

up to 100 for smaller weapons. Ah-pe's interesting papers on the gun are continued, but specially concern sportsmen only. Major Merrill gives the results of some tests with a *spherical* ball of 130 grains, fired with a heavy charge of 130 grs. powder, which will prove a surprise to most, as he shows that they give a better target and lower trajectory than could be obtained with a conical projectile.

RIFLES AND RIFLE SHOOTING.—XIX.

IV.—BY CAPTAIN HENRY F. PERLEY, HEADQUARTERS STAFF.

Where sighting shots are permitted do not fail to take them, and where they are not, great care and attention should be paid to the position of the first hit on the target with regard to the point aimed at, the amount of foresight taken, the position of the body, the grasp of the rifle and the windage allowed, for the success of the succeeding shots depends to a great extent on the knowledge thus gained, and every circumstance should be carefully noted.

To guard against any variation in the amount of foresight to be taken it is desirable to paint the block and part of the barleycorn—if a full sight is not used—with Chinese white, and the barleycorn, or the upper part thereof, with ivory black, and when aiming to be always careful to see a slight thread, as it were, of *white* over the bar, and by doing this one cannot fail in taking exactly the same amount of foresight each time. Of course the thread of white must not vary. The coloring of the foresight wholly black is not recommended for the reason that on dark days it is not possible to exactly estimate the same amount.

Allusion has been made to the fact that the bar V up is not usually raised to the defined marks on the leaf, and its position is therefore dependent to a great extent upon the firer. These actual positions are ascertained by practice, and allowances have to be made according to the state of the atmosphere, whether dry or wet, whether the sun shines brightly or is obscured, and whether a front or rear wind is blowing. The denser the atmosphere, and this is its state when the barometer shows a high reading, the higher must be the elevation, because the pressure of the atmosphere is considerable, or, in other words, the particles of air are more closely packed together, offering increased resistance to the passage of the bullet; and, *vice versa*, a low reading of the barometer denotes a want of pressure, a rarer atmosphere, therefore less resistance, and a consequent lowering of the elevation. The rule therefore obtains that higher elevations are required in fine clear bright weather than when it is cloudy, wet or damp.

With a front wind, that is one blowing directly from the target to the firing point, or, in shooting parlance, a 12 o'clock wind, the range of the bullet is decreased, and with a rear, or six o'clock wind, the range is increased. In such cases, and in fact in all cases, adjustments of the bar should be made by using a "vernier," and every shooting man should possess one of these little instruments, for by its use the 200th part of an inch can be measured. In using a "vernier" divided to 100ths of an inch in adjusting the sight of a Snider it is well to remember that each 100th is equal to *one* inch on the target at 100 yards, 2 inches at 200 yards, 5 inches at 500 yards, and so on; or to raise the sight 100th at 500 yards is equivalent to raising the point of aim five inches on the target, or two 100ths will raise it ten inches. With the M. H. a 100th is equal to $1\frac{1}{2}$ inches on the target at 100 yards, 3 inches at 200 yards, $7\frac{1}{2}$ inches at 500 yards, 12 inches at 800 yards, and so on. Within a few months a "vernier" has been brought out in England for use with the M. H., which is divided to 150th of an inch. With this instrument one 150th is equal to an inch on the target at 100 yards, 5 inches at 500 yards, or 8 inches at 800 yards.

For good shooting it is necessary that the rifle be held "plumb," and the back sight be thus placed upright, as this position is necessary where allowances have to be made for wind, or in fact when the centre line is shot over. As before stated there are some who cant the rifle, and this in some instances is done to counteract the pull-off, thus indicating the pull on the trigger to be a "jerk" and not a steady pressure. If a rifle be "canted" it will shoot low to that side towards which the "cant" is made, and therefore there must be a corresponding raising of the bar to counteract it.

There is much difficulty in fixing upon the proper elevation to be used, for with every atmospheric change some modification of previous results is required. If the air be moist and damp and the light a gloomy one, then a different elevation must be used from when it is dry and the sun shines brightly; and both of these in turn have to be modified to meet the resistance caused by the motion of the air, such changes being dependent on its velocity and direction. Thus side winds, or

those blowing directly across the range have a tendency to depress and deflect the bullet, and therefore a higher elevation is necessary. The extent of such elevation is dependent upon the strength of the wind. Both front and rear winds have to be allowed for, and those known as "fish-tail" are extremely baffling, and it is recommended in such cases to "aim low." When the atmosphere is hot and dry the fouling cakes and the barrel heats up. As a general rule this calls for increasing the elevation, which requires less bodily exertion and expenditure of breath than "blowing in the barrel," but there are some who delight to amuse themselves in that way.

When the targets in a clear light appear to be more visible than at other times reduce the elevation; in a dull light, if care be taken not to take an increased amount of fore-sight, the elevation must be raised. Passing clouds produce effects which are puzzling. If a cloud obscuring the sun passes by and the target is lighted up whilst the firing point remains shaded the elevation must be lowered or the shot will likely go over the target; and if the firing point be lighted up and the target remain in shadow the reverse takes place, and unless the bar be raised a *ricochet* will occur.

There is much dispute as to the effects of *mirage*, that is, the exhalations which rise from the ground during an extremely hot day. Some authorities deny that this produces any effect on the elevations; that the target stands fixed and immovable, and that only the usual precautions need be taken to hit it. Others again assert that this exhalation possesses peculiar refractive powers, the optical effect being to cause the target to apparently stand at a higher altitude than it actually does, and to guard against this it is necessary to lower the bar; and that if a side wind is blowing whilst this appearance lasts it has the effect of causing an apparent divergence of the target to one side or the other as well as apparently elevating it. This appearance does not often occur in Canada, and marksmen must adopt either side of the question as presented, and find out for themselves what to do in the event of having to shoot where a *mirage* is present.

When in doubt as to the exact amount of elevation required the safe rule is to err on the side of a *low* shot, for if the bottom of the target be struck, or even a *ricochet* made, either will be a sufficient guide for future shots; whereas if the first shot be over the target it is almost impossible to know where it went to, and there remains the uncertain feeling of being all abroad in firing until a hit is made.

If a Snider cartridge be examined it will be seen that there is only a pledget of cotton wool between the powder and the bullet, and no wad to reduce to a minimum the tendency of the gases to escape past the bullet before its expansion has thoroughly taken place. When this escape occurs "fire cut," as it is technically termed, takes place; and if the cut be heavy the shot must of necessity be a wild one; while, last though not least, the lead sets up such a cruel friction that no trustworthy results can confidently be expected. That some such decided effects exist is positive, or how is it possible to make a string of "bulls" and "inners" and then suddenly miss the target altogether.

According to the results of experiments by M. de St. Robert, it may be inferred that with a series of explosions a rifle barrel is gradually heated, and that a certain amount of the work of each charge is thereby lost, because this heating is due to or arises from the effect of the combustion of the powder. With a heated barrel the combustion takes place in a relatively shorter time, and with this quickness of action of the charge increased fouling will take place. This may also be a reason for stray and unaccountable shots, especially on a piping hot day.

Ricochets are nearly always charged to inferior or "short" cartridges, that is, those in which the proper quantity of powder has not been placed. This may be so, but as has been heretofore stated, great pains are taken to fill the shells with the quantity, 70 grains, of powder, and knowing this has caused an enquiry into the reason for *ricochets* and dropped balls. It has just been stated that a hot barrel may be a reason, and another reason given is that they are due to a prolonged stare at the fore-sight in taking aim. If the aim be prolonged the fore-sight, or so much of it as may be taken by the shooter, becomes as it were fixed on the retina of the eye, so that when the muzzle drops unconsciously, as it is apt to do when the holding of the rifle is continued, and sufficiently low to bring the fore-sight below the back-sight, it still appears to be in its proper place and a low shot is the consequence. That this fixing of the foresight on the retina can occur will be within the knowledge of any one who has ever seen a book issued some years ago called "Spectromania," in which were pictures, on any one of which, if the eyes were fixed intently for a given time and then raised to a white wall the picture in the book would appear on the wall almost as well defined as in the book. To counteract the effects of a prolonged stare, it is only necessary to close the eyes for a time, or to raise them completely above the target. (*To be continued.*)