SUGGESTIONS TO MILITARY RIFLEMEN

BY
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FIGURE 1.—U. S. Magazine Rifle, Model 1898 (Krag), Upper.
U. S. Magazine Rifle, Model 1903, with Gun-sling Adjusted for Firing, Lower.

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BY

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LIST OF WORKS CONSULTED.

Firing Regulations for Small-Arms, ———.

Guns, Ammunition and Tackle, Kephart and Carlin.

Infantry Fire, Batchelor.

Ideal Handbook, Ideal Manufacturing Company.

Journal Military Service Institution, Periodical.

Journal U. S. Infantry Association, Periodical.

Modern Rifle-Shooting, Hudson.

Modern American Rifles, Gould.

Modern Rifle-Shooting, Tippins.

Manual for Rifle Practice, Wingate.

Reports of the Chief of Ordnance, ———.

Sharpshooting for Sport and War, Greener.

Small-Arm Firing Regulations, Blunt.

Shooting and Fishing, Periodical.

School of the Krag, Foulke.

The Military Gallery Range, Bell.

The Book of the Rifle, Fremantle.

AN APPRECIATION.

In the preparation of this work I have been very greatly assisted by the information I have received from the writings of Dr. W. G. Hudson and also from the columns of *Shooting and Fishing*. Most of Dr. Hudson's articles have appeared in this paper, which is the authority on rifle-shooting in the United States. In fact, one cannot expect to keep up to date on matters pertaining to the rifle, rifle-shooting, and ammunition if he be not a regular reader of *Shooting and Fishing*.

INTRODUCTION.

In the days of the old Springfield rifle Blunt's Firing Regulations contained an excellent chapter entitled "Suggestions to Riflemen." This work, a most excellent one, was widely consulted and assisted to a large extent in improving marksmanship in the Army. To-day, however, rifle-firing has reached such a science that it is impossible to burden our Firing Regulations with this subject. The need of such information and knowledge in the service is greater than ever, and the desire for it expressed to me by many officers of the regular Army and National Guard has induced me to undertake this work. While the great part of it is compiled from my own experience, I have consulted practically all the modern writings on the subject obtainable in my endeavors to present to the reader everything on the subject of any practical value.

I shall not attempt to describe the rifle, for I do not care to take up the space necessary. The best description of it will be found in a pamphlet

entitled "Description and Rules for the Management of the U. S. Magazine Rifle, Model 1903." Nor will any of the data which is contained in the Firing Regulations for Small-Arms, other than that which is absolutely necessary to make the text clear, appear in these pages. A knowledge of the contents of both these works is necessary to a clear understanding of what is to follow. The reader is referred to any of the standard works on ballistics for the scientific part of rifle-shooting, as I shall take up only the practical side of the subject, it being my intention to give fully that information which the marksman and the instructor need to shoot and to teach on the range and battle-field.

When the words "the rifle" appear, it will be understood that the U. S. Magazine rifle, Model 1903, is meant, and the U. S. Magazine rifle, Model 1898, will be referred to as "the Krag."

The system of instruction which I have laid down was first given to the Army in a paper of mine entitled "The Scientific Coaching of the Riflman," published in the *Journal of the Mili-*

tary Service Institution for 1904, and the success of and publicity given to this article, as well as the results achieved by the system, have firmly convinced me that it is sound both in theory and practice. The system of coaching was first tried on a company of regular infantry in 1902, and since that time every competitor from that company has won a place on the Army team.

It is my hope that I have given something to the service which officers and individuals will care to study and to carry to the range with them.

TOWNSEND WHELEN.

Fort Crook, Nebraska, 1906.

CHAPTER I.

The Selection of an Accurate Rifle.

All rifles, even the new ones, vary greatly in their shooting qualities. Some group their shots in wonderfully small circles and are called very accurate, others can be relied upon to make fair scores, while a few will scatter their bullets all over the target. As a rule, the average enlisted man will have to use the rifle which is given to him. If, however, the weapon appears to be very inaccurate, it should be condemned and the man issued another piece. The officers and the expert shots will want accurate rifles, and in order that these may be chosen from the rifles at hand, and also the bad-shooting pieces may be condemned, a knowledge of the characteristics of good- and bad-shooting rifles is necessary.

The only infallible way of choosing an accurate rifle is to have it shot from a machine rest (vise), at 1000 yards, on a perfect day, by an expert. But a rifle selected in this way only, with no reference to size of bore, is risky, as, if the bore is large, its fine shooting qualities will

very quickly vanish. There are certain characteristics or "ear-marks" which all good rifles have and with a knowledge of these and a certain amount of skill in determining them a rifle may be selected with almost a certainty that it will perform well at the target at long range.

In selecting a rifle the points to be observed are *the muzzle, the bore,* and *the stock.*

The muzzle should be bright, free from rust and any injury or burr. The lands and grooves should be cleanly and sharply cut right up to their end. Examine the muzzle under a magnifying-glass. The dulling or rounding of the square edges of the lands and grooves by the cleaning-rod or thong should be especially looked for, as this is the principal defect in the muzzles of rifles which have been in the hands of troops for any length of time. Any of these defects, and particularly the latter, should be a cause for instant rejection. It must be remembered that the muzzle of the rifle is its most delicate and important part, for any injury or wear to it will allow the powder gas to escape on one side of the base of the bullet before the other at the instant that the base of the bullet leaves the barrel. Thus the gas first escaping will cause the bullet to tip from its correct line of departure and make the flight unsteady. Ev-

erything depends on perfect delivery of the bullet point on.

The rifle is first smooth-bored .300 inch in diameter and is then rifled .004 inch deep, making the measurements of the bore from the bottom of one groove to the bottom of the opposite groove .308 inch. Owing, however, to the speed of manufacture, lack of homogeneity in the barrel steel, and the wear of the tools, barrels will vary in their diameter from .307 inch to .311 inch, and some of them will be large (loose) in one place and small (tight) in another place throughout their length. To be accurate and have long-wearing qualities, the barrel should measure from the bottom of one groove to the bottom of the opposite groove not more than .3085 inch nor less than .30775 inch, and there should be no large or small places—*i. e.,* it should be a perfect cylinder or else it should be a trifle smaller at the muzzle than breech, with a smooth even taper the entire distance. The ideal barrel would measure .30825 at the breech and .308 at the muzzle.

The measuring of the interior of a rifle barrel is not so difficult as it appears, and anyone can become fairly expert at it in twenty or thirty trials. The implements necessary are a Brown & Sharpe's micrometer calipers, measuring to

thousandths of an inch an object 1 inch or smaller, which can be obtained from any first-class hardware store; a cleaning rod 36 inches long (40 inches for the Krag) and a quantity of soft lead conical bullets measuring .313 inch.* The cleaning-rod should be made of ¼-inch steel or brass by any gunsmith.

The barrel of the rifle is first made absolutely clean and then oiled slightly with a thin gun oil similar to "3 in 1." Now place the rifle with the muzzle resting on a wood floor, barrel vertical, bolt removed; and drop a bullet, point first, into the chamber so it will rest against the rifling at the throat of the chamber. With the end of the cleaning-rod hammer it about an inch into the rifling. This expands the bullet to fill the grooves of the rifling perfectly. Grasp the cleaning-rod by the end and with a steady, powerful motion push the bullet through the barrel until it rests in the muzzle against the floor. Do not allow the bullet to stop in its passage. It will take considerable force to start it. As it is passing through try to determine by the resist-

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***The best bullets are those for the .32-20 Winchester Center Fire Cartridge which can be obtained in lots of 1,000 from the Winchester Repeating Arms Co., New Haven, Conn., or through any sporting goods dealers.**

ance offered to the pressure the presence of any tight loose, or rough places and their location. This will come quickly with practice.

Now reverse the rifle and with the cleaning-rod still in the barrel, the right hand holding the cleaning-rod and the left hand holding the muzzle, tap the base of the bullet gently with the rod until the point protrudes from the muzzle and only about an eighth of an inch of the bullet remains in the rifling. Grasp the point of the bullet very lightly with the fingers and try by very light side pressure to move it. If it remains immovable, it is a sign of a good tight muzzle, which is very desirable. Very gently tap the bullet out of the barrel, being careful to catch it in the fingers and prevent any injury. Wipe the surplus oil off carefully and measure its largest diameter near the base with the micrometer calipers. The points at which the calipers should touch the bullet are the projections on the bullet which have been riding on the center of the grooves of the barrel. In using the calipers be sure that the contact points are perfectly clean and use no force in screwing up for measurement. This measurement will give you the smallest diameter in the barrel measuring from the bottom of one groove to the bottom of the opposite. If this is over .3085

inch or under .30775 inch, or if there are loose places near the muzzle, tight places near the breech, or very rough places anywhere, discard the gun for expert use. Note that it is often very hard to start the bullet traveling through the barrel, and do not confuse this with a tight place near the breech.

Supposing the gun has passed this test, we should next measure the breech and muzzle. To measure the breech, insert a bullet 1 inch into the rifling as before and then enter the cleaning-rod in the muzzle and drive it out gently, being sure to catch it in the fingers as it leaves the chamber to prevent injury; then measure. To measure the muzzle, force the bullet clear through the barrel to the muzzle as in the first instance, then rest the muzzle on the wood floor and with the cleaning-rod pound the base of the bullet until you are sure it is expanded to the muzzle size; then drive out carefully and measure.

Record these measurements as follows:

Rifle No.	Smallest	Breech	Muzzle	Bore	Remarks
50632	.30825	.3085	.30825	Loose in middle.	Fair.
51247	30925	30925	30925	Smooth cylinder.	Good.
56592	.31025	.3105	.3105	First half rough.	Very poor.
61327	.308	.30825	.308	Smooth even taper.	Excellent.

It is not to be understood that rifles which do not pass this test are not accurate enough for target work. It is very rare indeed that a poor-shooting rifle gets past the inspectors. For the use of experts and competitors, however, the rifle should pass these tests, as the rifle doing so will be the most accurate and have the longest life. Generally speaking, it is not fair to compel a man to use and qualify with a rifle measuring over .310 inch. The reasons for choosing rifles of these diameters will be treated fully in the chapter on ammunition. This method of choosing a rifle is not infallible, for a rifle may pass all these tests and yet not be bored straight; but I have never yet found such an one.

Having found a good barrel, be sure that the stock is of the best. The stock should be well seasoned and the grain of the fore part under the barrel should run parallel with the barrel; otherwise, if the stock warps from moisture, it will pull and press unevenly on the barrel and change the shooting of the piece. As the barrel heats up from firing it will increase in length, the average increase during a skirmish run being .02 inch; and if the bands which bind the stock to the barrel are very tight and retard this expansion, the barrel will actually buckle or bend; thus as the gun heats up the bullets will

either fly higher or lower, generally the latter. The bands should be removed and the stock and hand guard carefully filed until the bands can be pushed back into place by easy pressure of the fingers alone.

See that the bolt slides back and forth smoothly when oiled. Often a bolt will work hard and jerky, owing to a rough place on the receiver. This is detrimental to the best work in rapid and skirmish firing. If the trigger-pull does not suit you, do not attempt to fix it yourself. Have this done by a skilled gunsmith, and remember that there are very few gunsmiths in the country who should be trusted with a fine rifle.

CHAPTER II.

The Care of the Rifle.

A rifle requires a large amount of care to keep it in perfect condition. More rifles in the hands of troops are injured by cleaning than in any other way. I have seen thousands of rifles which were bright, clean, and free from rust, but which were absolutely useless for accurate work from having been cleaned from the muzzle. If a rifle is cleaned from the muzzle, it takes only a few days for the cleaning-rod to dull the muzzle, and then the gun begins to scatter. The reason for this has been given in the previous chapter. A "pull through" or thong, if used right (that is, inserted in the muzzle and pulled through to the breech), does not injure the muzzle; but it is a very hard and tedious process to clean a rifle thoroughly with a thong. Moreover, the thong is liable to break, and of all obstructions in the barrel a broken thong is the hardest to get out. The only safe way of cleaning is from the breech with a long cleaning-rod. This rod should be 36 inches long for the Model 1903 rifle and 40

inches long for the Model 1898 rifle, and made of ¼-inch tool steel or brass with a tip like the cut. The expert shot prefers a steel rod, because experience proves that dirt will stick to the softer metal and cut into the harder. For a company, however, brass is best, for with inexperienced men the time will come when one of them will get a rag and rod stuck in the barrel, and in a case like this the steel rod may injure the barrel while being removed. For cleaning use preferably Canton flannel patches about an inch square, the exact size to be determined by experiment. The rags should not fit the barrel very tightly and no great force should be necessary to push them through or pull them back. This is important. Also be sure not to use damp rags or rags of poor or thin cloth that the point of the rod may puncture. A rag stuck in the barrel is a very dangerous thing for the piece.

To clean a rifle, remove the bolt, place the muzzle on the floor, barrel vertical, and never remove the muzzle from the floor. Place a patch over the chamber, center it with the point of the rod, push it down to the floor, and pull it back, working it up or down four or five times. This will clean all the bore except about an eighth of an inch of the muzzle end. To clean this, use a

FIGURE 2.
Tip of the Cleaning Rod.

patch on a pointed pine stick, and with the same stick clean the chamber.

The fouling caused by the service cartridge may be divided under three heads.

First, a black carbon fouling. This is easily seen, and one or two rags will wipe it out, when the barrel appears clean; but look out, for it is not, and if the cleaning progresses no further than this, the barrel will be so pitted and rusted in a day or two as to be ruined.

Second, a sticky and almost transparent fouling. This is very acid in its action and will soon set up rust if not removed. It is almost proof against water or oil, sticks very tenaciously, and is actually driven into the pores of the metal. To remove it some alkali cleaning solution is necessary. The best material found so far is a liquid termed Powder Solvent No. 9, prepared and sold by Frank A. Hoppe, 1741 North Darien Street, Philadelphia. Many riflemen also use a solution devised by Dr. W. G. Hudson, of the New York National Guard, composed as follows:

Kerosene oil free from acid, 2 fluid ounces.
Sperm oil, 1 fluid ounce.
Turpentine, 1 fluid ounce.
Acetone, 1 fluid ounce.

If unable to obtain either of these, use ammonia or soda water. These two latter liquids must be thoroughly removed, as, if left in the barrel, they will of themselves set up rust. In cleaning, use a dry rag first to clean out the carbon fouling; then two rags wet with the cleaning solution, followed by dry rags until clean; then a rag wet with Powder Solvent No. 9, or, in its absence, oil. This fouling is forced into the pores of the metal and it sweats out for several days afterwards, so that the rifle must be cleaned daily for three or four days after using, in the same manner with the solution; otherwise it is sure to rust, no matter how thorough the first cleaning. When a gun has not been cleaned for twenty-four hours and a clean rag pushed through comes out clean, then the gun may be oiled with cosmoline oil, or preferably mercurial ointment, and put away with safety.

Third, metal fouling. This consists of particles of the cupro-nickel jacket of the bullet, and it often becomes welded to the bore by the heat, appearing in the form of a copper-colored plating. Some rifles escape this fouling altogether, while others, particularly those roughly bored, are very prone to it. No absolutely sure way has yet been found of removing this. The best method known is to scrub the bore thoroughly

with the strongest druggists' ammonia. This fouling often is deposited over the acid fouling, and prevents the latter from being removed, thus causing rust. Metal fouling also decreases the size of the bore, thus running up the breech pressures and causing changes in the shooting of the rifle.

Except in the tropics, no vegetable oil should ever be used on a rifle. The action should be liberally oiled with a good thin oil like "3 in 1." The stock should be rubbed with raw linseed oil. Cosmoline oil or mercurial ointment should be used inside the barrel. Mercurial ointment is the best rust-preventive known, and can be procured from any druggist at a small cost. Neat's-foot oil may be used on the sling to preserve it, but it is well to note that a sling so treated will soil the clothing. A piece of buckskin thoroughly saturated with oil is a good thing to carry to wipe the rifle off with after a day's shooting, to prevent the moisture of the hands from rusting the rifle. Once thoroughly saturated, it will last a lifetime and is a great saver of oil.

Never leave a rag in the muzzle of the gun. If the air is damp, it will collect moisture and rust the muzzle. Besides, you are liable to fire the rifle some day without removing the rag, when the best you can hope for is a ruined rifle.

A company should be provided with a long cleaning-rod for each squad, and the men should be able to procure Powder Solvent No. 9 in the post exchange. The men should be thoroughly instructed how to clean their rifles, and a company order should then be issued prohibiting cleaning in any other way; this order being aimed particularly at cleaning from the muzzle. The muzzle cannot be guarded too carefully.

When the rifle has been badly wet by rain, it should be taken apart and thoroughly dried and oiled. The stock should be dried and rubbed with raw linseed oil. In fact, the linseed oil should be applied to the stock every week or so, to prevent any swelling from moisture.

Before going on the range, carefully wipe all oil or cleaning solution from the bore. The bore must be perfectly clean and dry before firing. The presence of any oil in the barrel will cause the first few shots to go high and exceedingly wild. For the same reason cartridges should never be lubricated nor wet with saliva.

CHAPTER III.

The Firing Positions.

1. *The Standing Position.*

The standing position will be used almost entirely in short-range firing, or at longer ranges when the objective cannot be seen in the sitting or kneeling positions. Unlike the other positions, no specific rule can be laid down as to how the rifle should be held. The conformation and muscular development of men differs so much that it is far better to allow them, with certain restrictions to select their own position, than to compel them to take any prescribed one.

The standing or "off-hand" position may be subdivided into four distinct positions:

The full-arm extension,
The half-arm extension,
The body-rest,
The hip-rest.

We will take these up separately, describing each and showing to what class of men they are best suited.

The following general rules will apply to all positions:

The body must never be inclined forward, but an even balance on both feet must be assumed.

The right elbow must be held high enough to insure that the entire butt-plate from toe to heel rests against the shoulder.

The head must not be inclined over the stock, but the right cheek should rest against the side of the stock.

The right hand should do more than half the work of holding the rifle against the shoulder.

In the first three positions the fingers of the left hand should nearly encircle the barrel, holding it down firmly against the jump of recoil.

The rifle must be held exactly the same as regards grip of the hands and pressure against the shoulder for each shot. It is actually possible to make the shots vary as much as 4 inches at 200 yards by varying the pressure.

The feet in all positions should be about 12 inches apart, both resting firmly on the ground, knees straight.

The Full-arm Extension.

Stand with the left side facing the target, left hand grasping the barrel so far out that the left elbow will be absolutely straight, fingers of left hand well around the piece. The right hand is well wrapped around the small of the stock close to the trigger guard. The right hand and arm are to support most of the rifle's weight. The right elbow should be very high, at least 6 inches above the shoulder. The head should be leaned back, not forward, to get the eye in the line of sight. All motions to change position of the sights on the target are made by swinging on the hips. The left hand steadies and controls the piece with very little effort.

This is pre-eminently the position for shooting in a strong wind. It can be assumed best by tall men, and those having strong deltoid (shoulder) and trapezius (upper back) muscles. It is not adapted to men who stoop, small men, or those deficient in muscular development.

The Half-arm Extension.

This is the best all around-standing position. It is the best position for rapid fire, for snap-shooting, and for use when the marksman is unsteady from recent muscular exertion.

FIGURE 3.—Standing Position, Full-arm Extension.

Take the same position as in the full-arm extension, except that the left elbow is slightly bent, left hand grasps the piece just below the lower band, and the left elbow is well under the piece. This last is important. Only the weight of the arm is allowed to pull against the grip of the left hand. The right hand does all the rest of the work of holding the rifle to the shoulder. When the bolt is worked in rapid fire, the left hand pulls the rifle hard against the shoulder and holds it in the firing position while the right manipulates the bolt. Figure 4 shows the position with the sling, which may or may not be used.

This position may be used advantageously by all men, and should be the first one taught and the one most encouraged. While it is the best for all-around shooting and the one which will give the best average results, it is the hardest one in which to hold the rifle still.

The Body-rest Position.

The left hand is placed against and in front of the trigger guard, which rests in the hollow of the hand, while the fingers are wrapped well around the receiver and bolt handle, left fore-

FIGURE 4.—Standing Position, Half-arm Extension.

arm is vertical, and left upper arm is resting against and clinging to the breast. Rifle held to the shoulder and supported equally by both hands, right elbow level with the butt, head advanced into line of sight. All motions to change the position of the sights on the target are made by swinging on the hips as a pivot.

This position is a very steady one. It is not adapted to rapid fire, as in order to work the bolt it is necessary to change the position of the left hand and take the piece from the shoulder. Nor is it adapted to snap-shooting, for it is a hard position to assume quickly. It is not a good position for use in the wind.

It is best assumed by men who tend toward stoutness, and those who lack muscular development will probably choose it. Thin men will find difficulty in resting the left arm against the breast.

The Hip-rest Position.

The left elbow rests against the point of the left hip (pelvis bone). The rifle is balanced on the tips of the thumb and first and second fingers of the left hand. The thumb rests against

FIGURE 5.—Standing Position, Body Rest.

the bottom of the trigger-guard and the fingers against the stock about 5 inches in front of the trigger-guard, left wrist held very stiff. Right hand and arm same as in the body-rest position. The right hand must do all the work of holding the rifle against the shoulder. The left arm and fingers support the piece. It makes the bones of the body form a structure from the ground up to support the rifle and takes the work almost entirely from the muscles.

There comes a time in the shooting of every man who practices this position when he can hold absolutely still for several seconds so as not to be able to see any motion of the sights on the target. The trouble then comes in pulling the trigger, for the whole body is "frozen." This position is the steadiest of all when there is no wind, and the marksman is not unsteady from previous muscular exertion. It is impossible to use it in the wind. It almost entirely eliminates vertical errors. It can be assumed best by men who are thin and those with small waists, or men who stoop. Some men cannot rest the elbow on the hip. All men who can assume it should be taught to use it, as for them it is the best position for deliberate slow fire on still days. It is obviously unsuitable for rapid or snap-shooting.

FIGURE 6.—Standing Position, Hip Rest.

It is my opinion that the best work in the standing position can only be obtained when two or more positions are known thoroughly. For instance, the full-arm extension for use on windy days, the half-arm extension in rapid fire, snap-shooting, and under excitement, and the hip-rest for slow fire on calm days.

2. The Kneeling Position.

Assume the position as in the Drill Regulations, adjusting the sling as shown in Figure 7, and have it very tight. The left hand grasps the piece just under the rear sight. The sole of the shoe should be very heavy, and one should be able to sit on the right heel so comfortably as to be absolutely steady. Few men can do this, and for those who cannot the sitting position is far better.

The kneeling position is steadier than the standing. It is quickly assumed and one can take up the advance quickly from it. The sling holds the piece steadily in the firing position while the bolt is worked in rapid fire. It can be assumed only on smooth ground. It is hard to use in firing either up or down hill, and is a miserable position for those who cannot sit comfortably on the right heel.

FIGURE 7.—Kneeling Position.

3. The Sitting Position.

Assume the position illustrated in the Firing Regulations or cross the legs as in Figure 8. In order to be able to hold steadily in the first position, it is absolutely essential to have large holes in the ground to support almost the entire sole of the foot in its natural position. The second position is very steady and can be assumed when there is no time for making holes in the ground. It is a little awkward to assume, especially for stout men. Use the sling as illustrated, having it very tight. Elbows should be in the hollow of the inside of the knees When working the bolt in rapid fire, hold the piece hard in the firing position with the left hand and sling and work the bolt with the right hand, the right knee assisting the right arm and the right elbow and knee never losing contact. The left hand must grasp well around the piece with the stock resting hard against the bones at the base of the palm. Don't get the rifle up on the fingers of the left hand or it will tremble.

This position, even when one is obliged to assume it hurriedly, is a very steady one, and when time is available for digging holes for the feet, the rifle can be held almost as steadily as in the prone position. It is the only position which can

FIGURE 8.—Sitting Position, Legs Crossed.

be assumed when the marksman is on a steep hillside and firing downward. It is a very efficient position for rapid fire, particularly where more than one magazineful is to be fired.

4. The Prone Position.

Lie flat on the ground—the closer you can get to the ground the better. Lie at an angle of 45 degrees with the target, not head on (see figure). Spread the legs wide apart to allow the stomach to lie flat on the ground, thus taking away all trembling from this part of the body. Grasp the rifle at the balance or farther forward with the left hand, left elbow well under the piece, right hand at the small of the stock. Assume the firing position; then lower the rifle, and noting where the elbows have rested, with an old hatchet dig holes for them. This is unnecessary on grass or soft ground. The elbows must not only not slip, but there must be no feeling when they are in position that they might possibly slip, for if this feeling is present, the position will be unsteady. The cheek should rest comfortably against the stock. This position without using the sling is as steady as the sitting position. When the sling is used properly as described below, it becomes as steady as a

FIGURE 9.—Prone Position, Showing the Use of the Gun-sling.

rock. This position can be assumed on any ground except that which has considerable slope to the front or flanks. It is the best position for long-range work, extreme accuracy and rapid fire. It can be assumed more quickly than any other position except the standing.

The Use of the Gun-Sling.

The gun-sling should be used whenever it is possible to do so. It is even more of a factor in fine marksmanship than the wind-gauge. By its use the rifle may be held absolutely steady; in rapid fire it facilitates the quick return of the rifle to the point of aim, and it takes up almost half of the recoil. I am opposed to any way of using the sling other than as shown in the preceding cuts. The experience of hundreds of expert shots has proven this to be the best and only practical way of using it. Arrange the sling as shown in Figure 1. The essential points in its use are as follows:

The tension must come from the lower band (front attachment) of the sling only.

The sling must pass to the right of the left wrist to prevent canting, and thence around the left upper arm, preferably above the swelling of the triceps muscle.

The portion of the sling between the loop and the lower swivel must be loose in all positions, as any tension here will cause the rifle to be canted to the right and will pull the butt away from the shoulder.

The loop must be short enough to enable the rifleman to place a heavy pressure (about 100 pounds) on the sling—equal, of course, for each shot. This is what is meant by "holding hard," and it will cause the piece to steady down like a rock and distribute the recoil to the entire body so the shoulder will scarcely feel anything.

The left hand should always grasp the rifle well around the stock, letting the stock down on to the bones of the palm of the hand near the wrist; for if this part of the hand be held away from the stock, the rifle will rest on the fingers and each separate finger will tremble slightly. The theory of the position is that the sling binds the bones of the forearm to the rifle and to the ground or knee, and the heavy tension makes it a dead rest with a universal joint, the wrist, at its uppper extremity.

These remarks pertain more particularly to the kneeling, sitting and prone positions. It is doubtful if the sling is of much use in slow fire in the standing position except when shooting

in a high wind, which makes the holding unsteady. In rapid fire standing, however, its use as shown in Figure 4 takes up so much of the recoil that the rifle does not move off the target when firing or while working the bolt.

In rapid fire prone and in skirmish, as the bolt is pulled back by the right hand, right elbow remaining on the ground, the left hand should move to the right and low, without changing its grip on the rifle, causing a corresponding movement to the muzzle of the piece. As the bolt is closed the left hand brings the rifle back to its aim on the target, and a little practice enables one to bring the piece back exactly so that the aim for succeeding shots is absolutely correct without further movement. When the knack of doing this is mastered, one can shoot faster and more accurately prone than any other way. I have no trouble in getting in six hits in ten seconds on the prone figure at 200 yards using this method.

The piece may be carried with the sling adjusted to the left arm and held there by slipping down the keeper, in the positions of trail with the left hand, port arms, or ready, and the firing position assumed instantly. With the sling adjusted as shown in Figure 1, the rifle can be instantly slung over the shoulder. In the field and in

extended order drills all slings should be habitually kept adjusted in this manner.

In firing prone the left hand should grasp the piece as far forward as the length of arm will admit. The farther forward this hand grasps the less will be the tremble at the muzzle of the rifle. A man 6 feet tall can run his left hand right up against the lower band, and should be required to do so.

To some men the prone position with the sling tightly adjusted is intensely uncomfortable when assumed for the first time. Fifteen or twenty minutes' practice, however, will teach one the knack of it. This must be remembered when teaching recruits to use the sling, and the loop should not be made too loose even at the start. The beginner should be sure to learn the use of the sling. One cannot become an expert without its aid. In company and team practice its use should be made compulsory.

If a man cannot hold steadily when using the sling correctly, the fault can always be traced to his physical condition. My experience as a coach has taught me that during the shooting season men should have strong exercises for the arms, back, and chest daily. The setting-up exercises are not vigorous enough. "Chinning" on the horizintal bar and "dipping" on the paral-

lel bars are excellent. Strength enables one to hold hard and to prolong his holding after the trigger has been pulled.

Summing matters up, the advantages of using the gun-sling are: absolute steadiness in the prone position; distribution of the recoil to the entire body; quickening return of the rifle to the target in magazine fire; preventing the rifle recoiling off the target; and minimizing the effect of the wind on the holding.

NOTE.—The gun-sling illustrated in Figure 1 and the illustrations of the firing positions is the Shaw Gun Sling. At the present writing the Government issued for trial a shorter sling. This short sling cannot be used effectively as illustrated because the part running from the loop to the butt swivel is so short that tension is placed on it pulling the butt away from the shoulder and tending to cant the rifle. It is believed that this new short sling will be withdrawn and one substituted for it which will approximate very closely to the Shaw sling.

CHAPTER IV.

Holding and Pulling the Trigger.

By "holding" we mean that attempt on the part of the brain, nerves, and muscles to control or eliminate the trembling of the rifle long enough, while it is correctly aimed, to deliver the shot. Hence it will be seen that holding depends upon physical powers. It is impossible to hold a rifle absolutely still by hand. Even the best shots, when firing prone and using the sling, will, if they attach a telescope sight to their rifles, be able to notice a tremble of a few inches on the 1000-yard target. Trembling or poor holding is, of course, most noticeable among beginners, and gradually a man learns control and his gun steadies down.

Thus it would seem that men of a phlegmatic nature have a great advantage over nervous individuals. While this is so to a great extent, it it is by no means the general rule. Dr. W. G. Hudson, one of the most expert marksmen in the country, says: "Much has been said about the ability to shoot well being due to 'strong

nerves'—whatever that may mean. Riflemen often refer to an anticipated day's shooting by saying they are 'going to try their nerve.' According to my observation as a physician, however, nerve has little to do with it. I have had expert riflemen under my care suffering from pronounced neurasthenia—the very word means weak nerves—and they could, even during the height of their disorder, shoot almost if not quite as well as when they were in good health." The trembling, of course, lies in the muscles, and anything which tends to give better control over and education of the muscles will improve the shooting. Men who from their youth have been laborers and rough farm-hands will at the beginning, as a rule, make very poor shots. They have never learned that nicety of muscular coordination which is necessary. When a man is clumsy, carries himself badly, is slow in learning the manual of arms, etc., he will, unless educated to shooting from his boyhood, make a very indifferent shot. Mechanics, carpenters, and gymnasts, on the other hand, can be coached into good shots very quickly, for they have learned to control their bodies.

Some men learn to put their whole will into the control of certain muscles, and they are able to hold the rifle in the hip-rest, sitting, and prone

positions, so that no motion to the piece can be noticed by the eye. The trouble now comes with pulling the trigger, for the whole body, including the trigger finger, is "frozen," as it were, and when the finger starts to exert its pressure the whole rifle moves. The brain is incapable of concentrating its whole will on two things at the same instant. Thus while the rifle is held correctly with the top of the front sight just grazing the lower edge of the bull's-eye, the rifleman's brain will telegraph a message to the trigger-finger to pull. But something else has happened in the meantime. When the thoughts and control of the will were taken away from the holding and turned to the trigger-finger, the rifle was cast adrift without a guiding rudder, and if we were quick enough, we could see the sights drift off that little vital spot just before the recoil shut out the view of the target. This little fault must not be confused with flinching or jerking the trigger, for it must of necessity exist in everyone and can never be altogether eliminated.

There are two ways of pulling the trigger of a military rifle. One is to gradually increase the pressure ounce by ounce until the gun suddenly goes off, in the meantime holding the best you know how, the report and recoil coming in the

nature of a surprise. The other is to learn to put just so much pressure on the trigger that an ounce or so more placed on very carefully at the exact instant when it is desired to fire will discharge the piece. Both methods have their advocates. I believe the latter to be the best way, for we thus have the rifle go off when we want it to, whereas by the former method we limit the accuracy to the average error of holding while applying the pressure. Rapid fire forms such a large part of a rifleman's practice to-day that a man should be able to fire his rifle the instant he sees that his aim is correct. However, the former method is a great factor in teaching a man to overcome flinching, and it is perhaps better to teach recruits to fire in this way, and then, when they have overcome all tendency to flinch, change them to the other method. Jerking or snatching the trigger is, of course, fatal to good shooting. Control of the trigger is everything in rifle practice. It is that part of the art which is soonest forgotten. When we change to a rifle with a different trigger-pull, we must learn it all over again. Hence we should stick to one rifle as long as it remains accurate, and by daily trigger-pull exercises accustom ourselves to the pull and keep in practice.

Flinching is the quick setting of the muscles

at the instant of pulling the trigger to brace against the recoil. It comes from an instinctive dread of the blow of the recoil or from a nervous fear of the report of the rifle. I have seen men flinch so much that they failed to hit a 16-foot square shield placed 30 feet in front of the firing-point. Until this is conquered, of course, a man cannot shoot at all. It seldom demonstrates itself in gallery practice, but we will always find one or two men in a company who do it every time when firing the service cartridge, and who do not seem to be able to be taught otherwise. The remedy lies with the man himself, and if we cannot infuse into a flincher enough interest in the subject to make him work for his own improvement, we nearly always fail to eliminate it by our own efforts or by any system of instruction. In trying to help a man over this difficulty, start with gallery ammunition, then reloaded short-range ammunition, then use mid-range ammunition with a small recoil, and finally full service charges. Never let him use the more powerful ammunition for even a single shot until he has conquered the flinching habit with the less powerful loads. Be present with the man all the time. Encourage him and be sure not to antagonize him. Insist upon a gradual and even pressure of the trigger. Load the gun yourself,

alternating with dummy cartridges and loaded ones, so that the man does not know which is in the rifle. If with two or three months of conscientious work of this kind the man does not improve, you may as well give him up as hopeless.

I remember a private in my company who was one of the worst flinchers I ever saw. When he first came to the range, I started him in at 100 yards; 30 feet in front of the firing-point was a protective screen 16 feet square with a 2-foot window in the center, through which the target could be seen. Sometimes he hit that screen and sometimes he did not, and although he fired forty shots, he did not get a single bullet through that window. The man persevered, and so did I. He was made of the right stuff, and by the end of the season he was a fair shot, but it was awfully hard work. The next year he qualified as a sharpshooter and shot on two winning teams.

We have seen how the physical powers enter into holding and pulling the trigger. It therefore follows that anything which tends to improve or injure the physical condition will affect shooting to some extent. By cutting out smoking and drinking and taking up gymnastics, outdoor exercise, and a careful diet we improve our

bodies; but a sudden change of this kind will always hurt a man's shooting until he has become accustomed to the change. The time to institute such a reform is long before the shooting season starts; otherwise, moderation should be the keynote of all habits. A strong, muscular man will always have an advantage over a weak man in military shooting. The weak man may be able to shoot a score or two as well as his stronger brother, but the latter can hold so hard that the recoil is scarcely felt, while the former will be so kicked around that as the shooting progresses his work will fall off. In competitions like those in the regular Army, where the competitor has to compete at his post for top score and then go through two severe competitions of six days' duration each, strength becomes an enormous factor. So, too, in a strong wind the powerful man can hold his rifle more firmly against the wind than the weaker one. A tall man has a similar advantage over a short one.

CHAPTER V.

Position and Aiming Drills.

Position and aiming drills are the A, B, C of rifle practice. Not only are they necessary in recruit instruction, but they should be included in the every-day work of the most expert. They practice one in the holding, the sighting, and the pulling of the trigger. They educate and harden the muscles and teach control. Starting a recruit in with this form of instruction, the coach is able to correct poor positions and teach good ones.

A recruit must first be taught to see his sights correctly. There is no better system of instruction in this than that laid down in the Firing Regulations. This form of instruction, however, gets monotonous after a time, and men should be kept at it only long enough to qualify. I believe the half sight and the peep sight should be the only ones taught, and one or the other of these methods of sighting should be insisted upon. The use of the peep sight should be encour-

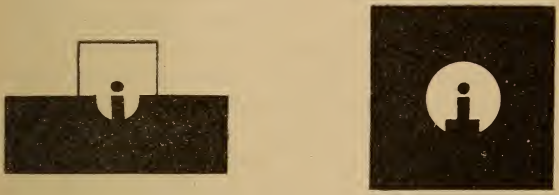


FIGURE 10.
Correct Appearance of the Open and Peep Sights in Aiming.

aged. This sight is used almost exclusively by nearly every expert shot in the country. With it the same amount of front sight is seen each time, thus eliminating the vertical errors in shooting. In different lights more or less of the front sight will be seen when using the open rear sight, no matter how careful the rifleman is to see the same amount each time. Thus with the open sight we have to be continually making allowances for light. With the peep sight, however, the light question becomes much simpler. To use the peep sight correctly, the top of the front sight must be exactly centered in the middle of the aperture and the front sight held just under the bull's-eye, as in Figure 10. The eye has a natural aptitude for centering objects, and with a little practice the top of the front sight will be centered exactly without effort. The middle of an aperture always has more light than the sides, and this also aids the centering. If we were to draw the top of the front sight down to the bottom of the peep-hole, we would have less light, and consequently poorer definition, and we would be unable to see the same amount of front sight each time.

When the recruit has qualified in correctly seeing both open and peep sights, he should pass on to the position and aiming drills, his first work

in this being under the eyes of an expert instructor and his positions being carefully corrected until he can assume them correctly as laid down in the chapter on the firing positions. The recruit is then encouraged to undertake the trigger-pull exercises and afterwards the rapid-fire exercises in all positions. He should be taught the great value of these exercises not only to the beginner, but also to the expert who desires to keep in practice.

In a company the men should be taught to take advantage of every opportunity to aim at some definite object, pulling the trigger each time. To this end the men's barracks should be furnished with aiming targets. A black bull's-eye half an inch in diameter inked on a small sheet of paper does as well as anything. There should be several of these for each squad, pasted or tacked on the walls of the squad-room. Place some of them 4½ feet from the ground, for use in the standing position, and others 18 inches from the ground, for use sitting, kneeling, and prone.

If one exercise the care that should be taken with this practice to make it successful, he will find that five shots are about as many as he should pull at one time when he first begins, but after a week or so he will be able to pull twelve

as easily as he did five at first. When one becomes used to the exercise, he should pull the shots in series of ten standing and sitting, and twelve prone, resting between series, for that is the number of consecutive shots he will be obliged to fire on the range. Officers should be constantly at hand to see that no bad habits or positions are acquired. Canting the rifle should be carefully watched for—also the jerking of the trigger. In slow fire a man can scarcely pull his trigger off carefully in less than four seconds.

In these exercises the first exercise or "position exercise" is intended to develop the muscles used in holding the rifle. To this end it should be given as an exercise, and not as a drill; that is, the exercise should be kept up just to that point where the muscle tires, in order that development may result. Also it should be given last; otherwise the men's muscles will be too tired for steady holding in the aiming and trigger-pull exercises.

The beginners should be made to understand that rifle-shooting is a complex science which requires a large amount of intelligent practice, and that they cannot master it in a few days or even in a season's practice. If a man is left to make this discovery for himself, he is liable to become

discouraged long before he reaches that degree of proficiency where his interest begins to rise with leaps and bounds. I have been shooting a rifle since I was a very small boy, but never have I seen the time when I could disregard the position and aiming drills.

CHAPTER VI.

Gallery Practice and Calling the Shot.

Gallery practice is taken up next after the position and aiming drills have been thoroughly taught. It consists in shooting at short range, 50 feet to 50 yards, with a service rifle with .22-caliber barrel or the regulation rifle with a reduced load. It offers a different and more interesting form of instruction than the position and aiming drills, with the same object in view—*i. e.*, instruction in position, holding, sighting, and control of the trigger. It is well to start the recruit in at 50 feet on the iron target, for at this range he can see the shot marks and the practice goes along quickly. After he has become proficient at this range, he should be moved up into the class firing at 50 yards and taught to "call his shots." This is where the great benefit of gallery practice comes in. *Until a man can call his shots he is a very poor marksman, and indeed he cannot be coached into a better one.* By "calling the shot" is meant the telling the in-

structor by the marksman the exact point on the target upon which the sights were aligned at the instant the rifle exploded. The marksman must form the habit of holding as steadily as possible and gradually increasing the pressure on the trigger, and then, just at the instant the gun goes off, he must catch in his mind a picture of where the sights were aligned, where the rifle was aimed, at that instant. The recruit cannot hold steadily; his front sight seems to wander aimlessly over the bull's-eye and four ring of the target while he tries to pull the trigger off carefully; then suddenly the recoil shuts the target from view. It is the point where the top of the front sight was the quarter-second before the recoil shut it out of view that should be called. Immediately after having fired, he calls to the instructor where he held or where he expects his shot to go, thus: "A 4 at 3 o'clock," "A bull at 7 o'clock," "A bull in the center," "A good hold a little towards 5:30 o'clock," or, "I got off just right," "A trifle low," "At 7 o'clock," etc. If the rifle is correctly sighted and the man has called his shot correctly, the bullet should hit the target at the spot the man called. If it does not do so and the man is sure of his call, he should alter his elevation and wind-gauge an amount corresponding to the distance and direc-

tion of the hit from the point of call. Or, if he is sure that the gun was correctly aimed to hit the bull's-eye in the center and his shot is marked a 4 at 8 o'clock, he must raise his elevation enough to make the next shot fall in a horizontal line intersecting the center of the bull's-eye, and move his wind-gauge to the right enough to make the next shot fall in a vertical line intersecting the bull's-eye. Then if the next shot is correctly aimed, it should hit dead center.

Under no circumstance should a man be allowed to hold on any part of the target other than the bull's-eye to correct an error in sight adjustment. The sight must always be moved to correct this error. One should always hold with the front sight just below the bull's-eye at 6 o'clock. The front sight should not touch the bull's-eye and a little strip of white target should always show between the top of the front sight and the bottom of the bull's-eye. This strip of white should be of equal thickness for each shot, as in Figure 9. It is of the greatest importance that men be taught to always aim in this manner, and it must be thoroughly impressed upon them at the very beginning of their instruction. So important is this that any departure from this iron-clad rule should be an occasion for strict disciplinary measures when discovered.

A recruit should never, if it can be avoided, be allowed to take up range practice until he has learned to call his shots; otherwise it is simply a waste of ammunition. It is necessary in teaching this that the target be removed to such a distance that the men cannot see the bullet-holes, otherwise they will call them instead of their points of holding. For the same reason the target should not be marked for about ten seconds after the shot has been fired. The bright men of the company will learn to call their shots very quickly, others may take a long time to learn it. It is thus well to start gallery practice very early in the season, so that all men may be qualified before the time for range practice. Too much gallery practice cannot be given. Interest may be kept up by competitions, prizes, and privileges to the best shots.

The service rifle with the .22-caliber barrel is undoubtedly the best for recruit and company instruction. Reloading reduced ammunition for the .30-caliber barrel is never satisfactorily done in a company; and to make this practice of any value and at all interesting it is necessary that the ammunition be sufficiently accurate to shoot steadily into the bull's-eye. The .22-caliber rifle has one disadvantage, however, in that the marksman using it does not become familiar

with the trigger-pull and feel of his own rifle—the one he will have to use on the range and in the field. Gallery practice is not to be considered only for recruit instruction. It is of great value to the good shots also. The latter can, by its aid, keep up his practice during the winter months and in inclement weather. There is a saying, "Beware of the man with one gun," which is a mighty true one. To become really expert with the rifle, one must use his piece until it becomes almost a part of himself; must know its trigger-pull, bolt, action, feel, balance, sights, and peculiarities as he knows the alphabet. Thus the very best can be obtained from gallery practice only when one uses in it the rifle he intends to use on the range and to stake his reputation on. For the expert, therefore, an accurate reduced load for gallery practice becomes a necessity, and it is not perhaps out of place to consider it here.

This load must be accurate enough to do justice to a man holding. In other words, it must be capable of shooting into the same hole at 50 feet, or into a 1-inch circle at 50 yards. It must not wear the barrel and must not be too strong for indoor use. It must also be cleanly enough to use without having to clean the rifle frequently. Keeping these qualifications in mind, we

must reject black powder and round bullets. With smokeless powder it is necessary to use a hard bullet (lead alloyed with tin and antimony), and this bullet must be at least .002 of an inch larger than the bore of the rifle to insure accuracy. In order that such a bullet may be seated in the month of the shell without deforming it, it is necessary to expand the neck of the shell to the diameter of the bullet. The powder charge must not be so large as to cause the bullet to strip and lead the barrel, nor must it generate a gas hot enough to melt the base of the bullet. The best results have been obtained with bullets No. 308245 and 308257, illustrated in Figure 11.

308245 308257

FIGURE 11.

With bullet No. 308245 use from 3 to 5 grains (weight, not measure) of Laflin & Rand "Bull's-eye," "Unique," or "Infallible" powder, or 5 to 6 grains weight of Du Pont's Smokeless No. 1 or

2. Size the bullets to .310 inch for a .308 barrel, and lubricate them preferably with Leopold's Banana Lubricant. This can be done easily and very accurately in an Ideal lubricating machine. The necks of the shells should be expanded to .310 inch in an Ideal tool, and the shells primed with a No. 2½ W. Winchester or a No. 7½ U. M. C. primer. The bullet should be seated just deep enough to cover all the grooves. This load is very accurate up to 75 yards. Bullet No. 308257 gives a little more powerful load. It is intended to be inserted into the shell by hand, the upper band being made large to prevent its receding too far. For this bullet use 5½ grains weight (corresponding to 10 grains black powder measure) of Laflin & Rand Unique powder. This load has placed ten consecutive shots in a 1-inch circle at 75 yards, and in calm weather will work well up to 200 yards. Both these bullets work best when cast from an alloy of 86 per cent lead, 7 per cent tin, and 7 per cent antimony, but will give good results with an alloy of 10 parts of lead to 1 of tin. These loads require about 400 yards elevation and a trifle left windage for use in the gallery. The exact sighting, of course, must be determined for each rifle. They are not too strong for indoor work nor for iron targets.

Reloading tools for this and for all other ammunition are made by the Ideal Manufacturing Company, of New Haven, Conn. This company issues a catalogue called "The Ideal Handbook," which will be sent to anyone on request. It is full of valuable information, not only on reloading cartridges, but on many other matters of interest to riflemen, and it will repay anyone to get a copy.

Gallery ranges are easily made. Bullet-stops may consist of 10 inches of wood, sand-bags, or a ¼-inch iron plate. The regular iron target issued by the Ordnance Department may be used, or preferably paper targets tacked on a wood framework set up just in front of the bullet-stop. Indoor targets may be lighted by lamps with reflectors placed just in front of and to one side of the target, so that their light will be thrown thereon. The best galleries are fitted with a trolley arrangement whereby the targets can be run down to the butt and back to the firing-point by hand, thus obviating the necessity of having a man near the target. The location of bullet-holes can be ascertained by having a cheap, powerful telescope trained on the target and rigidily fixed alongside the firing-point.

CHAPTER VII.

The Sights and Their Adjustment.

The front sights of both our military rifles are very similar, consisting of an immovable piece of steel in form like a knife-blade. When viewed from the rear, the top appears square and has a thickness of approximately .05 inch. The rear sights are known as the Model 1901, for the Krag, and the Models 1903 and 1905, for the Model 1903 rifle. The Model 1903 sight (see Figure 12) has been superseded by the 1905 type and will soon be obsolete. This sight presents many excellent features from a strictly military point of view, but is not so good for target-shooting as the other two forms. Its principal defect consists in serratures on the elevating leaf which prevent adjustments for elevation closer than 25 yards. Thus, for example, when shooting at 1000 yards, it is impossible with this sight to make a closer adjustment than 32.8 inches, or half the target.

The Model 1901 sight for the Krag rifle is well known and is very popular. The Model

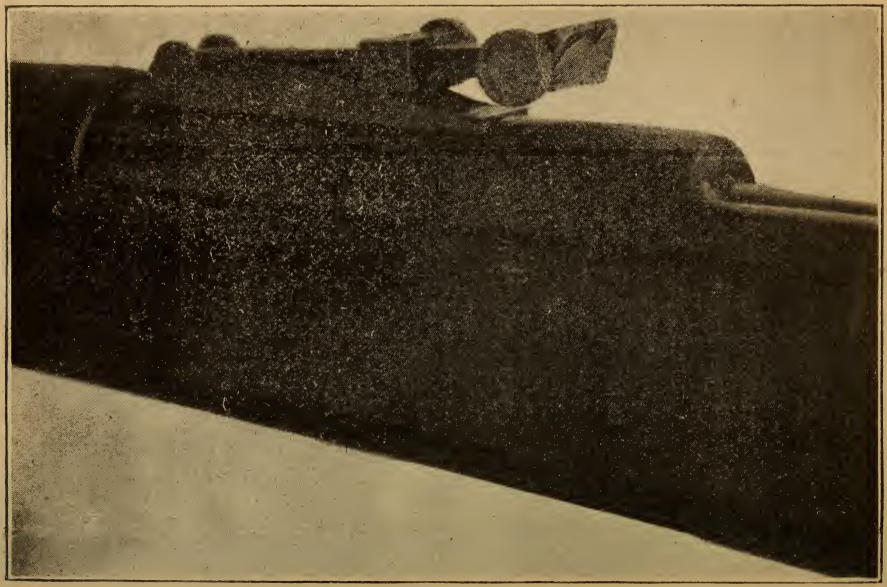


FIGURE 12.—Model 1903 Sight.

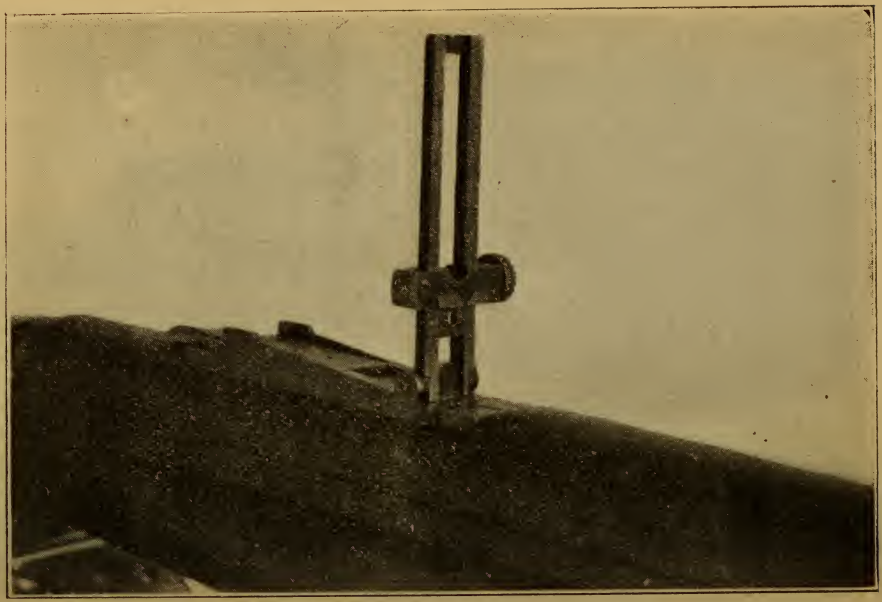


FIGURE 13.—Model 1901 Sight.

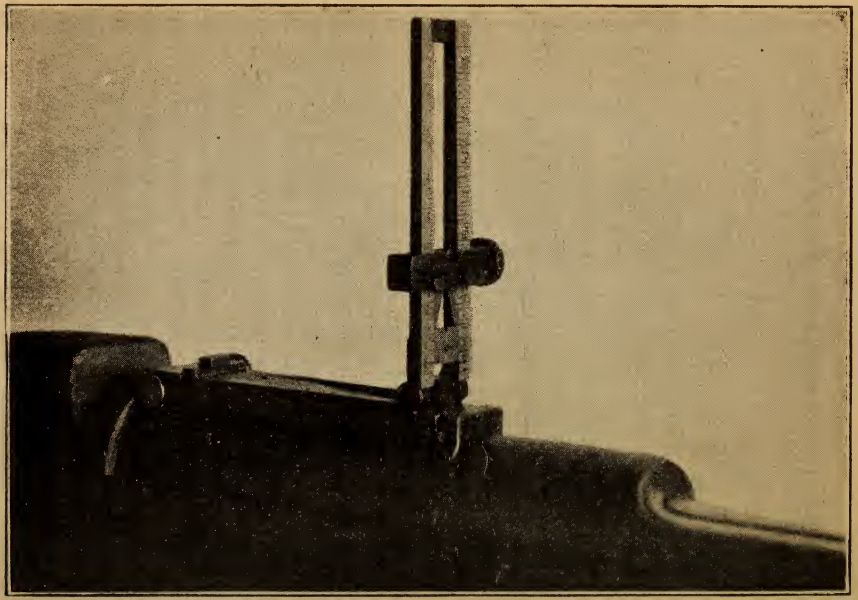


FIGURE 14.—Model 1905 Sight.

1905 sight is really a combination between this sight and the Buffington sight of the .45-caliber Springfield rifle. Although the 1905 sight is just making its initial bow to riflemen, I do not hesitate to say that it is the best sight for military target-shooting ever given to any nation. All target-shooting is done with the leaf raised; therefore we have a constant value for the wind-gauge scale, and the wind-gauge has a screw adjustment; both of these features being great improvements over the 1901 sight.

Next to the muzzle of the rifle, the sight is its most delicate and important part, and the recruit should be taught to guard it with the greatest care, especially from blows which would knock it out of alignment. The 1901 sight is fastened to the barrel of the rifle by screws, which must be kept tight at all times or the alignment of the sight will be uncertain. Removing a sight and then replacing it often changes the alignment. Many riflemen rust these screws in place by immersing them in salt water and then screwing them down tight, thus eliminating all chance of changes in alignment from this cause. The 1903 and 1905 sights, being firmly fixed to the barrel by a sleeve and pins, are free from this defect.

Accuracy in setting the sights is of the great-

est importance in target work. The front and rear 1905 sights are approximately 22.35 inches apart; and it therefore follows that if we move the rear sight up or down a distance of 1-150 inch, we will move the bullet 1 inch on the target for every 100 yards of range. That is, a change in elevation of 1-150 inch will raise or lower the position of the hit on the target 2 inches at 200 yards, 5 inches at 500 yards, or 10 inches at 1000 yards. An adjustment to this degree of fineness is almost absolutely necessary in fine target work, but there are very few men indeed who can see to elevate or lower their sights an amount as small as 1-150 inch. The distance between elevation marks can, however, readily be divided into four equal parts, giving an elevation reading to 25 yards. Consulting the table of sight adjustments, we will see that if we are shooting at 500 yards with a sight elevation of 500 yards, and we raise our elevation to 525 yards, our next shot will strike 9.4 inches higher than the preceding one. If, instead of raising it, we lower it to 475 yards, we lower the point of impact 8.75 inches, etc.

A rifle will very seldom be found which will hit the bull's-eye in the center with the sights set at the exact elevation for the distance. The difference in the velocity and fit of ammunition, dif-

ferences in light, differences in the amount of front sight seen, the effect of mirage on the target, heat developed during firing, personal equation of the rifleman, and the peculiarities of individual guns are all causes which may make as much difference as 150 yards in the elevation required for a certain rifle and man. Thus an individual may find that when shooting at 500 yards, his sight will have to be set at an elevation of 350 or perhaps 650 yards to make a center bull's-eye when aiming and pulling the trigger correctly. The graduations of the rear sight are correct only for the particular condition existing when they were experimentally determined, but if we take the average elevations of a large number of rifles, we will find the average to be just where marked on the sight.

Most expert riflemen have found it far better to use a small instrument called a "micrometer sight-adjuster" in adjusting the sights for elevation than to rely on the uncertainty of adjusting them by eye and hand. These instruments snap on the sight and by means of a micrometer screw and scale can be adjusted to read 1-150 inch; thus the sight can be elevated to read inches on the target, and the very fine adjustments can be recorded and the sights accurately set at them again. This is a great advantage in

fine target work. For instance, a man finds his average elevation for 600 yards to read 38 degrees on the micrometer. He comes to the firing-point and sets his sight at 38 degrees; he fires; his shot strikes 18 inches below the center of the bull's-eye. Now, if he raises his sight 3 degrees, or from 38 to 41 degrees, he knows positively that if he gets his rifle off exactly right, other conditions being the same, his next shot will strike 18 inches higher or in the center of the bull's-eye, for 1 degree, or 1-150 inch additional elevation will raise his shot 6 inches at 600 yards. His correct elevation at 600 yards may be 40 degrees, corresponding as nearly as he can see to a reading of 585 yards on the sight; but without the micrometer he cannot be positive that he sets his sight at exactly this point. There are two forms of micrometer sight-adjusters on the market at present: the Stevens-Pope Sight Micrometer (see Figure 15), which snaps on the sight and is held by springs, and the British Sight Vernier, which is held in position by hand while adjusting. The former can be kept on the rifle while firing. It can be procured from the J. Stevens Arms and Tool Company, Chicopee Falls, Mass. The latter can be procured from Thomas J. Conroy, 28 John Street, New York City.

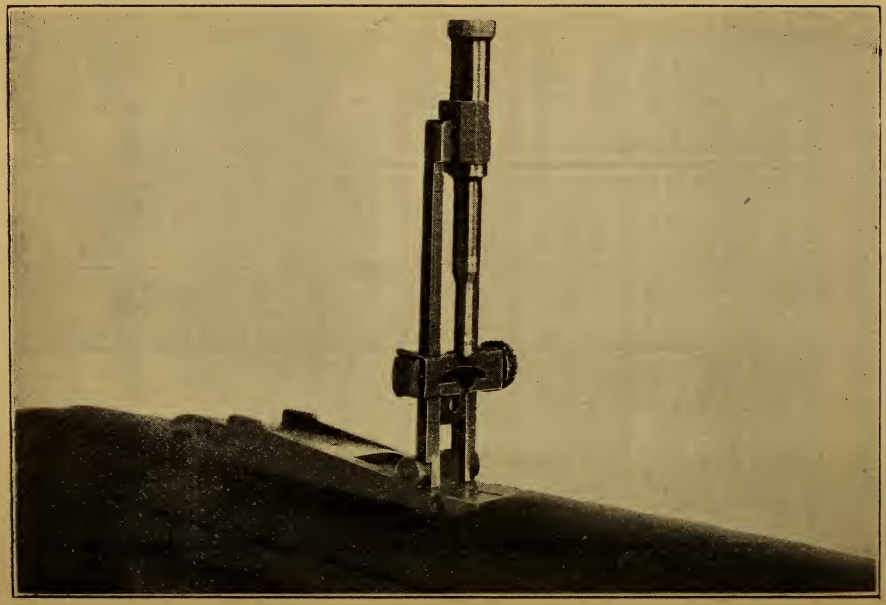


FIGURE 15.—Model 1901 Sight, with Stevens-Pope Micrometer Sight Adjuster.

FIGURE 16.—Model 1905 Sight, with British Vernier Sight Adjuster

So far, we have considered only the elevation adjustment of the sight. The windage adjustment, however, is of just as much importance. It gives the correction for horizontal errors and the allowance to compensate for the effect of wind on the flight of the bullet. To move the location of the hit to the right, move the wind-gauge to the right, and *vicę versa.* The divisions on this wind-gauge are called "points," and for convenience are divided into series of three. On the 1903 and 1905 sights these points are .025 inch apart; therefore, moving the sight 1 point will move the bullet 4 inches on the target for every 100 yards of range, as will be seen in the table of sight adjustments. On the 1901 sight, the points are .04 inch apart and 1 point equals 6 inches. It is very seldom that the zero on the wind-gauge scale is the true zero of the piece. Some guns may have to have the wind-guage adjusted to as much as 2 points right or left of the zero on the scale to shoot into a vertical line drawn through the center of the bull's-eye when there is no wind and the gun is correctly aimed.

Up to the present time no micrometer adjuster has been made for the wind-gauge, and experience has proven that it is not so much needed here as on the elevating scale. On the

new sight, a point on the wind-gauge can easily be divided into quarters or .0062 inch by the eye alone, and this will give an adjustment of 1 inch for each 100 yards.

Let us take an example of sight adjustment. Suppose the rifleman is firing at 800 yards with an elevation of 790 yards and a windage of 1 point left. On the first shot he gets a "3" at 10 o'clock, and the location of this shot appears to be 20 inches above the center of the bull's-eye, and 33 inches to the left of the center. If he now reduces his elevation 25 yards, or to 765 yards, and moves his wind-gauge 1 point to the right, or to 0 (see table of sight adjustments), and if the weather conditions remain the same and he gets his shot off correctly, he should get a hit in the center of the bull's-eye. If he was using the micrometer adjuster and his elevation for the first shot read 54 degrees, he would reduce it to 50½ degrees to lower the next hit 20 inches. If, however, the rifleman was ignorant of the value of movements on the sights—that is, if he had no table of sight adjustments, he might make too large or too small a move, and instead of getting a bull for his second shot, he would be just as liable to get a "3" or a "4." We thus see the great importance of fine and accurate sight adjustment, and the value of the tables given.

It will be noticed that the elevations in this table are given as plus or minus. By 25 yards + elevation at 800 yards is meant a change of 25 yards between the 800- and 900-yard marks, which is manifestly a larger movement of the sight than 25 yards — elevation, or between 800 and 700 yards.

To be well defined to the eye without blur or glimmer, the sights must not be bright, and to show up well against the white target in aiming, they should be black. To obtain this dull black color, most riflemen smoke their sights in the smoke of a candle or a small piece of camphor. Some riflmen prefer to paint their sights with a liquid sight black. Dr. Hudson's formula for sight black is as follows:

Ivory black "B" in japan (a black paste, obtainable from dealers in painters' supplies in 1-pound cans), 5 ounces.

Gasoline, 76 test, 12 fluid ounces.

Add the gasoline little by little to the paste, mixing thoroughly after each addition. If it is found to dry with any gloss whatever, there is too much "binder" in the paste; to correct this, add to the paste a little powdered lampblack and work up thoroughly with the first portion of the gasoline, which is added. Gasoline is used to thin down the paste because of its quick drying

properties. This mixture will dry on the sights in a few seconds.

If the sights are smoked, the elevation and windage scales should be carefully wiped free of black, so that they can be easily seen. No good work can be done with bright sights and men should never be allowed to come to the firing-point without their sights blackened.

DISTANCE IN YARDS	MODEL 1901 SIGHT. [KRAG]			MODEL 1903 SIGHT	MODEL 1905 SIGHT		MODELS 1903 and 1905 SIGHTS
	Value of 25 yards + and — on the target, Inches.		Value of one point of wind on the target, Inches.	Value of 25 yards elevation on the target, Inches.	Value of 25 yards + and — on the target, Inches.		Value of one point of wind on the target, Inches.
	+	—			+	—	
100	.62	—	6.	1.	1.12	—	4.
200	2.25	1.25	12.	2.4	2.6	2 25	8.
300	3.62	3.37	18.	4.1	4.5	4.	12.
400	6.4	4.83	24.	6.2	7	6.	16.
500	10.25	8.	30.	9.	9.4	8.75	20.
600	18.	13.12	36.	12.5	13.5	11.25	24.
700	—	—	42.	16.7	16.6	15.75	28.
800	30.	24.	48.	21.4	23.	19.	32.
900	—	—	54.	26.9	27.	25.9	36.
1000	45.	36.	60.	32.8	33.75	30.	40.

CHAPTER VIII.

Elevation and Zero.

We have seen in the previous chapter that a gun is seldom correctly sighted for a given range at the exact elevation as marked on the sight. A rifleman shooting a new rifle changes the elevation on his sights until the rifle is shooting steadily into the bull's-eye. He then records the reading on the sight or micrometer as the elevation for that range and for the ammunition he was then using. It is actually a fact, as will be seen later, that ammunition manufactured on different days or on different machines will require different elevations. It is also a fact that different weather conditions will require different elevations with the same man, gun, and ammunition. The expert shot determines the elevation for a new rifle on a day having average or normal weather conditions for the locality in which he is shooting. He carefully records in his score-book, opposite this elevation, the exact weather conditions existing at the time of firing, and it then becomes his "normal eleva-

tion," from which he adds or subtracts to obtain his actual elevation under changed weather conditions. Elevations are subject to many changes, the causes for which may be laid to the following:

Differences in ammunition,
Temperature of air and rifle,
Light,
Mirage,
Barometer,
Hygrometer,
Condition of the bore of the rifle,
Condition of the eyes,
Differences in position and hardness of holding.

A rifle also changes its normal elevation from time to time. A new rifle is constantly changing until the bore loses the polish which the tools gave it during manufacture and takes on the polish which the bullets passing through give it. The elevation of a modern rifle remains most constant between the two-hundredth and the twelve-hundredth shot, provided the barrel is well taken care of. The effect of temperature, light, mirage, barometer, and hygrometer on elevations will be considered later. Most guns which are bored near the standard size (.308 inch) have certain peculiarities of grouping their shots. If

the barrel is clean, cold, and free from oil, the first shot will go a trifle higher than the succeeding group; about half the width of the bull's-eye. After the first shot, the gun will group its shots very steadily in one spot until the barrel gets very hot, when they will begin to fly a little higher. There are many exceptions to this rule, however, and the only safe way of determining how a gun will group its shots, is to fire seven or eight scores carefully, plotting them on the elevation chart shown with the long-range page of the score book in Chapter XII. A rifle will shoot higher and therefore requires lower elevation, if shot in the prone position than if shot off-hand. It will shoot higher still if the barrel is rested on any object, such as a log, sand-bag, or intrenchment.

In determining the normal elevation, it is best to take the rifle after about 200 rounds have been fired from it and approximate elevations found. Choose a clear, sunny day, and when the rifle is shooting steadily into the bull's-eye at the end of the fifth or sixth shot, record the elevation as follows:

NORMAL ELEVATION 800 YARDS.

ELEVATION 790 YARDS, 54 DEGREES.

NOTES: *STARTED WITH BARREL clean and cold*

Elevation recorded after 6th shot.

AMMUNITION, Frank 5-22-04, Vel. 2170.
LIGHT, Bright Sunny 10 A.M.
MIRAGE, Light /
THERM., 70 degrees.
BAROM., 31 degrees.
HYGROM., 75 %.
WIND, 9 o'clock 12 miles.

To show how weather conditions may change the elevation, if we were shooting this same rifle and ammunition on another day and with no change in the weather conditions, except that the thermometer had gone up from 70 degrees to 80 degrees, then this increase of heat would make the bullet hit 12 inches higher, and we would have to subtract 1½ degrees from our elevation with the micrometer, making the elevation read 52.5 degrees (see Chapter X.).

By the zero of a rifle we mean that point on the wind-gauge to which the sight must be set to cause the rifle, when correctly sighted, to shoot into a vertical line with the center of the bull's-eye when no wind is blowing. It may be

as much as 2 points right or left of the 0 on the scale, and is, of course, the point from which all right and left windage is figured. If, for instance, the zero of our rifle is 1 point right, and the wind indications call for a correction of 1 point right, then we move the wind-gauge to read, 2 points right; but we have only taken a point of actual wind. The zero may differ for different ranges and it may be to the right for one range and left for another. It may change a little with the changes of ammunition. Changing from full service loads to reduced loads changes it considerably. On the Krag rifle it is often changed permanently when the rear sight is removed and then replaced. A blow on the front sight will often bend it so as to change the zero. Otherwise the zero is not affected by the many conditions which influence the elevation.

The best way to determine the zero is to shoot on days when there is no wind, and carefully record the wind-gauge readings. On some ranges, however, windless days are very scare. On such a range take a number of correctly pulled shots which have hit the bull's-eye, subtract from their windage data the number of points which the wind at the time of firing called for, and average the results. If the score-book has been carefully kept, the average will be the zero for that range.

When the rifleman knows the normal elevation and zero for his rifle at all ranges, he is prepared for accurate shooting and for competition work. Until these are determined his shooting must be largely experimental, or, as it is called in the Firing Regulations, "instruction practice." The expert starts the season's shooting with a new rifle. He simply shoots it carefully through the various courses, keeping all the while every speck of data very carefully in his score-book, as shown in Chapter XII. In a very few days he will be able to determine absolutely his elevations and zeros from this data. Some men trust to memory for their elevations, but these men are seldom found among the prize-winners.

CHAPTER IX.

Windage and Winds.

There is nothing which bothers the novice so much when he first undertakes range practice as the wind, and yet to the expert it is a very simple matter. The wind is the greatest disturbing factor to the flight of the bullet that we have to contend with. The effect of a wind blowing on the side of a bullet is to cause it to travel slightly with the wind. Thus, if a wind coming from the right is blowing on the right-hand side of the bullet, the bullet will drift to the left, and instead of the bullet hitting the bull's-eye, it will strike over toward the left-hand edge of the target. To compensate for this we adjust our wind-gauge to the right. This is all clear enough, but the lack of knowledge of just how much to allow on the wind-gauge for a certain velocity and direction of wind is the stumbling-block to most novices.

In speaking of the direction of the wind, riflemen consider the rifle range as they would the

dial of a clock with the target at 12 o'clock and the firing-point at 6 o'clock. Thus, a wind blowing from the right at exactly a right angle to the line of fire would be called a 3 o'clock wind, and a wind blowing straight toward the marksman would be a 12 o'clock wind. A 3 o'clock wind has the greatest deviating effect on the bullet, and this effect decreases as the direction approaches 12 or 6 o'clock until when in these latter directions the wind causes no lateral displacement of the bullet at all.

The direction and velocity of the wind are shown by its effect on the flags or streamers of red bunting with which every range is supplied. The rifleman judges the velocity by the way the flag stands out with the breeze. For instance, a wind with a velocity of 1 mile per hour gives a barely perceptible lift to the flag, while a 25-mile per hour wind will cause the flag to stand straight out from the staff. Many ranges are also provided with wind-clocks, which are large clock dials with a single hand so geared to a weather vane that when the wind is blowing from a certain direction the hand will point to that direction. They show the direction of the wind with a greater degree of precision than the flags will indicate.

As the velocity of the bullet is constantly decreasing, and the wind will deflect a bullet traveling at a low velocity more than it will one traveling at high velocity, it follows that the deflected path of the bullet with a lateral wind is a curved line, as in the case of the trajectory. That is to say, if the wind deflects the bullet 1 inch at 100 yards, it will deflect it more than 2 inches at 200 yards, and considerably more than 3 inches at 300 yards, and so on.

The estimation of the velocity of the wind will always remain largely a matter of guesswork. Figure 17 gives approximately the amount of lift which the different wind velocities have on the standard streamer when the streamer is dry. When the streamer is wet or damp from rain, dew, or fog, it will not stand out as much, and flags of different shape, size, and material will stand out differently. If the flags on a certain range do not stand out as shown in this figure, the lift had better be observed and compared with an anemometer and a sketch made of the flags as they lift with the different velocities of wind.

Being able in this manner to judge the direction and approximate velocity of the wind, we turn to the table of wind allowances, and from it

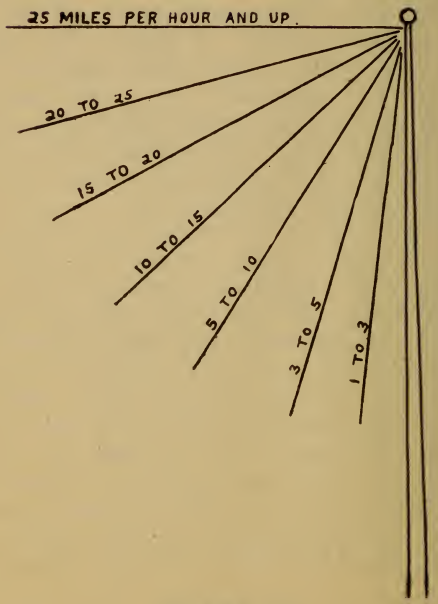


FIGURE 17.
Flag Lifts for Different Velocities of Wind.

are able to set our wind-gauge so that our first shot should be at least a close "4."

Let us take an example: We are to fire at 600 yards. We notice that the wind is blowing from 2 o'clock and the flags stand out from the staff at an angle of about 45 degrees, indicating about a 12-mile wind. We refer to the table and find that at 600 yards a 2 o'clock wind at 12 miles per hour will deflect the bullet 50.4 inches and that 2.2 points of windage will move the bullet this amount. We therefore set our wind-gauge at 2.2 points "right" for the first shot.

We have seen that 6 and 12 o'clock winds do not deflect the bullet laterally. A 6 o'clock wind, however, has an accelerating effect on the bullet and for it at 600 yards or over we deduct 1 degree with the micrometer from the elevation. A 12 o'clock wind retards the bullet, and at ranges over 600 yards we add 1 degree to our elevation. For ranges under 600 yards or for winds of less velocity than 10 miles per hour, these corrections may be disregarded.

Often the wind will vary greatly in velocity between shots, sometimes doing it so quickly and frequently that it is impossible to follow it by adjusting the sights. In this case the wind-gauge should be set for the average wind and the rifleman should endeavor to get his shot off

just when the flag blows out with that velocity. It hardly pays to try to shoot in a wind of over 25 miles per hour. Always observe the flags near the target in preference to those near the firing-point, as the former give the condition of the wind where the bullet's velocity is the smallest and where it is most easily deflected.

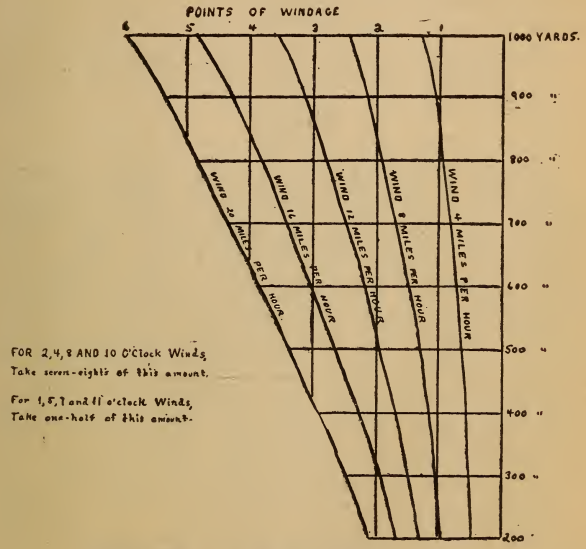
Often it happens that the flags will not show the true direction of the wind. They may be influenced by hills, valleys, or a line of trees at the side of the range. In these cases the flight of the dust kicked up by the bullets which strike the butts, the wave of the grass, the flight of small insects, etc., offer valuable guides. The best method of judging the deviating effect of the wind, however, is by the mirage or heat waves. To see these near the target a telescope of from 20 to 30 diameters, with an object-glass about 2 inches in diameter, is needed. When viewed through this, the mirage will be seen to drift with the wind. A little experience on the range will soon teach the rifleman how much to allow for a certain drift of mirage. Mirage is extremely sensitive to wind and shows clearly every change and current. The flags show the wind high up in the air and off to one side of the range, but if the telescope be focused on the target, the wind indications shown by the mirage will be those

directly in the path of the bullet. Experts have come to disregard the flags to a great extent and depend on observance of the mirage for wind judgment. On the Fort Sheridan rifle range, I have seen the flags giving an indication for 2 points right wind when the mirage showed indications for 1½ points left. Upon firing it was seen that the mirage indication was the correct one. It often happens, however, that mirage is not present, and then the flags have to be relied upon.

TABLE OF WIND ALLOWANCES.

Model 1903 Rifle. **Models 1903 and 1905 Sights.**

DISTANCE. [YARDS]	Force of Wind in Miles per Hour	By 1-5-7 and 11 o'clock Winds		By 2-4-8 and 10 o'clock Winds		By 3 and 9 o'clock Winds	
		Amount of Deflection	No. of Points Required on Wind Gauge	Amount of Deflection	No of Points Required on Wind Gauge	Amount of Deflection	No. of Points Required on Wind Gauge
200	4	1.7 in.	.2	3 4 in.	.4	4 2 in.	.5
	8	3.4 in.	.4	6.8 in.	.8	8.4 in.	1.
1 pt. =	12	5.1 in.	.6	10.2 in.	1 3	12 6 in.	1.6
8 in.	16	6 8 in.	.8	13.6 in.	1.7	16 8 in.	2 1
	20	8.4 in.	1.	16 8 in.	2.1	21. in.	2.6
500	4	6.5 in.	3	13. in.	6	16 3 in.	.8
	8	13. in.	6	26. in.	1.3	32 6 in.	1.6
1 pt. =	12	19 5 in.	1.	39 in.	1.9	48.9 in	2 4
20 in.	16	26. in.	1.3	52. in.	2.6	65 2 in	3 2
	20	32.6 in.	1 6	65.2 in.	3 2	81.5 in.	4.1
600	4	8 4 in.	.4	16 8 in.	.7	21.1 in.	.9
	8	16.8 in.	.7	33.6 in.	1.4	42.2 in.	1 8
1 pt. =	12	25.2 in.	1.1	50.4 in.	2.2	63.3 in.	2.7
24 in.	16	33 6 in.	1.4	67.2 in.	2.9	84 4 in.	3 6
	20	42.1 in.	1 8	84 2 in.	3.6	105.5 in.	4 4
800	4	16 1 in.	.5	32 3 in.	1.	40.3 in.	1.3
	8	32.2 in.	1.0	64.6 in.	2.	80.6 in.	2.6
1 pt. =	12	48.3 in.	1 5	96 9 in.	3.	120.9 in	3.9
32 in.	16	64.4 in.	2.	129.2 in.	4.	161.2 in.	5.2
	20	80.7 in.	2.5	161 4 in.	5.	201.6 in.	6.3
1000	4	24 4 in.	6	48.8 in.	1 2	60.9 in.	1.5
	8	48 8 in.	1 2	97.6 in.	2.4	121.8 in.	3.
1 pt. =	12	73.2 in.	1.8	146.4 in.	3.6	182.7 in.	4 5
40 in.	16	97.6 in.	2.4	195.2 in.	4.8	243.6 in	6.
	20	122. in.	3.	244. in.	6.1	304.6 in.	7.6



WIND CHART FOR THE KRAG RIFLE.

3 and 9 o'clock winds, Model 1901 Sight.

CHAPTER X.

Mirage, Light, and Atmosphere.

Mirage.

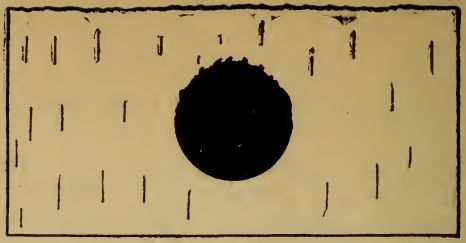
Mirage is that rippling haze or waves of heat which is so much in evidence when looking across ground heated by the summer sun. The effect of mirage is to deflect the image of the target vertically, laterally, or both together. When no wind is blowing, the mirage ripples travel straight up and the target image is deflected upward. When a lateral wind is blowing from the right, say 3 o'clock, the ripples travel up and to the left, and the target image is deflected in that direction. With 6 and 12 o'clock winds the image is deflected straight up.

In aiming when the mirage is present, we aim at the deflected image of the target, and not at the target itself. If the mirage ripples are running straight up, showing a simple upward deflection of the image, we must decrease our elevation. If they are also drifting to the left, we must use right windage. If both mirage and lat-

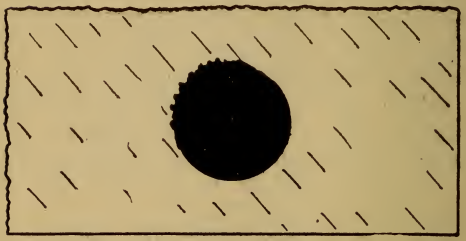
eral wind are very strong, the mirage may appear to have only lateral with no upward movement, in which case only windage correction will be needed. No rule can be given as to the amount of correction required. The amount of mirage running, its velocity, and the strength of the wind are the guides. On ranges in the northern part of the United States the displacement is seldom more than 4 feet at 1000 yards, but in the Southwest, where the mirage may be very heavy, it frequently deflects the image as much as 12 feet. This displacement can only be measured by setting a transit on the target at dawn, when no mirage is running, and noting the displacement thereafter.

Mirage can be seen when the light is bright over all the range and when the first half of the range is bright and the target half is shadowed. It is greatest when the ground is wet, on sandy plains, or where the range is traversed by watercourses. On ranges of this character mirage can be seen even on cloudy days and in cold weather. High winds will dispel it. The three diagrams will explain more plainly than words what to look for and the correction needed.

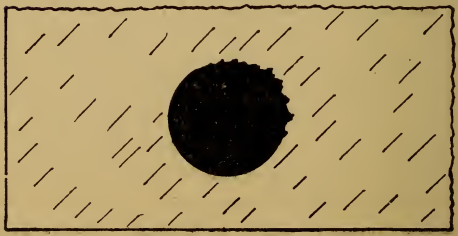
To judge the mirage correctly, a powerful telescope of long focus is needed. One of about 30 diameters power, with a 2-inch object-glass, is



WIND FROM 6 OR 12 O'CLOCK, OR NO WIND
IMAGE DEFLECTED UPWARD



WIND FROM THE RIGHT
IMAGE DEFLECTED UP AND TO THE LEFT



WIND FROM THE LEFT
IMAGE DEFLECTED UP AND TO THE RIGHT

FIG. 18.—Appearance of the Long-range Targets in Mirage.

the best, and it can be conveniently mounted about 12 inches above the ground and alongside the riflemen. Field-glasses of low power and short or universal focus mislead, for they show the mirage near the firing-point and not that near the target.

As we have seen in the previous chapter, mirage is a most trustworthy guide to the wind velocity and direction. The wind velocity may be determined by estimating the travel of the mirage ripples in miles per hour. Wind at 1 mile per hour equals 18 inches per second.

Light.

The amount of light present on the rifle range and the direction from which it comes affects the clearness with which the target may be seen, the marksman's eyes, and the manner in which he sees his sights. When the sun is behind the target and shining through it, the bull's-eye appears so gray that it almost blends with the white of the remainder of the target. A man with very strong eyes may still be able to aim at the bull's-eye, while others must be content with the calculated center of the target, and the scores suffer.

The effect of light on the seeing of the sights depends so much on the strength of the marksman's eyes and the pains he takes in seeing his sights exactly the same each time that no rule can be given. Light affects those who use the peep sight very much less than it does those who use the open. When using the peep sight, the great majority of men decrease their elevation for bright lights and sunny days and increase it for dark lights and cloudy days. The maximum correction will seldom be more than 2 degrees measured by the micrometer. Do not confuse the corrections for light and those for mirage. If the sights are shaded by some object, use the same correction as for a dark day.

Strong light falling on the side of the front sight reflects a glimmer on that side, making the front sight appear thicker, and the sights are thus really aligned on the target a trifle to the opposite side; move your wind-gauge a trifle toward the light. Here the question of eyes comes in. Some men will have such strong eyes that they will see right through this glimmer, and for them no correction is needed.

The open sight can be seen correctly and accurately when the day is dark or both sights are shaded. If the light shines strongly on top of the front sight, the glimmer will cause the sight

to appear higher than it really is, and in reality a fine sight will be taken; raise your elevation slightly. Here again strong eyes may see through the glimmer and no correction will be needed. With bright targets lower your elevation, and with dark targets raise your elevation.

These rules are by no means general. The effect of light on the seeing of the sights will have to be determined for each individual.

Temperature.

The temperature has a decided effect on elevations. When the weather is warm or the gun very hot, the shots will fly higher and less elevation will be required. Low temperatures call for increased elevation; 7½ degrees rise in the thermometer will require a decrease in elevation of 1 degree on the micrometer, for it will cause the shots to strike 1 inch higher for every 100 yards of range. A decrease of 7½ degrees in temperature requires 1 degree increase in elevation. When the barrel becomes very hot from rapid firing on a hot day, the elevation must be decreased. In slow fire the gun seldom heats up enough at one range to require a correction from this cause.

Barometer.

Changes in barometer also affect the elevation, chiefly through their influence on the character of the fouling in the bore of the rifle. A fall of 1 inch in barometer will require 2 degrees decrease in elevation on the micrometer, and *vice versa.*

Hygrometer.

The hygrometer is an instrument used to indicate the perecentage of saturation in the air. It consists of a chemically treated spiral chip, which, by its sensitiveness to moisture, actuates a hand on a dial. Much moisture tends to soften the fouling in the barrel, reducing the friction of the bullets in their passage and causing them to strike higher on the target; while in the absence of dampness the opposite condition will obtain. Experience has shown that in humid weather, especially if also warm, it is wise to start with a somewhat lower elevation than normal for the first shot, followed perhaps by a very slight increase for the next one or two shots; while in very dry, even though still warmer, weather the elevation for the first shot will need to be higher, followed by a somewhat greater increase than in the first instance for the succeeding shot

or two. Each 10 per cent of saturation is equal to about 20 inches in elevation at 1000 yards, or 2 inches for every 100 yards. Thus, if the hygrometer shows an increase of 10 per cent, lower your elevation 2 degrees, and the reverse for a decrease. Moisture in the bore may, however, produce opposite results in two rifles, one of which is .001 inch larger in bore than the other. All corrections given in this chapter were determined for standard rifles which had a bore measurement of .308 inch.

It is not perhaps out of place here to speak of the bad habit of wetting the bullets in the mouth before inserting them in the chamber. This habit is a relic of the old .45-caliber black-powder days, and no matter how efficient it may have proved then, with modern ammunition it will cause the shots to fly high and wild. The cartridges should be inserted in the rifle as clean and dry as possible.

Rain.

Theoretically, rain would call for only that correction which was indicated by the thermometer, barometer, and hygrometer. Practically, however, the drops of rain chill the top of the barrel and cause a contraction thereof. Until

the rain has soaked under the stock and wet the barrel all around, the elevation will be quite different from the normal. The character of the barrel steel, tightness of bands, stock, etc., are such large disturbing factors in this contraction that no rule can be given, and the correction must be determined by experiment for each rifle.

Example of Changes in Elevation and Windage Caused by a Combination of These Conditions.

RANGE 1000 YARDS.

Normal elevation 935 yards, 92 degrees. Peep sight.
Zero 1000 yards, ½ point right.

	Normal Conditions for normal elevation	Actual conditions for first shot	Change called for on micrometer	Changes in windage
Ammunition	F. A. 5-22-04 2170	Same		
Light	Bright Sunny	Dark Cloudy	+ 1	
Mirage	Light ↗	Light ↖	− 1	¼ right.
Thermometer	70°	55°	+ 2	
Barometer	31 in.	31½ in.	+ 1	
Hygrometer	75 %	85%	− 2	
Wind	9 o'k 12 m.	4 o'k 6 m.		2 right

	+ 1	
Normal elevation and zero	92	½ right
Sight adjustment indicated	93	2¾ right

CHAPTER XI.

Ammunition.

It is just as necessary to have accurate ammunition as it is to have an accurate rifle, and a knowledge of what constitutes good ammunition is needed by every rifleman. In order to understand the subject thoroughly, it will be necessary to glance for a moment at the history of modern high-power ammunition development. Prior to the year 1900, the cartridge for the Krag rifle was loaded with Du Pont and Peyton smokeless powders, and the bullet had a cupro-nickel jacket having one canelure, into which the shell was crimped. This ammunition was very defective—in fact, it would hardly stay on the target at 600 yards; and as a consequence, fine shooting with the Krag up to this time was an unknown accomplishment. The bullet was badly balanced and in diameter measured a scant .307 inch, while the majority of barrels then in the hands of riflemen were bored extremely large, recording on the micrometer all the way

from .308 to .313 inch. The consequence was that gas-cutting occurred—that is to say, the extremely hot gases rushed past between the bullet and the barrel and, cutting like a diamond-pointed tool, deformed both bullet and barrel and destroyed accuracy. The two mentioned kinds of powder, the only kinds produced at that time, were also deficient, giving a great amount of residue and many unburnt grains of powder. This fouling was flattened down into the grooves of the barrel by the passage of the succeeding bullets and caused variations in the velocity with the consequent increase in the vertical dispersion of shots.

Up to this time (1900) gas-cutting was almost an unknown factor in rifle ballistics. It did not figure in the ammunition for the .45-caliber Springfield rifle, because with black powder and lead bullets the explosion of the powder struck the bullet a severe blow, upsetting or expanding it immediately to completely fill the barrel to the bottom of the grooves. With smokeless powder and jacketed bullets there is scarcely any upset, and if the bullet in its original diameter does not fit the barrel completely to the bottom of the grooves, gas-cutting is sure to occur.

In the latter part of 1900 the Frankford Arsenal started the issue of ammunition load-

ed with Laflin & Rand W. A. powder and the "3-groove lubricated" bullet. This ammunition was so much better than the old that target practice started to improve immediately. The W. A. powder was found to be practically perfect, and to this day continues to be the standard and best powder for our military rifles. The "3-groove lubricated" bullet was very much better balanced than the old bullet having three canelures which contained lubricant. The bullet, however, still measured .307 inch and gas-cutting continued to occur. This ammunition behaved very well up to 900 yards, but beyond that distance many of the bullets lost their gyrostatic stability and tumbled or key-holed, making the ammunition very unsatisfactory for 1000-yard work. The lubricant in the grooves of this bullet has since proved to be unnecessary. There exists a need for lubrication of high-power ammunition, but no lubricant has been found up to the present time which will fulfill the requirements. Owing to the high temperatures developed by the smokeless powder, the ordinary lubricant undergoes chemical disorganization—is split up into its constituent elements, carbon and hydrogen. The hydrogen, being a gas, escapes, leaving the carbon behind; and the carbon, far from being a lubricant, only adds to the fouling of the gun.

In the summer of 1902, on the eve of an international rifle match, the Union Metallic Cartridge Company, aided by their expert, Mr. W. M. Thomas, produced the first really satisfactory bullet that had appeared. This is known as the "Thomas" bullet. It is perfectly smooth, with no canelures, and, owing to the fact that the great majority of barrels measured over .308 inch, the new bullet was given a diameter of .3085 inch and the base was made perfectly straight and square. This brings us to the two great desideratums of modern rifle bullets. The bullet should have a diameter a trifle greater than the diameter of the bore of the barrel to prevent gas-cutting and to prolong the life of the barrel. The base of the bullet should be perfectly straight and square, and the bullet should maintain its maximum diameter right down to the base. If the bullet is made in this manner, the instant that the base of the bullet leaves the muzzle of the barrel the gas will escape equally all around and perfect delivery will occur. This is a great element in the accuracy of a bullet. If the base is in the least rounded, the gas is very apt to escape unequally at the instant of departure, and the gas first escaping will strike the base and side of the bullet, tipping it and giving it an unsteady flight.

Shortly after the appearance of the Thomas bullet, the Frankford Arsenal started to produce its new smooth bullet, which was very much the same, except that it measured only .308 inch at its largest diameter, which was about ⅛ of an inch above the base. After that the Winchester Repeating Arms Company produced its Hudson-Winchester bullet and the Peters Cartridge Company its special bullet, so that to-day all the ammunition manufactured in this country for our military rifles is excellent and performs in a satisfactory manner.

When the Government first started to produce ammunition for the Model 1903 rifle, they used the new smooth bullet exactly as used in the Krag cartridge. With this bullet it was found that the increase of 300 feet per second in the velocity caused the jackets of about two bullets in every 100 to split, giving unaccountable misses. Therefore, in the spring of 1905, the jackets of the bullets were increased in thickness from .0016 inch to .0020 inch and the maximum diameter of the bullet increased from .308 to .3085 inch. This latter bullet is the one being issued at present by the Government for both the Krag and the Model 1903 rifle, and it fulfills all requirements.

I believe that the introduction of the new Hudson-Winchester bullet marks a new era in the manufacture of jacketed bullets. The half of this bullet which protrudes from the shell has a diameter of only .300 inch, and is designed to ride on top of the lands and to hold the bullet centrally on explosion and cause its entrance squarely into the barrel. The bullet is formed with a shoulder at its center, where the diameter quickly increases to .308 inch and then gradually increases to .3085 inch, its maximum diameter at the square base. This form of bullet is much more accurate and much less wearing on the barrel than the forms like the Thomas and Government bullets.

In considering the improvements in bullets and powder we must not forget the primers. Formerly the primers were of the mercurial variety, but it was found that the mercury combined with the zinc in the shell metal, causing amalgamation and making the fired shells so brittle that they could not be reloaded. Since 1900 all Government ammunition has been loaded with a non-mercurial primer, known as the H 48, and the shells no longer become brittle and can be reloaded many times.

Little apparently insignificant differences in ammunition affect the elevation required on the

sights very much. This results not so much through the slight change in velocity as in the change in "flip" or vibration of the thin barrel. Different dies make bullets which differ slightly in weight and diameter. Different lots of powder differ very slightly in strength. A powder measure may occasionally throw a grain too little or too great of powder, which will make a difference of 20 inches at 1000 yards. The only safe way is for the rifleman to get one box of 1200 rounds and use the ammunition from that entirely, and he will then not be bothered with constantly finding his elevations for new ammunition. It is bad enough for the expert to have to do this, but the novice, if supplied with different lots of ammunition, loses confidence in his gun, his ammunition, and himself, and often the nation loses an enthusiastic rifleman. It may be taken for granted that all the ammunition turned out in one day will shoot alike, but that manufactured on the next day is as likely as not to require 50 yards elevation, more or less. Nor is there any way of comparing different lots of ammunition to determine whether one lot will require more or less elevation than another. It would seem at first that a comparison of the velocities stamped on the boxes would give us a guide to this, but such is not the case. I quote

the following from a report of the Chief of Ordnance for 1902:

"During the fiscal year 1900 considerable difficulty in testing cartridges and powder was experienced in obtaining pressures and velocities that could be compared; as new rifles, loaded with the same ammunition, differed in velocity as much as 100 feet, and new pressure barrels gave as much as 6.000 pounds difference in pressure. While the lot of rifles received this year gave more uniform results, the greatest difference in velocity being 22 feet, considerable trouble is still experienced in getting results that can be compared, as in addition to the above variation, both pressure and velocity, after about 200 rounds, drop off considerably."

This holds true to a slightly less extent to-day. It is an evil that will probably always be present to a certain extent, and we must remember it in changing from ammunition of one date of manufacture to that of another. Formerly the differences between two lots would be very large; I have experienced as much as 6 feet at 500 yards. Of late years, however, the product has improved so much that it will seldom lose one the target, but it sets one all at sea as to normal elevations.

It is impossible here to go any deeper into the subject of the service ammunition. The best treatise on this subject that I know of is found in Dr. Hudson's book, "Modern Rifle-Shooting," published by the Laflin & Rand Powder Company, Wilmington, Del.

Mid-range Ammunition.

Mid-range ammunition is a recent product, having made its initial bow to riflemen at the National Competitions at Sea Girt, in 1905. The necessity and demand for this ammunition is due to two facts: first, the cost of the service ammunition and bullets; and, second, the great wear of the service ammunition on the barrels. Service ammunition is very expensive and the allowance of it is small, especially to the National Guard. The ammunition companies list the Krag ammunition at $50 per 1000 rounds, and the jacketed bullets at $15 per 1000. The price of Government ammunition is a little more than half this amount. Much practice at these prices is out of the question to the average man.

Service ammunition, with its jacketed bullets, its heat, and its gas-cutting, quickly wears out the barrel. If one has a good barrel measuring .308 inch and is careful to use only large bullets

measuring not less than .3085 inch, the probabilities are that the barrel will be capable of firing between 2000 and 3000 rounds before it becomes so worn as to be useless at long range. If, however, the bullets are exactly the size of the barrel, the life of the barrel will be only about 1200 rounds. With a barrel which is larger than the bullets gas-cutting will occur more and more as the difference increases, until a gun measuring .309 inch barely maintains its accuracy for 500 rounds. This is why, in the first chapter, I have advocated the choice of a rifle measuring .308 inch.

Realizing these two characteristics of the service ammunition, riflemen have been constantly experimenting during the last seven years to find a lead or alloy bullet which would give accuracy up to 600 yards, which could be moulded cheaply by the rifleman himself, and which would not wear the barrel. These experiments culminated in August, 1905, with the production by Mr. Barlow, of the Ideal Manufacturing Company, of the bullet known as No. .308284. This bullet weighs 207 grains, measures .311 inch, has three canelures for lubricating, and is cast from an alloy of 80 per cent lead, 10 per cent tin, 7 per cent antimony, and 3 per cent copper. Its distinctive feature consists of a small copper cap, called a

gas check, which fits on the base of the bullet. The function of the gas check is to prevent the hot powder gases from melting the base of the bullet, which they will do badly if the base be unprotected. In the experiments leading up to this bullet, two facts were clearly demonstrated. Cast bullets for smokeless powder must be at

FIGURE 19.

least .002 inch larger than the bore of the rifle to prevent gas-cutting, and the base of the bullet must be protected in some manner to prevent fusion. These bullets are loaded in shells, the necks of which have been previously enlarged to .311 inch by a shell-expanding tool. The powder charge for the Krag shell is 22 grains weight of Lafflin & Rand "Lightning" powder, and for

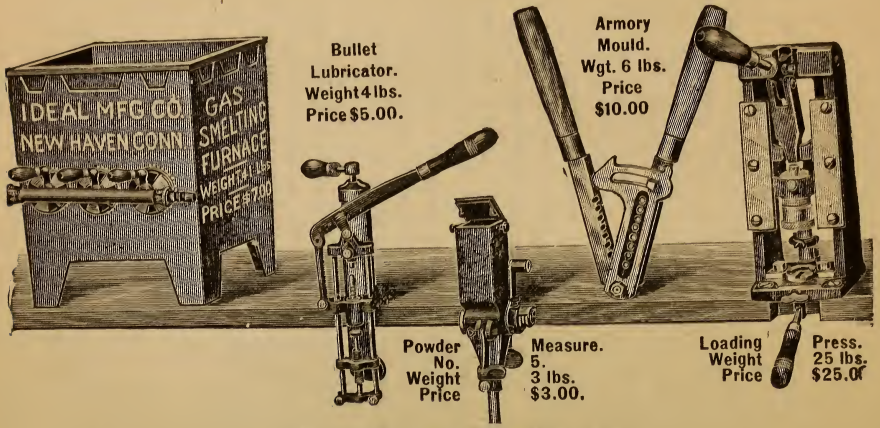
the Model 1903 shell 24 grains, developing a velocity of about 1650 feet per second. Non-mercurial primers are used. The bullets should be lubricated with a tough lubricant containing graphite.

This ammunition will give the same accuracy at 600 yards as the service ammunition, and at shorter ranges it seems to be a little superior. It requires about 100 yards more elevation on the sight than the service ammunition and about one-third more allowance for wind. Tools for making and loading this ammunition are sold by the Ideal Manufacturing Company, of New Haven, Conn. They also sell the bullet alloy in quantities to those who do not care to take the trouble to alloy the metals themselves. Taking it for granted that the rifleman will save the shells from his service ammunition for reloading, this mid-range ammunition can be produced at a cost of about $7.40 per 1000 rounds. This does not include the initial cost of the reloading tools. The cheapest complete outfit of tools for this work will cost about $15, so that there is a considerable saving even on the first 1000 rounds over the cost of the service ammunition.

Some of the many advantages of this load are: Its cheapness. The fact that it does not wear out the barrels. It can be used on ranges where the

service load would be unsafe, for it has not such extreme range, and the bullets, being very brittle, go to dust on contact with any hard object. It gives very much less recoil, and can therefore be used with great advantage as an intermediate load in teaching men to become accustomed to the recoil of the service charge. It is of great value in this respect in teaching men to overcome flinching, and there is a decided need of such a load now that the Model 1903 rifle with its heavy recoil has been issued to troops.

This load is no longer in the experimental stage. At the present writing (April, 1906), it is being turned out in quantities of hundreds of thousands of rounds in the armories of the National Guard in the East for the 1906 target season. Possibles of 10 shots have been made with it at 600 yards. I recommend it without reserve, especially to the expert who wishes to get all the practice he can and still save his fine rifle for the trying work of competitions.



The Ideal Army Reloading Outfit.

CHAPTER XII.

The Score-Book.

The score-book is an absolutely necessary adjunct to a rifleman's equipment. The science of rifle-shooting has increased so much during the last few years and become such a complex science, that without some systematic means of following all the various conditions and recording them accurately, one soon becomes hopelessly confused. Moreover, without a record of this kind our rifle practice teaches us nothing but holding, sighting, and pulling the trigger. One who does not keep a record is hopelessly handicapped when pitted against one who does.

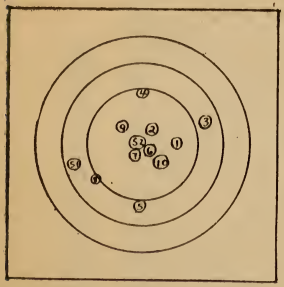
The score-book is not, as its name implies, a record of the score made in points. It is intended as an exact record of the rifle, ammunition, and man under the exact weather conditions existing at the instant the shot is fired, with also a record of these weather conditions. Any score-book which does not contain all this data is useless from the expert's point of view. We record

in our score-book first the ammunition used and the exact weather conditions. We then make our calculations, set our sights, record their readings and fire. Having fired, we record where we called our shot and the exact point where it hit the target. The official scorer at each firing-point takes care that the value of each shot is recorded. We may put this down or not, just as we like, but we must put down the other data, for it is of vital importance. For recording our scores we should use three separate sheets: one for short and mid-range and rapid fire, one for skirmish runs, and one for long range.

We will now take for example the case of a man actually firing at 600 yards, and show how he keeps a record of his shooting on the short- and mid-range blank. (Follow carefully on Figure 20.) The man, as he comes to the firing-point, places his ammunition near his right hand where it will not get in the dust or dirt. He adjusts his gun-sling to his arm, assumes the correct firing position in a comfortable spot where he can see the target clearly, and places his score-book open on the ground near his right hand. He has previously recorded in it the readings of the thermometer, barometer, and hygrometer, and the kind, date, and velocity of the ammunition he is going to use. Finding these

to be about the same as for his normal elevation, he decides to use that elevation and records it in the columns marked "Elevation." It reads 575 yards or 45 degrees. He now has to estimate his wind. The direction is 4 o'clock; he records that. The flag flies out at just about an angle of 45 degrees, showing about a 12-mile wind. He records this by drawing, in the column marked "Flag," two lines: one for the staff and one for the flag lift. He then examines the mirage through his telescope. This shows nothing different from the flag, and he records its direction by a little wavy line. He then consults the table of wind allowances, finds that this wind calls for a correction of 50 inches, and sets his wind-gauge at 2.2 points right. He then gets ready and fires his first sighting shot. As the gun goes off he is conscious that his sights were exactly and correctly aligned—that is, he calls his shot a bull's-eye, and so records it by placing a little dot exactly in the middle of the square in the column marked "Call." He then watches the target until it is marked. The marker scores him a 4 at 8 o'clock, and he marks it on the little target by placing the figures S 1 for first sighting shot just where the shot was marked and drawing a little circle around it. He also marks a 4 in the column of "Value."

RANGE 600 YARDS. DATE April 18th 1906 AMMUNITION F.A. 2/25/06 2170



THERMOMETER 70

BAROMETER. 31

HYGROMETER 75°

LIGHT Bright and sunny, after 7th shot cloudy a little dark.

No	Val	Elevation		Windage		Wind Direc	Flags	Mirage	Call	Remarks
Ss	4	575	45	2½	R	4	/	\	•	
Ss	5	590	46	3+	R	"	"	"	•	
1	5	"	"	"	"	"	"	"	•	
2	5	"	"	2¼	"	"	/	\	•	
3	4	"	"	"	"	"	/	\	•	Wind dropped at instant of firing.
4	5	"	"	¼	"	"	"	"	•	
5	4	560	44	1	L	8-10	/	/	•	
6	5	"	"	2	L	8	^	/	•	
7	5	"	"	"	"	"	"	"	•	
8	4	575	45	"	"	"	"	"	•	Sun obscured by cloud
9	5	"	"	"	"	"	"	"	•	" " " "
10	5	"	"	"	"	"	"	"	•	" " " "

FIGURE 20.—The Slow Fire, Short and Mid-range Score Blank.

Now this shot, according to the call, should have been a center bull, but it has gone 6 inches low and 15 inches to the left. He therefore raises his elevation 1 degree to 590 yards—46 degrees—and adds ¾ of a point to his windage; these being the corrections necessary to place the next shot in the center of the bull's-eye. He records this change in the appropriate columns, glances at the wind, finds it has not changed, the light remains the same, so he fires again. Again he calls his shot a bull and records the call, and his shot is marked in the center of the bull's-eye. He records it S 2. He has now gotten his correct sight adjustment; conditions remain the same. He fires his first scoring shot, but is conscious that just as his gun went off he was aiming a little toward 5 o'clock; he therefore expects his shot to be marked a little to the right of the center, and so places the dot in the column for the "Call." The call was correct and he gets a bull's-eye at 3 o'clock, which he records on the little target with the figure 1. He examines the weather conditions again. The flag appears to have dropped a little and the mirage appears to be going a little more straight up. He records this and deducts ¾ of a point from his wind-gauge, recording it. His second scoring shot, called a bull, results in a bull a little to-

ward 1 o'clock from the center, and is so marked on the target diagram by the figure 2. This shot is near enough to the center to satisfy him. The conditions seem the same, he fires again and calls a bull, but just as he pulled the trigger he saw out of the corner of his eye that the flag had dropped almost down, and sure enough he is marked a 4 at 2 o'clock. He changes his record of the wind, for he wants his score-book to record the exact conditions existing at the instant the shot was fired. In order to account for the shot going to the right place in the column of "Remarks" the words, "Wind dropped at instant of firing." He changes his windage to read half a point right and fires again—calls a bull's-eye—gets a nipper at 12 o'clock. Now the diagram shows that his last three shots have gone a trifle high, probably on account of the gun heating up. The last shot was 10 inches high. He therefore lowers his elevation by means of the micrometer to 560 yards—44 degrees. This time the flag did not show any change, it barely stood out to the left of the staff; but on looking at the mirage through the powerful telescope it was clearly seen that the actual wind was blowing from the left, causing the mirage ripples to travel to the right. This was recorded and the wind-gauge set at 1 point left. This shot was called

low and the shot went there also, showing that the gun was correctly sighted, the fault being that of the marksman.

The wind increases a little, at last the flag flies around, blowing from 10 o'clock, and the windage is taken at 2 points left. The call is for a bull, and a center bull's-eye results. Under the same conditions the seventh shot results in a bull. The sun goes under a cloud and the rifleman raises his elevation 1 degree in consequence. The shot is called at 8 o'clock and results in a "wart" with that location. The weather conditions continue, the next two shots are called as bulls and marked so.

The sheet now shows the exact record and conditions and becomes a valuable aid when the rifleman again uses this gun and ammunition at 600 yards. The actual score is 47 points out of a possible 50.

This blank may also be used for rapid fire at short and mid-range. If the rapid fire is at the silhouette target, then it is necessary to prepare the blank by drawing on the center of the target diagram an offhand representation of the silhouette of a man kneeling. The wind conditions are recorded, the sights set, and the score of 5 shots fired. After being marked, they are recorded on the target diagram with the aid of

the memory of the successive calls. The record becomes of value in showing whether or not a man requires a different adjustment of the sights in slow and rapid fire.

The long-range blank differs from the one just described. For it two pages of the book are needed, these two pages facing each other. The long-range target is, of course, very different from those used at short and mid-range. For convenience in calculating the distance of the shot from the center of the bull's-eye the target diagram is divided into dotted squares, the sides of each square representing 12 inches. On the page for the data three spaces are given for the sighting shots, as that number are allowed by the Firing Regulations at 1000 yards. Fifteen spaces are given for scoring shots, as some matches call for this number. The numbers in the "Flag" column indicate the velocity of the wind in miles per hour. The first column under "Light" is for the light at the firing-point, and the second for the light at the target. The first column under "Call" is intended to be used as a check on the dots. "B" means bull's-eye, "6" a low call, "7" a 7 o'clock call, "12" a high pull-off, etc.

On the target page the diagram at the left of the target is the plotting diagram designed

THERMOMETER 80° HYGROMETER 76%

BAROMETER 31° WEATHER. Clear.

No	Val	Elevation		Wd	Ga	Wind Direc	Flags	Mirage	Light. FP	Light. T	Call		No	Remarks
S S		975	90	2	L	9	∧ 8	/	Bt	Bt	B	·	S S	
S S		965	88	1¾	L	"	"	"	"	"	B	·	S S	
S S		"	"	"	"	"	"	"	"	"	6	·	S S	
1	5	"	"	"	"	"	"	"	"	"	B	·	1	
2	5	975	90	"	"	"	"	"	Bl	"	B	·	2	Cloud passed over firing point
3	5	965	88	"	"	"	"	"	Bt	"	7	·	3	
4	5	"	"	4½	L	"	∧ 16	/	"	"	B	·	4	Gusty
5	5	970	89	3½	L	10	"	⟋	"	"	B	·	5	Increased elevation a/c mirage
6	5	"	"	1¼	L	11	"	/	"	"	B	·	6	Left increase of elevation for these shots
7	5	"	"	½	R	12	"	⟆	"	"	B	·	7	a/c retardation of wind.
8	4	"	"	"	"	"	"	"	"	"	12	·	8	Pulled high
9	5	965	88	"	"	"	∧ 8	"	"	"	B	·	9	
10	4	"	"	"	"	"	∧ 4	"	"	"	4	·	10	
11													11	
12													12	
13													13	
14													14	
15													15	
48	Total Score.													

FIGURE 21.—The Long Range Score Blank.

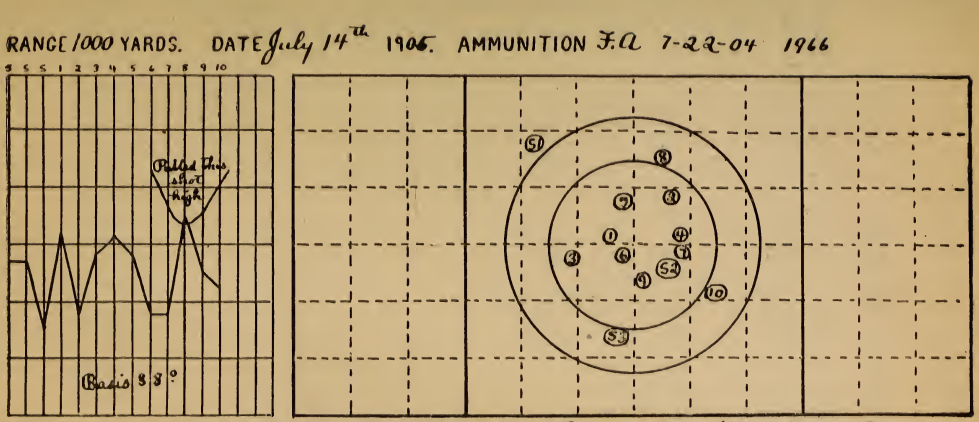


FIGURE 21.—The Long Range Score Blank.

by Lieutenant K. K. V. Casey, of the National Guard of New York. "This diagram is for plotting the shots to show the characteristics of the piece with reference to its vertical deviation. When the score is completed, take, as a base to work from, the elevation used for the the greater number of shots. It will be noticed that every line is numbered at the top; the three sighting shot lines being marked by the letters "SS." Place each shot on the line of the plotting diagram corresponding to the number of the shot. Also place the shots on their proper horizontal line in the position they would have been in had they been fired with the same elevation as the majority of the shots. When all the shots have been plotted, connect each of these shot-marks with its successor by a straight line. This zigzag line will give the rifleman an idea of the vertical deviation of the rifle and the manner in which it throws its shots. After several targets have been plotted, they will begin to bear a certain amount of resemblance to each other that will be apt to cause one to deliberate about changing the elevation where a shot has gone high or low."

The blank for recording the skirmish run is shown in Figure 22. Enter the data for the wind and weather, then calculate your elevations

RIFLE *Krag 433644* SKIRMISH RUN DATE *July 16* 1905

Yards	Elev.	W.G.	Zero
600	485	1/4 R	3/4 R
500	395	"	3/4 R
400	300	"	3/4 R
350	265	"	1/2 R
300	210	"	1/3 R
200	150	"	1/3 R

Wind Direction *10 o'clock*

Flags *A*

Mirage */*

Light *Very bright.*

Thermometer *69°*

Barometer *30.6°*

Hygrometer *85%*

Notes Target No 10 - 11 a.m. Ammunition *FA-7/22/04-1906*
Expert rifleman's test. The wind evidently was not quite as much as calculated. Elevations O.K. 9th shot was not pulled low. Prone figure hard to see at 600 and 500 on account dark earth background.

Hits Kneeling. *4*

Hits Prone *16* Score *96*

Started firing at prone figure at *400* yards.

FIGURE 22.—The Skirmish Score Blank.

carefully for the different ranges, referring to your normal elevations and to the record of your scores in slow fire and using a trifle less elevation. Enter the zero of your rifle at each range, and then calculate your wind allowances. In the instance given in the figure, the increase of the zero at the longer ranges was such as to cause the wind allowance to have the same reading for each range. It is well to write the elevation and windage figures in lead pencil on your cuff or on the magazine gate of your rifle, so that you can refer to them during the run. It will be noticed that the figures for elevation are given only in yards. It is impossible, with the short time limit in skirmish, to use the micrometer to adjust the sights. On the slow-fire score-blanks columns have been left for recording the elevation in yards, and this should always be done, in order to get the data for the skirmish elevations.

The consecutive shots are to be numbered on a separate diagram by an assistant. This assistant takes his place immediately back of the 600-yard firing-point. He is provided with a powerful telescope of at least 20 diameters, securely adjusted to bear on the target. As each shot is fired by the marksman the assistant, looking through the telescope, can note almost exactly where the shot struck, and numbers its lo-

cation with the appropriate number on his diagram. After the marksman returns from the run, he copies the figures from his assistant's diagram on to his own score-blank. The locating of the shots in this manner shows the marksman exactly how much and in what manner his elevation and windage are at fault at any range. Recording runs in this manner, one can improve greatly at skirmish in a few trials. In the absence of an assistant, the only possible alternative is to visit the target and mark with a cross on the diagram where each shot struck, and then make elaborate notes of where you saw the dust kicked up by the bullet at each range.

Everything that could possibly be of value in the future should be noted on these score-cards. The more elaborately and carefully they are kept the quicker will one get into the expert class. Improvement in marksmanship beyond a certain point is impossible without these records.

CHAPTER XIII.

Slow Fire.

In slow fire the shots must be fired in a time limit of 1 minute per shot, the time to be computed from the full appearance of the target, and after it has been marked, to the discharge of the rifle. Usually two men fire on one target, alternating shot for shot, so that one man has a much larger interval than 1 minute between his shots; but he has only 1 minute in which he can aim at the target. Calculations must be made quickly and entries in the score-book also hastened, so as not to go over this limit. If one will get his practice in these matters down to a system, there is plenty of time for everything. The rifleman should, if possible, make his calculations for the first shot and set his sights before he comes to the firing-point. Arriving there, he should deposit his cartridges, score-book, micrometer, lead pencil, and telescope, if he is using one, convenient to his right hand. He then assumes his position and thereafter remains quiet. He should not jump up or move around.

Above all, he should not hurry, but take his time and keep cool. He should obey without question all orders of the range officers, although he should not hesitate to appeal a decision which appears to him to be wrong or unfair. He should see that the scorer calls the value of each shot, when marked, in a loud voice, so that he can be plainly heard; then the rifleman can immediately check him if perchance he should give a wrong value for a shot. If shooting in pairs, the rifleman should pay no attention to the man alongside of him; in fact, the closer he attends to the details of his own shooting and the more he obliterates all other incidents the better will he succeed. These remarks pertain particularly to competitions.

Two sighting shots are required to precede the first scores at 500 and 600 yards. These must be taken and cannot be waived. Sometimes in matches sighting shots are also allowed at 200 and 300 yards. No warming or fouling shots are allowed, nor are they of very much value. The rifleman should not fire faster than he has to; otherwise his rifle will heat up and necessitate changes in elevation from this cause.

The rifleman should be very careful in pulling his trigger, and especially to avoid jerking it. In this respect he should follow carefully the

instructions in Chapter IV. It is best not to take up rapid fire or skirmish until one has become fairly proficient in slow fire and also until the pulling of the trigger slowly and without jerk has become second nature. If one has any tendency to flinch, he should stick to slow fire until he has entirely overcome it.

If the first shot misses the target and the dust kicked up by the bullet shows the direction of the error, the correction for the second shot should be made as indicated heretofore. But if no dust or other indications of the error can be seen, the direction of the miss must be inferred from the conditions of the weather. If a strong side wind is blowing, the velocity of which it is hard to determine, the miss was more than likely to the right or left. If there is but little wind, if the day is either exceedingly dry or very damp, very bright or very dark, or if there is much mirage, the elevation assumed was probably incorrect.

In the first case, where the deviation is horizontal, the wind-gauge should be moved to the right (if it is thought that the shot went to the left) a distance equal to half of the target. If this does not result in a hit on the target, then the wind-gauge should be moved in the opposite direction a corresponding distance from the adjustment for the first shot. One or the other

of these changes will almost surely result in a shot on the target.

If the error which caused the miss appears to be a vertical one, the elevation for the second shot should be lowered a distance equal to half the target, and if this does not result in a hit, it should then be raised the same amount for the third shot. The rifleman should always change his sights, and never his point of aiming.

Before leaving the firing-point one should always compare the score in his score-book with the record which the scorer has kept in order to avoid any possible error.

CHAPTER XIV.

Rapid Fire.

In rapid fire at 200 and 300 yards, a time limit of 20 seconds is allowed in which to fire the five shots contained in the magazine. At 500 yards 30 seconds is allowed. This practice is conducted on Target "F," which is the black silhouette of a man kneeling, placed in the middle of a white target 6 feet square. In timed fire, which we will also consider in this chapter, the time limit is 30 seconds for the five shots, and the target used is the regular short-range, slow-fire Target "A."

In these classes of fire the marksman takes his place at the firing-point, having previously made his calculations and set his sights, and he then fills his magazine, loads one cartridge therefrom, and at command comes to the position of "ready." At a signal given from the firing-point (trumpet or telephone), the target appears, remains in sight for the exact time limit, and then disappears. The marksman fires his five shots, emptying the magazine and firing at will

from the instant any portion of the target appears until it has completely disappeared. Each unfired cartridge counts as a miss. The target is then run up again and the shots are marked on it in succession

Usually a man will fire two scores of five shots each before leaving the firing-point. He should therefore watch the target very carefully while it is being marked, and if there appears to be any error in his sight adjustment, he should correct it immediately before the second score.

It will be noticed in Target "F" that the greatest area of the black figure appears to be in the region of the hips. One should endeavor to have his shots strike in the middle of this region, as he then stands a larger chance for making a bull. The easiest way to do this is to aim so that the top of the front sight just touches the middle of the lower line of the figure, giving the rear sight additional elevation to carry the bullet well up into the broad hips. About 25 yards increase over the normal elevation will be about right.

At 200 yards it is best to use the open sight, as it is hard to catch the peep quickly enough.

In rapid fire it is far better to keep the rifle at the shoulder during the entire score than to remove it therefrom in order to work the bolt,

In the standing position, assume the half-arm extension, with or without the sling. Immediately after firing a shot, pull the rifle hard against the shoulder with the left hand while you work the bolt with the right.

In the sitting position at 300 yards the right elbow and knee should never lose contact, for if they do, time will be consumed in regaining it. Make the knee follow the elbow and thus assist the right arm in working the bolt. Large comfortable holes for the feet are of great assistance here.

In firing prone at 500 yards, use the sling and assume the regular prone position. Having fired quickly, grasp the bolt handle with the right hand, turn it up and pull it back; at the same time pushing the piece over with the left hand so that the muzzle goes to the right and low. This latter movement makes it easier for the right hand to work the bolt quickly. As the right hand closes the bolt, the left hand brings the piece again into the position of aim. These movements should be thoroughly practiced in the position and aiming drills until at the instant the right hand regrasps the small of the stock with the finger on the trigger, the left hand will have brought the piece back so that it is correctly aimed at the target without farther

movement. This is entirely possible and easily learned when using the sling correctly in the way previously illustrated. One should be sure to get this manipulation down to a fine point, as it is used not only in rapid fire, but also in skirmish.

In all rapid and timed fire and in skirmish the bolt should be worked as fast as possible, in order that as much time as possible may be devoted to holding, sighting, and pulling the trigger carefully. Have the bolt of the rifle well oiled, so that it will run easily. Be very careful to squeeze the trigger gradually and to avoid jerking it. Do not hurry. One has plenty of time. In instruction practice it will be an advantage to have someone call each 5 seconds of time, thus: "5," "10," "15," so that the marksman may know how the time is going. It is easy to fire all five shots in 10 seconds, but this cannot be done with accuracy. One should endeavor to consume about 18 seconds in firing his five shots in rapid fire, and 25 seconds in timed fire and rapid fire at 500 yards.

In rapid fire at 500 yards it is very important indeed to judge the wind correctly. If the judgment of the wind has been wrong, then one may bunch all his shots on one side of the figure and get 4s or 3s instead of 5s.

Very often an individual will find that he does not shoot in the same place in rapid fire as he did in slow fire. Many men will find that if they use the same elevation and windage in rapid fire that they would use in slow fire, their shots will group in the upper left-hand corner of the target, or in other directions. These individual equations must be determined and allowed for.

In firing in khaki uniform it will often be found that the butt of the rifle will slip on the shoulder during the firing of a score. If this is found to be the case, wetting the shoulder of the blouse with water will cause the butt-plate to adhere more firmly.

On Target "F" hits to the left of the figure count 4, while those to the right only count 3. Therefore, in adjusting the sights for windage, it is well to calculate so as to place the shots a little to the left of the center of the figure, so as to lessen the chance of an accidental "3."

CHAPTER XV.

Skirmish.

In skirmish fire the target is known as Target "G." It is composed of two iron frames, one the shape of the silhouette of a man kneeling, and the other of a man lying prone. These are made to stand upright on the ground by means of suitable legs. On them is laced a canvas covering, and the black paper silhouette is pasted on the canvas. The figures are set on the ground, usually on the glacis of the target butt. They are placed in line with 1 yard between the centers of the figures, the prone figure being on the right, facing the target. The value of hits, direct and ricochet, are: on the prone figure, 5; on the kneeling figure, 4. Hits on the black paper silhouette only count. When two or more targets are used on the same range, they are placed in line with an interval of not less than 5 yards between centers of groups. For the procedure in skirmish fire one should consult Paragraph 141, Small-Arm Firing Regulations 1906.

In order to succeed in skirmish it is necessary that such details as the manipulation of the rifle and cartridges, the assuming of the prone position, the setting of the sights, etc., be reduced to a system, so that one will work like a machine, and without giving any thought to the matter, so that the mind may be free to attend to the actual shooting.

One should make his calculations and have his sight adjustments written on his rifle or cuff, and should set his sights before he is called upon to take his place in the skirmish line. The pieces are loaded and locked prior to advancing to the 600-yard firing-point. As one advances to the firing-point he should look at the ground, and within his limits he should choose a comfortable place to lie down where he will have a good view of his target. His gun-sling should have been previously adjusted to his arm and retained there by slipping down the keeper. He should lie down immediately, turning the lock of his rifle to the "ready" at the same time, assume the firing position, aim carefully, and quietly await the last note of the signal "Commence firing," before which he may not fire. At 600 yards two shots are fired. One should endeavor to get the first shot off as soon as possible after the signal, "Commence firing." Having fired, the marks-

man should immediately look at the target and try to see the little cloud of dust which will probably be kicked up by the bullet. This will tell him where he has hit. If the shot hits the figure aimed at and there is little wind blowing to make the dust travel, the puff of dust will appear behind the target, the cloud showing equally all around. If, however, one hits to one side or high or low, he should change his point of aiming an appropriate amount to make the next shot a hit, for there is no time in which to adjust the sights at one range to correct for these errors. Having fired the two shots at this range as quickly as is consistent with observation of the shots and a careful manipulation of the trigger, one should utilize the time remaining until he is again ordered forward in carefully adjusting his sights for the next range. One should practice adjusting his sights until he can do it accurately in 5 seconds. The first half of the advance between ranges is conducted in quick time, and the second half in double time. Execute the double time easily, so as not to become winded or to run up the heart-beats. As one approaches the 400-yard firing-point he will have but one shot in his rifle. He should, therefore, before he arrives at the firing-point, take a clip from his belt, and as he lies down he should place this clip on the

ground near his right hand, where he can get at it quickly to reload between shots. Immediately after firing at 350 yards, the rifle will be empty, and one should insert another clip and lock his rifle before adjusting his sights for the 300-yard range. In order to be able to do this quickly, it is best to take the clip from the belt before arriving at 350 yards and place it on the ground as at 400 yards. This also applies at 300 yards. One should practice so as to get all these details down to such a fine point that they can be done with great rapidity, leaving as much time as possible for the accurate setting of the sights, careful sighting, gradual pulling of the trigger, and rests to overcome breathlessness. Skirmish fire is really rapid fire, with an advance between scores, and the rifle should be manipulated as to the bolt in the manner described for rapid fire in the prone position in the previous chapter. One should practice all these details by running trial runs with dummy cartridges until they become second nature—that is, done without thinking.

The details described in regard to the cartridges apply only to the Model 1903 rifle. If one is using the Krag rifle, the magazine is kept filled and cut off until reaching the 300-yard firing-point. Until one reach 300 yards, the Krag rifle is used as a single loader. As one ap-

proaches a firing-point with this rifle he should take from his belt the number of cartridges he is going to fire at that range. While in the act of lying down, the right hand should place one cartridge in the chamber, close the bolt, and place the other cartridges on the ground convenient to the right hand. In placing cartridges on the ground, be careful not to place them in sand or dust. On leaving the 350-yard firing-point, make it a rule to always turn the cut-off up, for only magazine fire is used at 300 and 200 yards.

Always aim at the lower edge of the figure. Make the sighting appear as though the figure were kneeling or lying right on top of the front sight. It will thus be necessary to use a trifle less elevation than that used in slow fire. It will usually amount to about 10 to 15 yards, but had best be determined by each individual for himself. The matter of elevation and windage is of the utmost importance in skirmish. In slow and rapid fire, if one misses the bull's-eye, he stands a good chance of getting a "4," "3," or "2"; but in skirmish, if one misses the figure, he gets a zero for that shot. Therefore, one should spend much thought, time, and experiment in determining his skirmish elevations, and his true zero in both slow and rapid fire. At 600 to 350 yards, it

is best to set the sights with the slow-fire zero; but at 300 and 200 yards, one should use his rapid-fire zero.

The best way to determine skirmish elevations is to shoot several shots at a skirmish figure, and then have it marked. Do not attempt to get these elevations by pasting a skirmish figure on a paper target, for this would make the figure appear much plainer than it ever would on ground, and unconsciously the aim will be taken differently.

On some ranges, if the bullets strike several feet in front of the targets, they will glance or ricochet through the target. Hard ground and a gentle slope in front of the targets are necessary for this. On sand, or if the targets are set on ground having a steep slope, scarcely any ricochets will occur. On a range where one stands a good chance of getting ricochets, it is best to so adjust the sights for elevation that the center of one's group of shots will fall in the middle line of the figure and about 4 inches above the ground line. The tendency is to shoot high, and in this case, if one does go a trifle low, he still stands an excellent chance of getting full value for his shot through a ricochet. Moreover, one in every three or four shots will kick up a little dust in front of the target, and this becomes

an excellent guide in showing one where his bullets are hitting. On ranges where it is impossible to get any ricochets, one should, of course, adjust his sights to have his bullets strike in the center of the figure.

One must decide for himself as to which of the figures he will aim at at each range. The expert shots of the regular Army in the Army competitions usually pull the first shot low on the kneeling figure. They want to get dust on this shot to show them just how correctly their sights are adjusted, and they fire at the kneeling figure, hoping to catch a high ricochet. Thereafter they fire only at the prone figure. If one is very sure of his elevations, he may fire even his first shot at the prone figure; but there is usually a great desire shown to get dust for the first shot. This applies more particularly to ranges where the skirmish figures are set on a dirt glacis, and where dust can only be seen in front of the target, and not behind them.

On ranges like those on the Atlantic coast, where the temperature and weather are constantly changing, and one is never sure of his elevations, it is safer to fire at the kneeling figure as far as 400 yards at least and thereafter turn on to the prone. So too in bad lights it is best to fire at the figure which can be seen most plainly.

With recruits in their first season's qualification, it is best to have them fire entirely at the kneeling figure, unless they exhibit special skill. Of course, a hit on the prone figure counts 5, and one on the kneeling only 4; but the kneeling figure offers a larger target than the prone. The prone figure has, however, nearly the area of the kneeling one and it offers a better chance to one who is certain of his elevation, but doubtful as to his zero or windage, than does the kneeling.

It often happens that a ricochet will tear a large hole in one of the figures. In this case the remaining shots should be fired on the other figure, for there is a great chance that some shots may pass through this hole, leaving no indication of their passage.

On some ranges the background may be such that the figures appear very indistinct and can scarcely be aimed at at the longer ranges. On the Fort Sheridan range, for instance, the figures set on top of a gravel glacis and have for a background the dirt of the target butt. In wet weather the target butt appears almost black and the figures can scarcely be seen. On top of the butt, however, is a large number painted on a white board, the number indicating the number of the group. The gravel glacis always shows

up distinctly, the top line coinciding with the bottom of the skirmish figures. If one will take the pains to notice what point on the large number coincides with a vertical line drawn through the center of the figure he desires to aim at, he can still aim with accuracy, even though the skirmish figure be invisible, by aiming at the point where this vertical line and the top of the glacis intersect. Similar points of aim can be found on almost any range.

Physical condition tells greatly in skirmish, but almost anyone in fair health, by following carefully the instructions given in this chapter and keeping an accurate record in his score-book, can develop into a good skirmisher in a short time after he has become expert at slow fire. It is practically impossible for a man to average over 85 per cent at skirmish.

CHAPTER XVI.

Long Range.

On the rifle range 800 and 1000 yards are classified as the long ranges. At these ranges Target "C" is used; the target itself being 6 feet high and 12 feet wide, with a 3-foot bull's-eye in the center. Long-range shooting, especially at 1000 yards, is the most difficult of all the forms of rifle practice, and success in this class of shooting requires the maximum amount of science and careful attention to every detail. Before attempting long-range work, it is best to obtain a good telescope, for constant observation of the mirage is very essential. This should be mounted on irons or a small tripod and set and focused on the target. The most convenient place to mount it is parallel to and just to the right of the rifle as it is held in the firing position. It should be about 12 inches above the ground, and the eye-piece should be near the eye, so that immediately after firing one can thrust his head a little to the right and be able to ob-

serve the target through the glass without moving the body.

If spotting disks are not used in marking the target, one should arrange to have the target marked with the little short-range marking disks. The large disks provided for Target "C" will not show with any degree of accuracy where the shot struck the target. It is, of course, impossible to see the small marking disks or the spotting disks* without the aid of a telescope or field-glass. After one fires, he should lower his rifle and glance at the target through the telescope in time to see it marked, at the same time taking his observations of the mirage for the next shot.

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*Spotting disks are small .30 caliber pegs with a round head of cardboard about four inches in diameter. The peg is inserted in the bullet hole of the last shot fired and the cardboard is seen by the rifleman when the target is raised after being marked Black cardboard is used to mark shots which hit in the white target and white cardboard for the bull's-eyes. They have the great advantage of showing the marksman exactly where his shot has struck. This system of marking is used exclusively in the National Matches and at Sea Girt.

With the telescope mounted in the manner described, it is possible to thrust one's eye so quickly to the glass after firing as to be able to see the bullet kick up the dust at the butts. This is of great advantage in enabling one to quickly find the target, as even if the first shot does not strike the target, it can probably be located by its dust. Some riflemen in important matches will jump to the telescope after every shot, so that if by any chance they get a miss, they will be able to see where the bullet struck. It is well, however, not to indulge in too much of this, as it is liable to injure one's holding by interfering with that nice little retention of the holding after the trigger has been pulled.

The use of the micrometer sight-adjuster is very necessary in long-range work, it being practically impossible to adjust the sight with the required degree of accuracy by hand. For this reason the Model 1903 sight, with which the micrometer cannot be used and on which the adjustments for elevation are limited to changes of 25 yards, has proved to be very inferior for long-range work.

One should pay particular attention to slight changes in mirage drift, light, thermometer, and hygrometer, etc., in long-range work. There is a disinclination in some persons to change their

sights when the last shot has resulted in a bull's-eye. There is a saying, "When in the bull, don't change." This, however, is a very bad idea at long range. I have before me the record of a score at 1000 yards in my score-book which shows 8 consecutive bull's-eyes with changes of from 1 to 4 points of windage, and 4 degrees in elevation between shots. When conditions arise which give indications for the necessity of a change, do not hesitate to make it, even if the last shot has been a center bull. When the conditions remain the same and the rifle is behaving satisfactorily, pour in the shots as fast as is consistent with careful sighting and pulling of the trigger. One can economize time in this way and fire very slowly during changes and doubtful conditions.

The rifleman should be very careful to hold exactly the same for each shot. Little differences of pressure of the butt against the shoulder and tension on the gun-sling will make important differences at long range.

Despite all the care that one takes, he will occasionally get unaccountable shots at long range. That is, shots which hit in places where they are not called or which on perfect calls miss the target. Recent writers on this subject agree that there is almost always a cause for the unac-

countable shots, but that we fail to find the cause, and hence the name While this is true of the greater number of unaccountables, it is undoubtedly true that in the best ammunition one will occasionally get a true unaccountable shot. Many of these are due to slight variations in the powder charge. For the very best work at long range hand-loaded ammunition with weighed powder charges and bullets selected by calipering and passing over the scales should be used.

Long-range practice should be indulged in as much a possible. It makes one pay attention to the fine points and refinements which are apt to be missed in mid-range work; and thus it becomes the very best of practice.

FIGURE 23.—The Prone Position, Showing the Angle at Which to Lie and the Disposition of the Telescope, Score Book, Cartridges, and "Dope Bag."

CHAPTER XVII.

Coaching and Company and Team Practice.

A coach should be perfectly familiar with all the science and practice of rifle-shooting. It is desirable also that he be a good shot himself, otherwise he will fail to gain the confidence of many men. During the last few years, coaching has approached a very fine point, so that given men who can hold perfectly, sight correctly, and pull the trigger without deranging the aim, a competent coach should be able to cause them to make the scores of experts even if they know little of the art of rifle-shooting. However, something more than science is demanded in a good coach. He must understand human nature, must know his men and be able to judge their characteristics. Coaching should take the form of careful advice and plainly understood directions. The coach should always avoid antagonizing his men. An officer who is feared by his men will never succeed as a coach. There are some men in every company who stand in so much awe of their officers that the officers can

do very little with them. It is better to turn the coaching of such men over to an experienced private, and to rarely speak to the men while they are at the firing-point.

The coach should get right down on the ground alongside his man, taking care, however, not to shade his sights. All his directions should be in a low voice. He should avoid arbitrary directions and should be careful to give the reason for every bit of advice he gives, for his aim is not only to cause the man to make a good score, but also to give him valuable instruction. He should see that the man calls his shots every time and calls them truthfully. Also that he keeps his score-book correctly, makes the right changes, etc. He should inform the men that they should be very free in coming to him for advice, but he should not be too liberal with his advice when it is not asked for, because he wants his men to learn to rely on their own judgment. Telescopes should be provided for the men (two to each firing-point will be sufficient), and they should be used by every man in observing the mirage. It should be impressed upon the minds of the men that they must glance at the flags or mirage before every shot so as to be sure to note each change. Changes in light should be called to their attention and they must

be instructed to determine for themselves what corrections, if any, they need from this cause.

Some men seem never to learn to keep the score-book correctly, and it devolves upon the coach to keep the score for them. Until men become very expert, it is hardly necessary at the short ranges to do more than keep a record of the elevations and zero of their rifles. It is not wise to allow men to fire more than twelve shots at any one time. More than that number exhausts the beginner and he gets careless in his holding and aiming. There is only one case in which men should be allowed to aim anywhere other than directly under the bull's-eye. This is when the wind is constantly increasing and decreasing or in a "fishtail" wind. In this case the coach has the man set his sights for the average wind, and as the flags rise and fall or shift he calls to the man in a low voice, "5—6—6—5—6—7—7—6," etc.; the man trying in his holding to aim at these points on the target, pressing his trigger gradually the meanwhile.

The coach should be on the lookout for any men who intentionally call their shots incorrectly, or who alter their aim on the target to correct for an error in point of impact of the last shot. Such men should be subjected to strict disciplinary measures.

Sometimes a man will be found who is simply hopeless through flinching or defective eyesight. Unfortunately, the Firing Regulations say that all men will fire; otherwise it would be of more benefit to keep such men continually at gallery practice than to waste service ammunition on them. The time to try to cure the flinching habit in a man is not on the target range, but during the winter months, when there is plenty of time to devote to it personally. Allowing a flincher to fire service ammunition simply aggravates the trouble.

Coaching is particularly trying work on the man who attempts it, especially on the eyesight and nervous system. The coach should never attempt to watch every shot marked. Instead he should detail a man for a few scores to act as a spotter. The spotter tells the coach the exact location of each shot as it is marked. Fifty shots is enough work for one spotter, and he should then be relieved by another man, or there is danger of eyestrain. A man should not be required to act as spotter just before his firing. Also the coach should make himself as comfortable as possible at the firing-point. A "Gold Medal" folding chair is very comfortable and convenient and it brings one down near the ground, as he should be to properly attend to

his man. A very low desk to go with the chair is very convenient for the score-book, scratch-pad, and instruments, and a telescope mounting can be secured to the side of it.

In company practice an excellent way of keeping the records is to have the score-blanks printed on cards instead of in books, and to file these cards in a box like a card index. The box can be taken to the range each day, and when a man comes to the firing-point, the coach has placed before him all the previous score-cards for that man and a blank card for the score the man is to fire. These score-cards should have the number of the rifle entered upon them, as they will then be of value even after the man leaves the company. Orders should be issued in the company requiring every man to clean his rifle every evening with powder solvent, and never to come to to the firing-point without having wiped all oil from his barrel, oiled his bolt, and blackened his sights. Cleaning the rifle from the muzzle should be prohibited. Men should be issued ammunition from only one box, the names of three men being placed on each box of 1200 rounds.

In team practice the rifles should be zeroed together; that is, the differences in sighting between every rifle should be noted and carefully recorded. Then when one man finds the bull's-eye, the oth-

ers can follow right on by setting their sights to correspond to the difference between the rifles. In the National Matches coaching is not allowed, but the two members of the team at the firing-point may communicate with and coach each other. For this reason the men should be paired so that the best instructed men will shoot with and be able to coach those who are not so experienced. It is well to have the best shot shoot first, so that he can find the target quickly if there are any puzzling conditions. The men with the best eyes should shoot last, as they may be required to fire in a fading light. As each man comes back from the firing-point he should be required to give his elevation and windage to the coach, who then sees that the man to succeed him sets his sights correctly, taking into consideration the differences between the two rifles and men.

Many other duties devolve upon the coach. He must see that his team is provided with carefully selected rifles, and that they are issued satisfactory ammunition. He must attend to their physical and mental condition, conserve their eyesight, and see that they get the proper amount of exercise to keep their muscles and nerves up to the strain of holding.

Of course, it is understood that the coach's word is law.

CHAPTER XVIII.

The Eyes.

There is no doubt that rifle-shooting is a terrific strain on the eyes. We use our eyes to aim the rifle, to see the target marked, to catch the dust where the bullet strikes, to judge the mirage, and to watch the flags and light; and from all this long-distance work we must jump quickly to the delicate adjustment of the sights and entries in the score-book. It well behooves even those with good strong eyes to take extra care of them during the target season. The eyes should never be used any more than is absolutely necessary, and then never for long-continued intervals. The judging of mirage with the telescope is a severe strain. For this work it is best to use the left eye, so as to save the right for the strain of aiming. Dark smoke-colored goggles are excellent to rest the eyes from the intense light often present on the range, but they should never be used in shooting. These are better than green or blue, because they are less opaque and there is less loss of color in objects seen through them.

After a trying day on the range, the eyes should be bathed in cold water, or, if any inflammation be present, in very hot water in which boracic acid has been dissolved.

Perfect vision is the greatest necessity to riflemen. If one's eyes are not normal, then they must be aided by glasses to attain perfect vision. Refractive errors in the eyes are of three kinds: far-sightedness, near-sightedness, and astigmatism. The fitting of glasses should never be trusted to anyone but a skilled oculist. This should be impressed on all riflemen with imperfect vision. Glasses selected promiscuously simply because they seem to give one perfect vision are very liable to ruin the eyes permanently in one target season by reason of the great strain from ill-fitting and wrong refraction; whereas in the ordinary work of every-day life trouble might not be noticed with them in five years. The glasses used should be very large, so that one in aiming will not see around their rims. Gold, silver, or aluminum frames should be used, as they will not rust. Ordinary lenses have only the full correction in the center, but the rifleman always aims through the extreme upper left-hand corner of his right-eye lens. For this reason, shooting spectacles should always be of the toric or meniscus type, in which the line of sight in aiming passes through the lens perpendicular

to its surface. These lenses have the full correction to their very edges, and if the glasses be well fitted, there is no strain, as there undoubtedly is in using the ordinary lenses. It is a great advantage to have the glasses just a little smoke-tinted, as this will take the glare out of the eyes and aid the vision. Most oculists, in prescribing glasses for far- and near-sightedness, will give those which have not quite the corrective powers necessary to give absolutely perfect vision, in order that the eyes may have a little leeway to work for their own good. While this is correct for glasses for ordinary wear, the shooting glasses should always have the full correction to give normal eyesight, as without this there will surely be strain.

It is an advantage, if one can do so, to shoot with both eyes open, as it causes less strain. Sometimes a man will be found whose eyes are in such condition that it is impossible to get perfect vision for him with the aid of any kind of glasses. The only hope for such a man is the telescope sight. Many experts have unusual vision. Some can see the spotting disks on the 1000-yard target with the naked eye alone. I have also in mind the case of a man who could see the bullets "splash" on the steel target at 600 yards. Such men, of course, have a great advantage over the man with the ordinary eyes.

CHAPTER XIX.

The Rifleman on the Battlefield.

Rifle-firing in battle, with all its excitement, ignorance of exact range, unsteadiness from exertion, noise, confusion, indistinctness and motion of the target, is a very different matter indeed from range-firing. At the same time there is no doubt that target-shooting properly conducted is an excellent preparation for firing in action. The soldier who makes hits in battle is the one who has been so well trained on the range that without thought he never fails to take aim and to pull the trigger carefully without jerk. There are many conditions which confront the rifleman on the battlefield which never occur on the target range, and I have thought it well to consider some of these in this work.

Firing from a Rest.

On account of the excitement and exertion, it will often be difficult for the men to hold their rifles with any degree of steadiness. The best

way to overcome the trembling is to rest the rifle on some stationary object. In firing from an intrenchment, it will also usually become necessary to fire in this manner. A rifle shoots much higher when fired from a rest than when held in any one of the prescribed positions. This is on account of the solid rest interfering with the flip or vibration of the barrel. Moreover, a rifle does not shoot as accurately in this way (machine rest excepted) as it does when held in the hands of the man. A rifle will shoot the highest above its normal elevation when the barrel is rested on the object just back of the muzzle, and the difference becomes less as the point of rest approaches the trigger-guard. Solid rests like stone cause the rifle to shoot higher than soft rests like turf. The Krag rifle resting on a sand-bag 6 inches from the muzzle calls for a reduction of about 100 yards in the range. The same point of rest in the Model 1903 arm calls for about a 200-yard reduction. A safe rule is to deduct 150 yards from the range with the 1903 rifle if fired from a rest, and 75 yards with the Krag. Firing from a rest also alters the zero of the rifle, but this may, of course, be disregarded in action, as we are only desirous of exact elevation and a little horizontal dispersion is an advantage rather than otherwise.

The Bayonet.

The rifle will shoot much lower when the bayonet is fixed; also the zero is very much changed. These differences are very variable for different guns, and will have to be determined in each case. As the bayonet is only fixed at close quarters, and as the character of fire at short ranges is almost always rapid where men are apt to shoot high, the causing of the rifle to shoot lower by fixing the bayonet works to our advantage. This, of course, applies to the knife bayonet. The fixing of the rod bayonet does not make much difference at short range.

The Ammunition.

The ammunition issued to the soldier in time of war will be from many different lots, much of it being manufactured by private factories on rush orders, and it will not be as reliable as that obtained from the Government arsenals in time of peace. This was the experience in 1898. Moreover, one never gets the same date of ammunition twice and thus he can never tell what his exact elevation and zero will be. The only thing to do is to use the normal elevations, trust to luck, and try to see where the first bullet strikes by watching closely for the dust.

The Sights.

The sights must be guarded with great care against any blows which might throw them out of alignment. It will be impossible to keep them blackened, nor is this desirable when firing at khaki-clad targets in all sorts of cover and with all colors of background. Bright sights are, however, just as much of a disadvantage as on the target range. It will be an advantage to carry in one's pocket (not near rations, for it is poisonous), a lump of blue vitriol (sulphate of copper, or blue-stone, used in telegraph batteries). By moistening this and rubbing it on the front sight, the sight will become lightly plated with copper and will then show up very plainly on objects in the field without any glistening. The application of a little heat will turn the copper-plated sight back to a dead black. By taking advantage of this latter fact, when the rear sight becomes worn and bright so that it glistens, we may make it an excellent black by first copper-plating it and then turning the plating black by heating it in the flame of a candle.

Firing Up and Down Slopes.

When calculating elevations for an object which is either up- or down-hill, use only the base of the triangle, or the horizontal distance

between the riflemen and the object, and not the actual distance on the ground. The tendency in firing down-hill is to overshoot, due to too great an estimation of the distance and the fact that in looking down one sees and aims at the top of the object, and therefore is very liable to fire over. It is a good rule, in firing down-hill, never to use any elevation for distances less than 500 yards. In firing up or down cliffs or at an enemy on a house-top, the angle being very great, place the rear sight as low as possible and hold low, or the rifle will overshoot.

Firing at Objects in Motion.

While the velocity of modern arms is extremely swift, yet some lead or allowance is necessary at all but the shortest ranges. The aim must be taken at the estimated number of feet in front of the object that the object would travel during the time it takes the bullet to travel the distance. Let us take an example: An officer of the enemy is running from one bit of cover to another, direction of motion at right angles to the line of fire. Range 500 yards. At a run the officer will probably cover about 20 feet per second. The time of flight of the Model 1903 rifle at 500 yards is .84 second. Therefore the lead neces-

sary is about 16 feet. Aim quite a little in front of the officer and on the same horizontal line. Try to get the gun off the instant he crosses a line 16 feet from your line of sight. If the man were moving obliquely at an angle of 45 degrees, only one-half the above lead would be necessary.

If the enemy is moving toward one, he should aim at the feet of the enemy, and if the enemy is retreating, he should aim at the shoulders.

A man in quick time covers 5 feet per second; in double time, 9 feet per second; running, 20 feet per second.

A horse at a walk covers 5 feet per second; at a trot, 15 feet per second; at a gallop, 25 feet per second; at top speed, 46 feet per second.

In this work one must be very careful not to overestimate the lead, as there is a tendency to do so, and it is very difficult to estimate feet when looking over the sights.

Importance of the Direction of the Sun.

If one can get the sun over his own back and shining in the eyes of the enemy, he has attained a great advantage, which increases the nearer the sun approaches to the horizon. It will be almost impossible for him to be sighted upon with the sun near the horizon and back of him unless he

outlines himself against the sky-line, while he can see and sight on the enemy with great clearness. If, on the other hand, the sun is in one's eyes and at the enemy's back, he should seek particularly good cover under the shade of trees, if possible. It is a great advantage under these circumstances to rig up sun-shades for the sights. These can be easily and quickly made by using the small pasteboard boxes which will be found in each pocket of the bandolier. Pull out the ends and partitions and slip them as shades over the sights. Under these conditions, sights which do not blur are worth their weight in gold. It is the writer's opinion that the direction of the sun in planning attacks is not taken enough into consideration.

Judging the Wind.

Unlike firing on the range, there are no flags to give the force and direction of the wind. However, mirage is often present, and we also can judge the wind from the smoke-puffs, the waving of the grass and trees, the flight of insects, the feel of the wind on the face, and the way in which a few blades of grass thrown

straight up in the air are blown away from the person. Horizontal errors caused by wind and other components do not figure much in battle, where errors of this kind give a dispersion of the shots that is very much to be desired. They do figure considerably, however, when one has a chance to fire on a leader of the enemy.

APPENDIX.

A season's target practice with the U. S. Magazine Rifle Model 1903 has demonstrated the fact that it is particularly liable to metal fouling. This will appear in the form of lumps of bright metal adhering tenaciously to the bore. The cleaning rod will not remove it. While this fouling is present the accuracy of the rifle is very much impaired. To remove it, use the following solution:

Ammonium persulphate..... 1 ounce
Ammonium carbonate.. .. ..200 grains
"Stronger ammonia" containing 28 per cent ammonia gas, 6 ounces
Water.. .. .. 4 ounces mix

The ammonium persulphate and carbonate should be pulverized and left in the rest of the solution for half an hour in order that it may become thoroughly saturated. This will make a sufficient quantity to fill two rifle barrels. It should be mixed as required as if left bottled it will blow the cork out of the bottle.

To use it have the rifle barrel perfectly clean and dry. Cork up the breech and pour the solution in at the muzzle until the barrel is perfectly filled. Leave the solution in the barrel two hours. If metal (cupronickel) fouling be present the solution on being poured from the barrel will be dark blue in color, and the fouling will be dissolved. The solution has no action on the steel of the barrel.

To keep the rifle in the best condition it should be treated in this manner at the end of every day's firing and after every skirmish run. The solution can be used but once.

TOWNSEND WHALEN.

Suggestions to military riflemen