WEAPONS AND MUNITIONS OF WAR

PART I

INFANTRY WEAPONS

BY

CAPTAIN CHARLES CRAWFORD,
20TH INFANTRY

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SMALL ARMS

HISTORICAL NOTE

The use in war of crude hand fire arms such as the arquebuse and match-lock began during the latter part of the 14th century. They gradually increased in importance and in the last years of the 17th century, gave place to the flint lock musket. The latter was the infantry small arm for about a century and a half. Brought into England about 1690 during the reign of William III, it had been developed on the continent and was thereafter used in the wars of the Spanish Succession, of Charles XII, of Sweden, of Frederick the Great, the wars of the French Revolution and the Napoleonic period. Officially the British regulations permitted its use at 200 yards, but 150 yards was a long range for it, and only within 75 yards was was it an accurate weapon. Battles were fought with soldiers massed in dense formations, yet in the great battles the weight of ammunition expended amounted to one or two times the weight of all the killed. Battles were fought at very close range. During our Revolutionary War we hear of the Americans advancing until they could "see the whites of their enemies' eyes" before they fired. This must have been between 50 and 70 yards. Americans have always favored rifles. Our use of them in the Revolution and in the war of 1812 gained for us in Europe the enviable reputation of being with the Swiss, the most dangerous of enemies. However our rifles did not prevent our being beaten by the "Brown Bess" in the hands of British reg-

ulars on nearly every fair field on which we met. The difficulty of loading the rifle after it was fouled prevented its adoption generally, until the advent of the Minie bullet.

CALIBER.

The first muskets were from 8 to 10 guage caliber; that is, 8 to 10 lead balls of a size which fitted the bore, weighed a pound. Later these calibers were reduced to about .65 inches.

BAYONET.

About the time the flint lock musket was adopted by the military world, the bayonet was invented. At first it was an iron rod or blade fixed to a shaft, and this shaft when the bayonet was in use was in serted in the bore of the musket.

The socket bayonet in its present form was first noticed by the English during the reign of William III when a body of troops ordered to charge a French regiment was surprised to see the latter, with bayonets fixed, fire a volley at them. Thenceforth the bayonet replaced the pike.

DEVELOPMENT OF SMALL ARMS ABOUT 1850.

About 1842 the percussion lock and cap were introduced into all military services. About ten years later came the Minie bullet which greatly increased ranges of accurate fire and changed all muskets into rifles. In the Mexican war the percussion cap was used, but this was before the introduction of the expanding Minie bullet.

The following table giving the results of firing at a target six feet high and twenty feet broad, illustrates the shooting qualities of muskets used before the middle of the 19th century as compared with the improved rifles adopted by all countries between 1850 and 1860.

RANGE IN YARDS	SMOOTH BORE MUSKETS PER CENT. HITS	MINIE RIFLES PER CT. HITS
100	74.5	94.5
200	42.5	80.0
300	16.0	55.0
400	4.5	52.0

CIVIL WAR.

The small arm of the civil war was the muzzle loading rifle musket adopted in 1855.

Weight of arm complete.....9.9 pounds
Weight of projectile.....550 grains
Initial velocity.....960 feet per second
Caliber.....58 inches

Beyond 200 yards this weapon was very uncertain against individual objects as the deviations of the bullet were so great. It was effective against broad deep targets at 1000 yards but was hardly ever used until the objective was within 400 yards. Usually the fire fighting took place from 300 yards down to 75 yards, more often at the shorter range than at the longer.

THE SMALL ARM RIFLE AND ITS TACTICAL USE

Chapter I.

THE ARM.

The end of all warfare is attained by breaking up and destroying the enemy's forces in battle, and the chief instrument used is the small arm rifle. The comparative unimportance of all other devices for inflicting harm upon an enemy is shown after every battle. The casualties inflicted by the small arm are from five to fifteen times those inflicted by any other weapon. In the wars that Prussia had in 1866 and 1870 the rifle accounted for six times as many as did the artillery and twenty times as many as fell from bayonet and sword wounds. Statistics in the Civil War when kept, gave 90.1 per cent of wounds from the small arm, Since these wars, the proportion does not seem to have changed very much, for the only reliable information coming from the Russo-Japanese War in Manchuria does not greatly alter these percentages.

The chief of staff of General Oku's army gave Major Morrison, U. S. Attache, the following percentages for that army in the battle of Lio Yang, with the statement that the percentages in other battles did not vary materially from these. The army was exposed to artillery fire throughout the whole battle.

Losses from infantry fire....91.35 per cent.
Losses from artillery fire.....7.99 per cent.
Losses from bayonet and sword..66 per cent.

No accurate statistics such as the preceding, coming from the Russians are available. Two statements having the appearance of reliability are those of Colonel Hoff, U. S. Attache, and Captain Soloviev, 34 East Siberian Rifles. Colonel Hoff says, that of the wounds inflicted upon the Russians, 80 per cent were from infantry projectiles, 20 per cent from artillery and from other causes negligible. Captain Soloviev gives the casualties due to infantry fire as 85 per cent of the total.

The losses of a beaten army as compared with those of the victors show a greater proportion due to artillery because, after the line breaks the enemy's artillery finds the mass of soldiers fleeing without thought of cover or dispersion to be its most favorable target.

Some observers of the Russo-Japanese conflict were much impressed with the power of modern artillery, and were inclined to believe that the relative importance of artillery had greatly increased in late years. None of these officers gave statements showing the actual casualties made by different arms, their reports apparently reflecting their impressions only.

Infantry fire and the losses resulting therefrom have much less moral effect on the battle field than fire and losses from other arms.

The small arm rifle is a combination consisting of:

1st. A projectile-throwing weapon.

2nd. A stabbing pike.

Since small fire arms first became a factor in battles about five hundred years ago, the fire action has been constantly improved, especially in late years, until there is little comparison between the power of the small arm of today and that of even seventy years ago.

THE BAYONET.

On the other hand, the bayonet is the same as when the pike was first fixed to the musket about two hundred and fifty years ago. While the total of the casualties resulting from the bayonet in war is insignificant, the moral effect of training a soldier to advance upon the enemy until he can use the bayonet and the demoralizing effect upon the enemy of a bayonet charge make it very important to have this adjunct to the rifle. As a stabbing weapon alone it is inferior to the old pike. In fact, the soldier of today, armed with the modern rifle and without ammunition, would be unable to cope with the old Roman soldier carrying his shield, javelin and short stabbing sword.

Napoleon said "Fire is everything, all else amounts to little." However, war after war demonstrates that an enemy can not be overcome by fire alone when delivered at a distance; for he can shelter himself by accidents of the ground or by working a few minutes on intrenchments, and no amount of fire can reach him so long as he does nothing but hide and shield himself. Therefore, infantry* must advance and win the fight by putting their adversaries to flight or stabbing them with hand weapons.

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*In this text whatever is said of infantry applies equally to cavalry dismounted to fight on foot. Cavalry are armed with the same weapon but without the bayonet. They are given the same course in target practice and the cavalry drill regulations prescribe a *charge* as a culmination of the dismounted attack. Some cavalrymen object to the bayonet on the rifle and to the charge dismounted. The objection is probably prompted by a desire to simplify the action of mounted troops which now employ four weapons. The objection to the bayonet is not convincing, as it is no inconvenience to carry, and a cavalryman fighting on foot will, at the proper time, charge anyway, although he may have nothing but his clubbed rifle when he closes with his enemy. Of course he could use his pistol in close quarters but it is believed that few American cavalrymen in such a dilemma would throw away their rifles for the smaller weapon. Cavalry dismounted always seek to make the enemy believe that infantry opposes him.

The enemy may give up the fight either surrendering or running away, but until he does, the advance must be made in order to kill or disarm him and to take the ground he holds. Every effort of each individual of each arm must be put forth to compass this end.

If the object of the attack is to advance and engage the enemy hand to hand, the question may be asked, is it neccessary for the attacker to fire at all? The answer is that it would be better for the attacker to advance without firing if it were possible to do so in the face of the unmolested fire of the enemy. The attackers, advancing toward the enemy, expose themselves to the view and fire of the defenders and the latter, in turn, to fire upon the attackers must expose themselves. The attackers fire action upon the defenders kills and wounds a certain number of them, frightens and excites them and this causes derangement of their aim and lessens the volume of the fire; and all this makes it possible for the attackers to advance.

To obtain this necessary demoralization of the enemy the attacker's bullets must hit a number of their men, but the soldier on the offensive must keep in mind that his first and most important object is to advance close enough to deliver a bayonet attack and that his fire is but a means to attain this end.

This idea must be very strongly impressed upon the minds of men who have a great deal of target practice and little maneuver training; also upon men who have little training of any kind such as will make the war armies of this country. The belief among infantry soldiers that victory can be won by firing at the target which the modern enemy makes at an unknown but distant range, will be fatal to any army.

KINDS OF RIFLES.

The rifles of great military countries are much alike. They are of the bolt system, caliber from .25 to .32 inches, loaded from a clip or magazine, though serviceable besides as a single loader. The clip or magazine carries from five to ten cartridges. The arm weighs from 8½ to 10½ pounds and fires a bullet with an initial velocity varying from 2000 to 2900 feet per second.

The latest improvement that has been made to the arm is by the Germans and is being copied by other nations. This improvement reduces the weight of the bullet of the .311 rifle to 154.3 grains and increases the initial velocity to about 2900 feet per second. The Germans thus get a continuous dangerous space, when the muzzle is at the ground, for a man 5 feet 9 inches high, standing, of slightly more than 700 yards. In arriving at this result they have changed the shape of the bullet and used a more efficient powder. One of the greatest advantages of the new cartridge is that the ammunition is so light the soldier can carry one fourth as much more as he did formerly.

THE PRESENT RIFLE.

The U. S. Magazine rifle model 1903 has 90 component parts. Caliber, .30 inches.

Length of barrel, 24 inches. Rifling.—A uniform twist of one turn in 10 inches. There are 4 grooves each .004 inches deep.

Weight of rifle without bayonet,	8 lbs.	4 oz.
Weight of bayonet,	1 "	1 "
Weight of bayonet scabbard,		10 "
Total	9 "	15 "

The bayonet is of the knife pattern 16 inches long, sharpened on one side.

The rifle is loaded from a clip holding 5 cartridges. The cartridge belt is divided into 9 compart-

ments each holding two clips; total capacity, 90 cartridges.

AUTOMATIC RIFLES.

Experiments have been going on since 1900 to perfect an automatic rifle made on the principle of the Mauser pistol. One that will fire ten shots without reloading and, will require a separate pull upon the trigger by the finger to fire each shot, is sought.

Each shot fired from a small arm must be aimed, because the recoil and the flash will always throw the sights off the target. Aside from rapid loading and consequent rapid firing, the automatic rifle has the important advantage of reducing the fatigue of firing. Firing a number of rounds from a prone position is exhausting work when using the clip or magazine; for after each shot the body must be partly rolled over on the left side, the weight of the rifle shifted to the left hand, the right arm raised to force the bolt backward then forward, and the original position again resumed. One is under a strain in the prone position anyway, and so fatiguing is all this that the men in a firing line, advancing to a position from whence they can assault, will be almost exhausted physically, for they each will have fired from 100 to 150 cartridges.

The objection to such a rifle will probably be: (1) the complexity and weight of its mechanism; (2) the necessity its use will entail of increased fire discipline.

Then, too, the more complicated the arm and the more ammunition it can fire per minute, the greater will be the need for having a highly trained soldier to use it.

The manufacture of such an arm seems feasible and its use advantageous, but so far, little attention seems to have been given it by others than inventors.

MACHINE GUNS.

The rifle caliber machine gun is a more or less intricate mechanism to produce infantry fire. It is carried upon wheels or upon a pack animal and requires an appreciable length of time to come into action.

Firing from a wheel mount or from a tripod it can deliver 600 shots per minute, so that it is equal in fire effect to about 60 men. Its advantages are:

1. By it a rapidly concentrated fire effect can be secured and controlled.

2. It is easily concealed, especially when mounted on a tripod and used close to the ground.

3. It can be used as a range finder; the strike of the rapidly-delivered fire being visible when the strike of ordinary fire of infantry could not be seen.

Its disadvantages are:

1. The length of time required to come into action.

2. The noise it makes which reveals its locality.

3. The fact that it can be used at a halt only.

4. Inability to keep up a long sustained fire.

Whether machine guns should be distributed among the smaller units of a command, one to each battalion for instance, or whether they should be concentrated into sections or batteries and used together like guns of a battery of artillery has not been decided. The prevailing military opinion in Europe favors concentrating them into sections of about six guns each and attaching these to battalions or regiments. Operating more than six guns together is not favored because grouping the guns draws artillery fire. Our plan is to distribute them among regiments organized so that they may be grouped by order of brigade or higher commanders.

Machine guns are better adapted to defensive than to offensive action because their fire cannot be

delivered while advancing as can infantry fire, nor can they compete with artillery in length of range. It is believed that about two machine guns per thousand infantry should be provided, although no rule fixing the proportion can be prescribed because we have not had sufficient war experience to determine the exact place of the machine gun in tactics.

THE MAXIM AUTOMATIC MACHINE GUN, CALIBER .30, MODEL 1904.*

The United States has officially adopted the Maxim automatic machine gun for service. It is adapted for mounting upon either a tripod or a two wheeled carriage. The former mount is issued for use by troops in the field and the latter for use in and around sea coast fortifications. In both mounts the parts connecting with the gun are alike, so that guns are interchangable with mounts of both types. The ammunition used is the same as that for the U. S. magazine rifle, caliber .30. model 1903.

In this gun the force of recoil is utilized to open the breech, to extract the empty case, and to insert and fire the next cartridge. The cartridges are held in a canvas belt which is drawn transversly through the casing of the gun by the action of the feed mechanism. When the gun is fired, the barrel and lock move to the rear a short distance. At the end of this recoil the lock is drawn back from the chamber, thus opening the breach and at the same time drawing a loaded cartridge from the belt and extracting an empty case from the chamber.

The barrel is chambered and rifled the same as the U. S. magazine rifle, model of 1903.

The water jacket consists of a piece of drawn steel tubing holding twelve pints of water. With rapid fire 750 shots may be fired before replenishing the water. Thereafter it is necessary to add six pints of water for each 500 shots.

*A full description of this weapon is to be found in the "Handbook of the Maxim Automatic Machine Gun" in the Staff College Library.

THE REXAR RIFLE.

Inventors are now working on a device having a combination of the principles of a rifle and a machine gun; the Rexar rifle is a type. It weighs 17½ pounds and can fire 300 rounds a minute. It is like the rifle in that it is fired from the shoulder but its weight is such that the person firing it must take a prone position.

For infantry its advantages over tripod types of machine guns appear to be neither many nor important, although its portability may make it of great service to cavalry. Any machine gun carried on a pack horse yet not impeding the movement of the cavalry it supports should be a great factor in the operations of this arm; for a small number of men with machine gun fire can defend a line or a position which otherwise would immobilize a large number of troopers. The cavalry men thus set free increase the force which can utilize the mobility of the arm or engage in mounted action.

QUALITIES SOUGHT FOR IN RIFLES.

In seeking to improve rifles we look primarily for the following qualities:

1. Flatness of trajectory.
2. Power of rapid loading.
3. Accuracy of sighting.
4. Minimum weight of cartridge.

A flat trajectory is valuable because we thus avoid the necessity of knowing the range accurately, and do not have to be changing the sight constantly as the range varies. The U. S. magazine rifle, model, 1903 with the sight set at 500 yards, has a trajectory flat enough to make a change of sight unnecessary within that range if aim is taken at the feet of the enemy who is erect. That is, we have an arm that does not require a change of sight after the

charge begins. If however, we fire at an enemy who is prone or kneeling, the sight should be set at the proper range however close he may be.

Long range and penetration are qualities that accompany a flat trajectory. The rifle will shoot to a greater distance than we will ever use it; therefore we are not seeking to improve its penetration. It will pass through the bodies of five men at 100 yards range, three or four men at 400 yards and two men at 1200 yards. A stockade or, generally speaking, a tree is no protection.

The value of rapid loading is to lessen the time during which the rifle is not ready to fire and not to lessen the time for aiming. The time for aiming can not be reduced, and the soldier should be taught that all unaimed fire is useless.

Unless the rifle is sighted to shoot exactly where held the soldier loses confidence in his ability to hurt the enemy.

The lighter the cartridges the more of them the soldier can carry, an important consideration since the soldier, when he goes into a fight, must carry enough to last him until night.

Lightness of weight of rifle, absence, of recoil a bullet producing shock enough to stop the man or horse it hits, simplicity and durability of mechanism, are qualities of importance altho secondary to the first four mentioned.

RAPID LOADING DEVICES.

In peace experiments the rapidity of fire of a well drilled soldier using his rifle as a single loader about equals that of fire from a magazine or from a clip loader. Nevertheless, the use of the clip loader is favored. The battle experience of the soldier differs from that of the peace test in that the attention is diverted from the process of loading and is kept

fastened on the enemy. Many things must be observed in a fight; if we can divide by five the number of times the mind directs the hand to the belt for cartridges and places them in the rifle, a distinct gain has been made. Then again, to fire the rifle rapidly as a single loader would give a regular fire of uniform intensity, while the better plan is to expend our ammunition so as to bring short destructive storms of fire (rafales the French call them) on the enemy at intervals of time which will find him unprepared for them and take him by surprise. Clip loading facilitates this kind of action; it could be made much easier by the use of an automatic loading rifle.

Loading by clips should be a valuable aid in maintaining fire discipline. Unless firing is conducted by volleys, men once permitted to fire cannot be made to stop it. A continuous rattle is kept up, the voice of command is drowned and so long as danger threatens nothing can be done. By training the men to load at command only, we can insure silence on the firing line at intervals after each five rounds. This silence permits officers to give orders and to see that they are understood. It is believed that only in the rarest cases would the pauses between each five shots be disadvantageous.

THE EFFECT OF THE SLOPE OF THE BEATEN ZONE ON THE VALUE OF FIRE

Chapter II.

CONE OF FIRE.

In studying the effect of fire in battle, we do not consider a single shot but all the shots fired from one rifle or all the shots of a group of men whose fire can be controlled by a single commander. No two shots fired at a distant target follow the same path.

If we consider the space outlined by the paths or trajectories of all the shots fired from one place at the same target, we have a figure called the cone or sheaf of fire (Fig. 1.).

BEATEN ZONE, CENTRAL ZONE.

When these bullets strike the ground the area covered by all, except a few of the wildest shots, is called the "beaten zone." The middle part of this "beaten zone" containing 50 per cent of the bullets, is called the "central zone." (Fig. 2.).

VARIABLE SHAPE OF THE CENTRAL ZONE.

The shots of a cone of fire passing through a verticle screen or target will be distributed in some such manner as in Figure 3. Now if the target is close to the firing point, say within 1000 yards, when the bullets fall to the ground they will not be scattered so much laterally as they will be in depth. On the verticle target the bullets of the group will form, say, a circle; but when they fall to the ground, the higher shots are separated from the lower ones by

the distance the former move forward during the time they take in falling through the verticle distance separating them from the lower bullets.

At short ranges a very slightly higher elevation causes the bullet to go much farther. As the range is increased the angle of sight is increased, but the two do not increase uniformly. A particular increment in the angle of sight at short range corresponds to a particular increment in range; but at longer ranges this increment in angle of sight corresponds to a shorter increment in range.

For instance, with the U. S. magazine rifle, model 1896, caliber .30, to increase the range from 200 to 300 yards, we increase the angle of sight 6′ 8″, while to increase the range from 1500 to 1600 yards, we have to increase this angle 25′ 24″. So that errors in elevation at short ranges increase the depth of the central zone much more than the same errors would increase this zone at long ranges.

On the other hand errors made laterally cause the bullets to diverge more and more as the range increases, so that the longer the range the wider the central zone. Therefore we may say that the shape of the central zone at the shorter ranges is an ellipse with the longer axis in the direction of depth (Fig. 4,); that this axis shortens as the range increases while the lateral axis lengthens. The shape of the central zone becomes a circle at some longer range (Fig. 5.); and, as the target continues to recede, the circle changes to an ellipse again with the longer axis in a direction perpendicular to the range (Fig. 6.).

Colonel Mayne of the British army states that the beaten zone remains the same depth at all ranges, but that the central zone decreases with an increase of the range. Of course as the range increases, the liability of error in elevation also increases due

Fig 1

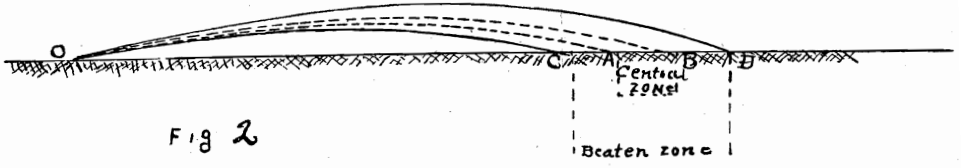


Fig 2

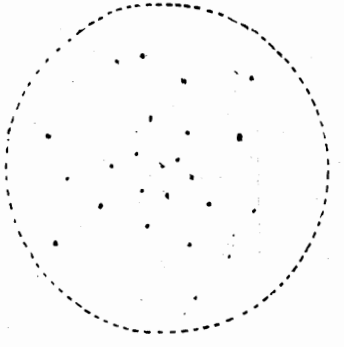


Fig 3

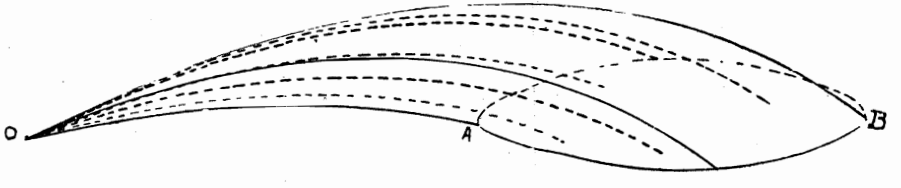


Fig 4

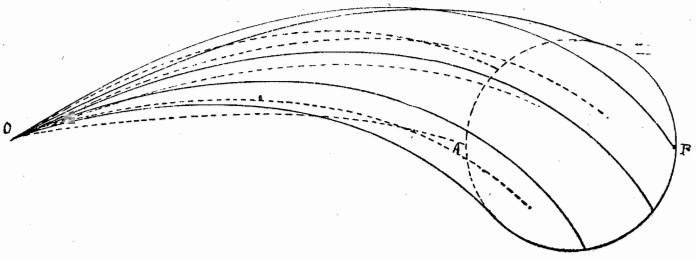


Fig 5

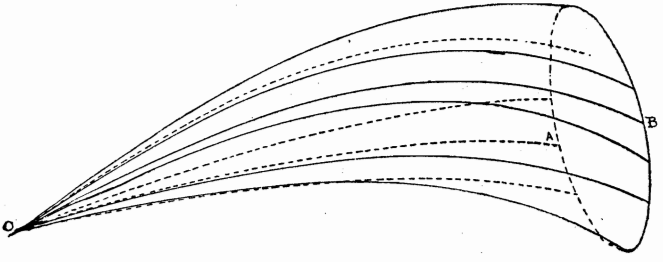


Fig 6

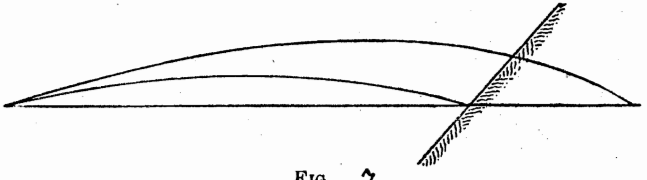


FIG. 7.

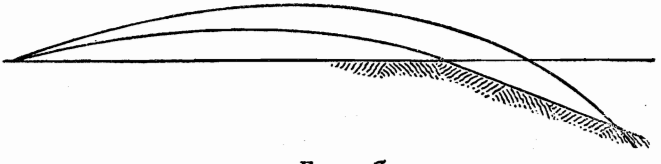


FIG. 8.

to dim eyesight and the awkward way in which the piece must be held to aim through the elevated rear sight, but all shots fairly well aimed fall within the central zone which has its characteristic shape.

INEFFECTIVENESS OF LONG RANGE FIRE.

We know that most of the bullets fall on areas of ground decreasing in depth as the range increases.

The significance of this is that the farther away the target, the more need there is of knowing the exact range in order to hit it. This, coupled with the fact that the farther away the target the more difficult it is to determine or estimate the correct range, is the principle reason why long range fire is so ineffective.

Another reason for this ineffectiveness of fire at long range is the rapid increase of the angle of fall of the bullet as the range is increased and the corresponding decrease of the dangerous space of each shot fired.

Thus the angle of fall of a bullet striking the ground at 300 yards is 19′ 25′ while at 1600 yards it is 7° 5′ 38.″

RISING GROUND, FALLING GROUND.

Unless the plane of the ground upon which the bullets fall contains the firing point and line of sight, the bullets are said to fall upon "rising ground" or "falling ground."

When the line of sight makes an angle of less than 180 degrees with the surface of the beaten ground the bullets fall on rising ground. When this angle is greater than 180 degrees the ground is falling.

Whether the ground is rising or falling depends on this angle and it is immaterial whether the beaten ground with respect to the horizontal at the firing

point is higher or lower, that is, whether the line of sight is inclined up or down.

Thus in Fig. 7, the line of sight is horizontal; the bullets fall on rising ground. In Fig. 8, the line of sight is horizontal; the bullets fall on falling ground.

In Fig. 9, the line of sight is inclined up; the bullets fall on falling ground. In Fig. 10, the line is inclined downward; the bullets fall on rising ground.

Let a cone of fire be directed on level ground covering the space betwen 1000 and 1100 yards from the target; now if the ground instead of being level, falls with a slope equal to the angle of fall of the bullet at 1000 yards (2° 46′), the beaten zone, according to computation, will be 250 yards deep instead of 100 yards.

Generally it may be said that when the ground falls away from the line of sight at an angle equal to the fall of the bullet at the corresponding range on level ground, the beaten zone is more than doubled.

Greater fall of ground of course increases the zone. Fig. 11 shows how the beaten zone varies with the slope. A cone of fire is indicated by A B C; d, e and f represent the firing line, the supports and the reserves respectively on rising ground; similarly d, e_1 f_1 and d, e_2, f_2, on level and on falling ground respectively. On rising ground the firing line alone is in danger, on level ground the firing line and the supports, while if the ground is falling all three lines are under fire.

When long range fire was first studied it was thought that important results could be obtained by indirect fire; for example, firing over the crest of a hill on supports and reserves posted on falling ground close behind. In case the enemy's supports on falling ground close behind a line that is receiving our fire we do get results, but as we do not know what these results

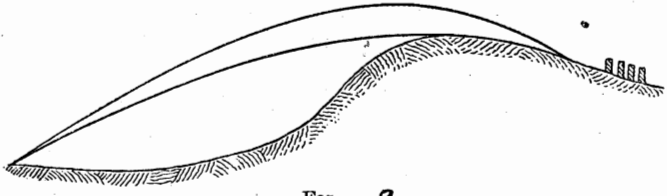


FIG. 9.

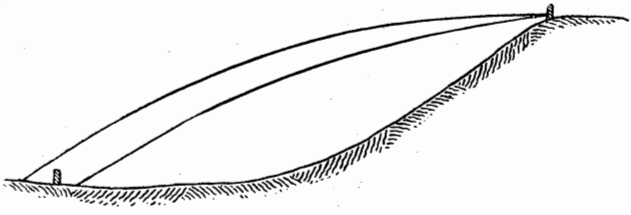


FIG. 10.

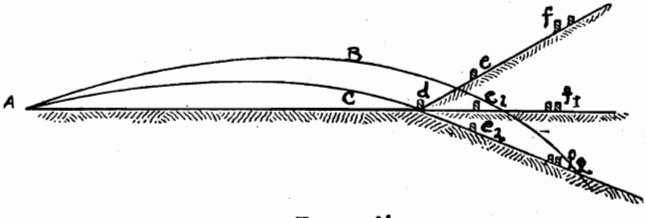


FIG. 11

are nor where the supports are posted, the value of this kind of fire is very problematical. Therefore we would not use indirect fire unless we could observe the effect and this would be in rare cases only. An exception to the general rule would be where we had obtained a position so as to enfilade a long line occupied by the enemy. Here if we knew the approximate location of his lines we would be justified in expending a great amount of ammunition though we might not see any of the opposing forces.

Artillery frequently if not habitually uses indirect fire. If the guns can be located it is proper for infantry to reply in kind and inflict damage by shooting over the crest of the hill which shelters the hostile guns.

Knowledge of the effect of the inclination of ground which receives fire is important because it enables us to place our supports and reserves so as to avoid losses from fire directed at our first line. It shows too that firing at an enemy on rising ground is disadvantageous. We should locate our firing line so as to make the enemy approach us over ground parallel to the line of sight or as nearly so as possible.

SELECTION OF A LINE OF DEFENSE ON A HILL.

To illustrate the principles governing the effect of fire on inclined ground, a discussion will be made of the proper place for a line of defense on a hill in rear of which is a level plateau. Military writers have considered three places:

1st. The crest of the hill.

2d. A position in rear of the crest, say 800 or 900 yards:

3d. A position in front of the crest of near the foot of the hill.

The normal procedure is to hold the crest. In this case the enemy, opening fire at a distance, sweeps not

only the crest but the ground in rear for some distance and on this ground we have our supports and reserves. As he approaches, the fire swept zone in the rear of the crest increases in depth, but finally the fire directed at the first line rises so high that there is a defiladed space immediately in rear. This space increases as the enemy nears the foot of the hill until finally the supports and reserves in rear of the crest are immune from the bullets. This is the time when they should be pushed forward. If a position in rear of the crest is taken, with the crest held weakly as an advanced line, these conditions as to the enemy are reversed. He would receive the fire of this line until close to the hill, when, this advanced line retiring, the main line opens on him as he appears on the crest. This fire would fall on the enemy's first line, also on his troops in rear. Moreover the fire coming from the main line would break out upon the attacker as a surprise, and if he continues the advance he must do so over ground parallel to the line of sight, not over rising ground as is the case when the crest is held.

The main advantages of the crest line are that we can always see what the enemy is doing; we can take immediate advantage of any fault he makes; we can forestall any attempt to mass troops for a sudden assault; we can bring up reserves unseen by the enemy to reinforce the firing line or to make counter attacks at opportune times and places.

If we hold the line in rear of the crest, the capture of the latter by the enemy is an easy preliminary operation, since we do not try to to defend it strongly. Thereafter his task is to attack us on level ground with the advantage of having his movements in rear screened from view if not from fire.

The present view, especially of the Germans, looks with disfavor upon advanced lines or positions

in front of the main defensive position. The troops occupying them suffer a certain amount of loss when the enemy attacks and upon their withdrawal are so disorganized and demoralized, that it is a question of some hours to assemble them and put them in condition for further resistance. The troops in the advanced line usually mask the fire of the troops in rear until the former retreat to the rear of the main position. Withdrawal of the advanced line must be at an opportune moment and to execute the movement properly is extremely difficult. The troops in the main line, seeing those in advance coming back, are sure to be more or less demoralized.

In the above discussion it has been assumed that the hills have concave surfaces. If the slopes are convex, troops posted near the crest can not see the base which thus becomes a dead angle where the enemy can reform for the final assault. Majuba hill in the first Boer war and San Juan hill at Santiago, Cuba, are among many examples of the attackers being sheltered at the base of the hill from the fire of the enemy posted near the crest.

Instances are numerous where troops attacking a fortress have found lodgement at the base of the parapet sheltered from fire, and have held on until reinforced so that they could successfully carry the work.

If the line of defense is put in front of the crest near the base of the hill we retain the view which the crest line offers and can also fire over ground nearly parallel to the line of sight. The latter condition is one of the advantages of a line situated in rear of the crest.

The firing line placed near the base of a hill is usually more easily concealed than one higher up. Several tiers of fire may be used and reserves placed just in rear of the crest on which dummy trenches

may be located to draw the enemy's fire. Moreover, the enemy in attacking is unable to use his artillery with so much advantage as when the trenches are higher up. With a trench on a steep hillside the enemy might continue his effective artillery fire on the defenders until his infantry arrived within fifty yards of the objective.

While locating the trench at the foot of a bare hill usually makes it impossible and always disadvantageous to reinforce when the enemy is close, it has the decided advantage of making the defenders hold it without hope of help or of flight. Their bridges are burned behind them.

The best fire effect is obtained when the ground in front can be seen and when this ground is grazed by the bullets. The location giving this effect is the best site for the trench if we are to fight the battle out to victory or defeat. If we are fighting a rear guard action where we wish to withdraw the firing line before the last assault, we must locate the trench so that the withdrawal cannot be seen.

INCLINED LINE OF SIGHT.

The graduation on the rear sight is for a horizontal line of sight. If, while using the same angle of sight and while the target remains at the same distance from the firing point, this target be elevated above or lowered below the horizontal, the rifle will shoot high. The bullet is fired with the angle of sight to counteract the force of gravity, which force, when the line of sight is horizontal, acts at a right angle to the line of sight. If the line of sight be inclined upwards, for example, the force of gravity will be exerted at an angle less than 90 degrees with the horizontal and will therefore deflect the bullet less from the line of fire than when the line of sight is horizontal.

Figure 12 will explain this graphically. Let A be the firing point, B the target and BAC will be the angle of sight necessary to make the bullet take trajectory AaB. Now elevate the target until it is nearly 70 degrees say, above the horizontal but the same distance from A. Using the same angle of sight, gravity will act close to the direction of the line of fire and the bullet will not go to B but to x.

In the first case gravity acts in a verticle direction with a force which may be represented by CM. This force acts on the bullet from the time it leaves the muzzle at A until it pulls it to the ground at B. Similarly if the bullet is to hit B_1 a force equal to CM which is represented by C_1S must act in the direction of C_1S perpendicular to AP, in order to draw the bullet to B_1. But gravity always acts in the same direction like C_1M_1 and only a part of this force like N_1M_1 draws in a direction perpendicular to AB_1. This amount of force NM would draw the bullet into the path Ax.

A formula for computing the range to be used with an inclined line of sight is,

$$R_1 = \frac{R \cos. (i \pm e)}{\cos.^2 i \cos. e}$$

The + sign is used when the line of sight is inclined up hill, the — sign, when down hill.

i is the angle made with the horizontal by the line of sight.

e the angle of sight when the range is horizontal.

R the actual distance to the target.

R_1 the distance the bullet will go before reaching the line of sight when this line of sight is inclined i degrees, using an angle of sight of e degrees.

With small inclinations of the line of sight and short ranges the trajectory sensibly corresponds to that of the horizontal line of sight.

Some ordnance authorities recognize this by considering the trajectories the same, according to what they call the principle of the "rigidity of the trajectory". But when ranges exceed 500 yards and the target is 10 or 15 degrees above or below the horizontal we must aim *below* a target if we would hit it. It is important to remember this in mountain warfare or when attacking or defending a high steep hill.

For example, in firing up a hill sloping at an angle of 30 degrees at a target 300 yards away we would decrease the rear sight elevation and use that for about 255 yards. If we use the 300 yard elevation the bullet would go above and about 55 yards beyond the target before reaching the line of sight.

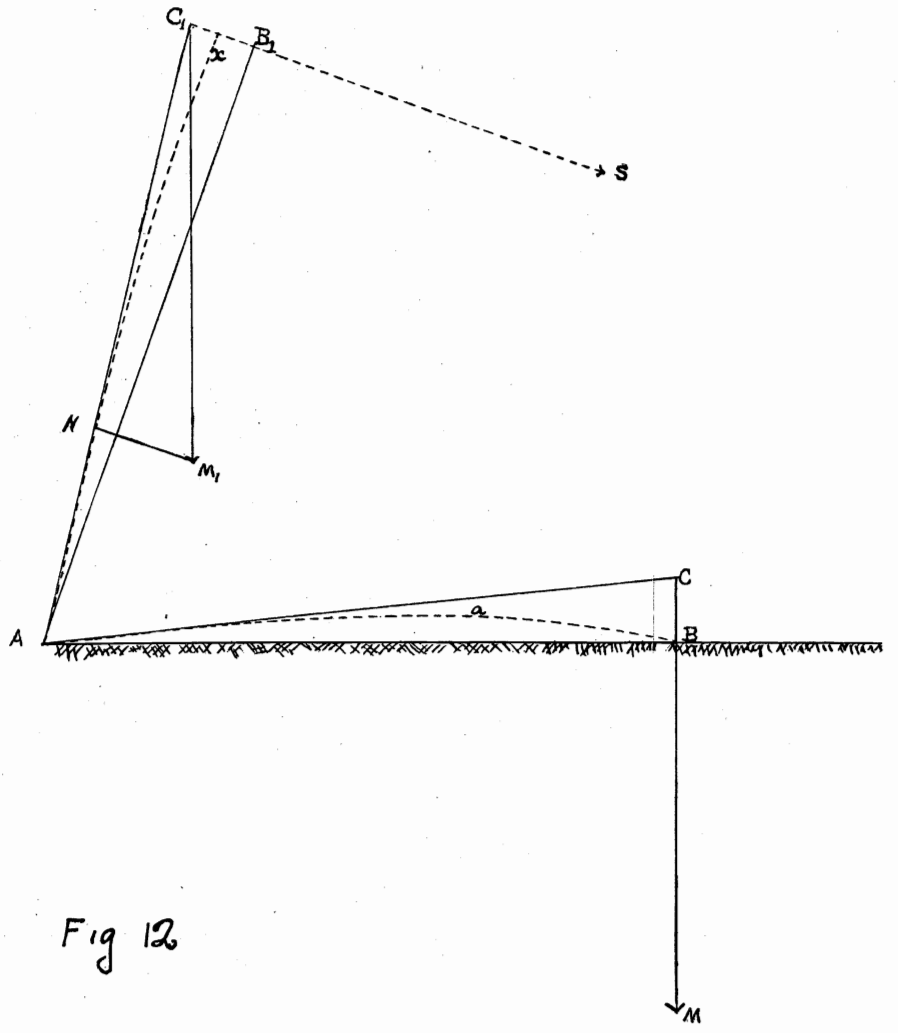


Fig 12

THE USE OF THE RIFLE IN BATTLE—IN ATTACK.

Chapter III.

Preceding a battle involving large forces there are a number of small engagements and skirmishes brought about by the hostile commanders endeavoring to obtain information of the enemy without disclosing their own position, strength or intentions. Some of this fighting may be severe, but it is between small units and the most of it is of the kind described as skirmishing. The skirmisher acts as an individual under little control; his use of the rifle at this time is not unlike target practice with moving and disappearing targets on unknown ground. He selects his own targets, judges his own ranges and regulates the number of rounds fired. A good skirmisher implies a well trained soldier and usually a peace trained soldier.

After a certain amount of preliminary fighting, one commander or the other will believe he is in touch with the main force of the enemy, or will wish to gain a certain piece of ground within the enemy's lines and will plan a decisive attack. This can be divided into the *general attack* and the *assault.* The general attack, which is by fire and precedes the assault, is made all along the line or at intervals, and is carried far enough to inflict loss upon the enemy and to hold down his reserves, but is not pushed so far that crippling losses will be incurred if the attacker must withdraw. Meanwhile, the place and time for the decisive assault have been chosen, and the troops to make it have been quietly assembled

under cover. After the general attack has progressed as far as believed best, the most violent storm possible of artillery fire and infantry fire of position, will be opened on the part of the enemy's line to be assaulted, and, in a short time, the assaulting troops are rushed straight forward against the enemy with all the impetus that can be given them.

Deciding upon the proper time and place for this assault, the volume of fire to be employed, the length of time to be given to the immediate fire preparation —which if too long will enable the enemy to bring his reserves to the place—and the formation of the assaulting troops is the supreme test of fighting leadership.

FIRE DIRECTION, FIRE CONTROL.

The supervision exercised over infantry fire in the attack may be considered from two standpoints: (1) those who have general direction of it; (2) those who immediately control it.

Fire direction is exercised by company commanders and officers superior to them; *fire control* by platoon, section and squad commanders. It is difficult to divide up these two subjects into their elements and they will be discussed together under the following heads:

1. Proper time to open fire and long range fire.
2. The target.
3. Range to be used, Range finders.
4. Kind of fire.
5. Rapidity and amount of fire.
6. Density of firing line.
7. Advance of firing line.
8. Assault.

TIME FOR OPENING FIRE, LONG RANGE FIRE.

In making a frontal attack, the range at which the attacker should begin firing depends upon many

circumstances, and the most definite rule that can be prescribed is that the fire should not be opened until one is compelled to do so. Attacking implies a superiority in numbers and morale at the point of assault and if the enemy is intrenched, as he always will be unless the collision is unexpected, this superiority must be in numbers varying from a little more than equality to five times that number; and even then, there is no certainty as to the outcome. With this superiority, if neither side could fire, the attacker must surely and quickly win.

However the advantages of the defensive, enumerated in Field Service Regulations, are so great that this superiority in men, formed compactly so as to be easily handled can not advance through the defendents field of undisturbed fire. It is therefore required of the attacker, (1) that he disturb the defenders aim by firing at him, thereby rendering his fire less effective; (2) that he adopt a formation less compact, that is, deploy in line of skirmishers. The first requisite is called gaining a "superiority of fire" and is absolutely essential to victory.

Efficacy of fire depends upon its accuracy, its direction with reference to the objective and its volume.

The direction from which fire comes is most important. In battle the casualities caused by enfilade fire are at least twice that caused by a fire coming from the front. The effectiveness of such a fire however depends upon moral consequences. The mind is constituted so that it cannot endure unseen dangers. When the enemy is in front all the attention of the soldier is fixed upon him alone. If then the soldier finds that bullets are coming from the flank, he apprehends the impossibility of opposing two enemies at the same time. He loses confidence in the situation which he conceives should protect

him from such a dilemma, discipline is destroyed and organization broken up.

Superiority of fire may be obtained by artillery fire alone, by infantry fire alone or by their combined fire. The necessary volume and accuracy of fire required is variable; it must produce such derangement of the enemy's fire as will enable our firing line to move forward. A very light fire delivered accurately may suffice, if the enemy's line is held by a small force whose morale is low; while if the defenders are a numerous body of skillful veterans with excellent artificial protection, a torrent of fire many times that of the defender's may be poured upon them for a long time without producing any appreciable effect.

The character of the ground of course effects the time when we must fire upon the opposing troops. If it is sufficiently broken, we may clear away the enemy's skirmishers and patrols with a few men likewise employed, then bring our assaulting troops, by a more or less winding course to keep them under cover, to within a few hundred yards of the enemy's main position. Here they are deployed and the real fighting begins. Most battle grounds have some cover and it is utilized to the utmost to shorten the range of opening fire.

If but little cover exists, the attacking troops will come under the aimed long range artillery or infantry fire; this will cause them to deploy, first, from column into line of battalion or company columns, and afterward into line of smaller sized columns, then into line and finally into line of skirmishers. At what ranges these deployments are made cannot be laid down even within limits, for they depend upon so many conditions, the ground, the light, the visibility of the troops, etc. The judgment of the commander must govern, remembering (1) that the troops must

be kept in close formation as long as possible, (2) that these close formations must not be seen and become a target for the enemy's effective fire.

The advancing skirmish line will reach a point where the enemy's fire permits it to go no farther without suffering a serious crippling loss, and this is the point where we must begin our firing. This is a vague and indefinite rule but a more precise one can hardly be given.

The time will often depend on the mental state of our own men. If it is their first time under fire, the sound of the enemy's artillery and infantry projectiles with other distracting sounds and sights will keep the soldier's attention fixed on his danger, so that if he is given nothing else to think about, his mind will gradually be worked up into such a condition that every other thing except danger and dread of death disappear from it, and panic ensues. A remedy for this phenomenon of the intellect is to keep the soldier's thoughts employed in *doing something.* Thus we read that European soldiers who were advancing under fire against the enemy were often made steady by being ordered to do the "goose step" or parade step; in the Civil war, regiments in similar situations were put through motions of the manual of arms. With a skirmish line nothing of this kind can be ordered so we have the men fire at the enemy and "shoot up their pluck" as the British say. This kind of fire will not do the enemy any material harm and is not warranted when troops are well drilled or when they have been accustomed to fire.

If the enemy appears in large compact bodies we should not lose opportunity to inflict loss upon him. Masses large and dense enough should be fired upon without hesitation at 2500 yards distance, for the rifle will kill that far away.

With steady troops, conditions favorable to the defender may halt the skirmish line and make it open fire as far back as 1500 yards. Bronsart von Shellendorf, one time German minister of war, states that skirmishers should be led forward to within 650 yards of the defender without replying to his fire. Colonel Mayne of the British army states that the English were unable to get closer than 800 yards to the Boer trenches before shooting back at them. Then too, the range will be shortened in direct proportion to the amount of artillery fire that can be concentrated on the defenders. Colonel Mayne states that the lack of artillery was the reason that the English could not approach so close as the Germans believe they themselves should do. But the Germans counted on having 6 guns, (slow fire), per thousand men while the English used 3 guns per thousand against the Boers. Generally it may be said, that if we cannot get up well within a mile of the enemy without being forced to open fire, the chances that this firing line will succeed in the attack are very small.

LONG RANGE FIRE

The percentage of hits that any rifleman can make on any target decreases rapidly as the range increases. In the years 1903 and 1904, the average percentage of hits made in the army, collective rifle and carbine firing on target L at 600, 800 and 1000 yards was 55 per cent, 45 per cent and 35 per cent respectively. That is, the decrease in percentage of hits in round numbers for the increment of range of 200 yards to the 600 yard range is $\frac{1}{5}$, and for an additional increment of range of 200 yards $\frac{1}{4}$.

We may reasonably assume that for the 1200 yard range the percentage of hits will be $\frac{2}{3}$ the percentage at 1000 yards; at 1400 yards $\frac{2}{3}$ of the 1200 yard percentage or $\frac{4}{9}$ or the 1000 yards percentage;

at 1600 yards $\frac{1}{2}$ the percentage at 1400 yards or $\frac{2}{3}$ of the percentage at 1000 yards. Then we will have at these ranges respectively 24 per cent, 16 per cent and 8 per cent of hits.

Target L consists of figures representing 48 men in various positions. The surface that is exposed to hits is probably four times the surface that would be exposed by the bodies of a hostile enemy equally numerous. Other battle conditions that reduce the percentage of hits are, (1) the distance to the target will not be accurately known; (2) the target made by the enemy will be of a much less conspicuous color than the black of the figures; (3) the target will be a shifting one and not stationary; (4) the average conditions as to light will be much less favorable; (5) the ground over which the shooting is done will be unfamiliar; (6) the men will not have just completed a course in individual target practice; (7) and most important, the physical and mental condition of the men will be incomparably worse.

The Germans with the best trained army in the world consider that $\frac{1}{10}$ the peace time hits will be made in war at the same range on the same area. Other countries make the proportion much smaller. The Austrians put it as low as $\frac{1}{70}$ and we will assume it to be $\frac{1}{25}$. With these factors we would expect to get in war the following percentages; at 1200 yards $\frac{32}{100}$ of one per cent; at 1400 yards $\frac{16}{100}$ of one per cent; at 1600 yards $\frac{8}{100}$ of one per cent. War experiences show that these percentages are much too high. Major Eben Swift, U. S. A., in his pamphlet "The Maneuver and the Umpire" considers that in battle it is good luck to make $\frac{1}{4}$ of one per cent of hits at 600 yards. The difference between Major Swift's results and those we have obtained are probably due to wild unaimed shots, which during every battle are discharged blindly into the air. The men

have gotten beyond control, and, but for their excitement, would know that their ammunition thus expended could hit nothing.

These computations indicate that between 1000 yards and a mile from the enemy is a line which the attacker must reach before the effect of his fire upon the enemy will compensate for the expenditure in its delivery of physical effort, eye strain and ammunition.

Opening and maintaining a fire at long range is obecctionable, (1) because it lengthens out the fight; (2) it wastes the bodily strength of the men; (3) it strains the eyes so that the men cannot see clearly after a time; (4) it diminishes the fighting spirit of the men; (5) it exhausts the ammunition which will be needed at the shorter and more effective ranges.

There is no doubt that the effect upon the soldier of delivering long range fire in the attack is the same as the delivery of such fire by the defender. The ordinary experiance of the Germans in 1870-71 in attacking the French positions was that the fire, which first began nearly a mile away, diminished in effectiveness when the enemy was approached closer than half a mile. The experience of the Russians in attacking, when the opposing Turks made use of fire at 2500 yards was the same. In an attack made by the Japanese on the Russians in front of the Sha Ho, Major Morrison, the U. S. military attache, observed the same thing. Therefore if we open a heavy fire at long range and continue to advance, we may expect this fire to become less effective when we get closer to the enemy.

The French General, De Negrier, in his "Lessons of the Russo-Japanese War" says "rifle fire is only employed at short range." If the firing line cannot advance within 1000 or 1200 yards of the enemy without diminishing the enemy's fire we

can reduce it (1) by bringing more artillery to bear upon him; (2) by using the fire of bodies of infantry on the flanks, or in rear and firing over the heads of the advancing troops (these bodies do not advance but pour in the most accurate fire possible.) This is called *fire of position*; (3) by waiting for night and moving up in the darkness.

But if none of these alternatives is available, what shall be done if the skirmish line finds it impossible to get farther forward than 2000 yards from the enemy due to hostile fire? If such a condition should arise—and with good troops it never should—fire should be opened and kept up so as to make a farther advance possible. In such a case the attack will not be finished by the troops of this firing line. They will exhaust themselves and their ammunition before reaching effective ranges, 1000 to 500 yards, and a new body of men will relieve them and finish the fight. Attacking implies a numerical superiority which will enable us to do this. In the general attack, in the "demonstration," and in the "false attack," the object being to contain the enemy, to hold down his reserves to a certain point of the line, to deceive him as to our own strength and intentions, but not to push the attack home, the attacker will use long range fire; so also, when there is an absence or insufficiency of artillery support. But when an enemy seriously intends to defend a place, and has any chances of success, the attacker will have to fight it out within 1000 yards. Everything that takes place beyond 1000 yards should be considered a mere preliminary to the real business.

To sum up, we would say that long range fire, that is, fire beyond 1000 or 1200 yards, should be used only as a last resort, and there should be employed in its place artillery fire, infantry fire of position, or postpone the advance until darkness per-

mits an approach to closer ranges without firing at all.

THE TARGET.

A company in line of skirmishers opposes a certain part of the enemy's line which, ordinarily, is the target. It may be well to assign a different target to each platoon, but usually no more than one target to a platoon is fired at simultaneously. While on the advance, even with short halts a change of objective of fire should not be made except it be imperative. Changes in the target quickly confuse the men and control is lost.

However, it is a principle well recognized that parts of the line must co-operate, and that fire must be concentrated on the enemy's line, if victory is to be gained. This will involve changes of target, but these will be made during a long halt in the attack. In choosing the target we will fire, first upon the portion of the enemy's troops at the time most dangerous; second, upon the portion most easily hit. Any especially vulnerable target, such as a compact mass of troops, should receive the rapid fire of all our troops within rifle range.

Usually the enemy will be invisible and we will fire where we think he is. The orders will be to fire at some feature of the landscape such as at a tree, a fence or the top of a hill. If artillery using indirect fire can be located, infantry may be ordered to fire over the crest of the hill at it, although the use of indirect fire by infantry should be rare. It is a reasonable inference that if artillery opposes the enemy's indirect fire by fire of the same type, infantry fire may be likewise employed.

Chapter IV.

RANGE TO BE USED, RANGE FINDERS.

More time and attention is devoted by officers and men of the army to target practice, to learning to shoot straight, than to any other one thing. Comparatively speaking, range finding is very much neglected, yet beyond short range, it is more important to set the sight at the proper range than it is to shoot well. If we do not use the exact range to the target, the better the shot the less effective the shooting will be. A poor shot using the right range has a good chance to hit, while a good shot using the wrong range will surely miss. Some officers believe therefore, that ability to shoot accurately, although desirable, is not a necessity in the make up of good soldiers.

At long ranges where the exact distance will be used only by accident, there is but very little difference in effectiveness between the best shots and those who shoot indifferently. At the shorter ranges—those well within 1000 yards—good shooting tells, for the flatness of the trajectory makes the use of the exact range unnecessary. This is the place where it is decided who shall be the victor; therefore our care for marksmanship is vindicated.

To counteract the tendency to overshoot the mark and get the effect of ricochets, we should, in all cases except where the enemy is running away, aim a little short of the target or set the range a little short. The old rule was to aim at the feet of the enemy, but in future we cannot hope to see his feet. In late wars combatants thought it great luck

to see the enemy at all. At the shorter ranges, say within 500 yards, when the distance to the enemy is diminishing it is better to order the sights put down to point blank range.

The longer the range the more care should be bestowed upon finding its actual length, for the longitudinal axis of the central zone gets shorter with increase of range, so that small errors cause us to miss the target. In order that we may get some effect, what have been called "combined sights" sometimes have been advocated; that is, having part of a command use a particular range and the rest a range that differs somewhat. Usually this difference is less than 100 yards. Thus the advocates of this method forego making a large number of hits in order to insure a few. The use of "combined sights' shows an unwillingness to rely upon what is the best estimate that can be made of the range and to take the chances of war. It is called timidity by some and implies that there is no danger of running short of ammunition.

The range may be obtained in four ways as follows, (1) by observing the strike of bullets; (2) by asking the neighboring artillery for it; (3) by using a range finder; (4) by estimation. To use the first method there must be at or near the enemy's position some ground that is bare of trees, brush or tall grass, dry and with a soil of sand or clay that will throw up dust when struck by the bullets. Volleys are used, for when the bullets fall together the dust may be seen, which is not the case with single shots. Machine guns clamped in position and fired rapidly will frequently show the strike when other means fail. Observing the strike is the best method of finding the range for it gives actual proof of the shooting.

Officers on the firing line will always be anxious to know the results of their fire and should have field

glasses for that purpose. Special observers often will be detailed for this duty but will watch, not only the strike, but other indications of suffering given by the enemy. An observer stationed at the flank must bear in mind that dust thrown up by bullets falling in front of the target seem to go on the opposite flank while those that overshoot seem to go to the near flank. Well aimed fire observed from the rear will throw up dust both to the front and to the rear of the target.

Artillery in position will always know the ranges and can give great assistance by communicating these ranges to the infantry.

Whether infantry should be furnished range finders is still an unsettled question. For some years infantry has loudly demanded them, but has seldom, if ever, used them in battle. Accurate knowledge of the range is needed only for long range fire and this long range fire is to be avoided. Captain Soloviev of the Russian army speaks of the use in Manchuria of effective rifle fire at 2300 yards. It seems as though long range fire will often be forced upon us, and instead of expending many pounds of ammunition on "combined sights" it would be better to carry a range finder that would make combined sights unnecessary.

The range finder should fulfill these conditions:

(1) Give ranges up to 2000 yards with less than a 6 per cent error.
(2) Be easy to operate,
(3) Require no more than one operator.
(4) Be light enough for one man to carry.

The inventors of the Forbes, and the Barr and Stroud instruments claim that they fulfill these conditions but thorough government tests have not been given them. They are tubes several inches in diameter, about six feet long with an arrangement of prisms giving the range directly.

KIND OF FIRE.

Fire may be controlled or uncontrolled. With uncontrolled fire every man chooses for himself the time for opening fire, the target, the range at which the sights are fixed, and the number of cartridges used. For a firing line to indulge in uncontrolled fire means that the men are completely out of hand; their superiors have lost all control over them. Even with the best of men, loss of control will come at a certain stage of the battle, but obviously every effort should be made to postpone this time until the latest possible moment. Little can be accomplished while uncontrolled fire goes on; and if the men are not soon brought under control they will break to the rear in spite of superiors; or at least there will be a line of men halted near the enemy and out of ammunition.

Controlled fire may be, (1) volley fire (2) fire with counted cartridges; (3) rapid fire; (4) fire at will.

Very high value has been set upon volley fire by writers on tactics during the last twenty five years, but it seems that volleys have been used less in war than is justified by this estimate of them. The advantages claimed for them are, (1) volleys give best control of the sighting range to be used, the number of rounds to be fired and the target to be aimed at; (2) fire can be concentrated; (3) the moral effect of volleys upon the enemy is greater than that of any other kind of fire. Many losses occuring at once no doubt produce a greater effect than if these same casualities were distributed over some period of time. Men feel helpless against a power that can cause a number of their comrades to be shot in an instant. Then, to hear the enemy fire volleys means to every soldier that he fights a foe that is still cool, deliberate and unafraid.

The disadvantages of volleys are, (1) that they cannot be delivered rapidly; (2) that pulling the trigger at command frequently means discharging the piece when it is not aimed ; (3) that the section of the firing line that can be controlled so as to deliver volleys is very small.

In order to fix in the minds of soldiers the importance of aiming, we should adopt it as a maxim that "every unaimed shot is a miss." We cannot hold up to them this ideal if we order them to fire at command whether their sights are on the target or not. It will be a rare case when 100 men on the firing line will be under such control that they will be able to fire volleys. It may happen sometimes at very long ranges. Platoons may often be so controlled. But when platoons are on the same line and try to fire volleys at the same time there will be confusion. Intervals between parts of the line firing volleys are necessary if good results are to be obtained. We can hardly expect troops in the attack to fire volleys at a shorter range than 1000 yards. Fire of position will most advantageously be volley fire.

Fire with counted cartridges. The advantage of this method over volley fire is that it permits every shot to be aimed. Target records show the percentage of shots fired that are hits to be about 10 greater in "fire at will" than at volley fire.

Rapid fire. According to the Drill Regulations, the command "rapid fire" is given only when bayonets are fixed and sights are set at point blank range, to repel a charge by the enemy or just before we ourselves advance to the charge. We may, however, designate as *rapid fire*, that which is delivered when we wish to make the greatest possible number of hits irrespective of the amount of ammunition expended, for instance, when the enemy unexpectedly exposes a large vulnerable target. To get such a fire beyond

point blank range we would order *Fire at Will*, then add words to indicate the intensity desired.

Fire at Will is permitted when it is possible to do sharp-shooting. Only general instructions are given to the line.

RAPIDITY AND AMOUNT OF FIRE.

The rapidity of fire depends (1) upon ability to fire rapidly; (2) upon the object to be gained by the fire.

Every soldier should be familiar with the maxim "only aimed shots hit" and aiming is the largest factor in determining the rapidity of fire. The time of aiming depends on the range, the amount of target practice the soldier has had and the strength of the eye. About twice the time is required to fire an aimed shot at 600 as at 300 yarns; much more time, perhaps twice as much, is required at 1200 as at 600 yards. At ranges beyond 1200 yards the time required does not change much. At short ranges, say within 350 yards, fire loses rapidly in accuracy if the rate rises above six rounds per minute. Six rounds per minute con not be kept up for a longer period than from five to ten minutes. A higher rate of fire, perhaps up to 10 or 12 shots per minute, will be delivered at short ranges where it is absolutely necessary to make the greatest number of hits in a given period of time; for instance, in the rapid fire just preceding a charge or when the enemy comes from his position to make a counter attack. At 600 yards three shots per minute is a high rate of fire; at longer ranges the rate would be still lower.

Training will shorten these periods of time but will not change the relative length of time at different ranges.

A strong eye, well trained, can catch the aim much more quickly than can a weak eyed recruit.

Men differ in strength of eyesight as they differ in degrees of strength in other respects. Seamen, mountaineers and plainsmen have longer, stronger vision than city bred men. General Buller of the British army said that the Boers could see troops two miles farther than could the British.

If the object be to contain the enemy, to threaten him or prevent his moving about in his position, a slow deliberate fire may be kept up. If we wish to gain a superiority of fire over him or produce a tactical effect it is best to do it as rapidly as possible. It is now the accepted belief that, with a certain number of rounds to fire, these are best employed in sudden, short timed bursts of rapid fire called by the French "rafales."

A writer on the Russo-Japanese war speaks of an expenditure of 100 rounds of ammunition per hour for each man by the Japanese at Lio Yang as the limit of expenditure for this period of time. In a few cases 400 or 500 rounds per man were expended in one day.

Having decided to get a certain result by fire we must shoot away until that result has been obtained. As long range fire is much less effective than short range fire, it follows that, to get a specific result, a great many more cartridges will be required at the longer ranges. It will frequently happen that many rounds will be expended at the halts made a long distance away from the enemy while at the halts made closer up but few shots will be fired. This is just the reverse of what is laid down in the drill regulations for the normal attack. But it is reasonable to believe that if we can shoot the morale out of the enemy at long range, he probably will not recover from his demoralization until we can reach him; our advance and a few shots at closer range will put an end to organized resistance.

DENSITY OF FIRING LINE.

Two conflicting principles determine the density of the firing line: (1) The men should be under control and this requires that they be kept in compact formations; besides, they should be disposed so as to be able to produce the greatest fire effect per yard front while firing, and the greatest shock effect when they charge. (2) They should be disposed so as to make the least vulnerable target to the enemy's fire.

Troops in the firing line should stand twenty to forty per cent casualties and win. Human nature will usually undergo no greater punishment, and we are forced to extend men in the firing line and maneuver them so as to keep their losses below these percentages. But the first principle is the more important, for it is not by avoiding losses, but by inflicting them, that battles are won. The line is disposed, therefore, so as to develop the greatest fire effect that can be delivered per yard front. This is one man per yard. Men formed closer together cannot use their rifles to the best advantage, and to make the line heavier is to increase our loss without increasing the corresponding loss we inflict. In the bayonet charge it is well to have men formed in double rank or even in column, but the enemy may be relied upon to prevent our getting up to the charging point and forming there enough men to make a column.

Results obtained in the Boer war by the Boers brought about a great deal of discussion as to the density of the firing line. The character of the country, open and very extensive, and the mobility of the mounted Boers made it possible for them to avoid the British attacks pushed home. The Boers, too, were able to concentrate their men and their rifle fire to a degree that suprised, not only the British but all other observers. To prevent this con-

centration of fire as well as of men, the British, who outnumbered their foe, adopted an abnormal extention of the firing line. This kept the Boers, who were not inclined to take the offensive, in a correspondingly extended formation. The British would then gradually strengthen their line where they wished to make the decisive attack.

ADVANCE OF THE FIRING LINE.

A soldier should have two mottoes, "Only aimed shots hit" and "Victory lies in the point of the bayonet". It is immaterial that these words are true only in an idealistic sense. We know that some unaimed shots accidently do hit, and that bayonet charges by victorious troops are rare; but we also know that a soldier who goes into battle imbued with the idea that he can and must aim every shot, must go forward to a point close to the enemy then charge him with the bayonet, is worth five men who think they have done their duty while remaining at a distance, shooting wildly in the direction of their opponents.

The firing line must advance and the problem is to get a formation and a method of moving the line that will insure control of the men and their fire. It is recognized that a regular systematic attack such as a normal formation is bad because the enemy will soon discover the system and much harm will result. The British in the Boer war adopted the method of deploying a very thin skirmish line, six to ten paces between skirmishers; this line went forward followed about 400 yards by another similar line and so on back. The first line advanced until it was delayed by the enemy when the second overtook it and carried it forward. In time all the succeeding lines overtook the first. This method surrenders control of the men and their fire at the beginning of the fight.

A French writer who has evidently made a thorough study of modern tactics states that the firing line can no longer be made up of a continous chain of riflemen but that it should be a line of groups or swarms—not greater than 50 men—with intervals of 50 to 100 yards. These groups advance, endeavoring to keep abreast or ahead of neighboring groups, and try independently to pierce the enemy's line. To advance from a halt the leader reconnoiters to the front, selects a position as well as he can and rushes forward to it. After him goes the whole swarm or a part it at a time.

Major Morrison describes the Japanese advance substantially as follows: At very long ranges the firing line is broken so as to offer the least favorable target to shrapnel fire, the parts of the line corresponding to gaps in the first line being from 50 to 200 yards in rear and opposite these gaps. When infantry fire becomes so effective that fire must be opened on the enemy, troops in rear of the advance groups move up into the gaps and a continuous line is formed. Ground to the front of the line is reconnoiterd or inspected as well as possible from the line and the new position selected. Fire is delivered until a superiority is obtained. The movement to the selected position is then begun. If possible, the whole line moves forward, but if this cannot be done as large a part as possible advances, the rest firing upon the enemy. After the first rush is made, troops coming up from the rear always halt abreast of those already in position. The part of the line in the advanced position aids with fire the movement of those coming up to them. The size of the force moving at one time depends on how large a part of the line must be employed in beating down the enemy's fire. If one fourth of the line can check the enemy's fire three fourths of the line goes forward together; if half the

line can do this the other half moves; if three fourths of the line must fire one fourth makes the rush and so on. Finally the time may come when the rush to the new position by units is out of the question, and one man at a time or two or three men together crawl along the ground, taking advantage of every bunch of grass, hummock or depression to conceal themselves and try to reach the new line where they can fire upon the enemy and thereby assist those behind to come up.

Captain Traub, U. S. A., witnessing the German maneuvers in 1906, observed a plan of attack which seemed to combine the British methods of the Boer war with the idea of taking up successive positions. A line arrived at a position where it would be under serious fire of the enemy. From this place a widely extended skirmish line was sent forward, which selected a new position where a new line was to be formed and, on arrival there, halted. This first line of skirmishers was followed at distances from 50 to 100 yards by successive lines and the new line established gradually. It is presumed that this advance would be made by part of the line, and, during the forward movement, the rest of the line would assist by fire the part that was advancing.

The advantage of these methods of attack lies in the degree of control which can be exercised over the line. The advance by rushes where part of the line moved past the other, once begun, could hardly be stopped. Stopping it requires a great effort, and after the halt is made the parts of the line must be adjusted before orders can be transmitted.

SHIELDS,

The immense development in fire power of the rifle has brought about the use of portable shields. One which the Japanese used at Port Arthur for men

who went forward to cut wire entanglements was of $\frac{3}{8}$ inch steel, 3 feet high by 18 inches wide and had a slot near the top to look through. The shield used on our artillery carriages stops a rifle bullet fired from a point 200 yards away. It is of $\frac{1}{5}$ inch steel and weighs 8 pounds per square foot. Japanese advancing to the attack at Mukden when the ground was frozen, carried forward sand bags filled with sand to give them some lying down protection on ground they had gained. The modern battle approaches the old siege in character and lasts a number of days so we may expect to become familiar with shields in battle when conditions permit their transportation.

THE ASSAULT.

The infantry sent forward in attack may reach the enemy in half an hour or it may take several days. An invariable rule must be that there shall be no backward movement. It is far easier to hold ground than to gain it; usually it is easier to hold it than to go back and give it up to the enemy, for fewer casualities occur to troops who lie still on ground already won than to those retiring over the fire swept zone in rear. If the advance is continued and victory is to be won, the bayonet charge must be undertaken against any enemy who does not give up. War experience does not indicate that bayonet attacks have become less frequent than they were during the Civil War. The thinning of the defenders line, due to the development of great fire power, has made this line more vulnerable to bayonet assaults by groups of determined men than it was in the old double rank, elbow touching elbow days.

The reduction in caliber has reduced the stopping power of the bullet so that probably many of the wounds, where the bones are not hit, would not stop a man whose blood was up in the bayonet charge.

The charge may be a rare thing because every officer and enlisted man on the defensive knows that, if he cannot stop his opponent with the advantages he has over him in the fire fight, the defender must be overwhelmed by a bayonet assault. Therefore, only from the most thoroughly trained and devoted soldiers or from fanatics can we expect opposition when the attackers' bayonets reach them.

As the attackers near the defenders position, the determination of the time to give the order for the bayonet charge more and more absorbs the mind of the leader of the attack. Much depends upon seizing the proper moment, but rules for doing so can not be given. Waves of courage and enthusiasm followed by depression and fear pass over both attacker and defender. These states of morale count for more than anything else and the true leader will intuitively feel the moment when the rush of his own men with bayonets fixed will be the most impetuous, and when the terror this rush inspires in the enemy will shatter his power of resistance.

Chapter V.

THE USE OF THE RIFLE IN DEFENSE.

If the action is a chance encounter, and the defender has no time to prepare the position he has taken, the conditions governing his use of the rifle will be much like that of the attacker. If however, he has time to prepare for his defense, he will have made entrenchments situated so as to bring the most effective fire upon the attacker. The time to open fire then presents a different problem to the defender than to his assailant.

The defender may take one of two courses: first, he may begin to oppose the enemy at a distance from the position he intends to hold to the last, and make full use of the long range powers of the rifle; second, the defender may permit the troops of his opponent to approach close up and then overwhelm him with a sudden, unexpected fire.

Knowing the ranges and with the problem of ammunition supply solved, the defender may indulge in long range fire when these considerations would prohibit it to the attacker. It does not seem reasonable for the defender to permit the enemy, in sight and within rifle range, to bring up troops and dispose them without molestation to carry out his program of attack.

If the enemy can be induced to bring heavy lines of troops close to the defender's position the latter may hold his fire until the enemy is near and then with a suddenly opened, rapid fire quickly and easily defeat him. The battle of New Orleans in 1815 is an instance. Such cases, however, are unusual.

The attacker to avoid traps or surprises sends out patrols or thin skirmish lines to oppose like form-

ations of the enemy and will gradually push the defender back and develop his main line. Still, experience shows that it is usually possible to dispose troops in hidden trenches who will frequently have an opportunity to bring a decisive flank fire to bear on the enemy's main firing line.

How much physical and moral strain troops can stand will also have a bearing on the question of long range fire. There is about a fixed amount of fight per day in a man. If we expend this at a high rate per minute while the enemy is at long range and our fire does him little damage, then, when he gets closer we will have little resistance left to use. Battles very frequently show that less damage is done the attacker the closer he gets to the defender. The question of long range fire must be solved by the commander on the ground according to circumstances.

TARGETS.

The rules governing the selection of the target are the same as those for the attacker. The defender has his fire under better control than the attacker and can take advantage of any unusually vulnerable target presented. The position will be arranged so that parts of the line can support the others and concentrate their fire. Tiers of troops one above the other can be placed on rising ground.

All parts of the position will be connected by telephone and the whole action kept in the hands of the commander who is at the most advantageous place for control.

Supports of the enemy in close formation may be fired upon. However a skillful opponent will have his supports, if exposed, deployed about a quarter of a mile in rear of the firing line and will take no chance of having them annihilated by a sudden unexpected fire.

Volley fire may be utilized to a much greater extent by the defenders than is possible in the attack. It follows that poor troops may make a better showing in defense than they would make in the attack.

RUSES.

The use of blinds such as grass, brush, etc., to conceal trenches, dummy artillery and dummy men to draw the enemy's fire is of great assistance in defense and should never be neglected where a defender has time to arrange them. Every improvement in weapons increases the necessity for concealment from the enemy's view. The enemy of a properly trained army will find his difficulty, not in defeating what men he can see, but in seeing the men he has to combat.

NIGHT FIRING.

At night the soldier can not ordinarily see the enemy nor the ground in front, nor, if it is very dark, can he see the direction in which his gun is pointed. The attacker should not fire at all in the night except when he wishes to make a demonstration. The troops in his main attack will move to the bayonet assault without any fire preparation. If possible, the attack will be a surprise, although night attacks will be undertaken when it is known that the enemy will anticipate them.

On the defensive men can prepare rests for their rifles, usually the top of the parapet of the trench, which will cause the fire to cover the ground in front. To see the muzzle of the rifle and give it the proper direction the end may be covered with a piece of white cloth. Fires may be lighted in front of the position to enable the enemy to be seen, or search lights may be used. No expedient will give the light of day and it should be remembered that in such

cases, or even when the light is dim, the tendency is to shoot too high. Although the soldier may be able to see the sights, he will use so full a front sight that the bullet will go above where he would shoot in broad daylight. Confusion among the defender's troops at night is his greatest danger. To guard against this, their fire must be kept under control, and volley firing when possible, should be used. Bodies of troops attacked at night, who are able to form and fire volleys, are usually safe.

FIRE DISCIPLINE.

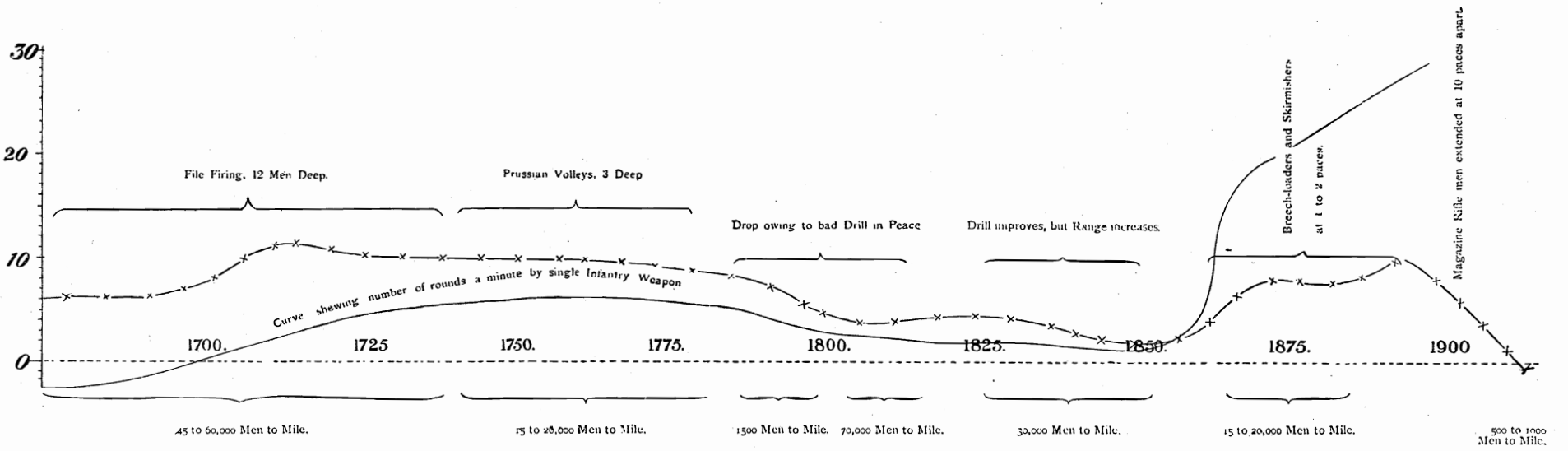
Fire discipline is the training of men to use their rifles to the greatest advantage under battle conditions. A good state of fire discipline is brought about by exercising the men in doing what they should do under fire until it becomes a habit. *Learning* what they should do, is only part of the work. The men must practice simulated battles until they do the right thing automatically. Discipline is founded on confidence; therefore, the first thing to inculcate in a soldier is confidence in his weapon. This can be done only by target practice. A man can not know his rifle too well; but besides this (1) he should never fire until ordered; (2) after opening fire he should listen for and obey any further orders; (3) he should keep his sights adjusted at the range indicated; (4) he should carefully aim at the indicated target; (5) when not under the immediate control of a leader he should judge with discretion the foregoing requirements himself, carefully husband his ammunition for the short ranges and when possible observe the effect of his fire.

Nothing but long unremitting drill will bring about such a state of discipline, yet no other state of discipline will enable an army to stand the test for which it is created and maintained.

DIAGRAM A.

SHOWING, FULL LINE, RATE OF FIRE OF WEAPONS INDIVIDUALLY.

CHAIN LINE, NUMBER OF BULLETS PER YARD DELIVERED BY NORMAL FIGHTING LINE PER MINUTE.



CURVE OF LOSSES PER HOUR AT VARIOUS PERIODS FROM TYPICAL INFANTRY BATTLES.

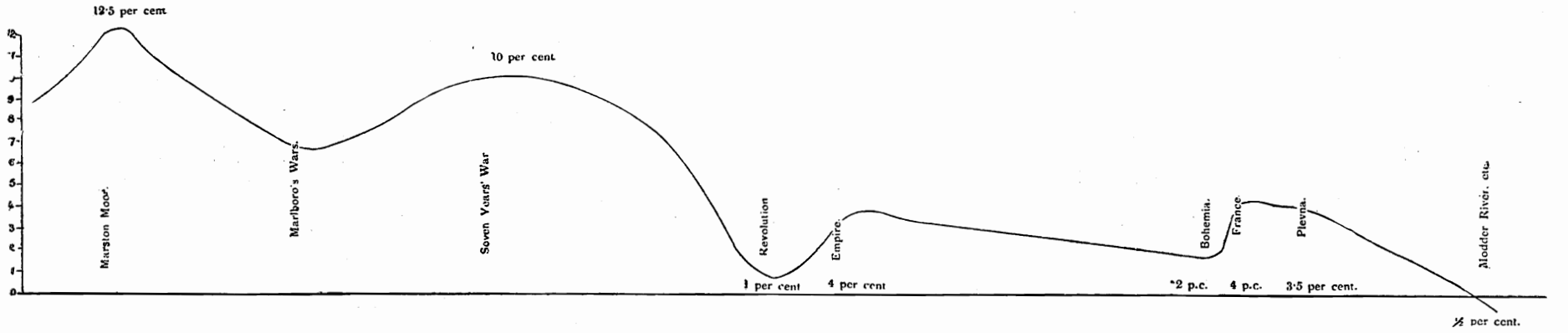


Fig 13.

To face p. 160.