Ist z. B. beim ersten Schießen ermittelt

| | | | | |
|---|---|---|---|---|
| für das | 1. | 2. | 3. | 4. Geschütz |
| die Spalte | 5 | 2 | 3 | 8 |

und ergibt sich an einem andern Tage für das 1. Geschütz allein die Spalte 9, so sind die obengefundenen Spalten auch entsprechend zu erhöhen. Man erhält demnach

| | | | | |
|---|---|---|---|---|
| für das | 1. | 2. | 3. | 4. Geschütz |
| die Spalte | 9 | 6 | 7 | 12. |

Für neu hinzukommende Geschütze muß selbstverständlich der Unterschied gegenüber dem Leitgeschütz neu erschossen werden.



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Es bleibt demnach bei diesem Verfahren zu beachten, daß der nach dem Hilfsziel erschossene Entfernungsunterschied streng genommen nicht allein auf einen Unterschied in den Anfangsgeschwindigkeiten zurückzuführen ist. Er enthält vielmehr neben anderen Ungenauigkeiten noch die unvermeidlichen Fehler in sich, die bei Ermittelung der Luftgewichts- und Windkorrekturen vor Beginn des Schießens nach dem Hilfsziel gemacht worden sind. Je genauer daher diese Ermittelungen ausfallen, desto besser werden die erhaltenen Spalten zutreffen. Weiter muß danach gestrebt werden, daß die einmal ermittelte Spalte wenigstens während eines Schießtags möglichst beibehalten wird. Dazu ist erforderlich, die **Patronen** vor Temperaturänderungen möglichst zu schützen, sie also in erster Linie **nicht der Sonnenbestrahlung auszusetzen** und möglichst lange bis zur Verwendung in den Munitionsräumen zu lassen (vgl. hierzu weiter S. 33/34).

b) Durch Regen oder Schnee wird die Schußweite verkürzt. Zahlenmäßige Angaben über das Maß, um das bei Niederschlägen an Entfernung zuzulegen ist, lassen sich im allgemeinen indessen nicht machen. Behelfsmäßig kann der Versuch gemacht werden, durch Vergrößerung des vorher ermittelten Luftgewichtes um 0,10 kg/cbm und entsprechendes Zulegen an Entfernung den Einfluß eines stärkeren Regens auszuschalten.



## Bestimmung des Tagesluftgewichtes

(kg/cbm).

Tafel I.

| Temperatur Grad C | Barometerstand 710 | 720 | 730 | 740 | 750 | 760 | 770 | 780 | 790 |
|---|---|---|---|---|---|---|---|---|---|
| — 30 | 1,36 | 1,38 | 1,40 | 1,42 | 1,43 | 1,45 | 1,47 | 1,49 | 1,51 |
| — 25 | 1,33 | 1,35 | 1,37 | 1,39 | 1,40 | 1,42 | 1,44 | 1,46 | 1,48 |
| — 20 | 1,30 | 1,32 | 1,34 | 1,36 | 1,38 | 1,40 | 1,41 | 1,43 | 1,45 |
| — 15 | 1,28 | 1,30 | 1,31 | 1,33 | 1,35 | 1,37 | 1,39 | 1,40 | 1,42 |
| — 10 | 1,25 | 1,27 | 1,29 | 1,31 | 1,32 | 1,34 | 1,36 | 1,38 | 1,40 |
| — 5 | 1,23 | 1,25 | 1,26 | 1,28 | 1,30 | 1,32 | 1,33 | 1,35 | 1,37 |
| 0 | 1,21 | 1,22 | 1,24 | 1,26 | 1,28 | 1,29 | 1,31 | 1,33 | 1,34 |
| + 5 | 1,18 | 1,20 | 1,22 | 1,24 | 1,25 | 1,27 | 1,28 | 1,30 | 1,32 |
| + 10 | 1,16 | 1,18 | 1,20 | 1,21 | 1,23 | 1,24 | 1,26 | 1,28 | 1,29 |
| + 15 | 1,14 | 1,16 | 1,17 | 1,19 | 1,21 | 1,22 | 1,24 | 1,26 | 1,27 |
| + 20 | 1,12 | 1,14 | 1,15 | 1,17 | 1,18 | 1,20 | 1,22 | 1,23 | 1,25 |
| + 25 | 1,10 | 1,12 | 1,13 | 1,15 | 1,16 | 1,18 | 1,19 | 1,21 | 1,22 |
| + 30 | 1,08 | 1,10 | 1,11 | 1,13 | 1,14 | 1,16 | 1,17 | 1,19 | 1,20 |
| + 35 | 1,06 | 1,07 | 1,09 | 1,10 | 1,12 | 1,13 | 1,15 | 1,16 | 1,18 |
| + 40 | 1,04 | 1,05 | 1,07 | 1,08 | 1,10 | 1,11 | 1,13 | 1,14 | 1,16 |
| Grad C Temperatur | 710 | 720 | 730 | 740 | 750 | 760 | 770 | 780 | 790 |
| | Barometerstand | | | | | | | | |

**Es ist nicht der auf 0 m Meereshöhe bezogene Barometerstand, sondern der wahre, für die Höhe der Batterie gültige zu verwenden.** Gibt die Feldwetterstation nur den Barometerstand für 0 m Meereshöhe, so ist er auf je 11 m Höhe der Batterie nach der Karte um 1 mm zu verringern.

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Tafel II a.

## Luftgewicht.

Entfernung abbrechen

| Entfernung | Luftgewicht kg/cbm | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| m | 1,02 | 1,04 | 1,06 | 1,08 | 1,10 | 1,12 | 1,14 | 1,16 | 1,18 | 1,20 | 1,22 |
| **Normale (ganze) Ladung.** | | | | | | | | | | | |
| **1000** | **30** | **30** | **30** | **20** | **20** | **20** | **10** | **10** | **10** | **0** | **0** |
| 1200 | 40 | 40 | 30 | 30 | 30 | 20 | 20 | 10 | 10 | 0 | 0 |
| 1400 | 50 | 50 | 40 | 40 | 30 | 30 | 20 | 20 | 10 | 10 | 0 |
| 1600 | 60 | 60 | 50 | 40 | 40 | 30 | 20 | 20 | 10 | 10 | 0 |
| 1800 | 70 | 60 | 60 | 50 | 40 | 40 | 30 | 20 | 10 | 10 | 0 |
| **2000** | **80** | **80** | **70** | **60** | **50** | **40** | **30** | **30** | **20** | **10** | **0** |
| 2200 | 100 | 90 | 80 | 70 | 60 | 50 | 40 | 30 | 20 | 10 | 0 |
| 2400 | 110 | 100 | 90 | 80 | 60 | 50 | 40 | 30 | 20 | 10 | 0 |
| 2600 | 120 | 110 | 100 | 90 | 70 | 60 | 50 | 40 | 20 | 10 | 0 |
| 2800 | 130 | 120 | 110 | 90 | 80 | 70 | 50 | 40 | 30 | 10 | 0 |
| **3000** | **150** | **130** | **120** | **100** | **90** | **70** | **60** | **40** | **30** | **10** | **0** |
| 3200 | 160 | 150 | 130 | 110 | 100 | 80 | 60 | 50 | 30 | 20 | 0 |
| 3400 | 170 | 160 | 140 | 120 | 100 | 90 | 70 | 50 | 40 | 20 | 0 |
| m | 1,42 | 1,40 | 1,38 | 1,36 | 1,34 | 1,32 | 1,30 | 1,28 | 1,26 | 1,24 | 1,22 |
| Entfernung | Luftgewicht kg/cbm | | | | | | | | | | |

Entfernung zulegen!



## Wind.

Tafel III a.

Wind von rückwärts: Entfernung abbrechen!

| Schußrichtung ↑ Entfernung m | Durchschnittl. Geschoß-Flughöhe m | Windrichtung und -geschwindigkeit in m/sec: ↑ 0 | | | 22½° ↖↗ 1 | | | 45° ↖↗ 2 | | | 67½° ↖↗ 3 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 |
| **Normale (ganze) Ladung.** | | | | | | | | | | | | | |
| **1000** | **5** | **10** | **10** | **20** | **10** | **10** | **20** | **0** | **10** | **10** | **0** | **10** | **10** |
| 1200 | 7 | 10 | 20 | 30 | 10 | 20 | 20 | 10 | 10 | 20 | 0 | 10 | 10 |
| 1400 | 10 | 10 | 20 | 30 | 10 | 20 | 30 | 10 | 20 | 20 | 0 | 10 | 10 |
| 1600 | 10 | 10 | 30 | 40 | 10 | 20 | 40 | 10 | 20 | 30 | 10 | 10 | 20 |
| 1800 | 20 | 20 | 30 | 50 | 10 | 30 | 40 | 10 | 20 | 30 | 10 | 10 | 20 |
| **2000** | **20** | **20** | **40** | **60** | **20** | **40** | **50** | **10** | **30** | **40** | **10** | **10** | **20** |
| 2200 | 30 | 20 | 40 | 70 | 20 | 40 | 60 | 20 | 30 | 50 | 10 | 20 | 30 |
| 2400 | 40 | 30 | 50 | 80 | 20 | 50 | 70 | 20 | 40 | 50 | 10 | 20 | 30 |
| 2600 | 40 | 30 | 60 | 90 | 30 | 60 | 80 | 20 | 40 | 60 | 10 | 20 | 30 |
| 2800 | 50 | 30 | 70 | 100 | 30 | 60 | 90 | 20 | 50 | 70 | 10 | 30 | 40 |
| **3000** | **60** | **40** | **80** | **120** | **40** | **70** | **110** | **30** | **50** | **80** | **10** | **30** | **40** |
| 3200 | 70 | 40 | 90 | 130 | 40 | 80 | 120 | 30 | 60 | 90 | 20 | 30 | 50 |
| 3400 | 90 | 50 | 90 | 140 | 40 | 90 | 130 | 30 | 70 | 100 | 20 | 40 | 50 |
| m | m | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 |
| Entfernung | Durchschnittl. Geschoß-Flughöhe | ↓ 0 | | | ↙↘ 1 | | | ↙↘ 2 | | | ↙↘ 3 | | |
| | | Windrichtung und -geschwindigkeit in m/sec | | | | | | | | | | | |

Wind von vorn: Entfernung zulegen!

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Tafel IVa.

## Besondere Einflüsse.

Entfernung abbrechen!

| Entfernung m | —1 | —2 | —3 | —4 | —5 | —6 | —7 | —8 | —9 | —10 | —11 | —12 | —13 | —14 | —15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Normale (ganze) Ladung. | | | | | | | | | | | | | | | |
| **1000** | **10** | **10** | **20** | **20** | **30** | **30** | **40** | **40** | **50** | **50** | **60** | **60** | **70** | **70** | **80** |
| 1200 | 10 | 10 | 20 | 20 | 30 | 40 | 40 | 50 | 50 | 60 | 70 | 70 | 80 | 80 | 90 |
| 1400 | 10 | 10 | 20 | 30 | 30 | 40 | 50 | 50 | 60 | 70 | 70 | 80 | 90 | 90 | 100 |
| 1600 | 10 | 10 | 20 | 30 | 40 | 40 | 50 | 60 | 70 | 70 | 80 | 90 | 100 | 100 | 110 |
| 1800 | 10 | 20 | 20 | 30 | 40 | 50 | 60 | 60 | 70 | 80 | 90 | 100 | 100 | 110 | 120 |
| **2000** | **10** | **20** | **30** | **30** | **40** | **50** | **60** | **70** | **80** | **90** | **100** | **100** | **110** | **120** | **130** |
| 2200 | 10 | 20 | 30 | 40 | 50 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 |
| 2400 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 90 | 100 | 110 | 120 | 130 | 140 |
| 2600 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 |
| 2800 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 160 |
| **3000** | **10** | **20** | **30** | **40** | **50** | **60** | **70** | **90** | **100** | **110** | **120** | **130** | **140** | **150** | **160** |
| 3200 | 10 | 20 | 30 | 40 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 | 170 |
| 3400 | 10 | 20 | 30 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 140 | 150 | 160 | 170 |
| m Entfernung | +1 | +2 | +3 | +4 | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |

Entfernung zulegen!



Feldartillerie-Regiment
4. Batterie.

Tafel Va.

## Seitlicher Windeinfluß.

Wind **von** rechts: Seite weniger!

Schußrichtung →

| Entfernung m | Durchschnittl. Geschoß-Flughöhe m | Windrichtung und -geschwindigkeit in m/sec: 1 ↘ | | | 2 ↘ | | | 3 ↘ | | | 4 ← | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 |
| Normale (ganze) Ladung. | | | | | | | | | | | | | |
| **1000** | **6** | **1** | **2** | **3** | **2** | **3** | **5** | **2** | **4** | **7** | **2** | **5** | **7** |
| 1200 | 7 | 1 | 2 | 3 | 2 | 4 | 6 | 3 | 6 | 8 | 3 | 6 | 9 |
| 1400 | 10 | 1 | 2 | 3 | 2 | 4 | 6 | 3 | 6 | 8 | 3 | 6 | 9 |
| 1600 | 10 | 1 | 3 | 4 | 3 | 5 | 8 | 3 | 7 | 10 | 4 | 7 | 11 |
| 1800 | 20 | 1 | 3 | 4 | 3 | 5 | 8 | 3 | 7 | 10 | 4 | 7 | 11 |
| **2000** | **20** | **2** | **3** | **5** | **3** | **6** | **9** | **4** | **8** | **12** | **4** | **8** | **13** |
| 2200 | 30 | 2 | 3 | 5 | 3 | 6 | 9 | 4 | 8 | 12 | 4 | 8 | 13 |
| 2400 | 40 | 2 | 3 | 5 | 3 | 6 | 9 | 4 | 8 | 12 | 4 | 8 | 13 |
| 2600 | 40 | 2 | 4 | 6 | 3 | 7 | 10 | 4 | 9 | 13 | 5 | 10 | 14 |
| 2800 | 50 | 2 | 4 | 6 | 3 | 7 | 10 | 4 | 9 | 13 | 5 | 10 | 14 |
| **3000** | **60** | **2** | **4** | **6** | **4** | **8** | **11** | **5** | **10** | **15** | **5** | **11** | **16** |
| 3200 | 70 | 2 | 4 | 6 | 4 | 8 | 11 | 5 | 10 | 15 | 5 | 11 | 16 |
| 3400 | 90 | 2 | 4 | 6 | 4 | 8 | 11 | 5 | 10 | 15 | 5 | 11 | 16 |
| m Entfernung | m Durchschnittl. Geschoß-Flughöhe | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 |
| | | Windrichtung und -geschwindigkeit in m/sec: 5 ↙ | | | 6 ↙ | | | 7 ↙ | | | 8 → | | |

Wind **von** links: Seite mehr!



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Noch: Tafel IIa.

## Luftgewicht.

**Entfernung abbrechen!**

| Entfernung m | Luftgewicht kg/cbm | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1,02 | 1,04 | 1,06 | 1,08 | 1,10 | 1,12 | 1,14 | 1,16 | 1,18 | 1,20 | 1,22 |
| **Normale (ganze) Ladung.** | | | | | | | | | | | |
| 3600 | 190 | 170 | 150 | 130 | 110 | 90 | 80 | 60 | 40 | 20 | 0 |
| 3800 | 200 | 180 | 160 | 140 | 120 | 100 | 80 | 60 | 40 | 20 | 0 |
| **4000** | **220** | **200** | **170** | **150** | **130** | **110** | **90** | **70** | **40** | **20** | **0** |
| 4200 | 230 | 210 | 190 | 160 | 140 | 120 | 90 | 70 | 50 | 20 | 0 |
| 4400 | 250 | 220 | 200 | 170 | 150 | 120 | 100 | 70 | 50 | 20 | 0 |
| 4600 | 260 | 240 | 210 | 180 | 160 | 130 | 100 | 80 | 50 | 30 | 0 |
| 4800 | 280 | 250 | 220 | 190 | 170 | 140 | 110 | 80 | 60 | 30 | 0 |
| **5000** | **290** | **260** | **230** | **200** | **180** | **150** | **120** | **90** | **60** | **30** | **0** |
| 5200 | 310 | 280 | 250 | 220 | 180 | 150 | 120 | 90 | 60 | 30 | 0 |
| 5400 | 320 | 290 | 260 | 230 | 190 | 160 | 130 | 100 | 60 | 30 | 0 |
| 5600 | 340 | 310 | 270 | 240 | 210 | 170 | 140 | 100 | 70 | 30 | 0 |
| 5800 | 360 | 320 | 290 | 250 | 220 | 180 | 140 | 110 | 70 | 40 | 0 |
| **6000** | **380** | **340** | **300** | **260** | **230** | **190** | **150** | **110** | **80** | **40** | **0** |
| m | 1,42 | 1,40 | 1,38 | 1,36 | 1,34 | 1,32 | 1,30 | 1,28 | 1,26 | 1,24 | 1,22 |
| Entfernung | kg/cbm Luftgewicht | | | | | | | | | | |

**Entfernung zulegen!**



## Wind.

Noch: Tafel IIIa.

**Wind von hinten: Entfernung abbrechen!**

Schußrichtung ↑

| Entfernung m | Durchschnittl. Geschoß-Flughöhe m | Windrichtung und -geschwindigkeit in m/sec | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 |
| **Normale (ganze) Ladung.** | | | | | | | | | | | | | |
| 3600 | 100 | 50 | 100 | 160 | 50 | 100 | 140 | 40 | 70 | 110 | 20 | 40 | 60 |
| 3800 | 120 | 60 | 120 | 170 | 50 | 110 | 160 | 40 | 80 | 120 | 20 | 40 | 70 |
| **4000** | **130** | **60** | **130** | **190** | **60** | **120** | **170** | **40** | **90** | **130** | **20** | **50** | **70** |
| 4200 | 150 | 70 | 140 | 210 | 60 | 130 | 190 | 50 | 100 | 150 | 30 | 50 | 80 |
| 4400 | 170 | 70 | 150 | 220 | 70 | 140 | 210 | 50 | 110 | 160 | 30 | 60 | 90 |
| 4600 | 190 | 80 | 160 | 240 | 70 | 150 | 220 | 60 | 110 | 170 | 30 | 60 | 90 |
| 4800 | 220 | 90 | 170 | 260 | 80 | 160 | 240 | 60 | 120 | 180 | 30 | 70 | 100 |
| **5000** | **240** | **90** | **180** | **280** | **90** | **170** | **260** | **70** | **130** | **200** | **40** | **70** | **110** |
| 5200 | 250 | 100 | 200 | 300 | 90 | 180 | 270 | 70 | 140 | 210 | 40 | 80 | 110 |
| 5400 | 300 | 110 | 210 | 320 | 100 | 200 | 290 | 70 | 150 | 220 | 40 | 80 | 120 |
| 5600 | 350 | 110 | 230 | 340 | 100 | 210 | 310 | 80 | 160 | 240 | 40 | 90 | 130 |
| 5800 | 400 | 120 | 240 | 360 | 110 | 220 | 330 | 80 | 170 | 250 | 50 | 90 | 140 |
| **6000** | **450** | **130** | **260** | **380** | **120** | **240** | **350** | **90** | **180** | **270** | **50** | **100** | **150** |
| m | m | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 |
| Entfernung | Durchschnittl. Geschoß-Flughöhe | Windrichtung und -geschwindigkeit in m/sec | | | | | | | | | | | |

**Wind von vorn: Entfernung zulegen!**



AUSTRALIAN WAR MEMORIAL AWM2023.9.29

Noch: Tafel IVa.

## Besondere Einflüsse.

Entfernung abbrechen!

| Entfernung m | —1 | —2 | —3 | —4 | —5 | —6 | —7 | —8 | —9 | —10 | —11 | —12 | —13 | —14 | —15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Normale (ganze) Ladung.** | | | | | | | | | | | | | | | |
| 3600 | 10 | 20 | 40 | 50 | 60 | 70 | 80 | 90 | 110 | 120 | 130 | 140 | 150 | 160 | 180 |
| 3800 | 10 | 20 | 40 | 50 | 60 | 70 | 80 | 90 | 110 | 120 | 130 | 140 | 150 | 160 | 180 |
| **4000** | **10** | **20** | **40** | **50** | **60** | **70** | **80** | **100** | **110** | **120** | **130** | **140** | **160** | **170** | **180** |
| 4200 | 10 | 20 | 40 | 50 | 60 | 70 | 80 | 100 | 110 | 120 | 130 | 140 | 160 | 170 | 180 |
| 4400 | 10 | 20 | 40 | 50 | 60 | 70 | 90 | 100 | 110 | 120 | 140 | 150 | 160 | 170 | 190 |
| 4600 | 10 | 20 | 40 | 50 | 60 | 70 | 90 | 100 | 110 | 120 | 140 | 150 | 160 | 170 | 190 |
| 4800 | 10 | 30 | 40 | 50 | 60 | 80 | 90 | 100 | 110 | 130 | 140 | 150 | 160 | 180 | 190 |
| **5000** | **10** | **30** | **40** | **50** | **70** | **80** | **90** | **100** | **120** | **130** | **140** | **160** | **170** | **180** | **200** |
| 5200 | 10 | 30 | 40 | 50 | 70 | 80 | 90 | 100 | 120 | 130 | 140 | 160 | 170 | 180 | 200 |
| 5400 | 10 | 30 | 40 | 50 | 70 | 80 | 90 | 110 | 120 | 130 | 150 | 160 | 170 | 190 | 200 |
| 5600 | 10 | 30 | 40 | 50 | 70 | 80 | 90 | 110 | 120 | 130 | 150 | 160 | 170 | 190 | 200 |
| 5800 | 10 | 30 | 40 | 50 | 70 | 80 | 90 | 110 | 120 | 130 | 150 | 160 | 170 | 190 | 200 |
| **6000** | **10** | **30** | **40** | **50** | **70** | **80** | **100** | **110** | **120** | **140** | **150** | **160** | **180** | **190** | **210** |
| m Entfernung | +1 | +2 | +3 | +4 | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |

Entfernung zulegen!



## Seitlicher Windeinfluß.

Noch: Tafel Va.

Wind **von** rechts: Seite weniger!

| Schußrichtung ↑ Entfernung m | Durchschnittl. Geschoß-Flughöhe m | Windrichtung und -geschwindigkeit in m/sec 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Normale (ganze) Ladung.** | | | | | | | | | | | | | |
| 3600 | 100 | 2 | 5 | 7 | 4 | 8 | 13 | 6 | 11 | 17 | 6 | 12 | 18 |
| 3800 | 120 | 2 | 5 | 7 | 4 | 8 | 13 | 6 | 11 | 17 | 6 | 12 | 18 |
| **4000** | **130** | **2** | **5** | **7** | **4** | **8** | **13** | **6** | **11** | **17** | **6** | **12** | **18** |
| 4200 | 150 | 3 | 5 | 8 | 5 | 9 | 14 | 6 | 12 | 18 | 7 | 13 | 20 |
| 4400 | 170 | 3 | 5 | 8 | 5 | 9 | 14 | 6 | 12 | 18 | 7 | 13 | 20 |
| 4600 | 190 | 3 | 5 | 8 | 5 | 9 | 14 | 6 | 12 | 18 | 7 | 13 | 20 |
| 4800 | 220 | 3 | 6 | 8 | 5 | 10 | 15 | 7 | 13 | 20 | 7 | 14 | 22 |
| **5000** | **240** | **3** | **6** | **9** | **6** | **10** | **15** | **7** | **13** | **20** | **7** | **14** | **22** |
| 5200 | 250 | 3 | 6 | 9 | 6 | 11 | 17 | 7 | 14 | 22 | 8 | 16 | 23 |
| 5400 | 300 | 3 | 6 | 10 | 6 | 12 | 18 | 8 | 16 | 23 | 8 | 17 | 25 |
| 5600 | 350 | 3 | 6 | 10 | 6 | 12 | 18 | 8 | 16 | 23 | 8 | 17 | 25 |
| 5800 | 400 | 3 | 7 | 10 | 6 | 13 | 19 | 8 | 17 | 25 | 9 | 18 | 27 |
| **6000** | **450** | **4** | **7** | **11** | **7** | **14** | **20** | **9** | **18** | **27** | **10** | **19** | **29** |

m Entfernung | m Durchschnittl. Geschoß-Flughöhe | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 — Windrichtung und -geschwindigkeit in m/sec

Wind **von** links: Seite mehr!

AUSTRALIAN WAR MEMORIAL AWM2023.9.29

Noch: Tafel II a.

## Luftgewicht.

**Entfernung abbrechen!**

| Entfernung m | Luftgewicht kg/cbm | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1,02 | 1,04 | 1,06 | 1,08 | 1,10 | 1,12 | 1,14 | 1,16 · 1,18 | | 1,20 | 1,22 |
| **Normale (ganze) Ladung.** | | | | | | | | | | | |
| 6200 | 400 | 360 | 320 | 280 | 240 | 200 | 160 | 120 | 80 | 40 | 0 |
| 6400 | 420 | 370 | 330 | 290 | 250 | 210 | 170 | 120 | 80 | 40 | 0 |
| 6600 | 440 | 390 | 350 | 310 | 260 | 220 | 170 | 130 | 90 | 40 | 0 |
| 6800 | 460 | 410 | 360 | 320 | 270 | 230 | 180 | 140 | 90 | 50 | 0 |
| **7000** | **480** | **430** | **380** | **330** | **290** | **240** | **190** | **140** | **100** | **50** | **0** |
| 7200 | 500 | 450 | 400 | 350 | 300 | 250 | 200 | 150 | 100 | 50 | 0 |
| 7400 | 530 | 470 | 420 | 370 | 320 | 260 | 210 | 160 | 110 | 50 | 0 |
| 7600 | 550 | 500 | 440 | 390 | 330 | 280 | 220 | 170 | 110 | 60 | 0 |
| m | 1,42 | 1,40 | 1,38 | 1,36 | 1,34 | 1,32 | 1,30 | 1,28 | 1,26 | 1,24 | 1,22 |
| Entfernung | Luftgewicht kg/cbm | | | | | | | | | | |

**Entfernung zulegen!**



Noch: Tafel III a.

## Wind.

**Wind von hinten: Entfernung abbrechen!**

Schußrichtung ↑

| Entfernung m | Durchschnittl. Geschoß-Flughöhe m | Windrichtung und -geschwindigkeit in m/sec | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ↑ 0 | | | ↙ 1 | | | ↙ 2 | | | ↙ 3 | | |
| | | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 |
| **Normale (ganze) Ladung.** | | | | | | | | | | | | | |
| 6200 | 500 | 140 | 270 | 410 | 130 | 250 | 380 | 100 | 190 | 290 | 50 | 100 | 160 |
| 6400 | 500 | 140 | 290 | 430 | 130 | 270 | 400 | 100 | 200 | 310 | 60 | 110 | 170 |
| 6600 | 600 | 150 | 310 | 460 | 140 | 280 | 420 | 110 | 220 | 320 | 60 | 120 | 180 |
| 6800 | 700 | 160 | 320 | 490 | 150 | 300 | 450 | 110 | 230 | 340 | 60 | 120 | 190 |
| **7000** | **800** | **170** | **340** | **510** | **160** | **320** | **480** | **120** | **240** | **360** | **70** | **130** | **200** |
| 7200 | 900 | 180 | 370 | 550 | 170 | 340 | 510 | 130 | 260 | 390 | 70 | 140 | 210 |
| 7400 | 1000 | 200 | 400 | 590 | 180 | 370 | 550 | 140 | 280 | 420 | 80 | 150 | 230 |
| 7600 | 1200 | 230 | 460 | 680 | 210 | 420 | 630 | 160 | 320 | 480 | 90 | 170 | 250 |
| m | m | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 |
| Entfernung | Durchschnittl. Geschoß-Flughöhe | ↓ 0 | | | ↗ 1 | | | ↗ 2 | | | ↗ 3 | | |
| | | Windrichtung und -geschwindigkeit in m/sec | | | | | | | | | | | |

**Wind von vorn: Entfernung zulegen!**

AUSTRALIAN WAR MEMORIAL AWM2023.9.29

Noch: Tafel IVa.

## Besondere Einflüsse.

Entfernung abbrechen!

| Entfernung m | —1 | —2 | —3 | —4 | —5 | —6 | —7 | —8 | —9 | —10 | —11 | —12 | —13 | —14 | —15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Normale (ganze) Ladung.** | | | | | | | | | | | | | | | |
| 6200 | 10 | 30 | 40 | 50 | 70 | 80 | 100 | 110 | 120 | 140 | 150 | 160 | 180 | 190 | 210 |
| 6400 | 10 | 30 | 40 | 50 | 70 | 80 | 100 | 110 | 120 | 140 | 150 | 160 | 180 | 190 | 210 |
| 6600 | 10 | 30 | 40 | 50 | 70 | 80 | 100 | 110 | 120 | 140 | 150 | 160 | 180 | 190 | 210 |
| 6800 | 10 | 30 | 40 | 50 | 70 | 80 | 100 | 110 | 120 | 140 | 150 | 160 | 180 | 190 | 210 |
| **7000** | **10** | **30** | **40** | **50** | **70** | **80** | **100** | **110** | **120** | **140** | **150** | **160** | **180** | **190** | **210** |
| 7200 | 10 | 30 | 40 | 50 | 70 | 80 | 100 | 110 | 120 | 140 | 150 | 160 | 180 | 190 | 210 |
| 7400 | 10 | 30 | 40 | 50 | 70 | 80 | 100 | 110 | 120 | 140 | 150 | 160 | 180 | 190 | 210 |
| 7600 | 10 | 30 | 40 | 50 | 70 | 80 | 100 | 110 | 120 | 140 | 150 | 160 | 180 | 190 | 210 |
| m Entfernung | +1 | +2 | +3 | +4 | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |

Entfernung zulegen!



Noch: Tafel Va.

## Seitlicher Windeinfluß.

Wind **von** rechts: Seite weniger!

Schußrichtung ↑

| Entfernung m | Durchschnittl. Geschoß-Flughöhe m | Windrichtung und -geschwindigkeit in m/sec: 1 | | | 2 | | | 3 | | | 4 ← | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 |
| **Normale (ganze) Ladung.** | | | | | | | | | | | | | |
| 6200 | 500 | 4 | 8 | 12 | 7 | 14 | 22 | 9 | 19 | 28 | 10 | 20 | 31 |
| 6400 | 500 | 4 | 8 | 12 | 8 | 15 | 23 | 10 | 20 | 30 | 11 | 22 | 32 |
| 6600 | 600 | 4 | 9 | 13 | 8 | 16 | 24 | 11 | 21 | 32 | 11 | 23 | 34 |
| 6800 | 700 | 5 | 9 | 14 | 8 | 17 | 25 | 11 | 22 | 33 | 12 | 24 | 36 |
| **7000** | **800** | **5** | **10** | **14** | **9** | **18** | **27** | **12** | **23** | **35** | **13** | **25** | **38** |
| 7200 | 900 | 5 | 10 | 15 | 9 | 19 | 28 | 12 | 24 | 37 | 13 | 26 | 40 |
| 7400 | 1000 | 6 | 11 | 17 | 10 | 20 | 31 | 13 | 27 | 40 | 14 | 29 | 43 |
| 7600 | 1200 | 6 | 11 | 17 | 11 | 21 | 32 | 14 | 28 | 42 | 15 | 30 | 45 |

| m Entfernung | m Durchschnittl. Geschoß-Flughöhe | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Windrichtung und -geschwindigkeit in m/sec: 1 | | | 2 | | | 3 | | | 4 → | | |

Wind **von** links: Seite mehr!

AUSTRALIAN WAR MEMORIAL AWM2023.9.29

Tafel IIb.

# Luftgewicht.

**Entfernung abbrechen!**

| Entfernung m | Luftgewicht kg/cbm | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1,02 | 1,04 | 1,06 | 1,08 | 1,10 | 1,12 | 1,14 | 1,16 | 1,18 | 1,20 | 1,22 |
| **Kleine Ladung.** | | | | | | | | | | | |
| **1000** | **20** | **20** | **10** | **10** | **10** | **10** | **10** | **10** | **0** | **0** | **0** |
| 1200 | 20 | 20 | 20 | 20 | 10 | 10 | 10 | 10 | 0 | 0 | 0 |
| 1400 | 30 | 30 | 20 | 20 | 20 | 20 | 10 | 10 | 10 | 0 | 0 |
| 1600 | 40 | 30 | 30 | 30 | 20 | 20 | 10 | 10 | 10 | 0 | 0 |
| 1800 | 40 | 40 | 40 | 30 | 30 | 20 | 20 | 10 | 10 | 0 | 0 |
| **2000** | **50** | **50** | **40** | **40** | **30** | **30** | **20** | **20** | **10** | **10** | **0** |
| 2200 | 60 | 60 | 50 | 40 | 40 | 30 | 20 | 20 | 10 | 10 | 0 |
| 2400 | 70 | 60 | 60 | 50 | 40 | 40 | 30 | 20 | 10 | 10 | 0 |
| 2600 | 80 | 80 | 70 | 60 | 50 | 40 | 30 | 30 | 20 | 10 | 0 |
| 2800 | 90 | 80 | 80 | 70 | 60 | 50 | 40 | 30 | 20 | 10 | 0 |
| **3000** | **110** | **100** | **80** | **80** | **60** | **50** | **40** | **30** | **20** | **10** | **0** |
| 3200 | 120 | 110 | 100 | 80 | 70 | 60 | 50 | 40 | 20 | 10 | 0 |
| 3400 | 130 | 120 | 110 | 90 | 80 | 70 | 50 | 40 | 30 | 10 | 0 |
| m | 1,42 | 1,40 | 1,38 | 1,36 | 1,34 | 1,32 | 1,30 | 1,28 | 1,26 | 1,24 | 1,22 |
| Entfernung | Luftgewicht kg/cbm | | | | | | | | | | |

**Entfernung zulegen!**



# Wind.

Tafel IIIb.

**Wind von rückwärts: Entfernung abbrechen!**

Schußrichtung →

| Entfernung m | Durchschnittl. Geschoß-Flughöhe m | Windrichtung und -geschwindigkeit in m/sec | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ↑ 0 | | | ↗ 1 | | | ↗ 2 | | | ↗ 3 | | |
| | | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 |
| **Kleine Ladung.** | | | | | | | | | | | | | |
| **1000** | **7** | **10** | **20** | **20** | **10** | **10** | **20** | **10** | **10** | **20** | **0** | **10** | **10** |
| 1200 | 10 | 10 | 20 | 30 | 10 | 20 | 30 | 10 | 10 | 20 | 0 | 10 | 10 |
| 1400 | 20 | 10 | 30 | 40 | 10 | 30 | 40 | 10 | 20 | 30 | 10 | 10 | 20 |
| 1600 | 20 | 20 | 30 | 50 | 20 | 30 | 50 | 10 | 20 | 40 | 10 | 10 | 20 |
| 1800 | 30 | 20 | 40 | 60 | 20 | 40 | 60 | 20 | 30 | 50 | 10 | 20 | 20 |
| **2000** | **40** | **30** | **50** | **80** | **20** | **50** | **70** | **20** | **40** | **60** | **10** | **20** | **30** |
| 2200 | 50 | 30 | 60 | 90 | 30 | 60 | 90 | 20 | 40 | 70 | 10 | 20 | 40 |
| 2400 | 60 | 40 | 70 | 110 | 30 | 70 | 100 | 30 | 50 | 80 | 10 | 30 | 40 |
| 2600 | 70 | 40 | 90 | 130 | 40 | 80 | 120 | 30 | 60 | 90 | 20 | 30 | 50 |
| 2800 | 90 | 50 | 100 | 150 | 40 | 90 | 130 | 30 | 70 | 100 | 20 | 40 | 60 |
| **3000** | **100** | **50** | **110** | **160** | **50** | **100** | **150** | **40** | **80** | **120** | **20** | **40** | **60** |
| 3200 | 120 | 60 | 120 | 180 | 60 | 110 | 170 | 40 | 90 | 130 | 20 | 50 | 70 |
| 3400 | 140 | 70 | 130 | 200 | 60 | 120 | 180 | 50 | 90 | 140 | 30 | 50 | 80 |
| m | m | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 |
| Entfernung | Durchschnittl. Geschoß-Flughöhe | ↓ 0 | | | ↘ 1 | | | ↘ 2 | | | ↘ 3 | | |
| | | Windrichtung und -geschwindigkeit in m/sec | | | | | | | | | | | |

**Wind von vorn: Entfernung zulegen!**

AUSTRALIAN WAR MEMORIAL AWM2023.9.29

Tafel IVb.

## Besondere Einflüsse.

**Entfernung abbrechen!**

| Entfernung m | —1 | —2 | —3 | —4 | —5 | —6 | —7 | —8 | —9 | —10 | —11 | —12 | —13 | —14 | —15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Kleine Ladung.** | | | | | | | | | | | | | | | |
| **1000** | **10** | **10** | **20** | **20** | **30** | **30** | **40** | **40** | **50** | **50** | **60** | **60** | **70** | **70** | **80** |
| 1200 | 10 | 10 | 20 | 20 | 30 | 40 | 40 | 50 | 50 | 60 | 70 | 70 | 80 | 80 | 90 |
| 1400 | 10 | 10 | 20 | 30 | 30 | 40 | 50 | 50 | 60 | 70 | 70 | 80 | 90 | 90 | 100 |
| 1600 | 10 | 10 | 20 | 30 | 40 | 40 | 50 | 60 | 60 | 70 | 80 | 80 | 90 | 100 | 110 |
| 1800 | 10 | 20 | 20 | 30 | 40 | 50 | 50 | 60 | 70 | 80 | 80 | 90 | 100 | 110 | 120 |
| **2000** | **10** | **20** | **30** | **30** | **40** | **50** | **60** | **70** | **80** | **80** | **90** | **100** | **110** | **120** | **120** |
| 2200 | 10 | 20 | 30 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 100 | 110 | 120 | 130 |
| 2400 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 |
| 2600 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 |
| 2800 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 |
| **3000** | **10** | **20** | **30** | **40** | **50** | **60** | **70** | **80** | **90** | **100** | **110** | **120** | **130** | **140** | **160** |
| 3200 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 90 | 100 | 110 | 120 | 130 | 140 | 150 | 160 |
| 3400 | 10 | 20 | 30 | 40 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 | 170 |
| m Entfernung | +1 | +2 | +3 | +4 | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |

**Entfernung zulegen!**



Feldartillerie-Regiment 7
4. Batterie.

Tafel Vb.

## Seitlicher Windeinfluß.

**Wind von rechts: Seite weniger!**

Schußrichtung ↑

| Entfernung m | Durchschnittl. Geschoß-Flughöhe m | Windrichtung und -geschwindigkeit in m/sec: ↘1 | | | ↗2 | | | ↘3 | | | ←4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 |
| **Kleine Ladung.** | | | | | | | | | | | | | |
| **1000** | **7** | **1** | **1** | **2** | **1** | **3** | **4** | **2** | **3** | **5** | **2** | **4** | **5** |
| 1200 | 10 | 1 | 2 | 3 | 2 | 3 | 5 | 2 | 4 | 7 | 2 | 5 | 7 |
| 1400 | 20 | 1 | 2 | 3 | 2 | 3 | 5 | 2 | 4 | 7 | 2 | 5 | 7 |
| 1600 | 20 | 1 | 2 | 3 | 2 | 4 | 6 | 3 | 6 | 8 | 3 | 6 | 9 |
| 1800 | 30 | 1 | 3 | 4 | 3 | 5 | 8 | 3 | 7 | 10 | 4 | 7 | 11 |
| **2000** | **40** | **2** | **3** | **5** | **3** | **6** | **9** | **4** | **8** | **12** | **4** | **8** | **13** |
| 2200 | 50 | 2 | 3 | 5 | 3 | 6 | 9 | 4 | 8 | 12 | 4 | 8 | 13 |
| 2400 | 60 | 2 | 4 | 6 | 3 | 7 | 10 | 4 | 9 | 13 | 5 | 10 | 14 |
| 2600 | 70 | 2 | 4 | 6 | 4 | 8 | 11 | 5 | 10 | 15 | 5 | 11 | 16 |
| 2800 | 90 | 2 | 4 | 6 | 4 | 8 | 11 | 5 | 10 | 15 | 5 | 11 | 16 |
| **3000** | **100** | **2** | **5** | **7** | **4** | **8** | **13** | **6** | **11** | **17** | **6** | **12** | **18** |
| 3200 | 120 | 2 | 5 | 7 | 4 | 8 | 13 | 6 | 11 | 17 | 6 | 12 | 18 |
| 3400 | 140 | 3 | 5 | 8 | 5 | 9 | 14 | 6 | 12 | 18 | 7 | 13 | 20 |
| m Entfernung | m Durchschnittl. Geschoß-Flughöhe | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 |
| | | ↖1 | | | ↙2 | | | ↖3 | | | 4→ | | |

Windrichtung und -geschwindigkeit in m/sec

**Wind von links: Seite mehr!**

AUSTRALIAN WAR MEMORIAL
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Noch: Tafel IIb.

## Luftgewicht.

**Entfernung abbrechen!**

| Entfernung m | Luftgewicht kg/cbm 1,02 | 1,04 | 1,06 | 1,08 | 1,10 | 1,12 | 1,14 | 1,16 | 1,18 | 1,20 | 1,22 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Kleine Ladung.** | | | | | | | | | | | |
| 3600 | 150 | 130 | 120 | 100 | 90 | 70 | 60 | 40 | 30 | 10 | 0 |
| 3800 | 160 | 140 | 130 | 110 | 100 | 80 | 60 | 50 | 30 | 20 | 0 |
| **4000** | **180** | **160** | **140** | **120** | **110** | **90** | **70** | **50** | **40** | **20** | **0** |
| 4200 | 190 | 170 | 150 | 130 | 110 | 100 | 80 | 60 | 40 | 20 | 0 |
| 4400 | 210 | 190 | 170 | 150 | 120 | 100 | 80 | 60 | 40 | 20 | 0 |
| 4600 | 220 | 200 | 180 | 160 | 130 | 110 | 90 | 70 | 40 | 20 | 0 |
| 4800 | 240 | 220 | 190 | 170 | 140 | 120 | 100 | 70 | 50 | 20 | 0 |
| **5000** | **260** | **230** | **210** | **180** | **150** | **130** | **100** | **80** | **50** | **30** | **0** |
| 5200 | 280 | 250 | 220 | 190 | 170 | 140 | 110 | 80 | 60 | 30 | 0 |
| 5400 | 300 | 270 | 240 | 210 | 180 | 150 | 120 | 90 | 60 | 30 | 0 |
| 5600 | 320 | 280 | 250 | 220 | 190 | 160 | 130 | 90 | 60 | 30 | 0 |
| 5800 | 340 | 300 | 270 | 240 | 200 | 170 | 130 | 100 | 70 | 30 | 0 |
| **6000** | **360** | **320** | **290** | **250** | **210** | **180** | **140** | **110** | **70** | **40** | **0** |
| m | 1,42 | 1,40 | 1,38 | 1,36 | 1,34 | 1,32 | 1,30 | 1,28 | 1,26 | 1,24 | 1,22 |
| Entfernung | Luftgewicht kg/cbm | | | | | | | | | | |

**Entfernung zulegen!**



## Wind.

Noch: Tafel IIIb.

**Wind von rückwärts: Entfernung abbrechen!**

Schußrichtung ↑

| Entfernung m | Durchschnittl. Geschoß-Flughöhe m | Windrichtung und -geschwindigkeit in m/sec: ↑ 0 — 6 | 12 | 18 | ↙ 1 — 6 | 12 | 18 | ↙ 2 — 6 | 12 | 18 | ⟨ 3 — 6 | 12 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Kleine Ladung.** | | | | | | | | | | | | | |
| 3600 | 160 | 70 | 150 | 220 | 70 | 140 | 200 | 50 | 100 | 160 | 30 | 60 | 80 |
| 3800 | 190 | 80 | 160 | 240 | 70 | 150 | 220 | 60 | 110 | 170 | 30 | 60 | 90 |
| **4000** | **220** | **90** | **170** | **260** | **80** | **160** | **240** | **60** | **120** | **180** | **30** | **70** | **100** |
| 4200 | 240 | 90 | 190 | 280 | 90 | 170 | 260 | 70 | 130 | 200 | 40 | 70 | 110 |
| 4400 | 250 | 100 | 200 | 300 | 90 | 180 | 280 | 70 | 140 | 210 | 40 | 80 | 110 |
| 4600 | 300 | 110 | 210 | 320 | 100 | 200 | 290 | 80 | 150 | 230 | 40 | 80 | 120 |
| 4800 | 400 | 110 | 230 | 340 | 100 | 210 | 310 | 80 | 160 | 240 | 40 | 90 | 130 |
| **5000** | **400** | **120** | **240** | **360** | **110** | **220** | **330** | **80** | **170** | **250** | **50** | **90** | **140** |
| 5200 | 450 | 130 | 250 | 380 | 120 | 230 | 350 | 90 | 180 | 270 | 50 | 100 | 150 |
| 5400 | 500 | 130 | 270 | 400 | 120 | 250 | 370 | 100 | 190 | 290 | 50 | 100 | 150 |
| 5600 | 600 | 140 | 280 | 430 | 130 | 260 | 390 | 100 | 200 | 300 | 50 | 110 | 160 |
| 5800 | 600 | 150 | 300 | 450 | 140 | 280 | 420 | 110 | 210 | 320 | 60 | 110 | 170 |
| **6000** | **700** | **160** | **320** | **480** | **150** | **290** | **440** | **110** | **220** | **340** | **60** | **120** | **180** |
| m | m | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 |
| Entfernung | Durchschnittl. Geschoß-Flughöhe | ↓ 0 | | | ↗ 1 | | | ↗ 2 | | | ⟩ 3 | | |
| | | Windrichtung und -geschwindigkeit in m/sec | | | | | | | | | | | |

**Wind von vorn: Entfernung zulegen!**

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Noch: Tafel IVb.

## Besondere Einflüsse.

**Entfernung abbrechen!**

| Entfernung m | —1 | —2 | —3 | —4 | —5 | —6 | —7 | —8 | —9 | —10 | —11 | —12 | —13 | —14 | —15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Kleine Ladung.** | | | | | | | | | | | | | | | |
| 3600 | 10 | 20 | 30 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 | 170 |
| 3800 | 10 | 20 | 30 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 140 | 150 | 160 | 170 |
| **4000** | **10** | **20** | **40** | **50** | **60** | **70** | **80** | **90** | **110** | **120** | **130** | **140** | **150** | **160** | **180** |
| 4200 | 10 | 20 | 40 | 50 | 60 | 70 | 80 | 90 | 110 | 120 | 130 | 140 | 150 | 160 | 180 |
| 4400 | 10 | 20 | 40 | 50 | 60 | 70 | 80 | 100 | 110 | 120 | 130 | 140 | 160 | 170 | 180 |
| 4600 | 10 | 20 | 40 | 50 | 60 | 70 | 90 | 100 | 110 | 120 | 140 | 150 | 160 | 170 | 190 |
| 4800 | 10 | 20 | 40 | 50 | 60 | 70 | 90 | 100 | 110 | 120 | 140 | 150 | 160 | 170 | 190 |
| **5000** | **10** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **110** | **130** | **140** | **150** | **160** | **180** | **190** |
| 5200 | 10 | 30 | 40 | 50 | 60 | 80 | 90 | 100 | 110 | 130 | 140 | 150 | 160 | 180 | 190 |
| 5400 | 10 | 30 | 40 | 50 | 70 | 80 | 90 | 100 | 120 | 130 | 140 | 160 | 170 | 180 | 200 |
| 5600 | 10 | 30 | 40 | 50 | 70 | 80 | 90 | 100 | 120 | 130 | 140 | 160 | 170 | 180 | 200 |
| 5800 | 10 | 30 | 40 | 50 | 70 | 80 | 90 | 110 | 120 | 130 | 150 | 160 | 170 | 190 | 200 |
| **6000** | **10** | **30** | **40** | **50** | **70** | **80** | **90** | **110** | **120** | **130** | **150** | **160** | **170** | **190** | **200** |
| m Entfernung | +1 | +2 | +3 | +4 | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |

**Entfernung zulegen!**



## Seitlicher Windeinfluß.

Noch: Tafel Vb.

**Wind von rechts: Seite weniger!**

Schußrichtung →

| Entfernung m | Durchschnittl. Geschoß-Flughöhe m | Windrichtung und -geschwindigkeit in m/sec: ↑1 | | | ↘2 | | | ↘3 | | | ←4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 |
| **Kleine Ladung.** | | | | | | | | | | | | | |
| 3600 | 160 | 3 | 5 | 8 | 5 | 9 | 14 | 6 | 12 | 18 | 7 | 13 | 20 |
| 3800 | 190 | 3 | 6 | 8 | 5 | 10 | 15 | 7 | 13 | 20 | 7 | 14 | 22 |
| **4000** | **220** | **3** | **6** | **8** | **5** | **10** | **15** | **7** | **13** | **20** | **7** | **14** | **22** |
| 4200 | 240 | 3 | 6 | 9 | 6 | 11 | 17 | 7 | 14 | 22 | 8 | 16 | 23 |
| 4400 | 250 | 3 | 6 | 9 | 6 | 11 | 17 | 7 | 14 | 22 | 8 | 16 | 23 |
| 4600 | 300 | 3 | 6 | 10 | 6 | 12 | 18 | 8 | 16 | 23 | 8 | 17 | 25 |
| 4800 | 400 | 3 | 6 | 10 | 6 | 12 | 18 | 8 | 16 | 23 | 8 | 17 | 25 |
| **5000** | **400** | **3** | **7** | **10** | **6** | **13** | **19** | **8** | **17** | **25** | **9** | **18** | **27** |
| 5200 | 450 | 3 | 7 | 10 | 6 | 13 | 19 | 8 | 17 | 25 | 9 | 18 | 27 |
| 5400 | 500 | 4 | 7 | 11 | 7 | 14 | 20 | 9 | 18 | 27 | 10 | 19 | 29 |
| 5600 | 600 | 4 | 7 | 11 | 7 | 14 | 20 | 9 | 18 | 27 | 10 | 19 | 29 |
| 5800 | 600 | 4 | 8 | 12 | 7 | 14 | 22 | 9 | 19 | 28 | 10 | 20 | 31 |
| **6000** | **700** | **4** | **8** | **12** | **8** | **15** | **23** | **10** | **20** | **30** | **11** | **22** | **32** |
| m Entfernung | m Durchschnittl. Geschoß-Flughöhe | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 | 6 | 12 | 18 |
| | | ↑1 | | | ↘2 | | | ↘3 | | | 4→ | | |
| | | Windrichtung und -geschwindigkeit in m/sec | | | | | | | | | | | |

**Wind von links: Seite mehr!**

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# Beispiel

(für normale Ladung).

## 1. Erschießen der besonderen Einflüsse.

Hilfsziel 5000 m Kartenentfernung.

Zunächst sind festzustellen:

**a) das Tagesluftgewicht.** Während bei Geschoßflughöhen über 500 nachstehende Tafel zur Ermittlung der Durchschnittstemperatur benutzt wird, handelt es sich in dem Zahlenbeispiel nur um eine Höhe von 240 m, also: augenblickliche Lufttemperatur im Schatten 14° C.

| Tag | Stunde | Lufttemperatur im Schatten | |
|---|---|---|---|
| Vortag ..... | 2 Uhr nachmittags | + ° C | |
| Vortag ..... | 10 Uhr abends | — ° C | |
| Gefechtstag ..... | 6 Uhr vormittags | — ° C | |

Summe . : 3 = . ° C (Mittelwert).

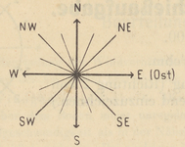
Barometerstand für die Meereshöhe der Batterie kurz vor dem Schießen = 770 mm.
Nach Tafel I: Tagesluftgewicht = 1,24 kg/cbm.

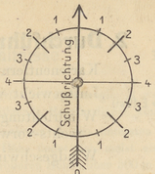
**b) der Wind.**

Für die durchschnittliche Geschoßflughöhe 240 m (ist von der Feldwetterstation oder Fliegerstation erfragt): 12 m/sec Ost (d. h. von Osten kommend).

Schußrichtung ist von Südwest nach Nordost. Also Wind von rechts — vorwärts unter Richtung 2 zur Schußrichtung.






Erforderliche Verbesserung für alle Geschütze.

| | Entfernung zulegen | Entfernung abbrechen | Seite + | Seite — |
|---|---|---|---|---|
| Tafel IIa für Luftgewicht ..... | 30 | . | — | — |
| Tafel IIIa für Wind ..... | 130 | . | — | — |
| Tafel Va für Wind ..... | — | — | . | 11 |
| Summe.... | 160 | . | . | 11 |

An der Geländewinkellibelle ist der nach der Karte usw. ermittelte Geländewinkel zum Ziel auszuschalten.
Die rechnungsmäßig ermittelte Tagesentfernung wäre demnach 5 160. Feuerbeginn auf 5 150 m.
Nach Ausschaltung der erforderlichen Änderung für Tagesluftgewicht und Wind ist erschossen:

| Geschütz | Erschossene Entfernung nach dem Hilfsziel | Entfernung gegenüber 5 160 zulegen m | Entfernung gegenüber 5 160 abbrechen m | Mithin aus Tafel IVa Spalte |
|---|---|---|---|---|
| I..... | 5150 | — | 10 | — 1 |
| II..... | 5100 | — | 60 | — 5 |
| III ..... | 5050 | — | 110 | — 8 |
| IV ..... | 5100 | — | 60 | — 5 |

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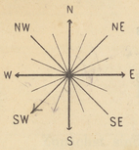


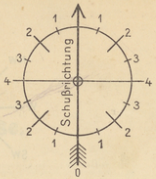

## 2. Durchführung einer Schießaufgabe.

Kartenentfernung des Ziels 7 200.

Luftgewicht wiederum 1,24 kg/cbm.

Windrichtung zur Schußrichtung (Richtung 2 von rechts-vorwärts). (Nebenstehend einzuzeichnen.)

Windgeschwindigkeit 12 m/sec.




### a. Erforderliche gemeinsame Verbesserung für alle Geschütze.

| | Entfernung | | Seite | |
|---|---|---|---|---|
| | zulegen | abbrechen | + | — |
| Tafel II für Luftgewicht..... | 50 | . | . | . |
| Tafel III für Wind..... | 260 | . | . | . |
| Tafel V für Wind..... | — | — | . | 19 |
| Summe.... | 310 | . | . | 19 |

### b. Erforderliche Verbesserung nach Tafel IVa für die einzelnen Geschütze.

| Geschütz | Stufe | Entfernung | | Summe der Änderungen Entfernung | |
|---|---|---|---|---|---|
| | | zulegen | abbrechen | zulegen | abbrechen |
| I..... | — 1 | . | 10 | 300 | . |
| II..... | — 5 | . | 70 | 240 | . |
| III..... | — 8 | . | 110 | 200 | . |
| IV..... | — 5 | . | 70 | 240 | . |

Um eine einheitliche Tagesentfernung für alle Geschütze kommandieren zu können, empfiehlt es sich nunmehr, für die ganze Batterie als Grundentfernung 7200 + 250 = 7450 zu wählen und beim I. die Flugbahn durch eine entsprechende Reglerkorrektur von 3 hoch um 50 m weiter, beim III. durch eine Reglerkorrektur von 3 tief um 50 m kürzer zu legen.

Außerdem ist für die ganze Batterie der Geländewinkel nach dem Ziel auszuschalten.



**Anlage 1.**

## Beurteilung der Windverhältnisse.

(Siehe Tafel VII.)

Die Beurteilung der Windverhältnisse in größeren Höhen erfordert eine möglichst weitgehende Berücksichtigung der am Boden herrschenden Bedingungen, wozu folgende Regeln dienen können:

1. Windgeschwindigkeit. Die Windgeschwindigkeit nimmt in den untersten Schichten bis etwa 5 m über dem Boden meist unregelmäßig zu. In 500 m Höhe findet sich meist eine doppelt so große Windgeschwindigkeit als in der Nähe des Erdbodens. In größeren Höhen über 500 m ist die weitere Zunahme erheblich geringer. Bei niedrigen Barometerständen und westlichen Winden ist die Zunahme meist beträchtlicher als bei höheren Barometerständen und nordöstlichen bis südöstlichen Winden.

Streicht Wind über Häusern oder Wäldern entlang, so wird seine Geschwindigkeit dadurch stärker verringert, als wenn er über Wasserflächen oder ebenem Boden herkommt. Je nach der am Boden zu erwartenden Reibung ist die beobachtete Windgeschwindigkeit am Boden zu verdoppeln bis verfünffachen, wenn man sie für größere Höhen abschätzen will.

2. Windrichtung. Bei durchschnittlichen Wetterverhältnissen dreht die Windrichtung mit zunehmender Höhe nach rechts, und zwar am stärksten bei Südwind, weniger bei Ost- und Westwinden und sehr wenig bei Nordwind. In größeren Höhen findet meist ein allmählicher Übergang zu westlichen Winden statt. Im ebenen Gelände drehen untere (meist schwache) Winde im Laufe des Tages mit der Sonne.

An der See bei Tage Seewind, bei Nacht Landwind (reicht nur etwa 500 m hoch). Im Gebirge Luftbewegung bei Tage talauf, bei Nacht talab. Scheinbare Steigerung der Windstärke in engen Pässen oder Abflauen unter Windschutz.

Besteht keine Möglichkeit, Windrichtung und -stärke in der durchschnittlichen Geschoßflughöhe zu messen, so ist wenigstens zu versuchen, Angaben über den Wind in 500 bis 600 m Höhe zu bekommen. Diese Messungen können dann ohne weiteres zur Verbesserung genommen werden. Für die große Masse der Artillerie ausschließlich höchstens des weittragendsten Flachfeuers liefern sie ausreichend genaue Ergebnisse.

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Tafel VI.

## Kennzeichen der Windgeschwindigkeit.

| Windstärke | Bezeichnung | Geschwindigkeit m/sec | Kennzeichen |
|---|---|---|---|
| 0 | Windstille | 0 | Vollkommene Windstille. |
| 1 | Leiser Zug (sehr leicht) | 1 | Der Rauch steigt fast gerade empor. |
| 2 | Leicht | 3 | Für das Gefühl eben bemerkbar. |
| 3 | Schwach | 5 | Bewegt einen leichten Wimpel, auch die Blätter der Bäume. |
| 4 | Mäßig | 7 | Streckt einen Wimpel, bewegt kleinere Zweige der Bäume. |
| 5 | Frisch | 9 | Bewegt größere Zweige der Bäume, wird für das Gefühl schon unangenehm. |
| 6 | Stark | 11 | Wird an Häusern und andern festen Gegenständen hörbar, bewegt große Zweige der Bäume. |
| 7 | Steif | 13 | Bewegt schwächere Baumstämme, wirft auf stehendem Wasser Wellen auf, welche oben überstürzen. |
| 8 | Stürmisch | 15 | Ganze Bäume werden bewegt; ein gegen den Wind schreitender Mensch wird merkbar aufgehalten. |
| 9 | Sturm (voller Sturm) | 18 | Leichtere Gegenstände, wie Dachziegel usw., werden aus ihrer Lage gebracht. |
| 10 | Starker Sturm | 21 | Bäume werden umgeworfen. |
| 11 | Schwerer Sturm | etwa 30 | Zerstörende Wirkungen schwerer Art. |
| 12 | Orkan | etwa 50 | Verwüstende Wirkungen. |



Feldartillerie-Regimen
4. Batterie.

## Schätzung der besonderen Einflüsse.

Ein wesentlicher Bestandteil der besonderen Einflüsse, nämlich die Einwirkung der veränderlichen Tagesanfangsgeschwindigkeit, kann im Notfalle auch rechnerisch ermittelt werden, wenn man die Verbrennungsraumlänge und die Pulvertemperatur kennt. Hierzu dient nachstehende Tafel VII.

Die Schußtafel ist auf eine Pulvertemperatur von + 10° C bezogen. Normale Verbrennungsraumlänge 199,5 mm.

Tafel VII.

| Pulvertemperatur | Verbrennungsraumlänge | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 200 normal | 203 | 205 | 208 | 211 | 213 | 216 | 219 |
| — 15° C | + 5 | + 7 | + 9 | + 11 | + 13 | + 15 | | |
| — 10 » | + 4 | + 6 | + 8 | + 10 | + 12 | + 14 | | |
| — 5 » | + 3 | + 5 | + 7 | + 9 | + 11 | + 13 | + 15 | |
| 0 » | + 2 | + 4 | + 6 | + 8 | + 10 | + 12 | + 14 | |
| + 5 » | + 1 | + 3 | + 5 | + 7 | + 9 | + 11 | + 13 | + 15 |
| + 10 » | 0 | + 2 | + 4 | + 6 | + 8 | + 10 | + 12 | + 14 |
| + 15 » | — 1 | + 1 | + 3 | + 5 | + 7 | + 9 | + 11 | + 13 |
| + 20 » | — 2 | 0 | + 2 | + 4 | + 6 | + 8 | + 10 | + 12 |
| + 25 » | — 3 | — 1 | + 1 | + 3 | + 5 | + 7 | + 9 | + 11 |
| + 30 » | — 4 | — 2 | 0 | + 2 | + 4 | + 6 | + 8 | + 10 |

Die Pulvertemperatur in den Feldpatronen folgt bei freier Lagerung (Trennung der einzelnen Schichten der Patronenstapel durch Knüppel, Bretter u. dgl., so daß die Luft frei zirkulieren kann) der Temperatur der umgebenden Luft (also der Außenluft oder der des Kartuschraums) mit einer Verspätung von etwa 2 Stunden. Daher kann an Tagen mit geringen Schwankungen der Außentemperatur, also meist bei trübem Wetter und bedecktem Himmel, die Pulvertemperatur etwa der jeweiligen Temperatur der Luft gleichgesetzt werden.

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Bei heiterem Wetter und in klaren Nächten mit großen Temperaturschwankungen dagegen ist die Pulvertemperatur in der Zeit von Mittag bis Abend etwa gleich der Lufttemperatur anzunehmen; in den Nachtstunden vor Mitternacht liegt sie im allgemeinen einige Grad höher, von Mitternacht bis Sonnenaufgang ist sie etwa gleich der Lufttemperatur. Von Sonnenaufgang bis Mittag ist die Pulvertemperatur besonders an heißen Tagen recht verschieden von der Lufttemperatur: sie liegt dabei in den späten Morgenstunden bis zu 7 Grad niedriger als die Lufttemperatur.

Diese Faustregeln (die aus länger dauernder thermoelektrischer Aufzeichnung der Pulvertemperatur in der Feldpatrone und der Außentemperatur gewonnen sind) gestatten es, auch bei der Feldpatrone, wo die unmittelbare Messung der Pulvertemperatur durch Einführung eines Thermometers in das Pulver schwierig ist, einen einigermaßen verlässigen Anhalt für die Pulvertemperatur zu gewinnen.

Erstes Beispiel: Am Nachmittag eines trüben Tages wurde bei einer Lufttemperatur von + 16° C eine Spalte der Tafeln IV ± 0 ermittelt. In der Nacht ist die Lufttemperatur langsam bis auf + 8° C gesunken. Man kann also auch ein Sinken der Pulvertemperatur von + 16 auf + 8° C annehmen. Diesem Sinken entspricht, wie aus Tafel VII zu entnehmen, ein Steigen der Spalte IV von rund 2. Man hat also zu dieser Nachtzeit Spalte + 2 zu nehmen.

Zweites Beispiel: Die Geschwindigkeitsstufe wurde in den Nachmittagsstunden bei klarem Wetter bei + 20° zu — 1 ermittelt. Um 10° nachts herrscht eine Lufttemperatur von + 6°. Nach Obigem entsprach die Pulvertemperatur am Nachmittag etwa der Lufttemperatur, war also + 20°; um 10° nachts dagegen lag sie um einige Grad höher als die Lufttemperatur, betrug also etwa + 10°. Dem Sinken der Pulvertemperatur von + 20 auf + 10° entspricht nach Tafel VII ein Steigen der Spalte um 2 Teile, mithin ist die Stufe um 10° nachts etwa + 1.

## II. Die erforderlichen Verbesserungen beim Nachtschießen.

In der Nacht tritt, namentlich bei klarem Wetter, eine starke Abkühlung der unteren Luftschichten und damit eine Zunahme des Luftgewichts ein. Gleichzeitig sinkt nach den vorausgehenden Gesetzen die Pulvertemperatur. Beide Einflüsse bedingen ein Kürzerschießen und daher ein Mehrbedarf an Erhöhung. Dem Einfluß der sinkenden Pulvertemperatur kann nach dem vorausgehenden Abschnitt einigermaßen Rechnung getragen werden. Zur Ermittelung des Luftgewichts ist die Durchschnittstemperatur der letzten Stunden zu nehmen.

Auch Änderungen in der Stärke und Richtung des Windes mit Einbruch und im Laufe der Nacht können beträchtliche Größen erreichen, namentlich in der Nähe des Meeres, hoher Berge, in tief eingeschnittenen Tälern usw. Es ist daher unerläßlich, wenn man bei nächtlichen Schießen mit einigem Erfolg Verbesserungen anwenden will, wenigstens den Bodenwind kurz vor der Feuereröffnung festzustellen.

Mit Rücksicht auf alle diese Umstände ist bei nächtlichen Schießen gegen Ziele in der Nähe der eigenen Gräben auch bei Anwendung der Berichtigungstafeln besondere Vorsicht am Platze.



## III. Die Verbesserungen beim Brennzünderschießen.

Einen ungefähren Anhalt für die zutreffende Brennlänge erhält man, wenn man mit der Zünderstellung in die Mitte zwischen Kartenentfernung und berichtigter Entfernung geht, z. B. Kartenentfernung 6000 m; berichtigte Schießentfernung 6200, demnach ers. Zünderstellung 6100 m. Durch Veränderungen in der Lagerung der Zünder, namentlich bei großer Hitze oder Kälte und Feuchtigkeit, durch Verschiedenheiten in der Fertigung des Brandsatzes und des ganzen Zünders je nach der Fabrik, durch unkontrollierbare Einflüsse von Luftströmungen, Hitze und Feuchtigkeit sowie des Luftdrucks auf das Zünderbrennen können indessen größere unvorhergesehene Abweichungen von der schußtafelmäßigen Zünderstellung eintreten. Aus all diesen Gründen stößt die vorherige Ermittelung der zutreffenden Zünderstellung oder Reglerkorrektur auf große Schwierigkeiten. Besonders tritt dies beim nächtlichen Brennzünderschießen hervor. Es wird daher meist empfehlenswert sein, bei nächtlichem Sperrfeuer nur im Äz. zu schießen.

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EW 1483

# Artillery Notes.

(Issued by the General Staff at General Headquarters.)

AUSTRALIAN WAR RECORDS SECTION
D21/1/1
CLASSIFICATION SUB-SECTION

## No. 2.—FIELD ARTILLERY AMMUNITION.

*neral Headquarters,*
*January,* 1916.

358.
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no. 2

(B333) 2000 6/16 H&S 3419wo

AUSTRALIAN WAR MEMORIAL
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# ARTILLERY NOTES.

*(Issued by the General Staff at General Headquarters.)*

## No. 2.—FIELD ARTILLERY AMMUNITION.

A. W. M.
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1. The War Office will shortly issue a full description of all natures of ammunition in use in the field. In view, however, of the many changes which have taken place, it is thought that the following notes will prove of use pending the receipt of the official pamphlet:—

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PRINTED RECORDS

### 13-pr. and 18-pr.

2. *Shell.*—Both Shrapnel and H.E. are issued for these two guns, and all marks of both except Mark I. Shrapnel range alike. This latter is now practically obsolete, but all the range dials are graduated for it, so that there is always a false range on the range dial. The amount that the true range varies from that shown on the range dial (all other factors being for the moment neglected) is shown in the form of a table at the foot of the range table.

This point, though not one of great importance, should be understood by regimental officers. It accounts for the fact that in the application of temperature corrections *minus* corrections are necessary at almost all temperatures, as shown in the small "card correction scales" recently issued.

3. High-explosive shell are filled with either T.N.T. or Amatol, those filled with T.N.T. having a green band, while those filled with Amatol have a green and a white band. The early issues of Amatol filled shell, of which many still exist, had, however, the white band omitted, and these can only be distinguished from those filled with T.N.T. by a fraction stencilled on the side of the shell, thus—40/60, 20/80. These fractions denote the proportion of ammonium-nitrate to T.N.T. The 20/80 shell give rather better results than the 40/60 shell.

The detonating effect of T.N.T. and Amatol is about the same, but in the case of Amatol the smoke is grey rather than black, and smaller in quantity. There has been some difficulty in securing complete detonation with Amatol, but this has, it is hoped, been got over.

4. *Fuzes.*—*Shrapnel* shell for 13-pr. or 18-pr. are fuzed with either No. 80 or No. 85 fuze. These are readily distinguished, for No. 85 is made of brass, while No. 80 is aluminium. The graduations on No. 85 are in the opposite direction to those on No. 80, and the setting mark for percussion is not so clear, so that care is required in order to avoid mistakes.

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In order to increase the output of ammunition, a large number of rounds have been issued without fuze covers, but it is intended to re-introduce the latter as soon as this is possible. All fuzes are waterproofed, but this cannot be so effective a protection as the covers, and if good results are to be obtained under present conditions, it is essential that every possible precaution should be taken against damp.

5. *H.E.* shell for 13-pr. and 18-pr. may have any of the following fuzes :—

(*a.*) 80/44 with gaine.
(*b*) 80/44 with 44/80.
(*c.*) 85 with No. 1 gaine.
(*d.*) 85 with No. 2 gaine.
(*e.*) 100 with No. 1 gaine.
(*f.*) 100 with No. 2 gaine.

(*a.*) *The "88/44"* is the ordinary No. 80 time fuze with some slight alterations in the setting and safety arrangements, *e.g.*, it cannot be "set" between 0 and 2, the numbers 0 and 2 are blocked out, and the creep spring is weakened. *There is nothing to do with No. 44 fuze in the "80/44."* All shell fuzed with 80/44 with gaine have been specially examined, and should be marked EXD. Any which are not so marked should not be fired, but should be returned to A.O.D., Railhead.

It is intended that all shell with 80/44 fuzes, whether examined or not, shall eventually be exchanged, and in the meantime they should not be fired except in an emergency.

(*b.*) *The "44/80"* is the ordinary No. 44 fuze with the cap removed. It is a percussion fuze, and fits into the shell below the 80/44 fuzes described above taking the place of the gaine. *It is never used by itself, but always in combination with the 80/44.* This combination may be considered as safe.

(*c*) and (*d*). *The No. 85 fuze*, owing to the construction of the percussion needle pellet, cannot cause a premature unless it has been set at zero. The No. 1 gaine, may, however, on rare occasions do so, and a No. 2 gaine has, therefore, been introduced. *See* para. 11.

(*e*) and (*f*). *No. 100** is a graze fuze, and the above remarks concerning the gaine apply equally to this fuze. Pending the provision of No. 2 gaines, arrangements are being made to fit a special washer under the fuze in all shell which have No. 100 fuze and the No. 1 gaine.

A red mark is painted on the dome of the fuze directly above the position of the closing screw for the detonator pellet, which is in the screw thread of the fuze under the flange. This mark is required in connection with the special orders regarding fuzing shell with No. 100 fuzes which will shortly be issued. Until these instructions have been received no shell are to be unfuzed and refuzed with No. 100 fuze regimentally.

Fuzes which have the cap painted blue are fitted with a delay pellet of ·04 seconds. These are intended to be fired for richochet effect or for the penetration of thick overhead cover.

* *See* Note at end of para. 9.



It is not only time fuzes which are affected by damp. The most probable cause of blinds with the No. 100 fuze is want of power in the cap composition, due to moisture getting into the fuze.

6. *The charge.*—The propellant used in 13-pr. and 18-pr. cartridges is either cordite or nitro-cellulose. Some of the latter have given a considerable amount of smoke, but this is not due to the nitro-cellulose, but to the material used in the bag in Mark III. cartridges. Steps have been taken to rectify this in future manufacture.

Where, however, corrections owing to the temperature of the charge are necessary, nitro-cellulose requires only one-third of the allowance which would be made for cordite.

It should be noted that all charges are "adjusted." This means that when the cartridges are made up the amount of explosive is varied, so as to give a standard muzzle velocity irrespective of the "lot" of explosive used. This fact is not generally known, and complaints have been made of charges being of different weights, whereas this had been specially arranged in order to ensure their shooting alike.

## 4·5-in. Howitzer.

7. *Shell.*—The high-explosive shell may be either, Lyddite, T.N.T. or Amatol, but it is expected that about one-third of the deliveries of H.E. shell in the future will be lyddite. All the H.E. shell range practically the same.

The distinguishing bands and marks are the same as for 13-pr. and 18-pr.

8. *Fuzes.*—Shrapnel are fuzed with the No. 82 fuze only and no modifications have been made to these rounds.

9. H.E. shell may be fuzed with :—

(*a.*) No. 44 fuze.
(*b.*) No. 100 fuze with No. 1 gaine.
(*c.*) No. 100 fuze with No. 2 gaine.

(*a.*) *The No. 44 fuze* gives good detonation, but has shown a certain tendency to be blind. This tendency is far more noticeable in wet soft ground. There is no gaine with the No. 44, and its safety is guaranteed by the presence of a "shutter."

(*b.*) and (*c.*) The remarks concerning the *No. 100 fuze* in para. 5 (*e*) and (*f*), apply equally to these fuzes when used with the 4·5-inch.

Note.—It is most necessary to realize that the No. 100 fuze, being a graze fuze, is designed to function whenever there is a check on the forward movement of the shell once the latter has armed. It is essential, therefore, that there should be no debris in the bore, either from the cartridge of the previous round or of any other kind, which may cause such a check.

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10. *Cartridges.*—Both cordite and ballistite cartridges are used for the field howitzer, but the muzzle velocity obtained with these two propellants at the normal temperature (60°) is precisely the same. Where, however, corrections owing to the temperature of the charge are necessary, ballistite required only one-third of the allowance which would be made for cordite. It will thus be seen that at charge temperatures below 60° F., ballistite will "range" further than cordite, whereas, at temperatures above 60°, cordite will "range" the further.

The card correction scales give the figures which are required with cordite charges.

The note regarding "adjusted" charges for 13-pr. and 18-pr. cartridges applies also to 4·5-inch Q.F. howitzer cartridges.

11. *Gaines.*—A "gaine" is a cylinder containing the exploder which is required to detonate the bursting charge of a high-explosive shell. It occupies the space immediately below the fuze. The name is taken from the French, and simply means "container." No. 2 gaine is much shorter than No. 1. It has been introduced as it was thought that the size of the other was a possible source of weakness. In future no fuzes with No. 1 gaine will be despatched from England, and it is hoped that most of those so fuzed now in France will be exchanged. As, however, the gaines and adapters are stabbed into the shell, it is not possible to effect the exchange in this country, and rounds which are to have their gaines exchanged will therefore be called in.

Shell which have fuzes fitted with No. 2 gaine are distinguished as follows:—

2G on two sides of the box.
2G stencilled on the shell.
2G stamped on the fuze.

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Artillery notes

A791
no.2

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