a small bead centrally mounted in a nearly circular hoop or shade—useful both for protecting the slenderly-proportioned bead and its stalk, and for assisting the aim by affording an easy object as an aid to the "centering" of the bead in the eye-piece of the aperture back-sight. This entire arrangement is so mounted on a small joint that it can be folded down upon the barrel, exposing then a small projection that can be used as the ordinary bead for aiming with the open back-sight; though, should such a back-sight be used upon a rifle in combination with the "Lyman," it should not have a fixed "standard" elevation, but folding leaves, so that these may be shut down, and leave an unobstructed view when the aperture sight is used. These sights have no lateral adjustment, consequently they can only be accurately "set" for

FIG. 100.

FIG. 101

BEACH FRONT-SIGHT.

short distances, any allowances required for wind influence upon the bullet being given by the usual mode of "aiming off" the estimated amount required.

Figs. 100 and 101 show the Beach front-sight; first, the sight as arranged for use with the aperture back-sight; and also shut down with the stud ready for use with the ordinary back-sight.

Figs. 104 and 105 give a view of the Lyman sight, also a section of the same, showing the mode of raising and lowering the pillar, and the attachment of the auxiliary eye-piece with a smaller sized aperture than that of the normal one in the head of the pillar, and suitable for use only in very fine lights.

It will be easily seen that the application of these sights to the purposes of actual sport is exceedingly limited. I need

only allude to some patterns of sights that have been produced from time to time with the intention of blending together as much as possible the good points of both peep and open sights; these have generally resulted in failure from a sporting point of view, for, though probably giving some slight advantage at the target, they needlessly hamper in the field that clear rapidity of aim so practically valuable on most occasions.

There is a kind of open bead front-sight much used upon a certain class of sporting rifles, that is, one in which

Fig 102

Fig 103

Front-sight with Side Wings

the bead (generally slighter than usual) is protected by side wings or flanges as shown in the figure.

This is a compromise between the bead alone and the same inclosed in the circular shade, and to some extent is a better arrangement than either, as the bead is not so exposed to hard usage as in the former case, while the aim is less likely to be embarrassed than in the latter, though instances have occurred where, in taking a hurried shot, one of the side wings has been used for the bead itself.

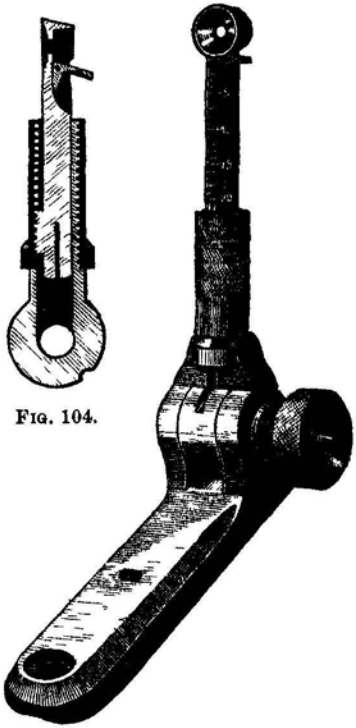


Fig. 104.

Fig 105. Lyman Back-sight.

A sight never much used in this country but rather more popular in the United States, where it is used upon rifles for

short range match firing, is the "telescope" sight, consisting of a telescope of moderate power and aperture, mounted upon, or at the side of the rifle. When required for use at the longer ranges, the latter method of mounting offers the greatest facilities for the introduction of those mechanical details necessary to the adjustments for elevation and wind allowance; but, for the shorter sporting ranges, the telescope answers sufficiently if attached to the rifle upon the upper surface of the barrel, when no provision is made for altering the angle of the instrument, except that it is fitted with three fine lines in the field of view, one vertical and the other two horizontal, some little distance apart. Thus for the short range of, say, 100 yards, the spot aimed at is intersected by the crossing of the *upper* horizontal line with the vertical one, while at the 200 yards range the *lower* horizontal line is used in

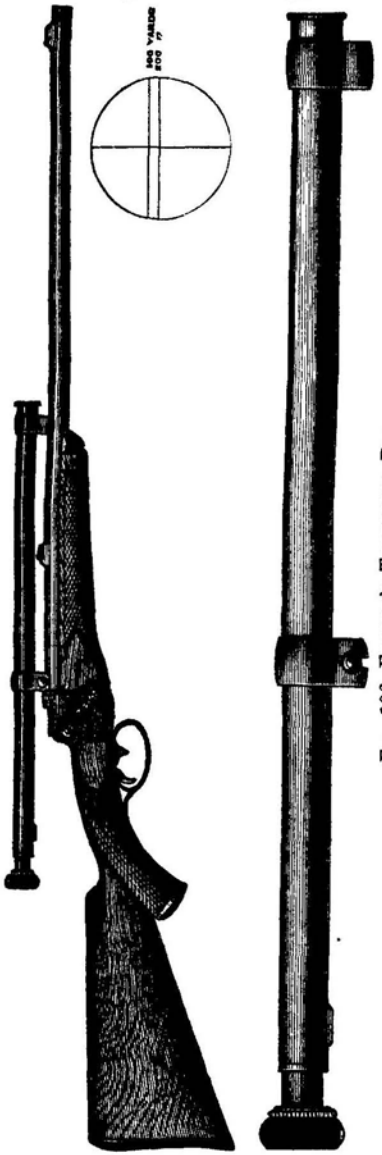


FIG. 106. FRASER'S TELESCOPE RIFLE

the same manner—the space between these two lines being equal to the amount of elevation required by the rifle from the one distance to the other. These sights were in use by American rifle-makers at a very early period, and were introduced into this country by Lieut.-Col. Davidson, about 1834. Fig. 106 shows a sporting rifle by Messrs. D. and J. Fraser, of Edinburgh, fitted with such a sight in its most modern form—the rifle having only been made during the late season of 1883, and having their new patent breech action, to be found fully described and illustrated in the Match Rifle section of this volume.

That the use of telescopic sights very much improve the clearness of definition, and consequently the accuracy of aim, is obviously unquestionable; but their extra cost and delicacy will doubtless prevent their use from ever becoming general among sportsmen.

Some ingenious devices have been invented for the purpose of facilitating the almost instantaneous changes of eleva-

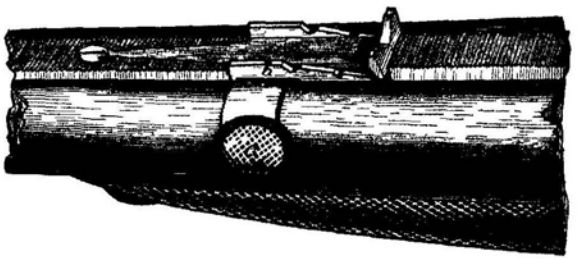


FIG. 107. RIGBY'S SIGHT.

tion sometimes required in the field, but the majority of them are of but dubious value. One of the best is that designed by Mr. John Rigby, and shown in Fig. 107.

The sight is shown as upon a double rifle, and is in fact a steel spring, one end being fastened to the rib by a screw and the other set at right angles to the long elastic portion, and shaped to resemble an ordinary back-sight. On each side

of the rib slide notched inclined surfaces whose motion is controlled by a thumb-piece; these inclines engage beneath the standard of the sight, and, by drawing them towards the firer, the sight is raised—an operation that can be performed while the rifle is at the shoulder; thus elevation can be instantaneously obtained for an increased range.

Adjusting the Rifle.

In proceeding to regulate and adjust our rifle (preferably for illustration a Double Express one) by shooting the same at a target, it is of course imperative that every technical detail involved in the process of firing the weapon should be fully attended to, as it is quite possible that the existence of an apparently trifling mechanical imperfection may seriously invalidate the results of our labour in this most important stage of our inquiry. To enumerate all, or even the chief, points to be attended to in this respect would be wearisome to the reader, consisting as they do of those mere technicalities so often *assumed* to be all right, and really only known in all their intrinsic importance to the experienced rifle-maker.

Having the rifle sighted and in a fit state for shooting, and the ammunition properly loaded, the next point to be considered is that of the support for the firer and his rifle—the "rest" used when regulating rifles fired from the shoulder. This need be but a simple affair—all that is absolutely necessary being a firm support for the elbows, against which he may lean the upper part of his body; and also a support of a sound inelastic kind for the barrels of the rifle—usually a sandbag or similar article. I may here be permitted to allude to the "machine rest" for firing rifles therefrom during the regulating process, almost identical in structure with the "rest" for shot guns shown facing page 46, Vol. I. That this rest would be an important auxiliary to the rifle-maker there is no doubt whatever, but, in its present stage of development, it is not

quite capable of successfully coping with the great variety at present existing in sporting rifles and their ammunition—the varying details of which require differing and particular manipulation of the rest for nearly each individual variety; still, I have every belief that in time, when the matter has received more attention than it has yet been able to obtain, the machine rest will become at least an important auxiliary assistance to shoulder firing in the process of regulating double rifles.

In the earlier stages of the shooting of our rifle, it is better, for many reasons, to use an iron plate as a target. This should be of substantial thickness, and of such a size as to render missing it difficult even with our weapon in its crudest stage. Before commencing to shoot, we must premise that the operator be so sufficiently acquainted with the art of rifle shooting as to be fairly able to accurately *repeat* his aim—that is, not from carelessness or want of practice to vary the amount of foresight seen and used in aiming, neither to fail in centering the same properly in the V, or upon the line of the back-sight. He must also be capable of "letting off" or discharging the rifle by a steady even pressure of the finger upon the trigger, without subjecting this latter to the influence of jerk or tremor. These apparently simple qualifications are not possessed in perfection as generally as supposed by many who believe themselves to be fairly "steady" shots; and, indeed, they can only fully belong to anyone while in perfect health—though a degree of robustness rather militates against the finest rifle shooting form. The beneficial effects of practice in accustoming the muscles of the firer to a rigid mental control is, as is well known, of the greatest value in rifle shooting.

In holding the rifle in position for firing, great care should be taken to keep it "square;" if this be not attended to, great trouble and expenditure of ammunition may be incurred before satisfactory results are arrived at.

The first series of shots may be fired from each barrel alternately without regard to the position of the respective groups to each other. This should test the shooting value of each barrel, and also that of the ammunition; and, should it terminate satisfactorily, the group obtained from each barrel will have the least amount of deviation ever likely to be obtained from either barrel during any subsequent shooting that may take place, because each tube is now *individually* in its most perfect state, though the two groups may be some distance apart.

Should the shooting at this stage *not* be considered good enough, the requisite correction should be made either in the workmanship of the barrel or the details of the ammunition, as observation and experience may determine. Except in rather rare cases, however well each barrel may shoot, there is always some want of agreement between the centres of the two groups obtained and the common point of aim. This error may be simple, as when the centres of impact are upon the same horizontal line, but inches or feet apart; or compound, as when, in addition, the groups differ vertically. In the former case the barrels are said to either "cross" when the right-hand barrel throws its shot to the left, or *vice-versâ*, or they may shoot "wide"—that is, each barrel throwing its shot to its own side of the point aimed at, but more or less away from it. These faults are caused by the barrels not inclining toward their common centre, as required by the ammunition with which they fired, as explained in the chapter on Construction, page 242. The makers of double rifles some years ago were sadly puzzled with this difficulty, though, as much smaller charges were then fashionable in comparison with those now used, the matter was really much more simple as to its conditions than it now is.

It will be easily seen that, when a shot is fired from, say, the right-hand barrel, the blow of the recoil is sustained by

the same side of the common axis of the piece. Thus the weapon receives an amount of motion, not only in the direction of the backward thrust, but also an outward swing, as it were, to the right, the centre of which would be the point of contact between the butt of the weapon and the firer's shoulder, were either the latter immoveable or the arm itself a rigid mass; but as, from its form and compound structure of wood and iron, it possesses a certain amount of elasticity, and, on the other hand, the shoulder gives way materially, a very complex motion is the result—the most important feature in relation to the point under consideration being, that the muzzle of the particular barrel of the pair moves in an outward direction a certain amount at or about the instant the bullet is passing therefrom during firing. There is some reason to believe that the centre of this motion is situated about the grip or "hand" of the stock, and that the time question prevents any movement of the shoulder ultimately due to recoil from influencing the bullet in the manner described. Fortunately, from the same cause, the bullet has left the barrel before any great amount of this motion has occurred to the muzzle, or we should have to proportionately increase the angle of inclination of the barrels to each other. As it is, barrels required to shoot together upon one spot 100 yards distant, frequently have to be so jointed that their respective axes intersect at ten or fifteen yards from the muzzles—an arrangement that would result in their fire crossing upwards of two feet or so at the longer distance, were it not for the operation of the recoil in the manner described. It can thus be easily understood that if any modification of the charges used with such a rifle take place in the direction of materially lessening the recoil, the barrels will thereupon shoot so as to cross their fire. On the other hand, if the charge be so altered as to increase the recoil, the contrary effect will be produced. Also, if any structural alteration be made in

the arm affecting its rigidity as when regulated, we must in consequence expect some change, more or less marked, to be observed in its shooting.

Our object now is to bring together the group of shots from each barrel into one; and, to effect this purpose, each tube must be submitted to an amount of flexure sufficiently altering the line of fire to bring about the desired result. This treatment is rendered necessary by the fact of the barrels at their breech end being firmly attached together—indeed, rendered practically one; therefore it is only by manipulating the forward portion of them that we can in any way modify their original errors of construction.

It will appear to many that the accuracy of each respective barrel must suffer from this treatment; and no doubt, if carried to excess or carelessly performed, the permanent deterioration of the barrel so treated is a certain result. But if in the first instance the barrels have been properly jointed together in accordance with formulæ derived from previous experiments correctly carried out, the amount of alteration required is so small as to not seriously, or even appreciably, affect the shooting of the barrel as far as accuracy is concerned. We are in this respect rather fortunate in the fact that the short projectiles commonly used in sporting rifles travel almost as well along a tube having a curvature of extremely large radius, as along one perfectly straight; but if the operation of regulating be so performed that a curve of small radius be established, or what is called a "short crook," then the arrangement becomes defective. Although for the time the shots are thrown near the desired spot, the tendency to radial dispersion in a group obtained from such a barrel is always greater than in one fired from a barrel perfectly straight—other things of course being equal. This is not the only objection existing against barrels so improperly treated. When we consider the unequal wear and tear upon

certain portions of the bore of such barrels, we need not be surprised to find that, after some year or so of hard use, they no longer shoot together as when first adjusted, but require regulating anew.

The manner of effecting the adjustment of double rifle barrels is briefly as follows: The errors in jointing having been made manifest upon the target, the barrels are dismounted and suitably arranged for alteration; they are then heated for some distance along from the muzzle end gradually and sufficiently to melt the tin used as a solder for attaching the two tubes and the upper and lower ribs together. While in this state, it is possible to alter the relative positions of the tubes to each other at the will of the operator. The requisite alteration having been made, the barrels are allowed to cool, and are again fired, when, if not found satisfactory, the process is repeated.

There are various modes of effecting the requisite degree of adjustment, but they all resolve themselves into a system of patient "trial and error," continued and repeated until the desired end be obtained; though, for obvious reasons, the fewer stages there are in this process the better for the ultimate perfection of the weapon. In conducting this operation conclusive proof is afforded that the entire structure of the weapon has a considerable influence over the shooting obtained therefrom, though it is generally the opinion that the barrels alone influence the accuracy of fire. Of course this is the case to a very great extent, yet it is not an uncommon thing for some considerable time and anxiety of mind to be spent on the alteration, adjustment, and re-adjustment of a pair of rifle barrels, when the real source of trouble lies in a defectively fitting breech action, or an improperly attached stock.

When at length the mutual adjustment of both barrels of the pair is such that, from a series of shots fired alter-

nately from each one, with the same aim, a group is obtained in which no bias of either barrel can be detected in any direction whatever, then the regulating process may be considered complete; providing the space occupied by this group be not unduly enlarged in size when compared with the space covered by either one of the approved groups, obtained from either barrel before the regulating process began. If the contrary be the case, it shows that the rifle has suffered more than necessary from the process, though the relative degree of excellence in grouping its shots shown by any rifle depends somewhat upon the skill of the firer.

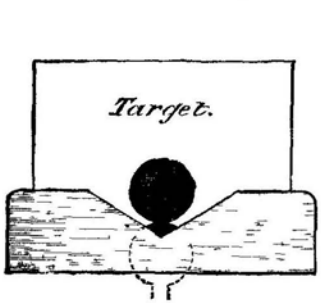
The back-sight, hitherto kept a little higher than it should finally be, may now be lowered to its proper height, so that the "elevation" of the rifle at this standard range shall be true; this is the case when a horizontal line, drawn across the point aimed at, cuts the centre or point of mean impact of the group of shots fired at this range. When the sights are truly aligned upon the target at the aiming spot or bullseye, the lower edge of this latter is the point of aim; and, if the weapon is accurately sighted, the shots should group around that spot. If this be not so, and the centre of the group be materially *above* this point, the result is that, at any shorter distance the rifle may be fired at, the shots will strike so high *above* the mark as to seriously impair the efficiency of the weapon; indeed, most sportsmen consider this defect a most objectionable one, though, for the purpose of partially compensating for the bullet drop at longer ranges, rifles are frequently so sighted as to shoot in this manner.

When the bullseye is used for SCORING purposes as well as an aiming spot, the sights of course require to be so adjusted as to allow the bullet to strike its centre—thus giving the best chance for the entire group striking within its circumference.

Aiming.

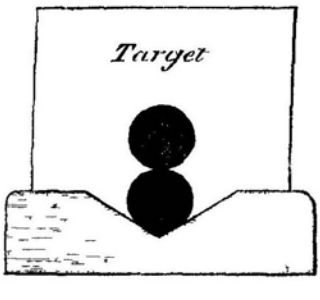
Some varieties of opinion exist as to the proper mode of aiming with sporting sights— some inclining towards what is called a "fine sight," and others favouring the "full sight" system of aim. The annexed sketches illustrate the two methods perhaps as well as the difficult nature of the subject permits it to be shown by a woodcut.

It will be seen that, though the "fine sight" in a good light and under favourable conditions is a most accurate method of aiming, especially at small objects, and when a



Fine sight

Fig. 108.



Full sight

Fig. 109.

leisurely aim can be taken, still there is much to be said in favour of the "full sight," as it does not try the eye so much as the fine sight, while it affords a better view around the object aimed at, and is more suitable for dull lights and hurried shots. In target practice it is considered an improper way to so aim with sporting sights as to *cover* the bullseye with the bead of the front-sight (only with a certain kind of aperture front-sight), for the obvious reason that it is next to impossible to tell whether the bulls-eye be only *just* covered by the sight, or whether the latter overlaps it, and to what extent. But in actual sport the front-sight is very frequently placed, in aiming, upon the exact spot of the body of the

animal that it is intended the bullet shall strike; and under usual circumstances this mode of aiming may be successfully practised, as the remainder of the figure of the animal acts as a check or set-off, as it were, to the point aimed at. As to the difference in elevation caused by taking a "full" sight, as compared with that obtained by using a "fine" sight, it of course largely depends—first, upon the relative size of the front-sight bead; and, secondly, how much of this bead be taken in when what the firer calls a fine sight be used. This latter varies considerably with different individuals; and the better plan is for each sportsman to ascertain this matter for himself, by a few shots with each kind of sight at a target.

A common source of error in firing rifles carrying heavy powder charges is that arising from the difficulty experienced in obtaining a clear aim after firing a few shots in moderately rapid succession. This is caused from the heat produced by the combustion of the powder being imparted to the barrels, and being thus transmitted to the surrounding air; this heated air produces a kind of "mirage," which, if allowed to arrive at a moderate degree of intensity by continuous firing, becomes very annoying, causing as it does the object aimed at to flicker and waver about in the most embarrassing manner. This trouble can be avoided by firing slowly, thus not allowing the barrels to become more than just perceptibly warm without getting them actually hot. It would also be possible to remedy this inconvenience by so raising the sights above the barrels as to avoid the stratum of heated air in contact with the latter; but, in addition to the structural objections there are to the adoption of this plan, there is also to be considered the fact that the higher the sights (and therefore the line of aim) be above the axes of the barrels, the more disastrous becomes the effect of slightly "canting" the rifle, or permitting any deviation in holding it other than truly "square."

Fortunately in sport a rapid series of shots is rarely or never required to be fired with a minute accuracy of aim.

Fouling.

The question of "fouling," if not duly attended to, is a fertile source of inaccuracy of fire, especially with sporting rifles, on account of their usually large powder charges depositing a proportional amount of the solid products of combustion within the bore of the barrel. This deposit is increased in quantity, and rendered more unmanageable, if the powder used be of an inferior quality, or crushed and injured during the loading process or otherwise, as I have before remarked in Chapter VIII., page 309. On examining the interior of a rifle barrel after firing, by looking up it from the breech end, it will be noticed that the greater portion of the fouling is deposited upon the lower side of the bore, showing that these grosser particles have been acted upon by the force of gravity in taking up their relative position, in opposition to the finer deposit upon the remaining portion of the bore. I need scarcely say that if shots be fired from the rifle while it is held in other than the normal position, this gravitation of the heavier portion of the fouling will still take place to the then underside of bore.

The conclusions arrived at from the observation of this manner in which the fouling is deposited have led to the endeavour, on the part of rifle-makers, to prevent, as far as is practicable, these solid products from passing into the rifled portion of the barrel, and thus interfering with the passage of the bullet. With this view, cartridge shells of such an internal shape as to offer some mechanical means of retaining within them as much as possible of these objectionable portions of the fouling, are preferred. The bottle-shaped shell is for this purpose considered to be much superior to the merely taper shell. Though probably not originally designed with

such intention, yet we may consider whatever value it may have in this respect as a set-off to some alleged objectionable features this shell is accused of—that is, increasing the recoil, and exerting additional strain upon the breech action as compared with the action of the taper form of shell employed with a similar charge. Not content with this property in the bottled shell, it has been the endeavour on the part of some to further intercept and retain more of this fouling by adding an internal ridge or fillet about the base of the neck of the cartridge where it joins the shoulder; but, as might have been expected, the increase in recoil caused by *this arrangement quite destroyed its* practical value. As can easily be understood, the amount of fouling retained by the fired shell is largely dependent upon its length as well as its form.

When, however, every possible precaution has been taken in these directions, we have still to confront the difficulty offered by a large amount of deposit being left in the barrel after each discharge, and what we have to do is to prevent this accumulating, and thereby, after several shots, unduly retarding the bullet fired when the maximum accumulation possible has been reached.

In my remarks on Waddings (page 310), I have indicated the most generally approved means of coping with this difficulty, most of which involve the application of "lubrication" in some form to the interior of the barrel with each successive discharge. It is found by experience, especially in sporting rifles, that this method works well, as, indeed, the existing conditions of the rifle during firing would seem to *demand* lubrication—there being great pressure, high speed, and a considerable amount of local heat, all simultaneously in operation; and when similar conditions exist in ordinary mechanical combinations, there is no hesitation shown in falling back upon the universally recognized remedy, that of applying lubrication.

Those authorities in the rifle world who are rather disposed to cavil at the employment in rifles, during firing, of this well-known agent for the reduction of friction, have generally acquired their experience in dealing with charges of powder that are relatively small, and consequently so much more easily managed in this respect. They are also, as a rule, disposed to unduly estimate the value of a "sweeping" wadding as compared with one of a more active lubricating nature—perhaps overlooking somewhat the fact that the bullet, especially when covered with a paper jacket and duly proportioned in all respects to its work, must of necessity perform a great share of the "sweeping" business, passing up the barrel, as it does, a complete "fit," and *in front* of the wadding. A barrel kept cool and moist internally by the action of the breath will suffer much less from the effects of fouling than one not so treated—all other things being equal.

It is to be noted that anything in the internal structure of the barrel, offering a mechanical obstruction to the onward rush of the dirt-laden powder gas, always causes the fouling to accumulate unduly at that point; and probably, from this cause mainly, one form of rifle groove may be preferable to another. Also we may reasonably assume that in barrels rifled upon a varying curve—the slow pitch occurring, as it does, at the breech end, and the grooving there running approximately parallel, or nearly so, to the path of the gas—less opportunity is consequently given for the fouling to lodge than would be the case with a sharp spirally cut groove forming a marked amount of angle to the action of the gas blast; and, therefore, under circumstances of imperfect lubrication, when no check of sufficient efficiency is supplied to restrain the accumulation of fouling about and just beyond the mouth of the chamber (always a dangerous spot), such a contrivance as that offered by the increasing spiral system of groove may be of some value.

Recoil.

Recoil is a matter much affecting the results obtained from a sporting rifle, acting, as it does, on both the firer and the rifle in various ways. As to its action upon the firer, there can be no doubt that a rifle having a severe amount of recoil is a great nuisance to its possessor. It may be quite true that, in the moment of excitement while firing at game, the recoil blow is not felt; but if, under circumstances where no excitement exists, a man be severely and unnecessarily punished with every shot he fires, can he become sufficiently acquainted with the qualities of his weapon?

The causes of undue recoil are several, the most usual being overloading the cartridge in proportion to the weight of the rifle; and this may result in either one of two ways—an excess of powder with a bullet of moderate weight, or a rather smaller quantity of the former with a decidedly heavier bullet. It can be shown that these opposite methods of overloading produce correspondingly different effects in the way of recoil. Setting aside the outward swerve of the barrels upon firing them one at a time—noticed in my remarks upon regulating (page 339), as only applicable to double rifles—the simultaneous movements of a recoiling rifle are distinctly two in number, viz., the backward thrust of the entire weapon, and the upward "jump" of the muzzle end of the barrels. It is the former movement that mainly inflicts the punishing blow upon the firer's shoulder, and, as might be expected from the facts stated at pp. 94–98, it is this motion that is intensified by the use of a heavy bullet.

It is, unfortunately, rather difficult to illustrate the actual effects of recoil upon the firer, as the usual method employed in measuring its amount only gives us the result or weight of the blow, without giving us the *speed* with which it is delivered—a most important point in treating of the effect of a blow upon the firer's shoulder. This probably accounts

for the differences observed in the amount of unpleasantness felt in firing two rifles whose recoil, as indicated by the spring balance, is within a few pounds of each other.

When a larger charge of powder and a lighter bullet is used, we can readily judge of the difference in the recoil blow from a rifle of the same weight, &c., as used in the opposite case; and we can further gauge the increase of "jump" by testing the performance of the rifle with varying charges. The effect of "jump" is produced by the bullet leaving the muzzle of the barrel while the latter is in motion both *backward* and *upward*. This effect has not hitherto been properly investigated, or fully understood in connexion with sporting rifles; though with field artillery a precisely similar result was observed and fully investigated by Sir J. Whitworth many years ago.* This peculiar effect (which, though apparently it seems so very accidental, is yet, if tolerable regularity in the loading of the cartridges fired be insisted upon, capable of exceeding uniformity in its manifestation) is due mainly not to any vibration, or "springing," of the barrels of the rifle, but to the upward leap of the weapon on firing, resulting from the shock of the explosion being received at a point wanting in stability, and much below the axis of the barrels or line of fire. When the rifle is fired from the shoulder rest with the sandbag support situated near the muzzle end of the piece, this latter being firmly held thereon, then the effect of "jump" is most palpable; while if the rifle be fired from the shoulder only, without other support than is afforded by the firer's left hand applied in the usual place near the breech end of the barrels, a slight reduction in the effect of the "jump" is apparent—probably on account of the rifle stock "buckling" a little across its weakest place, the grip, and thus allowing the

* "Guns and Steel," by Sir J. Whitworth, Bart. London: Longmans, 1873, see page 60 *et seq*

muzzle to droop to a slight extent. That the considerations affecting angular value of elevations, bullet drop, &c., are much affected by this action of "jump" may be easily understood; but it varies with change of circumstances, and in the section upon the theory of projectiles it is necessarily disregarded in the various tabular statements, which are based on the assumption that the muzzle of the rifle is motionless during the passage of the bullet and at the moment the latter is launched into the air.

In proceeding to consider the next cause of error likely to be met with—variation of powder charges used—an illustration will be given of the amount of interference the "jump" action of recoil has with the theoretical laws governing the bullet's flight.

It will perhaps be unnecessary to allude to other causes producing undue recoil in rifles; these are mainly errors in constructive detail, not necessary to enumerate here, as too technical to be generally understood from a mere verbal description. A rifle with its stock of such dimensions and shape as to be unsuitable to the physical requirements of the firer will frequently inflict a more severe amount of recoil blow than the charge fired would seem to justify; therefore a rifle firing heavy charges should, if possible, be fitted to suit the firer with the greatest care, or it will always be a most objectionable tool in this respect.

Variation of Load.

In loading up cartridges the sportsman or his assistant may be occasionally careless, and so inaccurately measure the quantity of powder filled into each shell. I use the word measure, as, though weighed charges are invariably to be recommended where extreme accuracy be insisted upon, yet measuring, if carried out with proper appliances and moderate care, is quite sufficiently accurate for ordinary sporting purposes. Still, as an example of what may be expected to ensue if any material

variation in the normal powder charge be made, either from accident or design, I give the illustration shown below (Fig. 110), which is a reduced copy of a cardboard target at which a double Express rifle has been fired, with cartridges loaded with three differing powder charges. To avoid unduly complicating the groups obtained, one barrel only of the rifle was used—the left hand one—*five* shots being

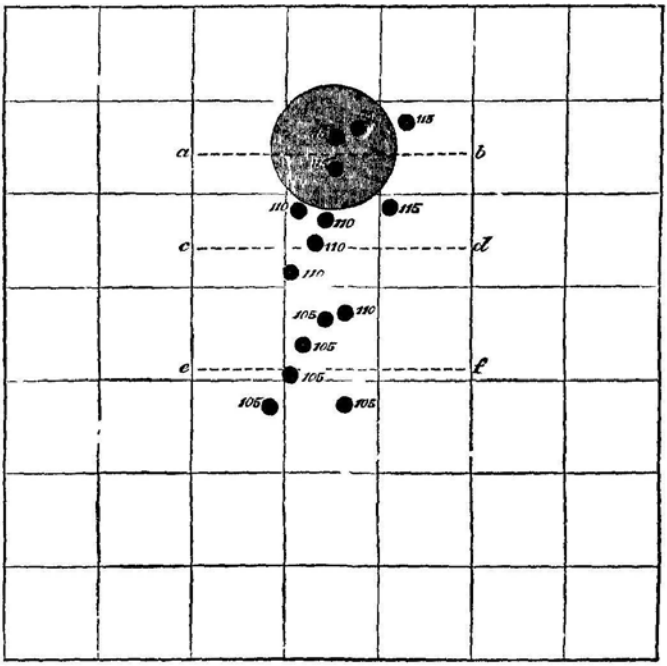


FIG. 110. DIAGRAM OF DIFFERENT POWDER CHARGES.

fired with each charge, the point aimed at throughout being the lower edge of bullseye, and of course the same amount of sight being taken. The distance was 100 yards, the rifle a double Express, ·450 taper solid shell, the bullet used, a paper covered one 280gr. in weight; the rifle weighed nearly 9lb., and the barrels were 28in. long. The target is divided into 3in. squares, with a 4in. circular bullseye indicated

thereon. The dotted line *a b*, drawn a little below the centre of the bullseye, is a horizontal line cutting the point of mean impact of the shots fired with the 115gr. charge; the line *c d* serves a similar purpose for the 110gr. group; and *e f* the same for the group made with the 105gr. charge. We thus see that a drop of 3in. results from the reduction of 5grs. in the powder charge—that being the distance the line *c d* is below *a b*; and a further drop of 4in. results from reducing the charge another 5grs., as shown by the distance the line *e f* is below *c d*; or a total drop of 7in. on the target with a reduction in the powder charge of 10grs. Of course it is very unlikely that such errors in the quantity of powder used would occur undesignedly; but, we can see in what direction and to what extent similar though smaller variations in our powder charge would lead us. I now come to another and most remarkable feature manifested by the rifle in connection with this experiment. These respective charges were tested from this rifle for muzzle speed, or its usual equivalent "observed velocity," at 105ft. from the muzzle of the rifle with the following results, as shown by the chronograph:

115 grain Charge.		110 grain Charge		105 grain Charge	
1810		1790		1765	
1810	Mean	1794	Mean	1755	Mean
1820	1818	1790	1790 8	1765	1747
1820	ft. per sec.	1788	ft. per sec.	1735	ft. per sec.
1830		1792		1715	

or a difference between the two highest charges of 28ft. per second nearly, and a difference of 43ft. between the medium charge and the lowest, making a total of 71ft. per second in all.

Now, according to the tables on page 143, *et seq.*, which have been most carefully elaborated from authentic data, the drop of the bullet due to the gross reduction of bullet speed would be certainly less than 1in. upon the target; but, as we find it so much more, we must seek for the additional cause. We find, in firing these respective charges, a noticeable reduction of the recoil blow with the smallest charge; and

it is very probable that, with less recoil, there is less "jump" of the muzzle, particularly as the bullet weight remains the same in all cases; therefore we must expect the bullet, deprived as it is of the upward direction given it by the superior "jump" of the heavier charge, to strike lower on the target when fired with the smaller one, which is the case. No doubt more extended experiments are wanted to fully establish this peculiarity attending rifles of moderate weight fired with heavy powder charges. Such investigations when carried out will most probably result in defining the influence exerted by "jump" under definite conditions—a point at present but vaguely understood; but I fully believe that my illustration of its effect in such a case as the one stated, and which I have endeavoured to describe to my readers, will be found to be substantially correct.

Wind Influence at 100 Yards Range.

The influence of wind on the flight of Express rifle bullets is much more marked than might be expected, considering the short ranges at which they are fired. It is indicated on pp. 73 and 74 of this volume what effect a "head" or "rear" wind might be expected to have on a bullet moving under certain conditions. It will be found, however, in practice, that the variations in position, or "up and down," upon the target due to the action of wind with Express bullets, will be rather more than we might expect from the illustration there given; but when we consider the lightness of these bullets, together with the amount of air-resistance set up by their rapid flight, and their consequent loss of speed in traversing comparatively short distances, we shall be prepared for an occasional amount of "drop" of some two or three inches, due to the action of a gust of wind from the front upon the bullet. With side winds the effect is more marked, as it is not unfrequent, in firing on a gusty day, with the wind blowing in a direction

square across the line of fire, to get a shot occasionally blown away to leeward some 4in. or 5in. from the mean centre of the group, and this, too, when the firer and his rifle occupy a sheltered spot. When we consider the superior surface offered by a conical bullet to the action of a side wind, as compared with the smaller end-on surface of the same bullet, the increased lateral deviation from this cause will be readily understood. Consequently, we must never expect a fine group of shots from a rifle on a gusty day, unless, indeed, we are lucky in catching the intermittent wind variations, as these cause the great trouble. If the wind blows strongly, but steadily, the group will be more or less away from the point of aim, but will more fairly represent the capabilities of the weapon.

Opinions upon "Jump" and "Flip."

Before quite leaving the question as to the amount of influence exerted upon the bullet by the movement of the rifle at or about the time of firing, and the consequent effect upon what should be the position of the shot upon the target as compared with the point of aim, I wish to lay before my readers the following remarks from Mr. Osborne, which give rather a different explanation of one portion of the performance of the rifle under the above circumstances. They are in reply to some queries addressed to him by me in relation to the matters treated upon by Mr. Metford at pp. 224 *et seq.*:

I cannot quite agree with the solution offered by Mr Metford as to the reason of what may be called the false zero in the sighting of rifles.

That some slight, very slight, "buckling" of a duly proportioned rifle barrel *may* take place during the explosion of the charge is probable, but that it occurs to any marked extent is not likely. Had the experiment quoted been continued, and the "grip" of the stock been either considerably reduced in diameter, or other-

wise weakened—for instance, by a saw cut partially through it—the peculiar action of the rifle during firing would have been much more marked, thus leading to the conclusion that the "flip" or drooping of the muzzle observed is much more due to the springing of the stock than to anything occurring to the barrel. No one having a large experience with rifles, which from their character as sporting weapons are apt to be pushed unduly in the matter of strength and consequent rigidity of stock attachment, while their barrels are more than usually stout and heavy, could arrive at any other conclusion.

It is just possible that with a long rifle barrel unduly light forward there *may* be, if rifled upon Mr. Metford's system of a gaining twist, a tendency to "buckle," on account of some extra strain put upon it towards the muzzle by the resistance of the bullet to the change of pitch which becomes most marked toward that portion of the barrel.

It will, of course, be easily seen that a rather slightly proportioned rifle barrel, so constructed as to have its wall of metal rather thicker (or harder) on one side of the bore than the other, might, if the weaker side happened to be in a certain position with regard to the mass of the rifle generally, be so acted upon by the force of the explosion as to amplify the peculiar effects that are the result of muzzle droop.

Other causes may operate in this direction more or less; for instance, you will remember the complaints against the early Lefaucheux B.L. shot guns, whose breech actions at that early period were so slight in scantling, and so loosely fitted that at every shot the muzzle drooped perceptibly.

With regard to the question of lubrication, I believe you will find that the felt waddings used in the Metford M.B.L. rifle cartridges are saturated with bees-wax, or some similar substance. Probably, with the small powder charge used in this rifle, the slight lubricative effect of such waddings so prepared is sufficient, at least *while the interior of the bore remains smooth and in good condition.*

That such waddings would give the *best* results in rifles carrying heavy powder charges with the bore surface damaged or rust-stained from the heavy wear and tear a sporting rifle is almost sure to incur, has not yet been demonstrated, to my knowledge.

As to what is to be considered "military" or not in such a matter, is not to be dogmatically laid down by any one individual,

or even by one party holding certain views. It is no long time since the rifle itself was stigmatised as "not military," and in their several turns every improvement it has since received has met with the same adverse criticism. I remain, yours faithfully,

FRANK OSBORNE.

Thus it will be seen that as far as the "flip" or drop of the muzzle peculiarity goes, one authority refers it to an elastic motion of the barrel, while another considers that the stock takes the greater share in the matter, and it certainly appears to me more likely that the wooden portion of the structure should, shaped as it is, be more affected by the blow of the discharge than a stout steel tube or pair of tubes attached as in a double rifle. At all events, as far as I am concerned, the question remains unsettled.

METHOD OF TESTING TRAJECTORY.

Having now discussed nearly all the points of any importance connected with the shooting of an Express rifle, and noticed the chief causes of errors in the results thereby obtained, I will proceed to consider an easily applied mode of ascertaining the trajectories of various kinds of rifles and ammunition at sporting ranges, which has been carried through by Mr. Osborne. This can be arrived at, according to his experiments, so that any sportsman can adopt his plan for himself, and obtain such sufficiently accurate results as to enable him to thoroughly understand the capabilities of his weapon, and the suitability of its sighting adjustment to the purposes for which he may require to use the weapon. The plan I pursued in obtaining a record of trajectories at the late *Field* trials, as set forth on pages 176, 177, and also in Chap. X., is probably, taken altogether, the most thorough mode of obtaining information on this very interesting subject possible, but it is unfortunately a method both troublesome and costly; whereas the plan Mr. Osborne describes is

exceedingly simple, and though probably not so rigidly accurate in its results as the former more complete method of experiment, has this merit, that the errors that may occur in carrying it out (if any) are precisely of the kind and degree that are likely to happen when firing at game, and therefore, if possible, should be legitimately taken into account. Mr. Osborne thus describes his plan :

The process can be carried out in two different ways, precisely identical in principle and results. Given a target, three distances are selected, say 50, 100, and 150 yards, and a series of shots are then fired from each distance at a bullseye that may be gradually enlarged in diameter so as to have the same aiming value at each respective range, care being taken that with each enlargement the lower edge of the bullseye (the actual point of aim) remain undisturbed. If these shots be fired *carefully* (a rest being used), and with exactly the same sighting with every shot, the vertical disagreement between the centres of the groups obtained at each distance will exhibit the trajectory of the weapon in a manner to be easily understood, and in full accordance with the sportsman's requirements. It is well to have the target and firing points arranged so as to be fairly upon the same level. The weak point in this plan is no doubt to be found in the difficulty there exists in aiming exactly alike at the different ranges, but this is precisely the difficulty the sportsman has to cope with in using his rifle in the field.

The use of aperture sights instead of those of the usual sporting pattern would tend to much reduce the amount of error arising from this difficulty, though I have carried out a series of experiments upon this subject with such sights attached to Express rifles, resulting in no *material* differences from similar experiments in which the ordinary sights were used.

The other mode of testing this matter is simply a modification of the above, that is, the shooting rest remains fixed and the target a sheet of cardboard affixed to a frame that can be placed in the ground is in succession stationed at the distances from the firer above mentioned. I give diagrams of the shooting of various kinds of sporting rifles when tested in the manner and for the purpose above described; from these it will be seen that some combinations of rifles and cartridges hitherto reputed to be of some

considerable value for sporting purposes, are, in the matter of flatness of trajectory (at least from beyond 100 yards), not quite all that may be desired; in others the degree of excellence obtained in this respect is such as to exceed what we might be prepared to expect from theoretical conclusions only, and in one or two instances to some extent justifying the gunmaker's boast that he can produce a rifle that is almost *practically* "point blank" up to 150 yards range—though, as a matter of fact, this phrase must be entirely sunk in speaking of rifle matters, conveying as it does the falsest of false impressions.

It should be noted in considering the following diagrams that the grouping value of the rifle is not what is intended to be shown—that feature in finely shooting rifles being sufficiently shown in your account of the *Field* rifle trials; indeed, in all cases, only one barrel of a double rifle has been fired, the object being to avoid needlessly complicating the groups obtained. It should also be understood that in no case has the aim been varied from "fine" at the shorter to "full" at the longer distances more than is perhaps unavoidable in such a series of shots at varying ranges. On observation it will be at once seen that such a variation would reduce the "up and down" of the rifle materially.

Trajectory of 12-bore Rifle.

The first rifle I shall take into consideration is one of 12-gauge, the long-standing favourite weapon of Forsyth and his contemporaries in Indian sport, though, instead of going back to his small charges of 4drs., or thereabouts, of powder, as used in the then muzzle-loaders, we can now venture to use 7drs. in our breechloader without fear of breaking down our rifle with fouling, or materially inconveniencing the firer from recoil, the rifle being of sufficient weight as usually made to practically absorb most of the blow from such a charge. The spherical ball is retained for reasons before stated, therefore we have a double 12-bore rifle weighing about 12½lb., with 26in. barrels, firing 7drs. of powder and a spherical ball of about 585grs. in weight, this being delivered at a muzzle speed of about 1580ft. per second. The annexed diagram shows the results obtained from firing a series of five shots (from the left barrel of the rifle only) at the respective distances of 50, 100, and 150 yards, with the same sighting and point of aim in each case as near as may be. The line *a b* passes

through the centre of the 50 yards group, *c d* cutting that of the 100 yards group, the drop of bullet, as shown upon the target between these ranges, being but 2½in. or thereabout. On firing at the 150 yards range, we find that the line *e f*, crossing the centre of group obtained at this distance, is no less than 14in. below the line *c d*, or a total drop of bullet between 50 and 150 yards of more than 16in. The results obtained at the shorter ranges are such as

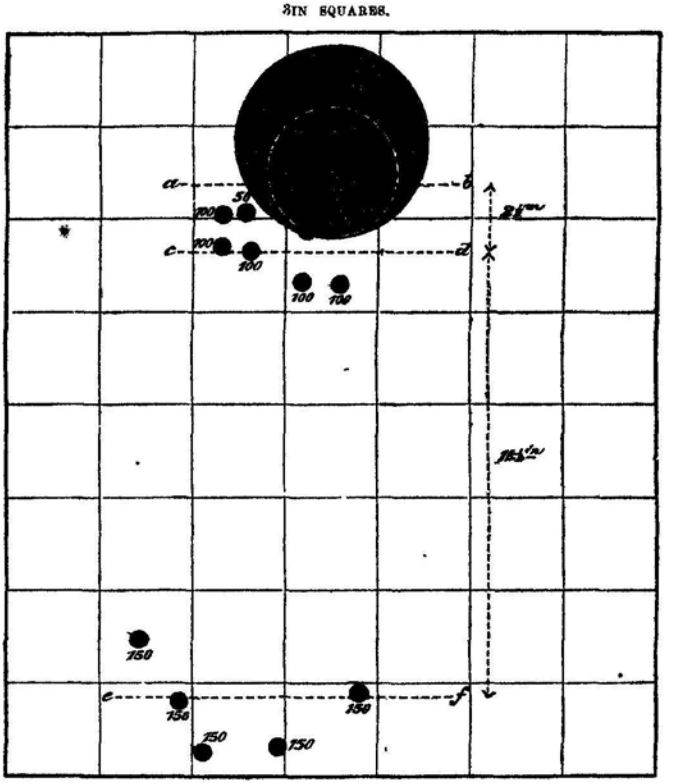


FIG. 111. DIAGRAM OF 12-BORE DOUBLE RIFLE FIRED AT THREE DISTANCES.

might be expected from the table given at p. 184, but the great drop in the next 50 yards in consequence of the rapid loss of speed from air resistance upon such a bullet as the one used may rather surprise some of your readers.

It will be sufficiently obvious that such a rifle and its ammu-

nition as that under our notice, though powerful and effective as it should be from the weight of the arm and the amount of powder charge employed, and sufficiently flat in its trajectory within the 100 yards range, is yet largely discounted in its usefulness for general heavy game shooting by the fact of its requiring an extra sight leaf for every thirty or forty yards range beyond that distance.

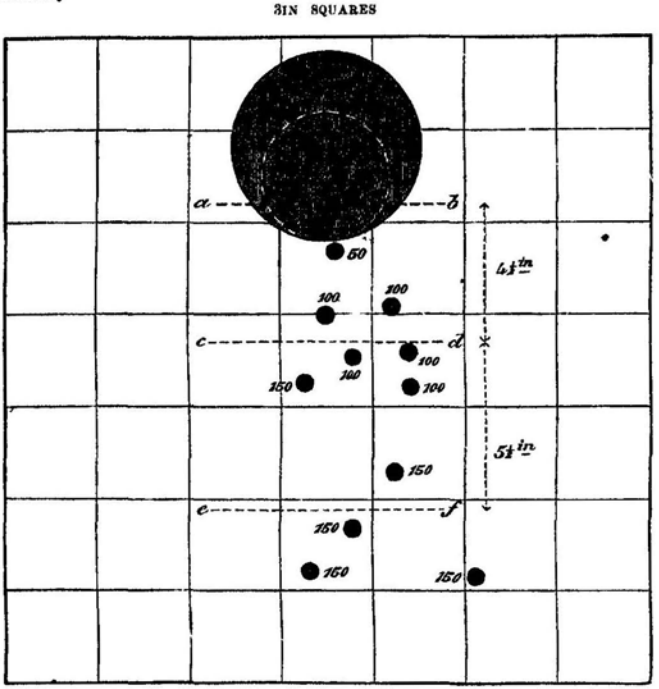


FIG. 112. DIAGRAM OF ·577 EXPRESS RIFLE FIRED AT THREE DISTANCES.

TRAJECTORY OF ·577 EXPRESS RIFLE.

The next rifle to be considered is a ·577 Express, so called, of about 10¾lb. weight, 27in. barrels, firing a charge of 160grs. of powder, and a 520gr. bullet at a muzzle speed of about 1670ft. per second. The above diagram exhibits the shooting of this rifle under similar conditions to those previously described; but we here find a rather different state of things, more nearly approaching what we require in an Express rifle, but still by no means attaining

our ideal of what that combination of rifle and ammunition should be. The difference between the line *a b* at 50 yards and that (*c d*) at 100 yards shows a drop of more than 4in., while a farther drop of over 5in. occurs between 100 and 150 yards, giving a total drop of about 10in. in the entire distance. This shows conclusively that, however *powerful* a tool the ·577 may be, it only possesses the true Express qualification in the matter of trajectory to a partial extent, though, if the method of aiming "fine" at the short range, and "full" at the longer, be adopted and *mastered*, but little practical difficulty need be experienced by the sportsman in this particular matter of using the same sight for all distances within 150 yards, showing a decided advance upon the 12-bore in this respect, besides giving us a much more easily portable arm of equal if not superior, power. On comparing this illustration of the trajectory of a ·577 rifle with the examples given in the *Field* trials, some little discrepancy may be found to exist between them; but, if allowances be made for the variation in load, and probably also in other details, the two statements will be found capable of reconciliation.

Trajectory of ·500 Express Rifle.

We now come to an example of a sporting rifle that very fairly illustrates the remarkable advance in the development of these weapons, resulting in the production of such an arm as that we are about to consider. This rifle is a double ·500 Express, of about 9¾lb. weight, 28in. barrels, firing 130gr. of powder, and a 350gr. bullet, having a muzzle speed of about 1880ft. per second. It will be seen from the accompanying diagram that a drop of over 3in. occurs between 50 and 100 yards, and only a drop of about 1in. between the latter distance and 150 yards. This is manifestly in utter disagreement with all the laws governing the flight of projectiles, and we must seek for an explanation of the anomaly in the action of the "jump" of the rifle in firing. That this "jump" has a greater angular value upon the target when the rifle is fired from a longer range is obvious, and therefore at, or between, the shorter ranges its effects are not so striking as upon the relative position of the group fired from the 150 yards, where, as will be seen, the "jump" has very nearly neutralised the drop of the bullet due to air resistance and gravity pull; thus, what is called the long "point blank" of the Express combination of rifle and

ammunition is largely due to the effect of the "jump" upon the rifle in firing, giving an increased momentary amount of angle of elevation, in addition to the permanent angle of the sight adjustment. The entire "up and down" of this rifle from the centres of the respective groups at 50 and 150 yards is but 4½in., thus giving the sportsman a command of the vital portions of any

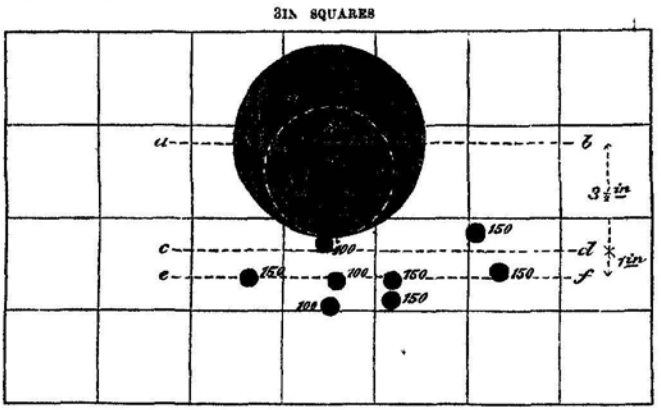


FIG. 113. DIAGRAM OF 500 EXPRESS RIFLE FIRED AT THREE DISTANCES.

ordinary-sized animal's frame from any point within the longer range—and satisfying every condition of sport likely to arise in the pursuit of heavy and dangerous game, especially when we consider the severe shock and lacerating effect of the bullet used. It should also be noticed that these advantages are combined with those of moderate recoil, and an easily portable weapon.

TRAJECTORY OF ·450 EXPRESS RIFLE.

One other example of a still higher degree of development of the Express rifle fired under the same conditions as those already discussed, is given on the diagram herewith.

The rifle is a double ·450 "Magnum" Express of 9½lb. weight, 26in. barrels, firing 150grs. of powder, and a 270gr. bullet, with a muzzle speed of 2000ft. per second and upwards.

It will be noticed that the lines crossing the centres of each group are in an up and down of less than 3in., and that the entire fifteen shots are in 6in. of vertical measurement; it will also be seen that the line *e f*, indicating the centre of the 150 yards group, is actually higher or nearer that of the 50 yards group than is the

line *c d* belonging to the shots fired at 100 yards range. Of course this abnormal state of things can only be attributed to the peculiar effect of the "jump" action of the rifle in firing, and even expe-

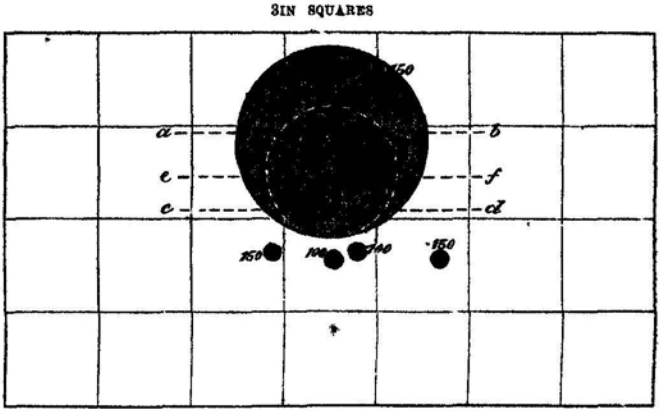


FIG. 114. DIAGRAM OF ·450 "MAGNUM" EXPRESS RIFLE FIRED AT THREE DISTANCES.

rienced rifle shots may be excused for having overlooked the influence this action of the rifle has upon the vertical deviation of its fire at various ranges with the same sighting used at each.

TRAJECTORY OF MARTINI-HENRY SPORTING RIFLE.

As an illustration of the manner in which a rifle and its ammunition of small calibre, constructed upon other than Express lines, comes out when treated for diagram upon this plan, I give the results obtained from firing a single sporting Martini-Henry rifle of 8¾lb. weight, 28in. barrel, using the Government pattern ·577-·450 service cartridges, containing 85grs. powder, and 480gr. bullet, with a muzzle speed of about 1240ft. per second.

It will be seen that, at 50 and 100 yards, there is no serious amount of drop or vertical deviation of bullet other than exists in most sporting rifles, but on firing at 150 yards, we find a serious drop really requiring an additional sight leaf to render the rifle useful for sporting purposes when fired from this range. As in the previous diagrams, the line *a b*, belonging to the 50 yards group, is here seen to be 3in. above the line *c d* of the 100 yards group, but the line *e f* of the 150 yards group is nearly 12in. below the former, showing a total drop of nearly 15in. in all.

The contrast between the two diagrams immediately preceding, and the one under consideration, affords conclusive evidence of the great value of the modern Express system for ordinary sporting requirements.

Having now as far as my space permits explained and illustrated, by examples of the leading types of sporting rifles, this method of ascertaining their trajectory values, it will be necessary for me to

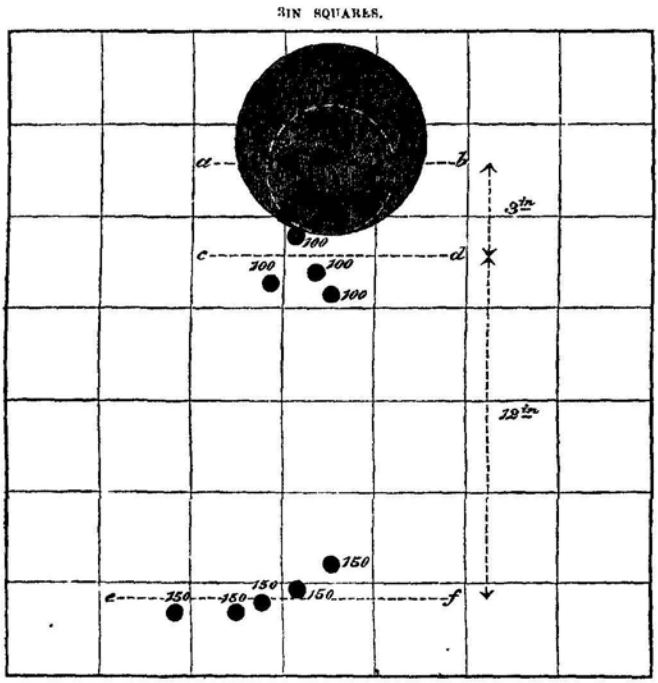


FIG. 115. DIAGRAM OF RIFLE USING THE ·577-·450 GOVERNMENT M.H. CARTRIDGE FIRED AT THREE DISTANCES.

state that the foregoing diagrams must not be expected to be *literally* repeated in the firing of any similar rifles by the sportsman. On the contrary, each rifle will be found more or less to have an individuality of its own in this matter of "up and down" (and also in other points) as compared with the results shown in the above diagrams, though these may be taken as representing about, or perhaps rather above, the fair average in the matter of trajectory of each system of rifle and ammunition investigated.

In testing the rifle for accuracy of fire, sighting, &c., a very similar plan may be adopted to the one I have described, but of course both barrels must be fired alternately, care being taken not to injure the groups obtained by firing too rapidly.

F. OSBORNE.

It will be seen that the requirements of sport have led to the development of the Express rifle and its ammunition, in a manner that may be best explained and understood by treating it as a combination of the accuracy and portability of the old-fashioned rifles using light bullet and powder charge, with the smashing power of the heavier and larger calibres; but the specially prominent feature of the Express, its flat trajectory (within sporting ranges), is peculiarly its own, and results, as I have endeavoured to explain, partly from the high speed of its projectile, and partly from the effect of the "jump" upon the rifle in augmenting the angle of elevation already established and existing upon the sights of the weapon. Of course the action of "flip" or muzzle droop during the act of firing would tend to destroy or neutralise the beneficial action of the jump in this respect. However, as I have before remarked, further evidence on these interesting subjects is necessary to their full elucidation, and I shall be glad to receive and publish in the columns of the *Field*, any results of carefully conducted experiments that may be transmitted to me for that purpose. Should Mr. Osborne's experiments be repeated by any of my readers who desire absolute accuracy in ascertaining the trajectory of a rifle, I would suggest that the front sight should be raised, so as to make the line of aim parallel with the axis of the barrel. The difference of angle does not practically affect the result to any appreciable extent, but theoretically it may be objected to.

Considerations of space now compel me to bring this chapter to a close, though the subject is by no means

exhausted, but I trust it has been so sufficiently treated as to give my readers some little information upon the very interesting points we have had under consideration. They will perceive that the questions involved in the construction of a first-rate double sporting rifle are of a very complex character, and demand, for their successful treatment, the possession of a high order of skill and considerable experience on the part of the rifle maker; and that, farther, it is not in the nature of things for us to expect that such a combination of science and art as is embodied in a really fine rifle should be available at a low price; and in this matter a few pounds judiciously laid out in what appears to be the extra charges of a good maker is most certainly money well spent.

CHAPTER X.

PUBLIC TRIAL OF SPORTING RIFLES.

OBJECTS OF TRIAL—REPORT OF TRIAL—ROOK RIFLES—EXPRESS RIFLES—LARGE BORE RIFLES—TABLES OF DIAGRAMS.

In order to establish a standard of the performances made by the several kinds of rifle used in sport, I instituted a public trial at Putney, in the summer of last year, giving fully two months' notice to the gunmakers. Unfortunately I was unable to get the ground for the trial later than October, and as a consequence, several leading firms, being engaged in preparing for the forthcoming season, were precluded from competing. Nevertheless, I was fortunate in obtaining an entry for every class from Messrs. Holland, who are admittedly in the A1 class, and, no pains being spared either by Mr. Henry Holland or his assistant, Mr. Froome, not only did they win every prize, but the performance of each rifle may be accepted as of the very highest character—and in fact this position has as far as I know never been disputed. In addition to the attainment of a standard, I was also anxious to ascertain, through an actual demonstration by means of screens, how far the Boulengé chronograph is to be relied on as a measure of trajectory; and, lastly, I was desirous of arriving at the actual distance up to which a "full and fine" sight will cover a vital part in an animal of the size of a deer, as *ex. gr.*, the heart or brain. This was clearly shewn to reach 150 yards, beyond which I was not able to test any rifle; but with the

Express rifle giving 1750ft. muzzle velocity, the highest point of the trajectory is little over 4in. on the average, and this is well covered by a "full and fine" sight.

It may, therefore, be alleged, without fear of contradiction, that I have, by means of the trial to be presently described, ascertained, 1st, the highest standard of the performance of the several sporting rifles in general use; 2ndly, that the Boulengé chronograph, giving the muzzle velocity of any rifle, will enable any person conversant with figures, by means of Bashforth's tables, to ascertain the trajectory of that rifle, as has been explained by my friend "T," in Book IV.; and 3rdly, that an Express rifle may be used with the same sight, "full and fine," up to 150 yards. I shall now proceed to give the report of the trial as published in the *Field* of Oct. 6 and subsequent issue, 1883.

Report of the Rifle Trial of 1883.

"It is a source of great gratification to us that the above trial (held at Putney, Oct. 1, 3, and 4), has been brought off without the slightest drawback, and with the most satisfactory results. In order to allow of the use of screens with the view of demonstrating to the eye of the spectator the trajectories of Express rifles, we were compelled to select a range which could be well fenced in from the wind, and at the same time so near our own residence as to enable us to level the screens with perfect accuracy. For this purpose we were luckily able to obtain the use of a piece of ground at Putney; but the annoyance to the inhabitants was so great, that we stopped before reaching the big rifles of 12, 10, 8, and 4-bore, and postponed their trial for a few days, with the view of shooting them at some one of the open ranges near London. The weather, on the whole, was favourable, and specially so on Monday and Tuesday; but on Wednesday there was a steady light rain all day, and on

Thursday a strong wind from the left front, against which even 9ft. fences were no great protection; but, the only rifles then tested being ·577 Expresses, the high velocities and heavy balls caused the wind to have little or no effect. We were enabled to obtain the trajectories of the four winning rifles, but time did not permit us to try any more; besides which, the wind on Thursday, blowing down the range when we proposed to do this, was so high as to burst the paper unless the wires were kept up to back it, and this we found to be dangerous, one of the balls hitting a wire which was of strong steel, and being thereby deflected off the target, and of course it might possibly reach an individual outside the range. Our butt was 25ft. high, of solid bricks, faced with 3ft. of sand, boarded in front, so that no ordinary shooting was attended with danger; but in one case Mr. Adams's ammunition was defective, and three balls stripped at 50 yards, upsetting, and going a foot or two outside the carton; so that he at once withdrew the gun, as possibly unsafe at the longer ranges, saving us from the disagreeable necessity of doing so ourselves.

Messrs. Holland's rifles performed throughout most splendidly, and, though occasionally they were beaten at individual ranges, their averages were highest in each class. In one instance, indeed (Class 4), they came second at each range, but, nevertheless, came out first on the average of the three ranges.

In all the classes Messrs. Holland abstained from cleaning out from first to last. The other competitors cleaned out after each change of range, as permitted by the conditions. This speaks volumes for the excellent lubrication used by the above firm, and for their plans of rifling.

The following is the score of the several classes, calculated by Mr. B. C. Evelegh, under the inspection of the competitors, from centres selected by themselves. The mean radial deviation is given in inches and decimal parts of an inch:

ROOK RIFLES.

Class 1. single rook rifles not exceeding 6lb. in weight, barrels not to exceed 28in. in length; ranges, 50 and 75 yards, twenty shots at each range. No trial for trajectory.

50 Yards.	In.	75 Yards.	In.
Holland	·395	Holland	·696
Tranter	·821	Adams	1·428
Watson	·914	Tranter	1·566
Bland	·916	Jeffries	1·728
Adams	1·077	Bland	1·905
Jeffries	1·170	Watson	2·034

Averages for the Two Ranges.		Order of Merit.
Holland	·545	1
Tranter	1·193	2
Adams	1·253	3
Bland	1·410	4
Jeffries	1·449	5
Watson	1·474	6

The diagram made at 50 yards by Messrs. Holland's ·295 is the best we have ever seen made, and astonished some of

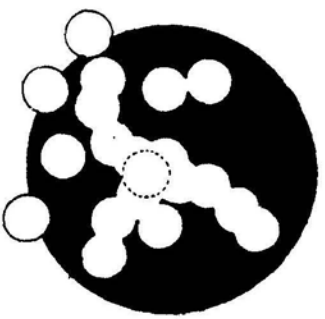


Fig. 116. Holland's Rook Rifle at 50 Yards.

the London gunmakers who were present, and who were previously sceptical as to the diagrams we have from time to time recorded in our columns. The bull was in fact cut all

to pieces in the centre, and it was difficult in several of the shots to fix the exact situation of each hole.

Their 75 yards diagram is also extremely good. All the

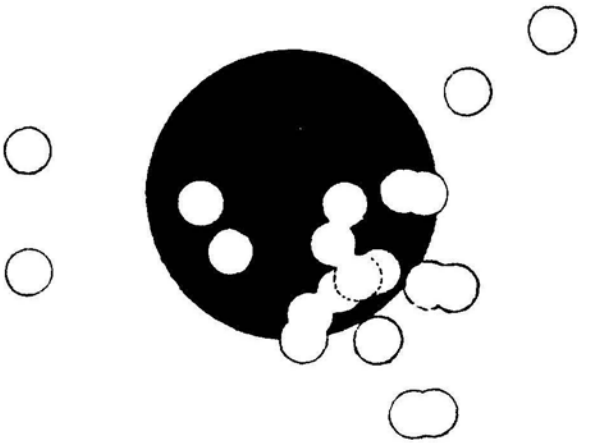


FIG. 117. HOLLAND'S ROOK RIFLE AT 75 YARDS.

competitors who had entered a second rifle withdrew it, not having any hope of beating Messrs. Holland's diagram.

EXPRESS RIFLES.

Class 2. For ·400-bore double rifles, weight not to exceed 8lb., barrels not to exceed 28in.; powder not to be less than 3drs., weight of lead not more than three times the weight of powder; ranges, 50, 100, and 150 yards.

	50 Yards.	100 Yards.	150 Yards.
Holland.....	1·139	2·139	3·232

Average of the three ranges..... ..... 2·183.

Here Messrs. Holland had no competitor, owing to Messrs. Bland's rifle being 1½oz. over-weight, and that Mr. Watson did not appear with his. The performance was of the very highest class, the weather and light being favourable. Recoil at 50lb. pressure, 71lb.

Class 3. For double rifles of 450-bore, weight not to exceed 9lb., barrels not more than 28in, powder not less than 4drs., weight of lead not to exceed three times the weight of powder, ranges as in Class 2.

	50 yds	Order of Merit at 50 yds	100 yds	Order of Merit at 100 yds	150 yds	Order of Merit at 150 yds
Bland, No 1	1 032	1	2 752	2	6·980	3
Holland	1 132	2	1 318	1	1 449	1
Bland, No. 2	1 300	3	2 763	3	5 936	2

	Average of the Three Ranges	Order of Merit
Holland	1 299	1
Bland, No 2	3 333	2
Bland, No 1	3 588	3

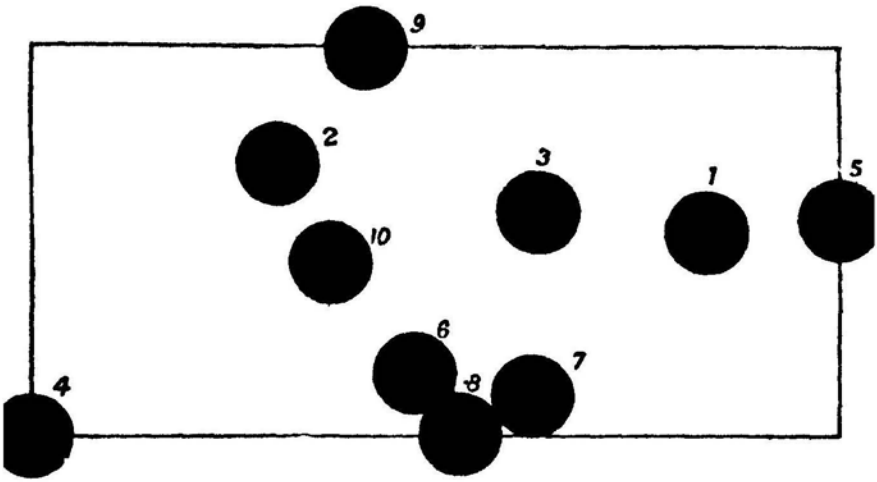


Fig 118 Holland's 450-Bore at 50 Yards

In this trial Messrs. Bland's made an excellent diagram at 50 yards, but were behind at the longer ranges. Messrs. Adams's rifle was withdrawn, as above mentioned, for three wild shots. Here again Mr. Watson did not appear. The recoil of the winner was 96lb.

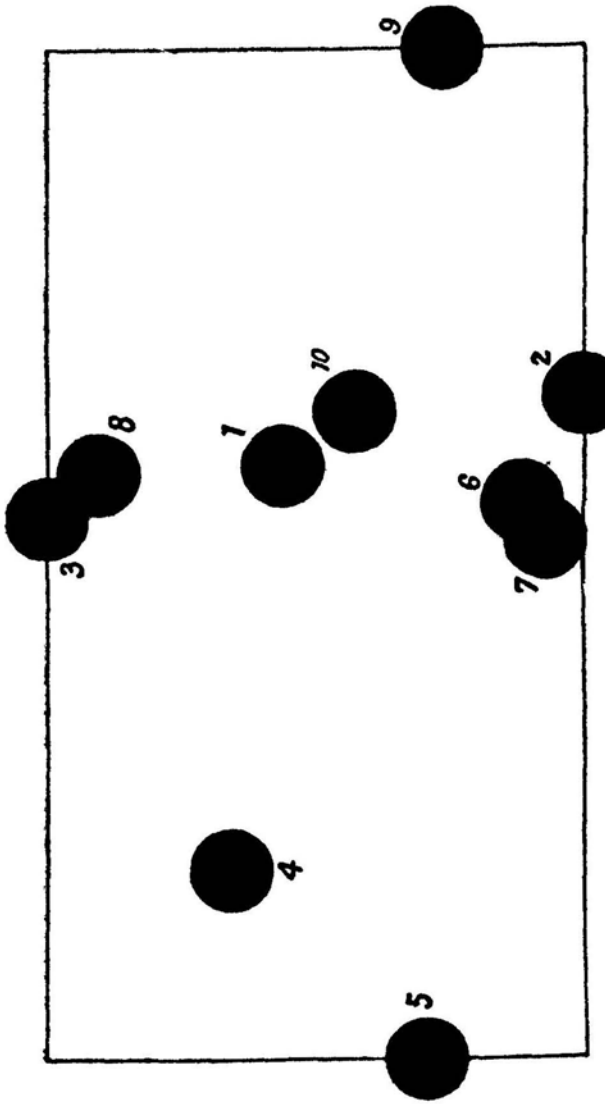


FIG 119. HOLLAND'S ·450-BORE AT 100 YARDS.

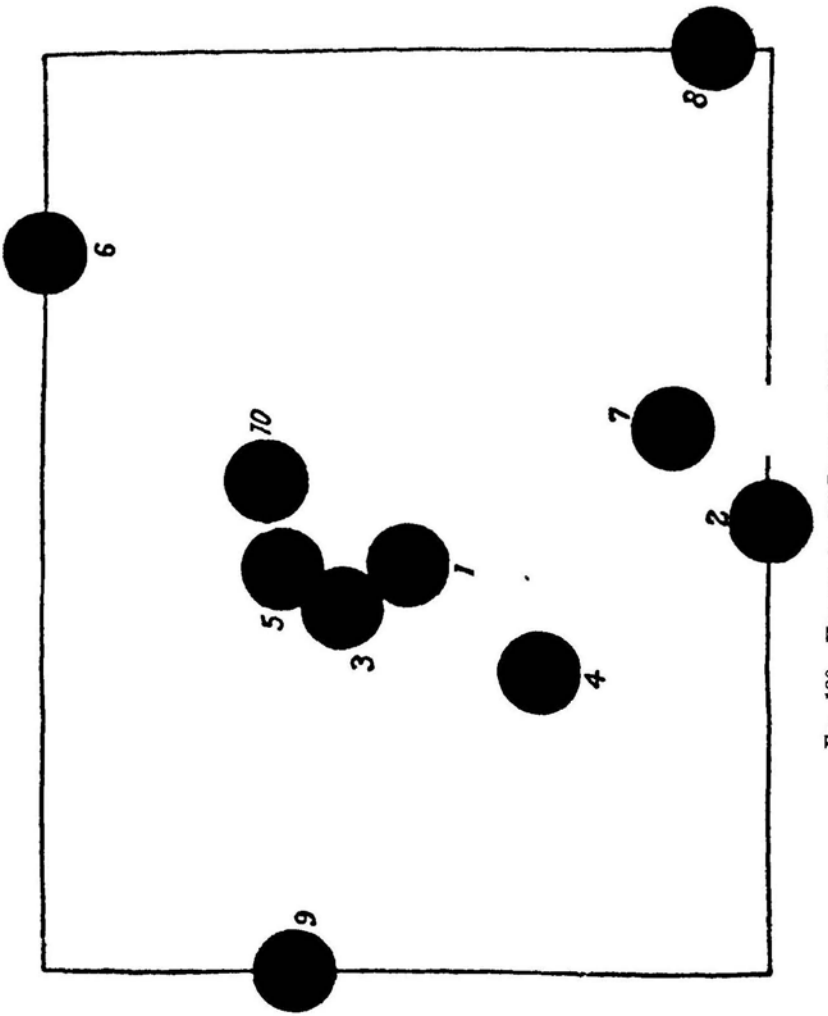


FIG. 120. HOLLAND'S ·450-BORE AT 150 YARDS.

Class 4, for double rifles of ·500-bore; weight not to exceed 10lb., length of barrels not to exceed 28in., powder not less than 5drs.; lead to be not more than three and a half times the weight of powder; ranges as in Class 2.

	50yds.	Order of Merit at 50yds.	100yds.	Order of Merit at 100yds.	150yds.	Order of Merit at 150yds.
Jeffries	1·052	1	1·004	1	4·124	3
Holland	1·093	2	1·164	2	2·900	2
Adams	1·489	3	3·872	4	2·400	1
Bland, No. 2 ..	1·928	4	3·405	3	8·209	
Bland, No. 1...	1·989	5	4·127	5	5·277	4

AVERAGE OF THE THREE RANGES.

		Order o Merit.
Holland	1·719	1
Jeffries	2·060	2
Adams	2·587	3
Bland, No. 1.....	3·797	4
Bland, No. 2	4·514	5

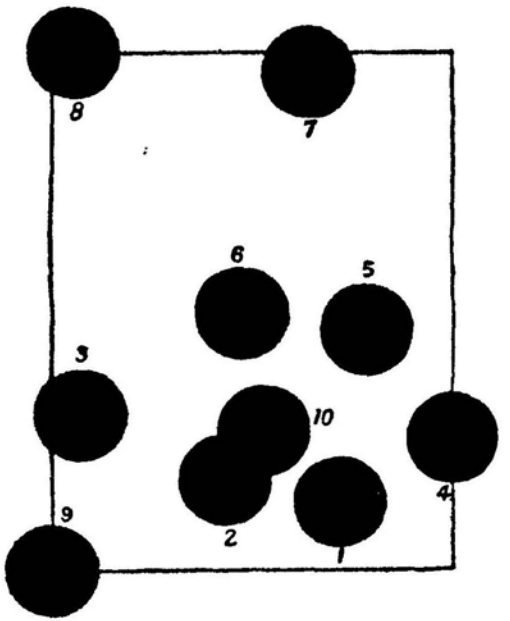


FIG. 121. JEFFRIES' ·500-BORE AT 50 YARDS.

In this class Mr. Jeffries pushed Messrs. Holland very hard, making a splendid diagram at the first two ranges, but breaking

down slightly at 150 yards. Mr. Adams's second rifle was disqualified for being overweight. The recoil of the winner was 101lb.

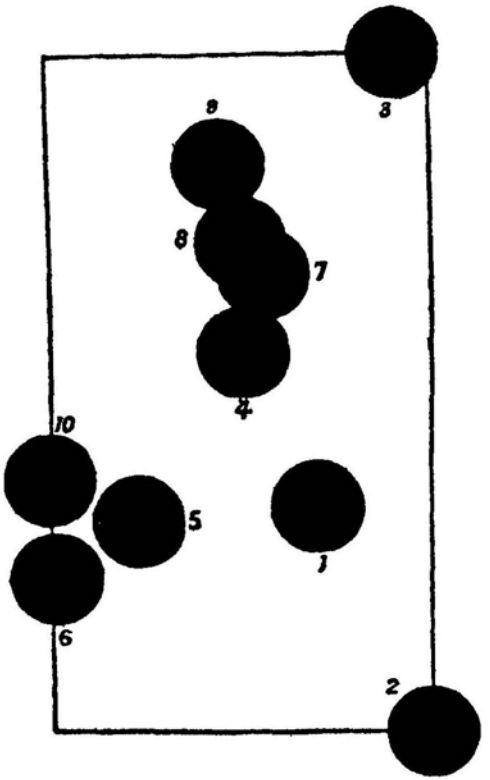


FIG. 122. JEFFRIES' ·500-BORE AT 100 YARDS.

Class 5, for double rifles of ·577-bore; weight not to exceed 12lb., length of barrels not to exceed 28in.; powder not less than 6drs ; lead not more than four times the weight of powder; to be shot at the same ranges as Class 2.

	50yds	Order of Merit at 50yds.	100yds.	Order of Merit at 100yds.	150 yds.	Order of Merit at 150yds.
Adams, No. 1..	1·056	1	2·791	2	5·874	6
Holland	1·128	2	2·098	1	2·418	1
Adams, No. 2..	1·200	3	3·131	4	3·427	2
Bland, No. 2	1·594	4	4·092	6	4·521	4
Watson	1·826	5	2·870	3	5·098	5
Bland, No. 1..	2·058	6	3·806	5	4·373	3

	Average of the Three Ranges.	Order of Merit.
Holland	1·881	1
Adams, No. 2	2·586	2
Adams, No. 1	3·240	3
Watson	3·281	4
Bland, No. 2	3·402	5
Bland, No. 1	3·412	6

In this class Mr. Adams (for whom Mr. Bates, the well-known match rifle shot, performed throughout) took the lead at 50 yards, but could not sustain his position further on, and Messrs. Holland again won on the average, with a very splendid rifle, which, indeed, was the pick of their wonderful basket. Recoil, 119½lb.

We may mention that all competitors expressed their entire satisfaction with the arrangements, including the measuring machine, which was designed and made for the occasion."

"For the completion of our trial of the large bores, we were permitted by Mr. Brown, of Nunhead, to use a portion of his capital ground on Tuesday, Oct. 9, and were fortunately favoured with a remarkably fine day, without either sun, rain, or wind. As at Putney, Messrs. Holland carried all before them, winning classes 6, 7, and 8 from Messrs. Bland, who were their only competitors, and scoring first in classes 9 and 10, owing to Messrs. Bland's man, who was charged to be at Nunhead by twelve o'clock, not appearing till 1.45, when Messrs. Holland had walked over with his smooth-bore, and had got half through with his 4-bore. The latter performed wonderfully, giving perhaps the best diagram made in the whole trial; but it was unlucky for Messrs. Bland that they had no chance of shooting with their smooth-bore, as that of Messrs. Holland was by no means first-rate, the diagram being just within a foot square. We have repeatedly been told by gunmakers that a diagram six inches square may be made with this weapon; but, after trying the experiment

at least twenty times, with guns from various makers, we have never seen less than nine-inch diagram; but this has resulted once or twice, and Mr. Froome, who shoots and regulates Messrs. Holland's rifles, states that he has more than once made a six-inch diagram within the last few days. Naturally, public performance seldom equals that done in private, but, making all allowance for this difference, Mr. Froome's shooting with the smooth-bore at Nunhead was such as to give Messrs. Bland a fair chance, if the trial had come off. In all the other classes, although he was occasionally beaten at 50 and 100 yards, he always had so much the best at 150 yards, that he came out the winner; and, taking the whole series of trials into consideration, his shooting has been of of the very highest order. Messrs. Holland may certainly congratulate themselves on the possession of so competent an assistant in regulating and shooting their rifles. Mr. H. Holland, who personally designed the whole of the magnificent series of rifles which were tested by us, also richly deserves the credit that attaches to their performance. We understand that the whole of them were rifled under his superintendence, and afterwards regulated and shot at his Kensal Green ground by Mr. Froome.

We append the diagrams made by his rook rifle, and also those of his ·450-bore, which, taking all the ranges, did perhaps the best. We have selected this bore for the following reasons: First, it is the only one in which we were able to test another of the same class (Messrs. Bland's) through the screens, and, secondly, because it is the same bore as that of the rifle we tested, and described in the *Field* of Feb. 24, 1883. On comparing the two diagrams, it will be seen that the one made in private is slightly the better of the two; but the 150 yards shoot at Putney is the best we have ever seen, being far superior in proportion to that made at 100 yards, as indeed was the case with almost all Messrs. Holland's rifles.

In the ·500-bore contest, as previously remarked, Mr. Froome was beaten at the 50 and 100 yards, Mr. Jeffries making a wonderful 100 yard diagram, but he fell off sadly at 150 yards, owing to the comparative lightness of his bullet, which on that account was not so true at the longer range. Mr. Holland had, however, so fixed his weights as to serve him well all through, and this was one great source of his success. The fact is, that the construction of rifles and the proper adjustment of their charges require long thought and careful trials; and it is only by the combination of theory with practice, such as is practised by the Bond-street firm, that success can be achieved.

We have not been able to measure the diagrams made at Nunhead, which requires the selection of a centre by the competitors; but there could be no doubt of the superiority of Messrs. Holland's rifles, and we have consequently awarded them the prize in each class, and they have, therefore, 'swept the board.'

We append the meteorological report of Mr. J. H. Steward (official optician to the National Rifle Association), giving the results of observations made each day at 11.30 a.m. We have added, however, the words 'light' and 'strong' after the direction of the wind.

Date	Barometer	Wind	Thermometer.	
			Dry Bulb	Wet Bulb.
Monday, Oct. 1	29·82	S.W., light	56	50
Tuesday „ 2	30·08	N., light	52	46·5
Wednesday, „ 3	29·65	W., light	49·5	48·5
Thursday, „ 4	29·56	N.W., strong	52	49

We may add that the range ran from north to south, the targets being at the northern end.

The following tables have been drawn up with great care, and give all the details of the shooting from the shoulder throughout the Putney trials, with the strings calculated on the plan laid down in the programme."

CLASS I.—ROOK RIFLES.

SINGLE RIFLES, not exceeding 6lb. in weight, nor 28 inches in length; ranges 50 and 75 yards; 20 shots at each range.

String at 50 Yards.

Average inches.

HOLLAND (·295-bore; weight, 5lb. 15oz.; length, 28in.; powder, 12grs.).—·69, ·53, ·32, ·29, ·53, ·58, ·48, ·81, ·56, ·71, ·48, ·68, ·18, ·11, ·13, 0, ·11, ·17, ·25, ·30; total, 7·91 inches ..... ·395

TRANTER (·300-bore; weight, 5lb. 15oz.; length, 27¾in.; powder, 17grs.).—·94, ·78, ·78, ·76, 1·65, 1·77, ·65, ·13, ·30, ·54, ·80, ·60, ·60, ·67, ·92, 1·11, 0, 1·02, 1·52, ·88; total, 16·42 inches .... ·821

WATSON (·300-bore; weight, 5lb. 15½oz.; length, 27¾in.; powder, 17grs.).—·26, ·20, ·55, 1·46, 1·68, 1·05, ·85, 0, ·32, 1·03, ·38, 1·30, 1·71, 1·77, 2·57, ·29, ·53, ·84, 1·00, ·49; total, 18·28 inches .... ·914

BLAND (·360-bore; weight, 5lb. 12oz.; length, 27½in.; powder, 14grs.).—1·30, ·82, ·70, ·26, ·48, 1·65, 1·20, 1·08, ·58, 1·15, ·82, 1·01, 1·45, 0, ·23, 1·37, ·81, 1·50, ·23, 1·65; total, 18·32 inches ·916

ADAMS (·360-bore; weight, 4lb. 10oz.; length, 25½in.; powder, 14grs.).—·60, ·50, 1·58, 1·46, 1·57, 1·04, ·99, ·81, ·55, ·86, 1·14, 1·11, ·87, ·81, 1·32, 1·40, 1·26, ·83, 1·45, 1·40; total, 21·55 inches .... 1·077

JEFFRIES (·300-bore; weight, 5lb. 12oz.; length, 27½in.; powder, 12grs.).—·14, 1·38, 1·86, 1·41, 1·14, 1·49, 2·05, ·40, 2·01, 1·09, 1·00, ·37, ·48, 1·99, 1·31, 1·00, 1·51, ·80, 1·24, ·74; total, 23·41 inches .... 1·170

String at 75 Yards.

HOLLAND.—1·59, 1·07, ·51, ·47, ·92, ·73, 2·01, 1·85, ·39, ·48, ·40, ·83, ·88, ·50, ·38, ·38, ·10, ·05, ·16, ·22; total, 13·92 inches..... ·696

ADAMS.—·52, ·74, 2·56, ·98, 1·66, ·73, 1·84, ·26, 1·50, 1·35, 2·62, ·38, 2·40, ·48, ·36, 1·99, 1·40, 2·47, 1·69, 2·64; total, 28·57 inches ... 1·428

TRANTER.—1·89, 1·32, 3·03, 2·93, 1·49, 1·77, 1·10, 1·50, 1·23, 1·70, 1·51, 3·04, 2·16, 1·80, ·55, ·38, 1·13, 1·25, 1·54, 0; total, 31·32 inches .... 1·566

JEFFRIES.—2·63, 1·36, 1·50, 2·90, ·64, 1·50, 1·70, 1·40, 1·42, 1·51, 1·81, 1·95, 1·25, 1·22, 2·89, 1·10, 1·34, 1·17, 2·87, 2·40; total, 34·56 inches .... 1·728

BLAND.—·72, ·76, 1·53, 3·13, ·79, 3·30, 3·29, 2·30, 2·71, 2·30, 2·24, ·84, ·78, ·71, 2·09, 1·00, 2·48, 1·76, 2·08, 3·30; total, 38·11 inches .... 1·905

WATSON.—·55, 1·89, 5·54, 3·49, 1·90, 3·64, 3·65, 1·78, 2·23, 0, ·68, 1·74, 2·32, 1·89, 2·08, ·83, 1·34, ·98, 1·59, 2·57; total, 40·69 inches .... 2·034

ORDER OF MERIT.

General position.	Position at respective ranges.	Makers.	Average of the two ranges.
1	1, 1	Holland	·545
2	2, 3	Tranter	1·193
3	5, 2	Adams	1·253
4	4, 5	Bland	1·410
5	6, 4	Jeffries	1·449
6	3, 6	Watson	1·474

EXPRESS RIFLES.

CLASS II.—·400-BORE.

DOUBLE RIFLES, not exceeding 8lb. in weight, nor more than 28 inches in length; powder not less than 3drs.; weight of lead not more than three times the weight of powder; ranges, 50, 100, and 150 yards; ten shots at each range.

String at 50 Yards. Average inches.

HOLLAND (weight, 7lb. 14oz.; length, 26 inches; 3drs. powder and 219grs. bullet, or proportion of 1 : 2·66; recoil, 71lb.; shot on Monday evening, in a good light, with no wind).—Right barrel, 1·29, 1·15, 1·15, ·14, 1·66; left barrel, 2·28, 1·20, 1·17, 1·21, ·14; total, 11·39 inches ..... 1·139

100 Yards.

Right barrel, 1·21, ·96, 2·04, 1·17, 2·08; left barrel, 4·00, 2·57, 2·82, 1·24, 3·70; total, 21·79 inches ..... 2·179

150 Yards.

Right barrel, 4·97, 1·77, 1·69, 4·54, 5·59; left barrel, 2·38, 2·36, 1·86, 1·81, 5·35; total, 32·32 inches ..... 3·232

Average of the three ranges ..... 2·183

BLAND.—Rifle not tried, being 1½oz. over weight.

Class III.—·450-BORE.

DOUBLE RIFLES, not exceeding 9lb. in weight, nor more than 28 inches in length; powder not less than 4drs.; weight of lead not more than three times the weight of powder; ranges 50, 100, 150 yards; ten shots at each range.

String at 50 Yards. Average inches.

BLAND, No. 1 (weight, 8lb. 13½oz.; length, 28in.; 110grs. powder and 300grs. bullet, or proportion of 1 : 2·72; shot at 11 o'clock on Tuesday).—Right barrel, ·51, ·84, ·85, ·49, 1·55; left barrel, ·58, ·97, 1·20, 1·98, 1·35; total, 10·32 inches ..... 1·032

HOLLAND (weight, 8lb. 4oz.; length, 26in., 110grs. powder and 328grs. bullet, or proportion of 1:2·98; recoil, 96lb.; shot on Tuesday afternoon).—Right barrel, 1·64, ·78, 2·34, ·92, 1·17; left barrel, ·76, 2·06, ·46, ·90, ·29; total, 11·32 inches 1·132

BLAND, No. 2 (weight, 9lb; length. 28in.; 110grs powder and 300grs. bullet, or proportion of 1 · 2·72; recoil, 89lb.; shot on Tuesday afternoon).—Right barrel, 2·32, 1·49, 1·17, ·98, 1·09; left barrel, 1·29, ·85, 1·48, ·95, 1·38; total, 13 inches . . 1·300

String at 100 *Yards.*

HOLLAND.—Right barrel, ·44, 1 78, 2·17, ·93, 2 13; left barrel, 1·08, 2·29, ·74, 1·41, ·21; total, 13·18 inches 1·318

BLAND, No. 1.—Right barrel, 5 49, 2·11, 3·32, 2·14, 3·27, left barrel, ·38, 2·39, 1·95, 3 28, 3 19; total, 27 52 inches 2 752

BLAND, No. 2.—Right barrel, 5 15, 3 49, 1·84, 3·54, 2 32; left barrel, 2 88, 1·89. 2·53, 2·8, 1·19, total, 27·63 inches 2·763

String at 150 *Yards.*

HOLLAND —Right barrel, ·38, 27, ·28, 1·88, 2 17; left barrel, 2·25, 1·21, 2 21, 3 33, ·51; total, 14 49 inches 1·449

BLAND, No. 2.—Right barrel, 6 16, 4 52, 10 67, 6·20, 3·18, left barrel, 4·94, 10·27, 6·06, 4·43, 2 93, total, 59·36 inches 5 936

BLAND, No 1 —Right barrel, 6 46, 16·51, 6·27, 6 43, 5·54, left barrel, 11·3, 2·4, 2·32, 6 47, 6·10; total, 69·80 inches 6·980

ORDER OF MERIT.

General Position	Position at respective ranges	Makers	Average of the three ranges
1	2, 1, 1	Holland	1·299
2	1, 2, 3	Bland, No. 1..	3 333
3	3, 3, 2	,, No. 3..	3 588

CLASS IV.—·500-BORE.

DOUBLE RIFLES, not exceeding 10lb in weight, nor more than 28 inches in length; powder not less than 5drs.; lead not more than 3½ times the weight of powder; ranges at 50, 100, and 150 yards; ten shots at each range.

String at 50 *Yards.* Average inches.

JEFFRIES (weight, 8lb. 4½oz.; length, 28in., 138grs. powder and 340grs. bullet, or proportion of 1 : 2·64, shot on Wednesday morning).—Right barrel, ·52, 1·79, 1·10, ·54, 1·17; left barrel, 1·80, ·16, 1·48, ·69, 1·27; total, 10·52 inches . .. 1·052

HOLLAND (weight, 9lb. 1oz.; length, 28in.; 138grs. powder and 435grs. bullet, or proportion of 1 : 3·17; recoil, 101lb.; shot on Wednesday morning).—Right barrel, ·86, 1·10, 1·25, 1·39, ·74; left barrel, ·98, 1·04, 2·00, ·75, ·82 total, 10·93 inches 1·093

ADAMS (weight, 9lb. 9½oz.; length, 28in.; 138grs. powder and 328grs. bullet, or proportion of 1:2·38; shot on Tuesday evening).—Right barrel, 99, 1·89, 1·66, 1·18, 1·68; left barrel, 2·03, ·83, ·51, 2·04, 2·08; total, 14·89 inches . . .. 1·489

BLAND, No. 2 (weight, 9lb. 5¼oz.; length, 28in.; 138grs. powder and 328grs. bullet, or proportion of 1: 2·38; shot on Wednesday, at midday).—Right barrel, 2·36, 1·89, 1·42, 1·35, 2·96; left barrel, 1·39, 1·37, 1·33, 2·25, 2·96; total, 19·28 inches ... . 1·928

BLAND, No. 1 (weight, 9lb. 12oz.; length, 28in.; 138grs. powder and 328grs. bullet, or proportion of 1: 2·38; shot on Tuesday evening).—Right barrel, ·83, 1·95, ·83, 1·68, 1·31; left barrel, 1·43, 3·09, 1·23, 3·67, 3·87: total, 19·89 inches ... . 1·989

String at 100 *Yards.*

JEFFRIES.—Right barrel, 1·14, ·64, ·88, 1·44, 1·40; left barrel, ·77, 1·47, ·21, 1·49, ·60; total, 10·04 inches .. . . 1·004

HOLLAND.—Right barrel, 1·51, 1·28, ·90, 2·70, 1·34; left barrel, 0, ·22, ·85, 2·17, ·67; total, 11·64 inches . . . . 1·164

BLAND, No. 2.—Right barrel, 7·54, 5·75, 2·03. 1·84, 2·69; left barrel, 5·18, 2·55, 1·23, 2·59, 2·65; total, 34·05 inches . .... 3·405

ADAMS.—Right Barrel, 4·53, 5·14, 1·82, 4·76, 2·78; left barrel, 3·75, 5·10, 5·12, 1·69, 4·03; total, 38·72 inches . 3·872

BLAND, No. 1.—Right barrel, 2·72, 3·40, 7·93, 7·04, 1·04; left barrel, 1·27, 3·38, 3·36, 9·62, 1·51; total, 41·27 inches . . ... 4·127

String at 150 *Yards.*

ADAMS.—Right barrel, 3·29, 2·69, 3·23, 1·98, 2·02; left barrel, 2·78, 1·15, ·89, 3·24, 2·73; total, 24 inches .. .. 2·400

HOLLAND.—Right barrel, 1·86, 2·49, 4·95, 2·48, 1·65; left barrel, 2·97, 4·22, 3·04, 3·15, 2·19; total, 29 inches ... ... 2·900

JEFFRIES.—Right barrel, 5·00, 6·55, ·20, 2·94, 5·32; left barrel, 4·87, 1·30, 4·46, 3·95, 6·65; total, 41·24 inches . .. . 4·124

BLAND, No. 1.—Right barrel, 4·5, 9·14, 2·90, 4·55, 2·65: left barrel, 11·43, 6·38, 4·35, 4·38, 2·49; total, 52·77 inches .. .. 5·277

BLAND, No. 2.—Right barrel, 17·58, 16·20, 8·99, 1·44, 6·36; left barrel, 6·84, 1·30, 4·64, 17·34, 1·40; total, 82·09 inches .... . 8·209

ORDER OF MERIT.

General position.	Position at respective ranges	Makers.	Average of the three ranges.
1	2, 2, 2	Holland	1·719
2	1, 1, 3	Jeffries	2·060
3	3, 4, 1	Adams	2·587
4	5, 5, 4	Bland, No. 1	3·797
5	4, 3, 5 .	Bland, No. 2 ..	4·514

CLASS V.—·577-BORE.

DOUBLE RIFLES, not exceeding 12lb. in weight, and not more than 28in. in length; powder not less than 6drs.; lead not more than four times the weight of powder; ranges 50, 100, and 150 yards; ten shots at each range.

String at 50 Yards. Average inches.

ADAMS, No. 1 (weight, 10lb. 11oz.; length, 28in.; 164grs. powder and 507grs. bullet, or proportion of 1 : 3·09; shot on Thursday morning).—Right barrel, ·84, ·87, 1·07, 1·40, ·57; left barrel, 96, 1·39, ·99, 1·26, 1·21; total, 10·56 inches . . .. 1·056

HOLLAND (weight, 11lb. 10oz.; length, 26in.; 164grs. powder and 598grs. bullet, or proportion of 1 : 3·63; recoil, 119½lb.; shot two rounds on Wednesday evening, the rest on Thursday morning).—Right barrel, ·44, 1·20, 1·80, ·19, 1·00; left barrel, 1·29, 2·11, 1·79, ·82, ·64; total, 11·28 inches . . .. . . 1·128

ADAMS, No. 2 (weight, 10lb. 14oz.; length, 28in.; 164grs. powder and 507grs bullet, or proportion of 1 : 3·09; shot two rounds on Wednesday evening, the rest on Thursday morning, one in very high wind) —Right barrel, 1·21, 1·26, ·53, ·88, 1·68; left barrel, 1·45, 1·29, ·58, 1·41, 1·71; total, 12 inches .. .. 1·20(

BLAND, No. 2 (weight, 10lb. 2oz.; length, 27¾in.; 164grs. powder and 512grs. bullet, or proportion of 1 : 3·12; shot on Thursday morning).—Right barrel, 1·18, 1·25, 1·58, 1·68, 2·84; left barrel, 1·29, 1·16, 1·37, 1·75, 1·84; total, 15·94 inches 1·594

WATSON (weight, 9lb. 12oz.; length, 28in.; 164grs. powder and 501grs. bullet, or proportion of 1 . 3·05; shot on Wednesday at midday) —Right barrel, 2 05, 1·36, 2·70, 0, 3·64; left barrel, 2·41, ·94, 1·85, 2·59, 1·22, total, 18·76 inches .. .. 1·876

BLAND, No. 1 (weight, 10lb. 10oz.; length, 28in.; 164grs. powder and 512grs. bullet, or proportion of 1 : 3·12; shot on Wednesday at midday) —Right barrel, 1·57, 1·00, 2·53, 1·29, 4·98; left barrel, 1·61, 1·20, 1·63, 1·38, 3·39; total, 20·58 inches . 2 058

String at 100 Yards.

HOLLAND.—Right barrel, 0, 1·39, 1·02, 3·01, 4·05; left barrel, 1·98, 2·70, 3·24, 2·61, ·98; total, 20 98 inches 2·096

ADAMS, No. 1.—Right barrel, ·38, 2·23, 1·85, 3·54, 2·15; left barrel, 4·40, 1·41, 3·09, 4·43, 4·43; total, 27·91 inches 2·791

WATSON.—Right barrel, 2·09, 3·50, 1·42, 2·83, 5·67; left barrel, 0, 3·50, 3·64, 4·34, 1·71; total, 28·70 inches . ... 2·870

ADAMS, No. 2.—Right barrel, 3·01, 1·05, 5·13, 4·85, 3·84; left barrel, 3·30, ·23, 2·54, 5·00, 2·36; total, 31·31 inches 3·131

BLAND, No. 1.—Right barrel, 5·85, 1·39, 2·08, 8·04, 1·79; left barrel, 3·39, 1·10, 2·81, 3·42, 8·19; total, 38·06 inches ..... 3·806
BLAND, No. 2.—Right barrel, 1·69, 9·03, 6·64, 3·15, 3·00; left barrel, 2·73, 1·96, 1·15, 5·70. 5·85; total, 40·92 inches..... 4·092

String at 150 *Yards.*

HOLLAND.—Right barrel, 4·61, 1·74, 1·33, 3·46, 4·53; left barrel, 2·95, ·33, 1·94, ·69, 2·60; total, 24·18 inches..... .... 2·418
ADAMS, No. 2.—Right barrel, 2·36, 5·23, 1·75, 3·32, 4·55; left barrel, 2·37, 5·26, 2·80, 2·25, 4·38; total, 34·27 inches ..... 3·427
BLAND, No. 1.—Right barrel, 5·31, 5·24, 1·64, 5·30, 9·09; left barrel, 3·84, 4·43, 5·33, 2·16, 1·39; total, 43·73 inches ..... 4·373
BLAND, No. 2.—Right barrel, ·74, 3·85, ·80, 2·96, 3·81; left barrel, 3·85, 6·60, 6·87, 3·73, 12·00; total, 45·21 inches ..... 4·521
WATSON.—Right barrel, 8·56, 0, ·93, 6·67, 9·46; left barrel, 7·45, 9·44, 2·73, ·57, 4·67; total, 50·98 inches .... 5·098
ADAMS, No. 1.—Right barrel, 3·59, 4·16, 9·05, 2·78, 7·15; left barrel, 4·71, 5·12, 5·08, 8·29, 8·81; total, 58·74 inches..... 5·874

ORDER OF MERIT.

General position	Position at respective ranges.	Maker.	Average of the three ranges.
1	2, 1, 1	Holland	1·881
2	3, 4, 2	Adams, No. 2.....	2·586
3	1, 2, 6	„ No. 1.....	3·240
4	5, 3, 5	Watson	3·281
5	4, 6, 4	Bland, No. 2	3·402
6	6, 5, 3	„ No. 1	3·412

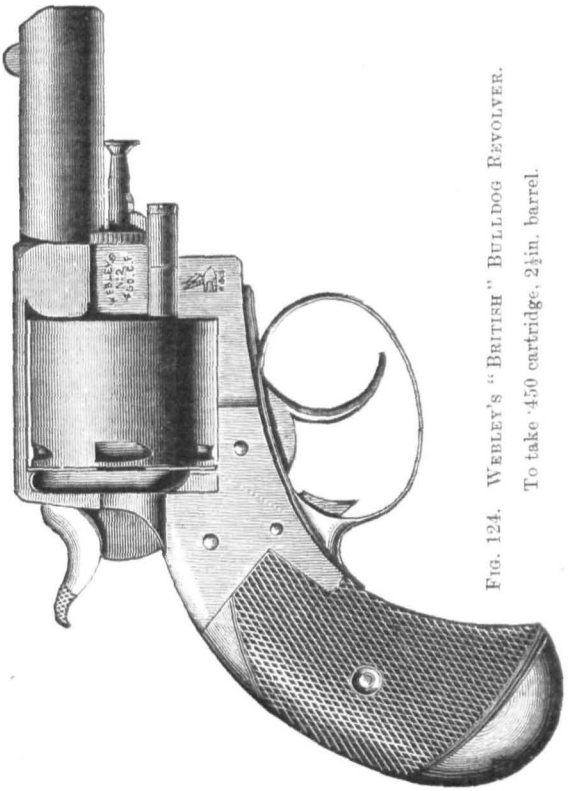
"In order to compare the results under the 'string' calculation with those made on the 'squaring' principle, we append a table constructed on the latter plan.

It will be seen that the 'squared' diagrams produce some little difference from the 'strings,' but the main positions are the same. For instance, the average of rook rifles on 'the square' would make Jeffries one place higher, while the relative positions of Bland's rifles would be altered among the ·500 bores. On the whole, however, the variation is so slight as to show that one method is as good as the other."

Metropolitan Police, the Royal Irish Constabulary, and the Webley No. 5; Colt's ·45 and Frontier ·44.

All these pistols possess the common features of a solid frame, and a rod for extracting the fired cases.

Webley's "British" Bulldog (built on the lines of the



SCALE ½ SIZE.

FIG. 124. WEBLEY'S "BRITISH" BULLDOG REVOLVER.
To take ·450 cartridge, 2½in. barrel.

American single action Bulldog) is double action, designed for the ·450 service cartridge, and is the most powerful pocket revolver in the market. A good shot can make a 2in. diagram at 10 yards with this pistol, though it has but a 2½in. barrel.

THE FOLLOWING TABLE IS CALCULATED ON THE SQUARE FOR THE PURPOSE OF COMPARISON.

I.—ROOK RIFLES.

General Position.	Position at respective Ranges.	Makers.	Dimensions and Area of Diagrams. At 50 Yards.	Dimensions and Area of Diagrams. At 75 Yards.	Average of the two ranges.
			Inches.	Inches.	Sq. Inches.
1	1, 1	Holland	1·2 × 1·2 = 1·44	2·2 × 2·5 = 5·50	3·47
2	3, 2	Tranter	2·4 × 2·7 = 6·48	2·9 × 6·0 = 17·40	11·94
3	4, 3	Adams	2·5 × 2·7 = 6·75	3·7 × 4·8 = 17·76	12·25
4	2, 6	Bland	2·1 × 2·9 = 6·09	4·5 × 6·4 = 28·80	17·44
5	6, 4	Jeffries	2·6 × 4·0 = 10·40	3·8 × 5·6 = 21·28	15·84
6	5, 5	Watson	2·6 × 3·7 = 9·62	3·9 × 6·8 = 26·52	18·07

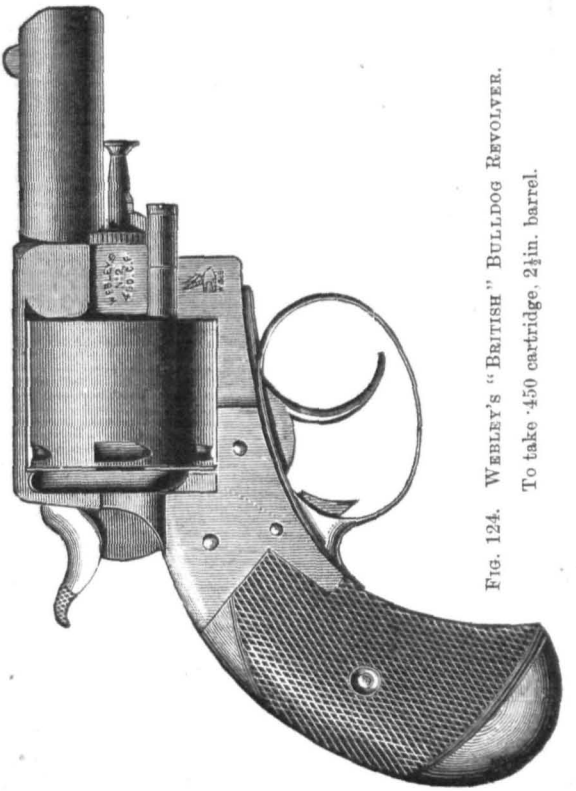
II.—EXPRESS RIFLES.

General Position.	Position at respective Ranges.	Maker and Bore of Rifles	Dimensions and Area of Diagrams. At 50 Yards.	Dimensions and Area of Diagrams. At 100 Yards.	Dimensions and Area of Diagrams. At 150 Yards.	Average of the three Ranges.
			Inches.	Inches.	Inches.	Sq. Inches.
·400-Bore.						
1	.....	Holland	1·5 × 3·6 = 5·40	3·25 × 6·5 = 21·12	3·7 × 10·5 = 38·85	21·79
·450-Bore.						
1	3, 1, 1	Holland	2·1 × 4·3 = 9·03	2·9 × 5·4 = 15·66	3·9 × 4·9 = 19·11	14·60
2	2, 2, 2	Bland. No. 2	2·6 × 3·2 = 8·32	4·4 × 8·8 = 38·72	10·8 × 13·9 = 150·12	65·72
3	1, 3, 3	Bland, No. 1	2·1 × 3·1 = 6·51	6·2 × 7·5 = 46·50	9·5 × 21·8 = 207·10	86·70
·500-Bore.						
1	1, 2, 2	Holland	1·8 × 2·8 = 5·04	3·0 × 3·4 = 10·20	5·6 × 6·1 = 34·16	16·47
2	2, 1, 3	Jeffries	1·9 × 3·6 = 6·84	2·0 × 2·8 = 5·60	6·5 × 12·8 = 83·10	31·85
3	3, 4, 1	Adams . . .	3·5 × 3·6 = 12·60	6·0 × 9·9 = 59·40	4·7 × 6·0 = 28·20	33·40
4	4, 3, 5	Bland, No. 2	3·0 × 5·5 = 16·50	4·5 × 10·0 = 45·00	6·0 × 39·0 = 214·00	91·83
5	5, 5, 4	Bland, No. 1	4·4 × 5·5 = 24·20	6·0 × 11·9 = 71·40	8·4 × 15·4 = 129·40	75·00
·577-Bore.						
1	3, 1, 1	Holland . ..	2·7 × 3·0 = 8·10	4·8 × 6·3 = 30 24	4·8 × 7·7 = 36·96	25·10
2	2, 2, 2	Adams, No. 2	1·6 × 3·5 = 5·60	3·8 × 9·8 = 37·20	4·3 × 10·7 = 46·01	29·60
3	1, 4, 5	Adams, No. 1	1 8 × 2·6 = 4·68	7·5 × 7·6 = 57 00	6·8 × 18·0 = 122·40	61·36
4	5, 2, 6	Watson .. .	3·8 × 4·0 = 15·20	4·0 × 9·3 = 37·20	10·7 × 13·5 = 140·45	64·28
5	4, 6, 3	Bland, No. 2	2·5 × 4·3 = 10·75	7·0 × 12·2 = 95·16	6·8 × 14·9 = 101·30	69·07
6	6, 5, 4	Bland, No. 1	4·0 × 6·1 = 24·40	8·0 × 10·9 = 87·20	8·4 × 13·1 = 110·04	73·88

Metropolitan Police, the Royal Irish Constabulary, and the Webley No. 5; Colt's ·45 and Frontier ·44.

All these pistols possess the common features of a solid frame, and a rod for extracting the fired cases.

Webley's "British" Bulldog (built on the lines of the



SCALE ½ SIZE.

FIG. 124. WEBLEY'S "BRITISH" BULLDOG REVOLVER.
To take ·450 cartridge. 2½in. barrel.

American single action Bulldog) is double action, designed for the ·450 service cartridge, and is the most powerful pocket revolver in the market. A good shot can make a 2in. diagram at 10 yards with this pistol, though it has but a 2½in. barrel.

"Having now received Major McClintock's trajectories, we have great pleasure in coming to the conclusion that the reliability of the chronograph is completely confirmed by our experiments with the screens. With regard to these, some curious results are brought to our notice by our valued correspondent T., who has kindly examined them, and whose report we append. We insert the two series of curves as drawn by Major McClintock, which show at a glance how small is the variation between them.

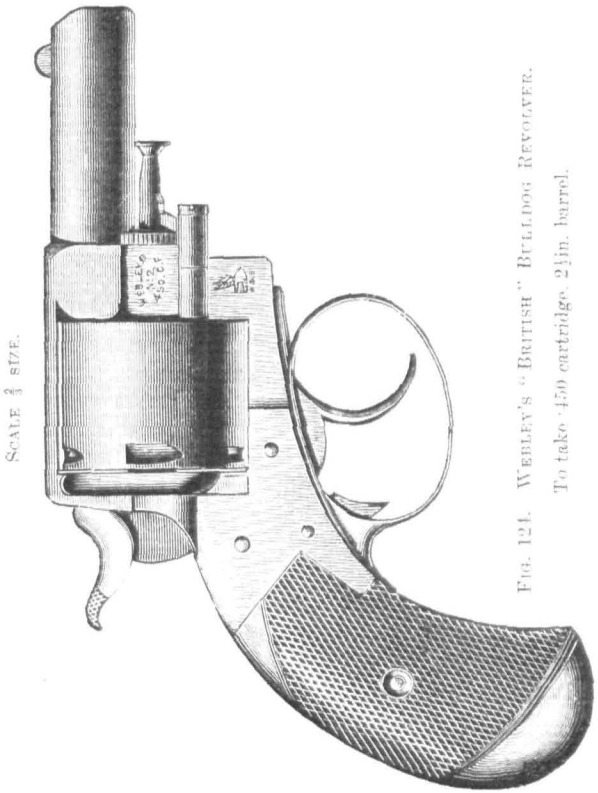
As a result of these experiments, we can now positively decide that an Express rifle must have a greater velocity than 1600 feet, if it is desired to shoot "full and fine" with the same sight up to 150 yards, as is the practice of most sportsmen. To do this with success, the ball must not rise and fall much more than two inches from the line of sight, or, in other words, the trajectory must not be more than 4½ inches, or thereabouts, in 150 yards. A valuable and simple definition of the Express is thus obtained, for mere muzzle velocity is not sufficient. To exemplify this, we have only to examine the trajectory of Mr. Jeffries' ·500 bore, which, from its comparatively light bullet, had a very high muzzle velocity, and shot splendidly up to 100 yards, but fell off frightfully at 150 yards, and at that range would be practically useless.

We may now take Messrs. Holland's diagrams as a standard for comparison, and our experience leads us to believe that they will not easily be beaten, or indeed equalled. To obtain such a standard was the main object of our trial. Up to this time sportsmen had no means of ascertaining whether or no they had the best rifles which could be made; but they can now judge for themselves, with the aid of a competent shooter, if they are not themselves up to the mark. It is quite true that all may not desire a rifle to perform well beyond 100 yards; but if it can

Metropolitan Police, the Royal Irish Constabulary, and the Webley No. 5; Colt's ·45 and Frontier ·44.

All these pistols possess the common features of a solid frame, and a rod for extracting the fired cases.

Webley's "British" Bulldog (built on the lines of the



Scale ½ size.

Fig. 124. Webley's "British" Bulldog Revolver. To take ·450 cartridge, 2½in. barrel.

American single action Bulldog) is double action, designed for the ·450 service cartridge, and is the most powerful pocket revolver in the market. A good shot can make a 2in. diagram at 10 yards with this pistol, though it has but a 2½in. barrel.

SCALE ⅔ SIZE.

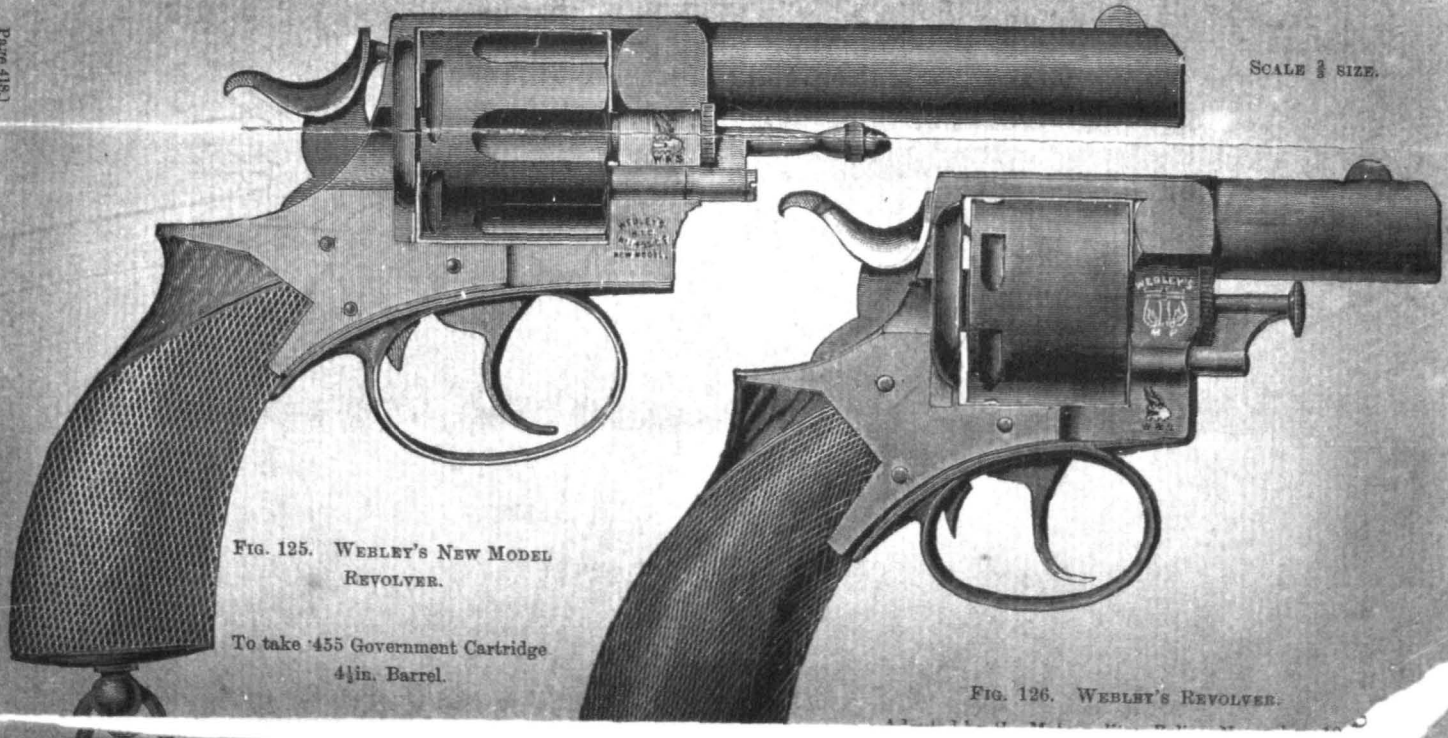


FIG. 125. WEBLEY'S NEW MODEL REVOLVER.

To take ·455 Government Cartridge
4½in. Barrel.

FIG. 126. WEBLEY'S REVOLVER.

Adopted by the Royal Irish Constabulary, Queensland and Victorian Governments, and Cape Mounted Police.

Adopted by the Metropolitan Police, November

·450, 6 Shot. 2½in. Barrel.

be got to do well at that distance, and also at the longer range, surely no sportsman can be insensible to the advantage thus obtained. Jeffries' 100 yards string beat, on the average, that of Messrs. Holland's by 1·16 inch; but the latter at 150 yards averaged 2·9 inch against Jeffries' 4·9 inch. Of course, there is a certain amount of luck in making these diagrams, for Messrs. Adams' ·500-bore made a far better diagram at 150 yards than at 100, which can only be accounted for in this way. It is possible, therefore, that Jeffries' 150 yards shoot *may* be thus explained; but the lightness of his bullet would lead us to expect the result, and we believe it to be the true explanation. Numberless other points of great interest are brought out by the trial; but we prefer leaving them to be dealt with more scientifically by our friend T. than we can pretend to do.

With reference to the machine rest, its performance greatly exceeded in accuracy our anticipations, founded on the limited number of trials which we were able to give it. All that is required is to graduate the spring pressure to the charge used; but this could only be done with certainty by experiment, and as we were prevented from resorting to this test by the fear of an injunction, we were compelled to abandon it. On comparing the diagrams made by it in ascertaining the trajectories of Messrs. Holland's rifle, it will be seen that there was little difference from those of Mr. Froome, in some cases being slightly better and in others worse, but those made by it with Messrs. Bland's 450-bore were very superior to the shooting of their assistant. All that it wants to make it a complete substitute for the shoulder is a little practice, and, when this is carried out by Mr. Jones, we expect to hear of its being very generally adopted by gunmakers in regulating their rifles—especially as there is no doubt about its efficacy in regard to shot guns and single rifles."

SCALE ⅜ SIZE.

FIG. 125. WEBLEY'S NEW MODEL REVOLVER.

To take ·455 Government Cartridge.
4½in. Barrel.

Adopted by the Royal Irish Constabulary, Queensland and Victorian Governments, and Cape Mounted Police.

FIG. 126. WEBLEY'S REVOLVER.

Adopted by the Metropolitan Police, November,

·450, 6 Shot. 2½in. Barrel.

STRING MEASUREMENTS OF THE LARGE-BORES.

"The following are the details of the trial of the large-bores at Nunhead:

Class VI.—12-BORE.

DOUBLE RIFLES, not exceeding 14lb. in weight, nor more than 28 inches in length; powder, not less than 6drs.; range, 50 yards.

	Average string in inches.
HOLLAND (weight, 13lb. 8oz.; length, 26½in; powder, 7drs.; recoil, 141lb.)—·30, ·32, ·39, 2·60, 1·24, ·29, ·59, ·79, 1·77, 1·77, 1·63; total, 9·93	·993
BLAND (weight, 11lb. 8oz.; length, 28in.; powder, 6drs.; recoil, 132lb.)—4·08, 5·01, 3·51, 3·96, 2·18, 1·77, 2·61, 1·02, 1·44, 1·04; total, 26·62 inches	2·662

Class X.—No. 12 SMOOTH-BORE.

DOUBLE GUN, not exceeding 8lb. in weight, nor more than 30 inches in length; powder, not less than 4drs.; range 50 yards.

HOLLAND (weight, 7lb. 8oz.; length, 28in.; powder, 4drs.; recoil 81lb.)—·32, 6·98, 3·72, 4·48, 3·07, 4·75, 2·88, 3·83, 3·85, 2·77; total, 36·65 inches	3·665

Messrs. Bland absent.

Class VII.—10-BORE.

DOUBLE RIFLES, not exceeding 16lb. in weight, nor more than 26 inches in length; powder, not less than 8drs.; range 50 yards.

HOLLAND (weight, 12lb.; length, 26in.; powder, 8drs. 5grs; recoil, 163lb.)—·30, ·40, ·23, 0, 1·83, 1·55, 1·81, 1·76, 1·14, 1·90; total, 10·92 inches	1·092
BLAND (weight, 12lb. 8oz.; length, 26½in.; powder, 8drs.; recoil, 162lb.)—·67, 4·15, 2·32, ·33, 1·40, ·65, 2·36, 3·57, ·77, 2·21; total, 18·43 inches	1·843

Class VIII.—8-BORE.

DOUBLE RIFLES, not exceeding 18lb. in weight, nor more than 26 inches in length; powder, not less than 10drs.; range 50 yards.

HOLLAND (weight, 17lb. 8oz.; length, 26in.; powder, 10drs; recoil, 185lb.)—1·84, 2·79, ·29, 0, 1·63, 2·45, 1·45, 1·64, 1·71, ·72; total, 14·52 inches	1·452
BLAND (weight, 17lb.; length, 26in.; powder, 10drs., in Kynoch's brass cases; recoil, over 200lb., the extent of the spring balance in the machine).—2·05, 3·22, ·55, 2·70, 4·67, 3·01, 3·00, 3·82, 2·59, 3·02; total, 28·63 inches	2·863

Class IX.—4-Bore.

Double Rifles, not exceeding 24lb. in weight, nor more than 24 inches in length; powder, not less than 12drs.; range, 50 yards.

Holland (weight, 23lb. 8oz.; length, 24in.; powder, 12drs.; recoil could not be taken, owing to want of strength in the spring balance of the machine, which is the largest made by Salter).—·40, ·40, ·31, ·66, ·40, ·45, 1·55, ·73, 1·11, 1·81; *total*, 7·82 inches ..... ·782

Messrs. Bland absent.

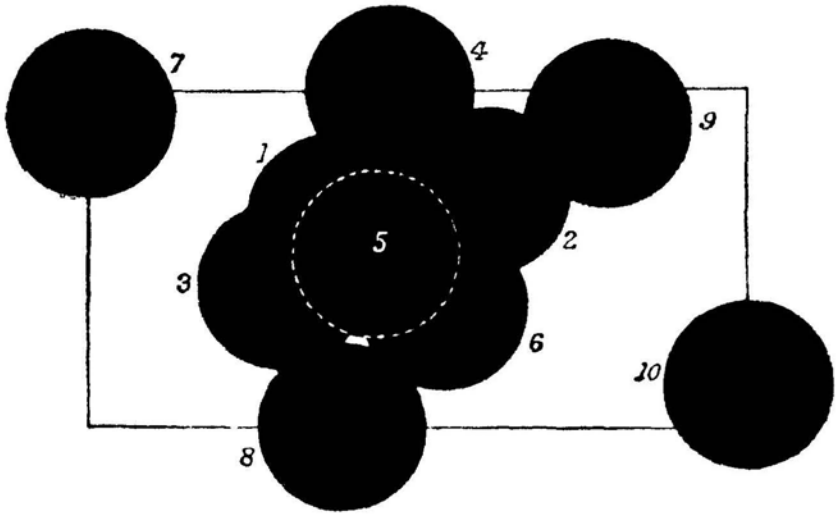


Fig. 123. Holland's 4-Bore at 50 Yards.

"SQUARED" DIAGRAMS OF LARGE-BORES.

12-Bore Rifle.

Holland, 3·4 × 3·4 = 11·56 sq. in. | Bland, 5·2 × 8·8 = 45·76 sq. in.

12 Smooth-Bore.

Holland, 7·6 × 11·2 = 85·12

10-Bore Rifle.

Holland, 2·7 × 3·8 = 10·26 | Bland, 4·6 × 6·8 = 31·28

8-Bore Rifle.

Holland, 4·2 × 5·0 = 21·00 | Bland, 6·8 × 7·0 = 47·60

4-Bore Rifle.

Holland, 1·8 × 3·5 = 6·30

NOTES ON THE TRAJECTORIES OF RIFLES AT "THE FIELD" TRIAL AT PUTNEY.

The trial of rifles recently carried out by the Editor of the *Field* having interested me considerably, I have with pleasure accepted his invitation to make a few remarks on the ascertained results with respect to the trajectories of the rifles. But, before proceeding to the trajectories themselves, it may be desirable to give some description of the method by which they were obtained.

A range of 150 yards in length was terminated by a high fence of deal boards, and in grooves upon the smooth surface was slid a piece of thick cardboard, 3ft. square, in the centre of which was printed a black bullseye of 3in. diameter. This formed the target. At intervals of 25 yards each were erected frames to hold the paper screens through which the bullets were to be fired, and which would show the height of the respective projectiles at the distances of 25, 50, 75, 100, and 125 yards, while an additional target was interpolated at 80 yards. This was assumed as about the culminating point of the trajectory, as for several yards the differences are so minute as to be practically non-existent, for recourse must be had to thousandths of an inch to show which is the very highest point. It is therefore not very material whether a yard or two under or over 80 yards be taken, although with light bullets and high velocities the extreme point would be somewhat over; and for heavy bullets of lower speed it would be rather under that distance. This screen was interpolated for the purpose of ascertaining whether there was any noticeable increase of ascent from mid-range to the point at which the bullet would begin to drop towards the 100 yards screen.

The framework of these screens, besides the supports fixed in the ground, consisted of two square 3ft. frames, one of which was crossed at right angles by two tightly-strained