



The Development of Field Artillery Material

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GENERAL J. T. WALKER, C.B., F.R.S., &c., Member of Council, in
the Chair.

*7-4-91
Pres.*

THE DEVELOPMENT OF FIELD ARTILLERY MATERIAL.

By Lieutenant-Colonel N. L. WALFORD, R.A.

THE Franco-German War of 1870, owing not only to the colossal scale of its operations and to the far-reaching character of its results, but also to the persistence with which we have been called upon to regard its lessons as embodying all that is essential in tactics and strategy, has grown to be considered as an absolute standard, any divergence from which requires explanation if not excuse. There is thus much danger that its name may become a fetish, and the outcome of its experience a formula to be accepted, but to be by no means criticized.

The War of 1870 marked the first grand stage since Waterloo, for the Wars of 1848, of the Crimea, of 1859, and even of 1866 (of which the results were scarcely inferior), are almost forgotten, while the later war between Russia and Turkey, which was a more severe and far more costly struggle, has, so to speak, never been remembered. The reason of this pre-eminence of the War of 1870 is not far to seek; it is founded on the fact that this war was a duel between the two most skilful warrior nations in Europe, and was as such followed with the same intense interest as would be excited by a contest between two passed masters in fencing who had been rivals since they could handle a foil, whose reputation was unequalled, and whose skill was supposed to be irreproachable. The campaign of 1870 was a lesson in war given by experts to Europe, and as such it is still regarded. It emphatically marked an epoch, but that epoch is past.

This war, though of the very first importance to the military

student; is indeed an old tale, more than twenty years old, and twenty years, as the world moves now, is a very long time, and entails very considerable changes. This fact is especially true of material, since while opportunities for the practical study of tactics occur only at, sometimes, considerable intervals, the progress of material is unceasing; for it advances with the march of science, with improvements in methods of manufacture, and with the development of the skill and resources of a nation. That which we could not attempt twenty years ago is now, in many cases, an accomplished fact; to take one single instance, the last twenty years have seen the death of the iron age for guns and armour, and the birth of the present age of steel; such guns and armour as we now have were impossible in 1870, and will, in their turn, be obsolete twenty years hence. For neither invention nor enterprise will stand still; woe to us if we do not advance with them!

It may be said, however, that the progress of material is a purely technical matter, interesting to those who are concerned with it, but by no means a necessary part of military knowledge. Those who so speak cannot have studied past history, for, if we examine the changes which mark the growth of the art of war, we shall find that some variation in material underlies most of the successive modifications of tactics. It is interesting to note how in the 16th century the gradual increase of the proportion of musketeers to pikemen slowly modified the tactics of the day, while the invention of the bayonet (which caused the abolition of the pike) resulted in the first appearance of the line as a formation for infantry. Again the struggle to obtain a quicker rate of fire, or rather I should say a more rapid rate of loading, led to the successive invention of the bandolier, the flint lock, the iron ramrod, the cartridge, the percussion lock, and the breechloader; each of these in its day exercised a preponderating influence on the tactics in vogue, while the effect of their direct successor, the magazine rifle, is one of the questions of which we anxiously await the solution from the next great war.

Following the universal law of progress, Artillery has since 1870 tended to develop in every direction; the guns of the present day are more accurate, and have a longer range than those then in use, the projectiles are more effective, the character of the powder has improved, the fuzes are incomparably better (though there is yet some improvement possible in this respect), while greater knowledge and experience have been brought to bear upon the various problems connected with the draught and stability of gun-carriages. Time will not permit me to say much about the past, interesting as such a retrospect would be, but I will ask you to let me draw your attention to one fact which alone would show how different are the results which, in the next war as compared with that of 1870, we may expect from the fire of artillery. In the Franco-German War, the German Army, with the exception of the Bavarians (who had a very inferior shrapnel), possessed but one projectile, the common shell, and but one fuze, a percussion fuze, while the French, who had, it is true, a shrapnel in addition to the common shell, had for the majority of

these projectiles a time fuze, which was so absurdly constructed that it would act at only two ranges, 1,500 and 3,000 metres; if, therefore, the enemy happened to be at any other distance, the shell became practically solid shot. We need scarcely wonder that, under these circumstances, the loss of the Germans from the fire of the French artillery was so small.

The subsequent improvement of the projectiles of field artillery may be best estimated from the fact that the shell used by the Germans in 1870 gave about thirty to forty splinters at its burst, while their present ring shell gives from 150 to 180, and their shrapnel discharges 262 bullets; this latter projectile is, moreover, fitted with an admirable time fuze, which acts with very great regularity at all ranges up to 3,500 yards.

It is proposed to divide the consideration of artillery material under four heads; viz. :—

- I. The gun.
- II. The carriage.
- III. Ammunition.
- IV. Miscellaneous.

I. The Gun.

Present Armament.—The field guns of the principal European nations are as follows :—

Austria.—Two descriptions of guns, both made of hardened cast bronze.

- i. Calibre, 3·14-inch; weight, 5·9 cwt.; m.v., 1,365 f.s.; common shell, 9·5 lbs.; shrapnel, 10·27 lbs.

This gun is issued to horse and light field batteries.¹

- ii. Calibre, 3·54-inch; weight, 9·5 cwt.; m.v., 1,440 f.s.; common shell, 14·1 lbs.; shrapnel, 15·6 lbs.

The gun for heavy field batteries.

France.—Two guns, of which the tube and jacket are made of cast steel, and the reinforcing rings of puddled steel.

- i. Calibre, 3·14-inch; weight, 8·4 cwt.; m.v., 1,607 f.s.; common shell, none; shrapnel, 13·8 lbs.

- ii. Calibre, 3·54-inch; weight, 10·4 cwt.; m.v., 1,492 f.s.; common shell, none; shrapnel, 19 lbs.

The first is the horse, the second the field, artillery gun.

Germany.—One gun (slightly lightened for H.A.), made of forged steel.

- Calibre, 3·46-inch; weight, 8·85 cwt. (for H.A. 8·2 cwt.); m.v., 1,407 f.s.; common shell, 15·5 lbs.; shrapnel, 17·7 lbs.

¹ I have been informed, on the best authority, that the Austrians have now abolished light field batteries, and that their field artillery has now but one gun, the 3·54-inch.

Great Britain.—One gun, made of forged steel.

Calibre, 3-inch; weight, 7·5 cwt.; m.v., 1,720 f.s.; common shell, 12·5 lbs.; shrapnel, 12·5 lbs.

Italy.—Two guns, both made of hardened cast bronze.

i. Calibre, 2·75-inch; weight, 5·8 cwt.; m.v., 1,400 f.s.; common shell, 9·4 lbs.; shrapnel, 9·8 lbs.

This gun is used by the horse and light field batteries.

ii. Calibre, 3·5-inch; weight, 9·2 cwt.; m.v., 1,480 f.s.; common shell, 14·7 lbs.; shrapnel, 15·3 lbs.

This is the gun of the heavy field batteries.

Russia.—Three guns, all made of forged steel.

i. Calibre, 3·4-inch; weight, 7 cwt.; m.v., 1,351 f.s.; common shell, 14 lbs.; shrapnel, 15 lbs.

The horse artillery gun.

ii. Calibre, 3·4-inch; weight, 8·6 cwt.; m.v., 1,450 f.s.; common shell, 14 lbs.; shrapnel, 15 lbs.

The light field battery gun.

iii. Calibre, 4·2-inch; weight, 12 cwt.; m.v., 1,223 f.s.; common shell, 25·9 lbs.; shrapnel, 27·5 lbs.

The heavy field battery gun.

The diversity of these guns is remarkable, so much so that it is impossible to discover any general principle on which they have been selected; for example, the weight of shell varies from 9·4 lbs. of the Italian light gun to 27·5 lbs. of the Russian heavy field battery gun, while the muzzle velocity varies from 1,223 f.s. in the last-named gun to the 1,720 f.s. of our 12-pr.

This fact is in part due to the fact that most of these guns are really obsolete; for example:—

Austria: Pattern of 1875.

France: Pattern of 1877.

Germany: Pattern of 1873, slightly modified in 1888 as regards the horse artillery gun.

Italy: Patterns of 1874 and 1876.

Russia: Patterns of 1877, modified in 1879.

The adoption of a new pattern by one of the above Powers would probably be the signal for an entire renewal of the field artillery of the world, and such a renewal (which is already foreshadowed in the case of France) will probably take place as soon as smokeless powder has been generally and definitely adopted; in the meantime, since the re-armament of a gigantic artillery must be a matter of very serious expense, all nations are content to forego an advantage which has been as yet taken by none. It may be well to endeavour to point out the direction in which further progress, when the time for it arrives, will probably be made.

Signs of the Future.—There are certain signs which point to the

possible adoption, in imitation of the infantry rifle, of a small calibre, a shell of great length, and a high muzzle velocity, and it will be interesting to examine the effect of such a choice.

The use of a *small calibre* will necessarily entail the employment of a shell of small section, while in order to resist the action of the pressure needed to generate a high velocity, the shell must, even if it be made of forged steel, be of considerable strength, and, therefore, of a certain thickness. Such a shell will, even though it be made of great length (say 6 calibres), have but a comparatively small content, either of bursting charge or bullets; as regards common shell, this defect may perhaps be made good by the use of a high explosive (of which we shall speak presently), but with respect to shrapnel it cannot be surmounted.

The use of a *long shell* is intended to serve two objects, viz.:—

- i. To supply the necessary space for the burster or the bullets.
- ii. To ensure a high remaining velocity.

On the other hand, its employment necessitates the use of a rapid twist of rifling, and will probably affect injuriously the accuracy and the length of life of the gun.

The *high muzzle velocity* will be needed to give the requisite rotation (without an excessive slope of rifling) to the long projectile, and is further desired by some Officers for its own sake.

It is said, and is undeniable, that a high velocity will give a flat trajectory, and it is assumed that a flat trajectory will add to the efficiency of the gun. This contention is undoubtedly true of a rifle, which throws a solid bullet, and is equally true of a solid shot, and to some extent of a percussion shell which strikes before it bursts. Shrapnel is, however, and appears likely at present to remain, the principal projectile of field artillery, and the question should, therefore, I urge, be considered mainly from the point of view of its effect on that shell. A shrapnel shell bursts in the air, its bullets descending in a cone of which the apex angle is approximately 12 degrees; this being the case, it is evident that the dangerous zone, which the flat trajectory is intended to increase, will depend less upon that trajectory than upon the height of the burst of the shrapnel and the slope of the ground on which the target stands; in other words, the number of bullets which sweep the ground will vary under different circumstances, and is very slightly dependent upon the direction of the motion of the shell before it bursts. For the above reasons, it appears doubtful whether an increased muzzle velocity will give a more effective shrapnel, more especially since the high velocity of rotation will tend to give very great dispersion to the bullets at the moment of burst. I should, however, perhaps, warn you that I am now trotting out a special hobby, which may really be as lame as most hobbies.

The reasons which have been given above, viz., the limited content of a small calibre shell, the difficulty of obtaining accurate shooting with a shell of great length, and the slight advantage, if any, to be obtained from a high muzzle velocity (which carries with it many

difficulties) incline me to the belief that the direction in which the progress of field artillery appears to show a tendency to move is an erroneous one, and that a return will, after a trial, be made to the principle that the main object of artillery is not to hit a given mark with unerring accuracy, but to obtain the greatest possible effect from its shrapnel, a condition which is incompatible with a small calibre, even though the shell be lengthened, while it is not facilitated, and is perhaps even rendered more difficult of fulfilment, by a high muzzle velocity.

Quick-firing Guns.—Passing from this subject, we come next to the desire which many Officers have expressed to introduce a quick-firing gun for the use of the field artillery.

We all know that guns have been invented which will throw as many as 40 projectiles per minute, and this rate of fire, provided that the practice be accurate, must be acknowledged to be overwhelming. Such extreme rapidity is, however, possible only in the case of guns of very small calibre, the objections to which have been already stated.

Other quick-firing guns of larger calibre, up to 3 and even 4 inches, can be fired at the rate of from twelve to fifteen rounds per minute, which is, of course, in excess of the rapidity possible with ordinary B.L. guns. This rate is, however, attainable only in the case of unaimed or uncorrected fire, that is to say, on condition that the gun be not re-laid between the rounds. It is evident that such a power of rapid fire is, therefore, of value only when the gun is on a fixed mounting, and will be practically useless (since the fire will be inaccurate) when the gun is on a field carriage, except under two conditions, viz., either

The field carriage must, when the gun is fired, have no recoil or other motion which can disturb the aim; or

The target must be of such a character and at such a distance that accuracy of aim is not necessary.

Of these conditions, the first has not as yet been attained on a field carriage with any gun of a sufficient calibre, while the second would limit the use of a quick-firing gun to occasions when case-shot is the best projectile, under which circumstances its place might with advantage be taken by a machine gun.

Even though it be admitted that the rate of fire of a quick-firing gun must in practice be limited by the necessity of re-laying it after each round, its advocates may yet claim in its favour that, like the B.L. rifle, it is always loaded; even this is, however, not strictly the case, for ammunition must be brought up to the quick-firing as to the ordinary gun, and the time required for this operation will in each case be the same.

As a matter of fact, the rate of fire of artillery in the field is governed by the time required to run up and lay a gun, together with that necessary for bringing up the ammunition; the operations of opening and closing the breech, and of putting in the shot and cartridge, can be performed as quickly as is needed with any B.L. gun. In conclusion, it may be said, therefore, that, with respect to rapidity

of fire, no advantage would be gained by the introduction of quick-firing guns for field artillery, except as regards the fire of case.

On the other hand, it may be acknowledged that no disadvantage would attend their use, except beyond as is caused by the fact that they are dependent on a metal cartridge case, and that thus each round of quick-firing ammunition is heavier than a round of the corresponding ordinary ammunition by the difference in weight between a silk cartridge and this metal case. That excess of weight would, however, seriously diminish the number of rounds which it would be possible to carry. For example, thirty-two rounds of the present 12-pr. ammunition weigh 47 cwt.; for this weight it would be possible to carry only twenty-seven rounds of quick-firing ammunition, a reduction of 16 per cent.

Some of the quick-firing breech actions are, however, extremely simple, especially as regards their means of igniting the charge, and it is very probable that, if the artilleries of Europe are re-armed, some such form of breech action will be adopted, the increase of weight due to the cartridge case being counterbalanced by the diminution which is made possible by the change from black to smokeless powder.

Field Mortars.—In addition to the inclination which has been mentioned above, to test the value of a small-bore, high-velocity gun carrying a long shell, we find a tendency in almost all European armies to revert to the employment of field howitzers or mortars, throwing a heavy short shell with a low velocity. This type of field gun has of late years been abandoned, except in the case of our heavy field batteries in India, but there is now a very marked movement, led by Russia, in favour of its re-introduction.

It has been foreseen that the defensive positions of the future will, wherever possible, be provided with entrenchments, of great extent and of considerable strength, and it is recognized that against such defences the projectiles of ordinary field guns will be practically powerless, while the flatness of their trajectory will render it difficult, if not impossible, to obtain good effect from their shell on troops who are retained under cover. It is, therefore, now generally agreed that a field army must in future be provided with a certain proportion of mortar or howitzer batteries, which shall throw a shell of considerable weight, but with a very low muzzle velocity, thus obtaining a high angle of descent. Against such a projectile the defenders would be without protection, except on the condition of providing a very large amount of good overhead cover, while such a provision would in most cases be impossible in the field, on account either of want of time or of want of material.

Russia, incited perhaps by recollections of Plevna, has alone at present completed an organization of this description; she has two regiments, each of four mortar batteries, the piece itself having a calibre of 6 inches, and throwing a shell of about 60 lbs. Since the equipments of other nations are still in the experimental stage, it is impossible to give accurate details, but the following data are founded upon good authority.

Austria: Calibre, 4·7-inch.

France: Calibre, 6-inch.

Germany: Calibre, 4·7 or 6-inch; one battery per army corps.

Italy: Calibre, 3·5-inch. (The same as that of the heavy field gun.)

Spain: Calibre, 6-inch. (Gun of position.)

Sweden: Calibre, 4·7-inch.

Switzerland: Calibre, 4·7-inch.

The one great objection to this addition to the field artillery lies in the undoubted want of mobility of such a battery, since even though the howitzers (as may be possible) be kept within reasonable limits of weight, their shell, if they are to be really effective, must be of considerable size, and the choice thus lies between carrying a very few rounds or transporting a vast weight of metal. For example, 37 rounds of the Russian 60-lb. shell will weigh a ton, which is, roughly speaking, as much as can be carried in a limber and wagon, each of which shall have 50 cwt. behind the team.

The Russians, to some extent, get over this difficulty by allowing in these, as in all, batteries twelve wagons to the six guns.

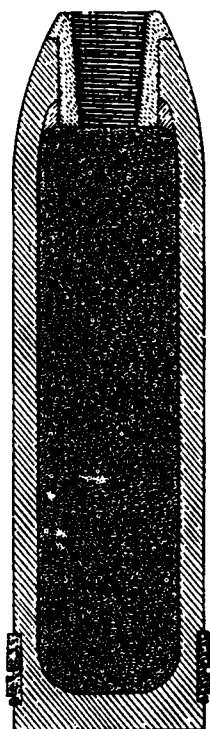
The advantage of possessing a howitzer which will throw a heavy shell is undeniable, more especially in the case where an enemy has been permitted to thoroughly entrench himself in a defensive position, for high-angle fire alone can reach troops who are behind really good cover, whether natural or artificial, while the great elevation at which the mortars will be laid will enable them, if their position be well chosen, to discharge their duty with absolute immunity from injury from the fire of guns of comparatively high velocity; there must surely be, nevertheless, some hesitation in accepting a weapon of which two projectiles weigh more than a cwt. as the arm of a field (and therefore, presumably, mobile) battery.

Uniformity of Calibre.—The question of uniformity of calibre, which simplifies manufacture in peace, and the supply of ammunition in war, has, up to the present time, been practically tried by Germany alone, but there are not wanting signs to show that this problem will be seriously considered by other nations when the time arrives for the re-armament of their artillery.

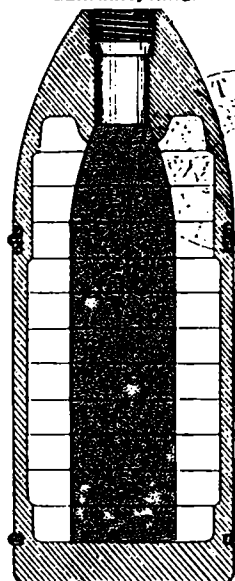
The Germans, using the same gun for horse and field batteries, have lightened it for the former, to the extent of 67 lbs., by turning down the gun, by hollowing out the trunnions and by chambering the breech-wedge; they have further lightened the gun-carriage axle by 50 lbs.,¹ and the limber by 121 lbs.; with the result that the total weight behind the team of horse artillery is (no men being mounted in either case), 2·5 cwt. less than is the case with the field gun.

¹ This has, it is reported, been effected by the use of a hollow axle, made of a steel tube drawn by the Mannesmann process; a similar tube, made in the same manner, is used by the Gruson factory for the trail of a mountain gun-carriage.

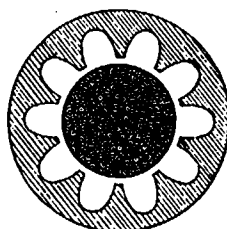
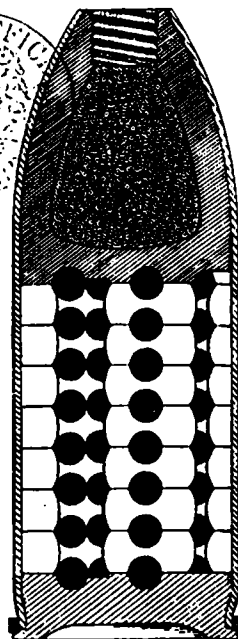
ENGLAND, COMMON.



GERMANY, RING.

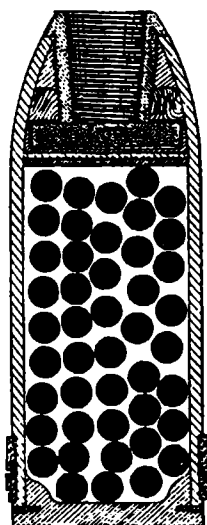


FRANCE, SHRAPNEL.

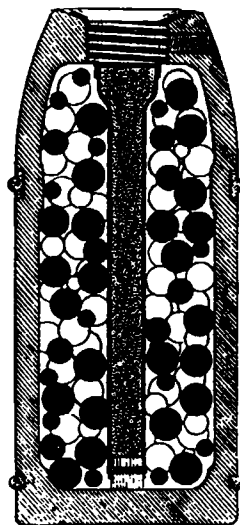


SECTION.

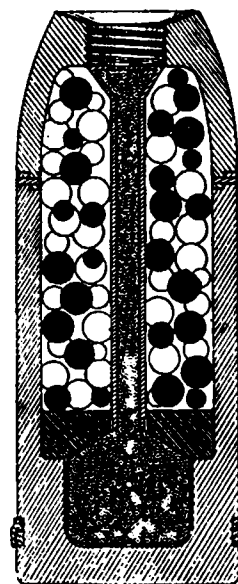
ENGLAND, SHRAPNEL.



GERMANY, SHRAPNEL.



TYPICAL SHRAPNEL.



II. *The Carriage.*

On this subject I propose to say very little, since the tendency throughout Europe with regard to this portion of the equipment is the same, though the extent of its practical expression varies in proportion to the manufacturing skill and financial position of each Power.

Material.—The carriages of all artillery have been made, of late years, both lighter and stronger, by the employment of steel, both for the carriage itself, for the axles, for the naves, and for the tires; there are, however, numerous instances of the survival of iron and even of wooden carriages, but they will certainly tend to disappear.

Brakes.—Owing to the increased muzzle velocity of field guns, it has been found necessary to use special means to check the recoil, in order to, as far as possible, diminish the physical strain brought upon the men of the detachment by running-up after each round; these may be divided under two heads:—

i. Nave brakes, such as the Gruson, and that on the 12-pr. carriage, Mark I.

ii. Tire brakes, such as the Lemoine, the German service, the Buffington, and that on the 12-pr. carriage, Mark II.

I regret to say that time will not allow me to enter upon a description of these brakes, still less to open a discussion upon the vexed question of the relative superiority of nave and tire brakes, but it would appear that general opinion declares strongly in favour of the latter.

Buffers.—The strain brought upon the carriage by the sudden check given to the recoil by any kind of severe brake (and if the gun have a high muzzle velocity, all brakes must be severe in order to be efficient) is so heavy that the destruction of the carriage can be only a matter of time, unless this shock be gradually brought to bear upon the inert mass. This need is met by the employment of a buffer—hydraulic, air, or spring—which absorbs the first blow of the recoil, and, so to speak, hands it on gradually to the carriage.

Owing to the exceptionally high muzzle velocity of our 12-pr., we have, up to the present, paid more attention than other nations to the construction and use of these buffers, as applied to field guns, but any reconstruction of material will certainly be accompanied by their more general use.

Though much remains yet to be said upon the subject of military carriages, you will perhaps excuse me if, our time being so limited, I now pass on to—

III. *Ammunition.*

Projectiles.—Omitting case-shot, which is the same in all armies, and a new variety of shell, of which I shall speak later, the typical field projectiles are—

- (a.) A shell for ranging, generally called common shell.
- (b.) A man-killing shell, or shrapnel.

If we examine the former of these, as exemplified by the material of England, France, and Germany, we shall find that there appears to be some difference of opinion between the artillery experts of these several armies. We use a forged steel shell containing 2 lbs. of powder, the Germans have a cast-iron ring shell with a bursting-charge of 6 ozs., while the French employ their shrapnel shell (which in the horse artillery gun holds only 2 ozs. of powder) for the purpose of ranging. These differences are, however, easily explained.

Our shell was designed with the idea that a large bursting charge would be useful in destroying field entrenchments, a task which is now, I believe, accepted by all as being beyond the power of field guns. The French and Germans have, on the other hand, assumed that a shell which is to be used in ranging should be of a character to inflict considerable loss on the enemy even while the process of ranging is going on; in order to ensure this effect, they have been willing to render the observation of their fire difficult, by diminishing the bursting-charge, and therefore the amount of smoke given by an exploding shell. The French, going beyond the Germans in this direction, have, with a view to the further advantage gained by using only one projectile for each nature of gun, restricted themselves to a shell of which the burst must be very difficult to see, except under peculiarly favourable conditions.

When we turn to shrapnel, we find again a difference of opinion; we and the French place the burster in the head of the shell, which is contrary to the practice of other nations, who all use a burster in the centre or in the base, in which latter case it is connected with the fuze by means of a tube which passes down the axis of the shell.

These differences are also easily explained. The French and English place the burster in the head, because it is for our purposes essential that the shrapnel shall burst on graze when used with a percussion fuze; but these purposes are not identical. The French need percussion shrapnel for the process of ranging their batteries; we require it because, our common shell not being a man-killing projectile, we must trust percussion shrapnel in cases where there is no time for the setting the more complicated time fuze, as, for instance, when a battery is suddenly charged by cavalry. A shell which, like the German, has its burster in the centre, and still more a shell which has the burster in the base, would be less effective with a percussion fuze than ours, since the length of time required to carry the flash of the fuze down the shell to the burster would allow the projectile to rise some distance from the ground before exploding, in which case most of the bullets would be thrown into the air over the heads of the enemy. Among nations which differ from us in the construction of shrapnel, the part which we allot to percussion shrapnel is played by ring shell, and with good effect. For example, thirteen rounds of ring shell with percussion fuzes from a 6-pr. gun gave 277 hits on a line of twenty skirmishers, standing at a range of 1,640 yards, two men only being unhit.

Those armies who prefer shrapnel carrying its burster in the base state that they do so because, if it be the head, its explosion tends

not only to diminish the velocity, but also to increase the dispersion, of the bullets, while their system, on the contrary, increases the velocity at the decisive moment and does not injuriously affect the dispersion. There appears to be much truth in these statements, for it is found in practice that the shrapnel with the burster in the base does not, in order to produce an equal effect, require to be burst so close to the target as is the case when the burster is in the head; the former does not, therefore, in its use, require the same accuracy either of ranging or of fuze as is the case with the latter. Such a shell is, however, as I have said, far less effective when used with a percussion fuze than is the pattern which we at present possess. It will be observed, on reference to the list of European artillery on pp. 323, 324, that the French, German, and Russian shells are of great size and weight.

Common Shell filled with a High Explosive.—We are most of us aware that those substances which we term "high explosives" act, when detonated, with tremendous local power, to which not even the toughest steel offers any effectual resistance, and we shall not therefore be surprised to find these terrible forces called into play in war.

High explosives have been adopted for the bursting charges of field common shell by both the French and the Germans, and trials have been made in the same direction by other nations. In order to take full advantage of this bursting charge, there is a tendency to use shells of great length and of large capacity.

The French shell is a steel common shell, four calibres (as an experiment even six) in length, filled with cresylite,¹ of which it holds 3 lbs.; it is used with a percussion fuze, and is intended to destroy cover, such as earthworks, walls, &c. A ninth wagon has been added to each heavy battery for the purpose of carrying seventy-five of these projectiles.

The German shells which replace a portion of the complement of powder shell are of the same weight as the ring shell (15·8 lbs.), and are filled with wet guncotton with a dry guncotton primer; they are intended to be used as a rule with a time fuze against men.

The theory of the use of this shell is as follows:—

It is recognized that, owing to the low trajectory of modern artillery, troops can obtain shelter from its fire by standing close into a parapet, provided (as will generally be the case) that this parapet is too thick to be breached by field guns; the German military authorities have considered that, under these conditions, the ordinary fire of artillery may, as at Plevna, be found useless for the purpose of preparing the infantry attack on a strongly fortified position, since the defender's infantry will remain under cover up to the moment when the guns of the assailants will be compelled to cease firing (owing to the advance of their own infantry), and will then, having suffered no previous loss, be prepared to offer a stubborn resistance to the

¹ Cresylite is a compound of cresol, as melinite is of phenol, each of these being a product of gas-tar.

endeavours of the attacking troops to pass over such open ground as may lie in front of the entrenchments.

Realizing the absolute necessity of reaching these sheltered troops with artillery fire, the Germans propose to take advantage of the fact that the enormous local power of a high explosive is able to altogether overcome the velocity of the projectile at the moment of burst, and thus distributes the splinters of the shell in all directions; they anticipate that it may, therefore, be possible, by bursting shell in rear of the concealed troops, to drive splinters in upon them from the rear, and thus to some extent to cancel the value of their cover. It is, however, evident that, in order to obtain such an effect, the burst must be very accurately timed, while the difficulty of ensuring this exactness will be much increased in practice by the fact that the absence of smoke from the detonation of guncotton will render uncertain the observation of fire.

From what has been said above, it will be evident that the two nations have assumed totally distinct objects in their use of high explosive in the field; the French have prepared what is practically a flying mine of enormous power, intending to destroy such cover as the enemy may make or find, while the Germans hope to produce an equal effect by rendering the protection of the parapet valueless, and to thus attain their object without the necessity for the expenditure of time, which must always be required for the destruction of earth parapets. The next war will possibly enable us to judge as to which of the two nations has reasoned most rightly.

I have said "may possibly enable us to judge," for the reason that it does not appear certain that this new engine of warfare will ever be brought to the test of the actual combat, and it is much more than probable that, even should this be the case, the French will in the meantime have abandoned melinite and its derivatives, which have already led to many very serious accidents. Whatever form of high explosive may be retained, or may be invented, it is in any case unlikely that it will be free from the very serious defect that an accidental explosion in the gun, whether it be caused by a defective fuze or by a defective shell (and neither shells nor fuzes can be always perfect), will almost certainly lead to the destruction of the gun by a violent and most dangerous explosion; setting aside the physical, the moral effect upon the collateral guns of such a burst will be most disastrous.

Some of you may perhaps have remarked that neither of the two Powers proposes to use the new shell against troops in the open, each apparently preferring to trust to the well-known effect of shrapnel. The cause of this decision is not far to seek, and may be found in the tremendous action of the high explosive itself. A shell so filled is on bursting broken up into a very large number of very small fragments, which are projected violently in all directions (or as we should say, the angle of opening is 360 degrees); few of these fragments are much larger than the finger nail, and their effect, devastating on the spot, is limited to a very short radius, while, moreover, a large proportion of them are thrown vertically into the air or

into the earth, leaving a comparatively small number to pass to the front into the ranks of the enemy. The result of the want of size, and therefore of weight, of the fragments is that they soon lose their velocity and energy, and are thus useless unless the shell be burst very close up to the target; it is no exaggeration to say that a man would probably be safe at a distance of 50 yards from the burst. If we compare this description of projectile with shrapnel shell, of which the bullets are effective to a distance of at least 150 yards from the point of burst, we shall see that the high explosive contrasts unfavourably with the latter in the following respects:—

i. Its effect on a deep target, such as a column of infantry or cavalry, or indeed any deep foundation.

ii. The fact that it will be necessary to burst it with a far greater accuracy than is required with shrapnel, with such accuracy, indeed, as is at present scarcely within the capability of the time fuze.

Under those circumstances we need not be astonished that the new projectile is intended, not to replace, but to supplement, existing shell; it remains to be seen whether its importance in war will be found to counterbalance the undoubted risk which, whether in war or peace, is inseparable from its use.¹ It is, moreover, obvious, as has been hinted above, that, since all high explosives are smokeless, it will be impossible to ensure the accurate observation of such fire, since no means will exist by which to judge of the position of the burst, and therefore of the efficiency of the shell.

Smokeless Powder.—The preservation of the secret of the composition of its peculiar kind of smokeless powder has been a matter of particular care on the part of every nation in Europe, but it may probably be said, speaking generally, that there is a very strong family likeness between them. I should not wish, even if I were competent to do so, to enter into a description of the chemical constituents or proportions of any of these explosives, but it may perhaps be of interest that I should describe the appearance of Nobel's "Ballistite," which is a fairly typical representative of the class; in doing this no indiscretion will be committed, since the powder in question is an article of commerce.

"Ballistite" is a semi-transparent gelatinous substance, of a colour varying from yellow to brown; it is made in sheets of different thickness, according to the nature of the gun for which the powder is intended; and these sheets are afterwards cut up into dice, the so-called powder being used in this form.

Though the subject of the composition of smokeless powder is rather dangerous ground, there can be no objection to considering the advantages to be derived from its use; these may be divided under two heads; viz.:—

a. The technical advantages.

b. The tactical advantages.

¹ In speaking thus I refer only to the use of high explosives *in the field*; under other circumstances, notably in the case of siege operations, it seems not unlikely that the advantages to be gained by their use will far outweigh the diminished risk which accompanies such conditions.

The principal technical advantages to be derived from its use are:—

i. A diminution in the weight of the charge, as compared with black powder; this renders it possible either to obtain the same effect with a lighter cartridge, or to increase the velocity of the shell without augmenting the weight of the charge.

Among Continental nations the tendency, up to the present time, has been to retain the old muzzle velocity and to diminish the charge to about one-third of the weight previously used.

It is evident that this diminution of weight will permit either of carrying more rounds in the limber and wagons, or, should it be preferred, of using fixed ammunition without adding to the weight behind the team.

ii. Greater uniformity of action than it has been found possible to obtain with black powder, leading obviously to more accurate and regular practice.

iii. Less fouling of the bore.

iv. Less recoil with the same muzzle velocity.

It is generally allowed, however, that further knowledge is needed with regard to two very important points; viz. :—

A. The keeping qualities of smokeless powder, especially under trying climatic conditions. This is, of course, the weak point in the smokeless sporting powders, with which we have been so long acquainted, and many of us so completely realize this failing that we do not keep cartridges from one season to another; we have again all experienced how untrustworthy are cartridges which have become even a little damp, while gunmakers will advise us not to use such as have been exposed for any considerable time to a heat of 100 degrees. It is evident that such characteristics would be fatal to the serviceability of a military powder, since all these contingencies must befall an explosive which is to be used in war; any new powder must, therefore, in order to have a claim for adoption, be able to resist them without any sensible deterioration.

B. Very little is known at present, since no one has had sufficient experience to form an opinion, as to the corroding or eroding qualities of smokeless powder. While some hold that the absence of solid particles in the gas as it rushes through the bore will tend to secure comparative immunity from erosion, others consider that the great heat which is undoubtedly developed by the combustion of all smokeless powders will have a fatal effect upon the interior of the gun; we may, I think, wait for time to decide this question, which, in any case, is not vital.

Should it be found, after the experience of some years under varying circumstances, that smokeless powder is as trustworthy as gunpowder (which was, as we know, by no means unaffected by heat and damp), the great technical advantages to be derived from its use would be sufficient, even if we disregarded the tactical benefits, to ensure its adoption, in some form or other, in every army in the world. It is at present, however, almost everywhere upon its trial,

and has, I believe, been as yet definitely adopted for field artillery by France alone of all the Continental Powers:

Should any of the various descriptions of smokeless powder now under trial in the world prove to be uncertain or undesirable, the Power which is affected by this failure will assuredly call in again the aid of science, and demand the solution of the problem, making, if necessary, repeated trials to obtain success; of one thing we may, I believe, be sure, namely, that a complete and reactionary return to our old explosive, gunpowder, is as impossible as is the re-adoption of bows and arrows for our national weapons.

b. The tactical effects of the introduction of smokeless powder.

Since this subject would alone afford sufficient matter for a lecture, you will not perhaps expect me to do more than merely suggest a few important points with regard to field artillery.

It is anticipated that the absence of smoke will permit batteries which carefully select their positions to open fire, and even to continue firing, without disclosing to the enemy their exact locality. When considering this point, a German authority has laid down that it will sometimes be necessary for the Officer commanding a battery which is so fired on by an unseen foe to place himself in prolongation of the graze of the enemy's shells, in order to obtain, from the direction of that graze, some guide as to the position of the guns from which they were fired; a refinement on this suggestion points out that, if high explosive shells are used (which burst immediately upon impact), there will be no trough by which to judge, and offers this as a reason for their adoption.

This attribute of invisibility has, I venture to think, been somewhat over-estimated, both as regards its extent and its effect.

As regards its *extent*, for the following reasons:—

i. Though the powder be smokeless, yet the discharge of the gun is accompanied by a very vivid flash (closely resembling the flash of a heliograph), and this flash it will be difficult to conceal in the case of guns which are laid over the sights, and which must be, therefore, except for some intervening cover, partially visible to the enemy. In some respects the flash is a better guide than smoke to the position of the enemy, since it shows (it is true, but for a moment) the actual position of his guns, whereas the smoke either hangs as a pall in front, or drifts away to one side.

ii. The existence of this flash necessitates, if invisibility is to be preserved, very great care in the choice of a background; while a good background, since it requires that we shall "see ourselves as others see us," is a most difficult thing to select.

iii. The amount and the great velocity of the gas which issues from the muzzle throws up from any ground which is at all loose or sandy (and almost all ground will tend to become loose when the guns have been fired a few times) a cloud of dust, which, though it is equal neither in volume nor density to the smoke of gunpowder, will yet offer a mark sufficient to show the position of the battery.

I am inclined to doubt the *effect* on tactics of this assumed invisibility, because it will, I believe, be found obtainable only at the cost

of efficiency, and will, therefore, be discouraged. I cannot think that that army will be victorious which thinks firstly of hiding itself, and only secondly of fighting, while we must further remember that only victorious armies lay down rules for war; no one studies the tactical principles of a defeated nation.

Again, speaking of Continental armies, the proportion of the artillery to the other arms has been so very much increased, while, at the same time, the actual size of the battlefield is practically regulated by the numbers of the infantry, that it seems probable that the great difficulty in the conduct of the former arm will be to find room for the mass of guns, and that thus all considerations, except those affecting the amount of injury that can be done to the enemy, will be allowed to lapse.

The absence of smoke will certainly materially assist the practice of the battery, inasmuch as not only will the observation of fire be easier, but there need be no delay in laying, since the target will be always visible. I need scarcely enlarge on this very obvious advantage; but there are others closely connected with it which do not strike one so directly.

Many of you will remember how constantly in the history of the Franco-German War we find mention made of the fact that when the wind was on a flank the smoke of the windward batteries tended to silence those to leeward, and how, in order to overcome this disadvantage, it was customary to increase the intervals between brigade-divisions, and also to arrange the several units in *échelon* from the leeward flank. At first sight, these remedies, especially the latter, appear sufficient, but we shall realize how different theory is from practice if we endeavour to apply them in the case of a large force of artillery, say the batteries of an Army Corps, on any piece of ground taken haphazard; it will frequently be impossible to make the guns fit in. We must, moreover, remember that such an arrangement could not in war be made beforehand (since no one could know which way the wind was going to blow), but must be improvised amid all the excitement and hurry of battle. May we not feel certain that nine times out of ten the remedy was illusory or insufficient?

The invention of smokeless powder has made us independent of any such complicated formations, and Officers are now at liberty to adapt their troops to the ground in such a manner as may best ensure their efficiency, without reference to their own or anybody else's smoke.

But the Germans have gone further than this; realizing how difficult it will be to find space for the masses of artillery which they propose to use in war, they have strained every nerve to find a way to increase the number of guns which can stand on a given space. In order to do this, they have reduced the interval between guns to fifteen (in some cases even to six) paces, but without diminishing battery or brigade-division intervals, which they consider necessary for the preservation of fire discipline.

In place of *échelons*, which obviously take up a large extent of ground in proportion to the number of batteries, they propose to use

successive lines or tiers of guns, and thus to crowd such ground as is available for artillery with the greatest possible number of weapons. Both of the above changes are entirely dependent for their inception, as they will be for their advantage, upon the fact that the new powder has no smoke which may hide the enemy.

IV. Miscellaneous.

I had hoped to be able, under this head, to say a few words with regard to material as affecting mobility, which, next to accurate shooting, is the highest attribute of good artillery, but I have found that to do so would open out a subject too large and too complicated for the present occasion, and I have, therefore, been reluctantly compelled to limit myself to—

- (a.) The amount of ammunition carried in the field.
- (b.) Armoured defences in the field.

Amount of Ammunition Carried.—If we compare the artilleries of France and Germany, as they now are, with the same forces as they were in 1870, we are struck at once by two points of difference: 1st, the enormous increase in the proportion of guns to infantry; and, 2nd, the great addition which has been made to the amount of ammunition which was then carried in the field. Upon the first of these I do not intend to touch, but the second comes fairly under the head of "Material," and calls for some remark.

The Germans have added two wagons and the French three to the establishment of each battery; omitting the increased storage due to an improved pattern of wagon, we may thus say that the former have added 33 per cent., and the latter 50 per cent., to their former equipment in ammunition. The Russians have gone even farther, and have now 12 wagons to the battery, exclusive of forge, store wagons, &c.

The following table shows the number of rounds (approximately), and the total weight of ammunition, carried by a battery of each of the Powers named.

	No. of shell.	Weight in cwt.
Austria—		
Horse artillery	912	81·4
Light field	912	81·4
Heavy field	768	102·8
France—		
Horse artillery	936	115
Field artillery	852	144
Germany—		
Horse artillery	808	119
Field artillery	808	119
Great Britain—		
Horse artillery	648	72
Field artillery	648	72

	No. of shell.	Weight in cwt.
Italy—		
Horse artillery	858	73·5
Light field	852	72·9
Heavy field	780	104·4
Russia—		
Horse artillery	840	108·7
Light field	900	116·5
Heavy field	648	154·5

Armoured Defences in the Field.

The accuracy and volume of modern fire, both of artillery and infantry, has led at various times to different suggestions, having for their object the protection of guns by some species of armour. These have, up to the present, been rejected in practice, owing to the unavoidable increase of weight which would be the consequence of the adoption of such a form of protection. Since, however, this desire for invulnerability is a sign of the times, it will be well to consider the latest form which such cover for guns in the field has taken.

This may be found in the Gruson travelling shielded mounting, which was tried at the German Manœuvres of 1889, and which was also exhibited to a gathering of Officers of all nations in September last at Magdeburg.

The mounting consists of a sheet-iron cylinder, which is provided with a floor and a revolving curved roof, and has a door at the rear. The weight of the gun (which is without recoil), and that of the roof are taken on a central column, and do not fall upon the thin iron sides. The system rests on four small rollers, which are used to place the mounting in position, while the transport of the whole is rendered comparatively easy by the use of a transporting axle, carrying two wheels. It is considered that the whole can be drawn by three horses, which are driven by a driver sitting on the cupola itself.

These mountings are made in three sizes, as follows:—

i. For a 1·46-inch quick-firing gun, which fires a 1 lb. shell with a velocity at the muzzle of 1,588 f.s.

The weight behind the team in this case is

Weight of gun.....	81 lbs.
Weight of mounting	4,188 "
156 rounds of ammunition....	233 "
Total.....	4,502 " or 40 cwt.

ii. For a 2·09-inch quick-firing gun, throwing a 3·85 lb. shell with a m.v. of 1,624 f.s. The weights are as follows:—

Weight of gun.....	313 lbs.
Weight of mounting	6,834 „
130 rounds of ammunition....	662 „
Total.....	7,809 „ or 69 cwt.

iii. For a 2.24-inch quick-firing gun, which fires a shell of 6 lbs. with a velocity of 1,575 f.s. Of this, the weights are

Weight of gun.....	397 lbs.
Weight of mounting	6,393 „
80 rounds of ammunition	710 „
Total.....	7,500 „ or 67 cwt.

If we divide these weights by the number of horses which are intended to draw the gun and mounting, we find that the draught for each horse is—

i. 13.3 cwt.; ii. 23 cwt.; and iii. 22.3 cwt.

It follows from the above that these mountings can travel only on roads, and are not, therefore, in the true sense of the word, field artillery mountings; they may be of great use in defensive positions and in sieges, but they have not sufficient mobility to rank as field carriages.

It is intended that they shall be buried in the ground in such a manner that the roof and the gun are alone visible, and it is anticipated that they will thus be safe from injury owing both to their invisibility and to the shape of the curved roof, which will throw off shell travelling on a flat trajectory, while their small area will render it extremely difficult to hit them with high-angle fire from field howitzers or mortars. These claims are doubtless well grounded, and such defences would be very hard to see, and still more hard to injure.

On the other hand, the guns used in the mountings are of so small a calibre that it is very doubtful whether they would be of much value in the field, since, as has been already said, the common shell would carry but a small bursting charge, while the shrapnel could contain but very few bullets; it is probable, however, that the ring shell, the true projectile for quick-firing guns, might be of some practical use. It is, nevertheless, a question whether the protection given by the mountings might not be better employed in covering machine-guns, which, remaining invisible during the artillery struggle, would be available for use when the infantry attack developed, and would be entirely invulnerable to infantry fire.

These mountings might, as has been already said, be employed in defensive positions, in cases where such positions were decided on some time in advance of the struggle and deliberately prepared for a stubborn defence, but their true vocation is in the defence of fortresses, for which they are sufficiently mobile and in which, if armed with machine-guns, they might be of considerable use.

I have now, as far as the time at our disposal will admit, brought

before you the present general position of the material of field artillery, and have further endeavoured to point out the various directions in which progress appears to be about to take place; these may be summed up as follows:—

Universal use of smokeless powder.

Use of high explosives for shells.

Increase of the length, and therefore of the capacity, of shells.

Employment of field howitzers or mortars.

Increase of the muzzle velocity of guns.

Increase of the amount of ammunition carried.

Probable employment in the future of quick-firing guns.

In mentioning these, I have, I believe, selected for notice the most vital of the many questions connected with field artillery, but have, as many of my audience may doubtless remark, been compelled by the inexorable clock to omit such important matters as rifling, fuzes, tubes, sights, and laying, and, which I most regret, the subject of material as affecting mobility.

It only remains for me to thank you for the kindness with which you have received my unavoidably technical paper.

MR. ARNOLD FORSTER: Perhaps I may say one word on this subject. What strikes me most is this, having very carefully read this paper and having heard it now, namely, how little we seem to have learnt from the experience gained in other countries compared with what might have been the case. One or two matters referred to in the lecture appear to me as excessively important for observation. The lecturer has referred to the question of high-angle fire. A short time ago I was at Okehampton and saw the firing with our two experimental howitzers which were taken there for their trials. I must say the trials at that time did not seem to me to do fair justice to the guns. The howitzers were fired against two 20-pounder experimental field guns, and they were fired not to strike objects on the reverse slope, but at objects facing the gun. Whether it may have been that the result was considered unsatisfactory or not I am not aware, but, as far as I am able to ascertain, very little has been done in carrying out the idea of high-angle field firing. At the end of last year I had an opportunity of seeing the practice with Krupp guns by the Swiss artillery when visiting the artillery practice ground at Thun. I have now seen a considerable amount of artillery practice, and when I recall the fact that these guns were many of them worked by volunteer gunners, not regular soldiers at all, the results of the high-angle fire with 30-pr. howitzers seemed to me something extraordinary. The range was from 2,000 to 2,400 yards, firing in all cases at unseen objects. Now it does appear to me that we are in a position in which practice of that kind would be even more essential than it is to the Swiss. It is easy to imagine cases in which we might be called upon to act, where we should be compelled to fire against a landing party, or against objects afloat where high-angle fire would be destructive and direct fire would be inoperative. I should like the lecturer to tell us whether anything is being done in this country to promote the study of high-angle field firing at unseen objects. It is clear to me, from what is mentioned in the paper, and from what I have myself seen in Switzerland, and also in Russia, that the system of high-angle fire is being carried out to a very large extent abroad. That brings me to another matter. The lecturer notices the uniform tendency on the Continent to lighten the carriage and limbers, and as far as possible assimilate all field guns to one pattern. In view of what I saw in Russia, I endeavoured to ascertain what would be our position with regard to the pattern of the gun for which we should have to find ammunition in case we were

engaged in any operations against a Continental Power; and, although I was prepared to find a certain variety of types, I was not prepared to find the extraordinary confusion which exists with respect both to service projectiles and service guns in India and in this country. I do not think, I must say, we are likely to suffer from one danger suggested by the lecturer, that of having our guns overcrowded. I think we should probably have always as much space to put the guns as they could possibly require.¹ Colonel Walford gives point to that observation by calling attention to the fact of the very large increase considering the normal number of guns per thousand men that is taking place upon the Continent, and he calls attention to the fact that a similar increase has not been made in this country at all. I do not know whether anything has been done with regard to another development of field artillery of which I saw an example at Moscow, that is, the adoption of the principle which we have in our own artillery, namely, the application of the plan of the screw gun to larger types of gun than those to which we are at present applying it. I saw a gun, one of the pair in use for a very long time at Plerma and which fired a very large number of rounds. It was a gun of a type very much larger than any ordinary field gun, but which, owing to the fact that it was divided into three sections and joined together upon the screw principle, was capable of being transported, and was transported where there was no railway carriage available, along with the field train and made use of in bombarding the entrenchments at Plerma. I can only say again the moral of the lecture we have heard to-day, which to me has been one of the greatest possible interest, is this—that with all this mass of information which has now been concentrated, and put before us, as far as I can make out from the study of the actual condition of our batteries,—both service batteries and what are supposed to be auxiliary field batteries—we have practically learnt no lessons from what has been done in that direction on the Continent. Major Walford spoke of the use of coal-dust in the French shell to distinguish the burst on graze. I do not know whether any attempt has been made to produce a similar effect of any of the high-dispersion shells by the introduction of any smoking product, or flaming product, which would give indication, by night and day, of the place of graze of the percussion shell.

Colonel WALFORD: There would be one great objection, namely, that it would take up the space of a certain amount of high explosive. That is, of course, the objection to using coal-dust as in the French shrapnel; for you must give up a portion of the bursting charge in order to put in some powder which may smoke, while this implies that you reduce the power of your missile.

Major W. J. ROBERTSON, R.A.: I should like to draw attention to one point. Colonel Walford says, "Some of you may, perhaps, have remarked that neither of the two Powers proposes to use the new shell against troops in the open, each apparently preferring to trust to the well-known effect of shrapnel." I am afraid I shall stand in a minority here and elsewhere; at the same time I should like to throw a doubt on this "well-known effect of shrapnel." I am not aware that it has been tried and found to succeed in actual warfare, and I am perfectly certain, with regard to horse artillery at least, if not in many cases with field artillery, that there are occasions when shrapnel will fail, either because there is not sufficient time to regulate and to set the fuze, or on percussion, because it has not many of the qualifications that a simpler filled shell with a larger bursting charge would have. This I think would be *more particularly* found with regard to firing at cavalry.²

¹ Some of the best of our so-called auxiliary field batteries have *one* wagon for four guns. Many other batteries have *none*. The guns, therefore, might, of course, just as well be in the Patent Museum, or at Madame Tussaud's, as far as any practical use in time of war is concerned.

² I here used the words "more particularly." Colonel Walford, in his reply, asked me if I did not attach too much value to the rôle of artillery fire against cavalry. I do not think I do. I attach, it is true, overwhelming importance to the cavalry that drives back its opponent in the initial phases of the struggle, but I have little faith in shrapnel when fired in great haste or feverish excitement, and I believe many rounds will come under one or other head of this category.—W. J. R.

During the late Cavalry Manœuvres in Berkshire we constantly were in action, drawn up in a certain place, expecting cavalry suddenly to appear. All of a sudden we got a glimpse of them. I am perfectly sure, if we had a man-killing shell of a simpler construction with a bigger bursting charge, we should do a great deal more damage than with shrapnel, either with a time fuze or percussion fuze. Then, again, you talk of moral effect, but, undoubtedly, to the cavalry soldier moral effect has a great deal to say. There is a great noise made by common shell bursting among horses; it upsets them and disturbs them. We look, as artillerymen, to the moral effect of artillery from our own point of view, from our end of the range. We forget the noise made by common shell bursting. I have mentioned before, and I may mention again, that once in India, in order to test the matter I took a horse, well known in the battery to absolutely mind no noise of firing. I took the horse into a covered butt, where he was quite close to common shell bursting, and it was absolutely impossible to hold him—the horse was frightened out of his wits. I am perfectly certain we should be wise if we paid more attention to issuing a shell in place of common shell, because it appears that the steel common shell which we use would be absolutely useless as a man-killing weapon; it would break up into far too few pieces to be of use. Therefore, I stand here to-day as a pleader for a man-killing shell, more in the form of a ring shell or segment shell, with large bursting charge. I have not had the opportunity of reading over the lecture previously. There are many points I should have liked to have spoken upon, but I do not feel sufficiently rash to speak upon them after simply having heard the lecture read.

Colonel WALFORD (in reply): The first remark made was with regard to the field howitzer and the practice at Okehampton. I was not at Okehampton during the year in question, but I saw the whole of the record of the practice, and I know, as a matter of fact, that what was attempted there was to test the comparative value of howitzers and 20-prs. in breaching a parapet. I confess that I think all shell which are employed in breaching parapets are absolutely thrown away. The enemy puts up a parapet with the object of inducing you to fire at it and not at him, and I consider that the proper way to use your gun is to endeavour to kill men and not merely to injure material. I think that we have in the past made a great mistake throughout, in field artillery, in siege artillery, and in coast artillery, in that we have persisted in trying to break through and destroy inanimate matter, instead of giving our whole mind to killing men. There is no greater mistake, in my opinion, than to use a howitzer to shoot at a parapet; you want rather to hit the people behind the parapet. For similar reasons I should never attempt to destroy a gun-pit with common shell, but should strive to kill the gun detachment without expending time in destroying the gun-pit. With regard to the practice of the Swiss artillery, I was present at the Swiss Manœuvres in 1889, and also at their practice at Thun. At the time I first saw them they had been eight days in training, not having been out previously for two years. I have no hesitation in saying that I have never seen better practice. In the last number of the Journal I published a paper, which was sent to me by Colonel Schumacher, the Chief Instructor of the Swiss Artillery, on the subject of practice carried out in order to ascertain the effect of artillery fire on different formations of infantry, cavalry, and artillery; if any one of you will read the record of that practice, you will say, I think, that some portions of it are as good as anything you have ever seen in the matter of time and in rapidity of fire, while the effect was very remarkable. This I believe to be, to a great extent (and perhaps Major Robertson will be glad to hear this), due to their use of ring shell. I saw one case, where 6 ring shell and 12 shrapnel were fired at 40 infantry at a range of 1,830 yards; these 18 shell gave 936 hits, or 52 hits per shell. Of the 936 hits about 200 were due to the 6 ranging shell, of which only three were effective, since the others burst beyond the target. After such results very little can be said against ring shell. With regard to whether we ourselves are trying any form of howitzer, I may say, that we have, at the present moment, a quick-firing howitzer under trial, but whether it will ever be introduced for field artillery I can offer no opinion. I think that Mr. Forster suggested that I should make some comparison between the work that is being done on the Continent and the work that we are doing here. I am afraid, much as I

should like to make comparisons, that I cannot very well, in my present position, do so in public. I have carefully avoided, in the whole of my paper, making any comparisons; I have stated all the facts I possibly could, and left the comparisons to you.¹ With regard to the "screw" gun, Mr. Arnold Forster mentioned that the Russians had a screw gun at Plevna. The only gun of which I have any knowledge was an 8-inch gun, which was used during the siege of Rustchuk; this was a screw gun, and was capable of division into three parts. One thing particularly struck me in the report of this gun; it was said that it had only been tried at short ranges, never having been fired over 5,300 yards; that appeared to be a very fair range. I may say that I think we have a better system for large guns than that then used by the Russians. We had a gun in use last year which can be taken to pieces without any difficulty, and which is on a stronger system than the Russian. I am not at all sure that Mr. Arnold Forster is not a little disposed to over-estimate foreign artillery as compared with our own. I am inclined to think that, so far as material goes (I do not say projectiles), but as far as the gun and carriage are concerned, we are ahead of the rest of Europe; I do not state this with any particular desire to claim perfection for our equipment, and I should deprecate any cessation in our efforts to advance, but I feel that the rest of Europe is knowingly behind the times, and I think that the majority of their guns are really obsolete.² Major Robertson spoke of the effect of shrapnel. It is perfectly true that shrapnel has not been tried in war, and I quite understand the objection to the use of time shrapnel, as requiring time and also great steadiness in action. He desires some other projectile to use against cavalry. I do not know exactly how to put my meaning, but I would ask Major Robertson himself (perhaps that will be the fairest way), whether in this, as in other points, he does not think, perhaps, a little too much of horse artillery, solely in connection with cavalry. After all, if we cannot beat cavalry with horse artillery, there is more important work for horse artillery to do. We can beat infantry; if we can get the best possible projectile against infantry, we should, I think, be prepared to let the cavalry take care of itself; or, if we cannot do better, then to wait until the cavalry come within case range. I do not think I would alter my projectile, if it were effective against infantry, for all the cavalry in the world. A battle, after all, is won by infantry, and it is the infantry which the artillery must stop or beat down. I should agree with him that, if you are compelled to fire percussion shell (and there undoubtedly are circumstances under which you *must* fire percussion shell), that you would do better with ring shell than with percussion shrapnel, and I should myself prefer to have a ring common shell and a shrapnel shell with the burster in the base. This, however, I give only as my personal opinion, and I fully realize that a very large number of Officers, for whose opinion I have a very high esteem, are totally and entirely opposed to both these suggestions. I do not feel entirely convinced that the effect of percussion shrapnel would not be sufficient against cavalry, even putting aside the question of the introduction of ring shell; for this reason, that in my experience, and, I believe, in that of most others, percussion shrapnel is generally used under the most unfavourable conditions, that is to say, it is employed either against troops under cover, such as a shelter trench, for which it is wholly unsuited, or it is used against a line of skirmishers in the open, or a line of dummies in the open,

¹ It has since occurred to me that the audience may have presumed, from my words, that I intended to imply that such comparisons, had they been made, would have been entirely to our disadvantage. This was not at all my meaning, nor is it by any means the case. The reason for my reticence was that, in order to make a full comparison, I should have been compelled to make public matters which are still in an experimental stage. No one realizes more clearly than I the astonishing advance which our field artillery has made during the last five years.

² Our 12-pr. gun and carriage are, in my opinion, in advance of those at present used by any other nation, and mark, in some degree, the direction in which the progress of Continental artillery material will take place. So far, this is satisfactory; but we must take care that, when the great artillery re-armament takes place, we are not left behind to an equal degree.

for which again it is wholly unsuited. If, however, you take cavalry soldiers on their horses, averaging 8 feet in height, and put them in two ranks, in the front of a troop or of a squadron, and burst a percussion shrapnel on graze 15 yards short of that front, you will, I feel sure, make a very considerable hole in that troop or squadron. I have never seen percussion shrapnel tried against what I should call a fair cavalry target. There are, I believe, no other points which call for remark from me.

General J. T. WALKER, C.B., late R.E.: It is much to be regretted that we have so small an audience to hear this very excellent paper. It happens, unfortunately, that the day chosen is one on which it is not usual to have lectures delivered in this Institution,¹ and it also happens to be the very day on which a lecture on some subject of the same kind is taking place at Woolwich: therefore, there are not as many persons here as one would like to have been present to have joined in the discussion, which is usually one of the main features, and one of the most interesting parts, of the proceedings. I think, therefore, I can do no more than convey your cordial thanks to Colonel Walford for the excellent paper which he has read to us, and I hope that it will lead, in the long run, to the extension of the amount of ammunition with English batteries, which he has shown in one of the valuable tables illustrating his paper is so lamentably short of the amount that is furnished to all the batteries in Europe. I am sure you will all join in giving Colonel Walford your best thanks.

¹ The day was chosen to meet the convenience of the lecturer.—Ed.