THE GIFT OF
HENRY GARDNER DENNY,
Of Boston, Mass.
(Class of 1852.)

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THE BIBLE.

AND HOW TO USE IT.

BY

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NEW YORK

1847.
THE RIFLE:

AND HOW TO USE IT.

COMPRISING

A Description of that valuable Weapon

IN ALL ITS VARIETIES.

BY

HANS BUSK, M.A., D.L.

CAPTAIN VICTORIA RIFLES.

AUTHOR OF THE "NAVIES OF THE WORLD," "RIFLE VOLUNTEERS,
AND HOW TO DRILL THEM,"
"A TABULAR ARRANGEMENT OF COMPANY DRILL,"
"THE HANDBOOK FOR HYTHE,"
&c. &c. &c.

Eighty Edition,

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Gift of

Henry G. Denny, Esq.

of Boston.

(H. U. 1852.)
TO

MAJOR-GENERAL HAY,
INSPECTOR-GENERAL OF MUSKETRY,

WHOSE PRE-EMINENCE AS A RIFLE-SHOT IS UNIVERSALLY
ACKNOWLEDGED,

AND WHOSE COURTESY AND URBANITY
ON EVERY OCCASION,
HAVE GAINED THE SINCERE THANKS OF ALL WHO HAVE
SOUGHT HIS ASSISTANCE AND ADVICE,

THE SEVENTH EDITION OF

This Manual,

AS A SLIGHT TOKEN OF ESTEEM AND REGARD,

IS INSCRIBED

BY THE AUTHOR.
Nothing can afford more convincing evidence of the extent of the great movement now taking place throughout the kingdom, than the sale within the last few months of eighteen thousand copies of this book. My publishers inform me that a Seventh Edition is already called for, and that the demand appears daily on the increase. Some new matter will be found incorporated in the present work; more particularly a notice of General Boileau's views on the Rifle, a brief description of Major Nuthall's new Rifle, and of Mr. Leetch's Breech-loader; together with some observations on modern improvements in the rifles of other countries. Several of the statements respecting them are made upon the authority of Lieut. Wilcox of the U. S. army, the author of a recent treatise on rifled fire-arms.

It gives me the sincerest pleasure to find that the observations offered by me, scarcely eighteen months ago, on the formation of Volunteer Corps, should have fructified as they have done, and that the appeal I then made to the manly spirit, to the
chivalry, to the patriotic feeling of this great nation, should not have been made in vain.

The result may be imparted in a few words:—

In November, 1858, it would have been a difficult matter to have assembled, upon any emergency, 300 Volunteer Rifles fit to take the field. While I write, we have nearly 100,000 already enrolled and equipped, and before the autumn of the present year, I have little doubt that there will be fully 250,000, well-drilled and tolerably disciplined, equal in most essentials, to any soldiers that this country ever possessed.

I have received many hundred letters* from some of those who are taking a lively interest in this matter, expressing the most gratifying eulogies upon my exertions in the cause, thanking me for having initiated, as they consider I have done, the Volunteer movement. Without entirely arrogating to myself that merit, I cannot but admit that much pleasure has been afforded me by the communications to which I have alluded; and I trust that nothing will now occur to check the progress of that organization which will shortly place us, at once and for ever, in such a position as to be able to defy the hostility of the world.

We have—or at any rate we shall shortly have—once more, a national weapon; a weapon the most effective and the most deadly that human ingenuity has ever devised: but we neither want it, nor shall we

* In 1859, no less than 736 letters were addressed to me by gentlemen, desirous of information on the organization of rifle corps, &c.
ever wield it, for any aggressive purpose; not a bullet
will be fired in anger, till our homes are assailed—and
then—woe betide the luckless invader!

Before closing these prefatory remarks, it may be
well to observe, that, as a sudden and unprecedented
demand for rifles has arisen, and as the supplies of
good and trusty arms are not likely, for some time
to come, to be adequate to meet it, there is no
doubt that unprincipled salesmen will continue to
vend, as they are now doing, vast quantities of
rubbish of a most dangerous character.

Some most alarming accidents have already oc-
curred; and unless purchasers exercise considerable
caution, and apply to makers of unquestioned re-
spectability, they will have cause to rue the hour
when, from mistaken economy, they saved a few
shillings in the price of an instrument which may at
any time occasion the loss of a life or a limb.

If many of the rifles offered at £2 or £3, or
even at higher rates, be examined, they will often
be found to bear the Government mark of con-
demnation stamped upon them. Should this
appear upon the barrel, or should there be no proof-
mark thereon, an omission, I regret to say, of not
unfrequent occurrence, the gun ought to be un-
hesitatingly rejected, unless the buyer be ambitious
of figuring as principal in a coroner's inquest!

United University Club, S.W.
10th April, 1860.
PREFACE

TO

THE THIRD EDITION.

Within two months of the issue of the Second Edition of this little treatise, it was gratifying to find that nearly every copy had been sold. It is still more satisfactory to be enabled to add that, out of many communications received from private individuals, as well as among numerous notices of the book in various periodicals, not one opinion has been expressed which could be regarded otherwise than satisfactory. To have produced a popular work whose utility seems to be universally admitted, and without having provoked any hostile criticism, is an event of not very frequent occurrence, and I trust that I may deduce therefrom a hopeful augury as to the reception which the present much improved edition may obtain.

The Manual has been carefully revised, and contains much additional and, I believe, useful matter, as well as several new woodcuts. Its form also has been rendered more convenient.

Since the publication of the Second Edition of this work, several inquiries have been addressed to me
upon the subject of rifles of different kinds, not alluded to in these pages.

I may as well repeat here, once for all, the answer already given on other occasions, that the rifles I have noticed and described are incontestably the best now in use. Those not mentioned by me, whether English, French, American, German, or Swiss, possess no such merits as to entitle them to my commendation. In arriving at my decisions on these matters, I have subjected every arm to a severe, but at the same time fair trial, seldom being content with less than three hundred rounds from each piece; and as, in the course of my experiments, I have fired, on the aggregate, upwards of sixty-eight thousand rounds, I have had considerably more experience on the subject than most people would wish to take the trouble of acquiring, and have at least tolerable grounds for my conclusions.

Very frequently a rifle or a revolver has been shown me which, for simplicity of parts and elegance of finish, appeared all that could be desired. On subjecting some of these same weapons, however, to the rude test of repeated firing in bad weather, and under the varied contingencies of actual service, I have discovered defects that would never have been detected by the closest inspection in the maker's shop.

If the purchaser of a rifle cannot rely upon his own judgment, and will trust to mine, he may rest assured that a muzzle-loader such as General Jacob has perfected, a breech-loader of the kind patented
by Prince or Leetch, or a revolver of the latest form manufactured by Colonel Colt or Mr. Daw, will at least equal in all essentials, if not prove superior to, every denomination of similar weapon as yet before the public, be the maker who he may.

I have described other arms that cannot fail to afford satisfaction; but as it might have been deemed invidious to have catalogued those, which for some reason or other, are less perfect, I have thought it preferable to omit all mention of them.

No doubt, as time rolls on, the arm or the projectile we now consider faultless, may in its turn be beaten.

Great things are anticipated of Whitworth's rifle for instance, and it can hardly be matter for surprise if, when that gentleman's experiments are concluded, he should be enabled to exhibit a rifle capable of beating all its predecessors. But then it falls to the lot of few men, labouring in this pursuit, to possess his scientific attainments, or such mechanical appliances as he can bring to his aid.

A report has gone abroad that barrels made and tested by Mr. Whitworth have not been found at Hythe to yield the results anticipated from their previous performances at Manchester. On investigation, it was ascertained that the fault rested with the Government powder; the proportions of the component ingredients of that article, as well as their incorporation, being the same, whatever its ultimate destination may be, whether for cannon or for small arms, the only difference consisting in the size of the grain.
Mr. Whitworth selected for his experiments Curtis and Harvey's (No. 6). This powder leaves no perceptible residuum after many hundred rounds, whereas the common service ammunition fouls so rapidly, as in a very short time to annihilate all the advantages arising from the mathematical precision of Whitworth's system of boring.

This is a circumstance which should be borne in mind, not only because it serves to show to what slight causes the failure of a series of experiments, with so delicate an instrument as the rifle, may sometimes be attributable, but to prove, moreover, that, even in so important an article as gunpowder, the Government manufacture cannot yet compete with the production of private enterprise.

United University Club,
18th September, 1858.
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BROWN BESS AND HER RIVALS.

During the last hundred years little has been ascertained relative to the theory of projectiles which had not already been discovered by the careful and laborious experiments of Robins and of Hutton; yet there is no doubt, that even since 1830 great improvements have been effected in the artillery practice of our own and of every European nation, and more recently still, most important results have been achieved in the construction of small arms.

Nothing indeed could well have been worse than the weapons supplied to every branch of the Service during the Peninsular war, unless it were the want of skill displayed in their use. To give an idea of the miserable deficiencies in both particulars, I may mention, upon the authority of Colonel Schlimmbach, of the Prussian artillery, an officer of great experience, whose statistical calculations extend over a long series of engagements during the wars of the First Napoleon, the indisputable fact, that on the average, a man's own weight in lead and ten times his weight in iron were consumed for each individual placed hors de combat!

At Vittoria, on the morning of the 21st of June, 1813, each British infantry soldier had in his cartouch-box 60 ball-cartridges, altogether three million rounds; besides which, one million three hundred
and fifty thousand rounds more were issued by the field-train to the troops. We will assume that only 3,675,000 were altogether consumed. Now, it is known that, on the side of the enemy, 8000 out of 90,000 men were killed and wounded, consequently only one musket-shot in 459 took effect; and this calculation excludes entirely from account the injury inflicted by 90 pieces of artillery, each firing 73 shot or shell, or a total of 6570 rounds. Taking this into consideration, we may readily believe that there was not on that occasion above one musket-ball in 800 which was not utterly thrown away. To show that our infantry of the line, so lately as 1851 had not made much progress in the use of "Brown Bess," I may add that a patrolling party at the Cape, in the month of August of that year, expended 80,000 ball-cartridges in killing or disabling 25 naked savages; just 3200 rounds to each Kaffir!*

Rapid firing, erroneous estimation of distances, long ranges, and insufficient target-practice are the chief causes of the enormous expenditure of ammunition in battle-fields, compared with the effect produced.

General Gassendi estimates that 3000 cartridges are expended to every man disabled. Decker fixes the lowest limit at 10,000 for each man. In the French attack upon Algiers, in 1830, which closed in 15 days, 3,000,000 cartridges were consumed, with comparatively little slaughter. The French are said, in the Crimea, to have expended 25,000,000 small-arm cartridges without having put 25,000 Russians hors de combat.

The operations of the American forces, more practised in the use of firearms, showed a better result. At the battle of Churubusco, during the

* Need we be surprised to learn, on observing such items as these, that even such a miserable war as this cost us for a long period 3800£. per day?
IMPROVEMENTS REQUIRED.

Mexican war, it is estimated that the Americans expended only 125 and the Mexicans 800 rounds of cartridge to each soldier disabled on the opposite side.

If we are still far from having attained absolute perfection, there is now no doubt but that a weapon will shortly be produced, uniting every quality which it is desirable that a rifle should possess.

The greatest range really requisite for all the purposes of war has been reached, and it is more in minute matters of detail that further improvement is desirable, than in the principles of construction.

The weight, the mode of loading, the length of barrel, the form of stock, and, above all, the arrangement of the sights, demand the next consideration.

An important movement, having for its object the perfection of the musket, rifle and pistol, originated some few years since in France—a country certainly at one time far behind our own in the quality of her small arms as well as in the proficiency with which they were wielded. But this was not always the case; in the wars waged between England and France, during the reign of Louis XIV., the Regency, and of Louis XV., Victory as frequently declared herself on one side as on the other.

Under Louis XVI., however, during the Revolution, and under the Empire, the French uniformly experienced a series of repeated reverses on every occasion upon which they fought a pitched battle with the English. To prove this, it is only necessary to cast a rapid glance over the engagements of the former and of the latter epoch.

During the earlier period there were seventeen battles, eight of which were contested at sea, with the following results: Steinkerk in 1692, and Neer-winde in 1693, gained by the French; Hochstedt in 1704, Ramilies in 1706, and Malplaquet in 1709,
won by Marlborough; Dettingen, in 1743, by George II. Then Fontenoy in 1745, Laffeldt in 1747, and Hastenbecke in 1757, showing a contrary result: thus five out of the nine engagements terminated favourably for the French. Of the eight sea-fights, the French with equal forces gained three; they lost four, where they were numerically weaker; and the eighth was a drawn battle.

During the second period above adverted to, there were no less than thirteen land and sixteen naval engagements, which it is scarcely necessary to particularize. Under the Empire, the English manifested a decided superiority over their enemies in every campaign. Alexandria, Maida, Vimeira, Corunna, Talavera, Busaco, Albuera, Fuentes de Honoro, Salamanca, Vittoria, Orthez, Toulouse, and Waterloo afford irrefragable proof of this fact. Here, in thirteen hard-fought fields, Napoleon’s veterans, renowned for their valour and hitherto accustomed to conquer wherever they appeared; led too, by his ablest and most experienced generals, and finally by himself, were signally and utterly defeated. In each of the sixteen sea-fights also which occurred during this period, the French, always with equal, and frequently with superior forces, were completely vanquished.

It is difficult to understand how France, competent up to the reign of Louis XVI. to carry on a successful struggle with England, should, so frequently since, have been compelled to yield to the fate of arms, and to acknowledge the supremacy of her rival, unless this recent superiority be accounted for by the supposition that, bad as they intrinsically were, the cannon and small arms used by the English were better served, and superior still to the more faulty implements of destruction then in use among their
antagonists. It is impossible to ascribe these events to accident, because chance would not occasion the loss of a long series of battles in succession; nor can it be seriously maintained that the English generals who encountered the French in the Peninsula, possessed such immeasurable superiority over Napoleon's best and bravest marshals. During the last thirty years however, vast improvements have been made by the French, not only in their artillery but more especially in their small arms; and it is no longer to be presumed, merely upon the faith of what has already been done, that the result of future wars will infallibly resemble the past. French artillerymen of 1860 are no longer what they were in 1815; in accuracy of aim they are but little if at all inferior to our own; while as marksmen, their troops of the line, and more especially their riflemen, are very far our superiors. There is no difficulty in assigning the true cause for this. The lighter and more efficient weapon in the hands of the French infantry-man, together with the incessant practice to which he is subjected, sufficiently account for the fact.

Much misapprehension exists as to the real requirements of the musket, its proper qualities, and real use in the field. However desirable it may be to arm with the rifle all light troops, including the light companies of regiments, it cannot be admitted that any essential advantage would be gained by placing generally in the hands of soldiers of the line, a weapon, whose chief advantage consists in its length of range, unless it be, at the same time, as simple as possible in construction, little likely to get out of order, and be moreover divested of all complicated appliances. The short Enfield rifle is open to few objections in these respects; and therefore,
for the present at least, its introduction should be gladly hailed as a step in the right direction. Strength, moderate length, lightness, durability, are among the primary essentials of the infantry musket; precision and accuracy of fire are the next considerations.

Troops on active service do not halt for the purpose of firing at each other at the greatest possible range. The tactics of war present a series of movements the object of which is to close in upon an adversary, or to out-flank him, and to deliver at a distance of from 200 to 250 yards an effective fire into his ranks. It is the province of artillery to pour destruction into the adverse host at greater ranges than this. At the same time, no one would deny that a firelock capable of delivering a ball with precision at 1200 yards is a most valuable weapon; nor that in skilled hands it may, upon various emergencies, render important service, even to the extent of silencing field artillery.

File-firing is the customary fire of lines of troops drawn up in action, and is always the fire employed by skirmishers. While the more accurate fire, it has, on the other hand, the objection of begetting in the soldier careless and slovenly habits, only to be rectified by volley-practice.

At close quarters, volley firing is highly effective. Cavalry are very apt to wince under a volley from the front of an infantry square, delivered at fifty, or even at seventy yards.

As to rapidity of firing, the word rapid, in that connexion, ought to be expunged from the soldier's vocabulary. With proper aim and deliberation, four to five rounds may be fired in two minutes. So far from urging soldiers to fire rapidly, they ought to be urgently cautioned against it. The instructor should
compel deliberation and a cool steady aim, by fixing the minimum time for each motion of the loading and firing exercise at the 90th part of a minute.

The momentum of a musket or rifle ball is, of course, not comparable to that of cannon shot; but, on the other hand, the destructive fire of musketry is capable of far more rapid and greater concentration than that of artillery. Consequently, the fire of infantry in line, is within the limits of its range, more formidable even than that of a series of batteries exhibiting an equal front.

In defensive combinations, where infantry occupy a fixed position, its fire is steady, and may be maintained without interruption for an indefinite time. It is under such circumstances that its power is most effective. Again, it is available at all times, and in every locality, and must always be considered as the most certain and efficacious check to the advance of an enemy.

Motion being incompatible with the maintenance of steady fire, musketry can never be as efficaciously employed for purposes of attack as for defence.

A cloud of light troops however, says Jomini,* should always accompany those of a column. The fire of these skirmishers weakens and distracts that of the force defending the position attacked, and will materially contribute to the success of the operation.

For infantry fire, unless from a body of picked and experienced men, to be delivered under ordinary circumstances at anything like the distance of six to eight hundred yards, would be mere waste, and would only tend to produce unsteadiness. People who write very authoritatively on these matters are too apt to forget that in action, after the first few rounds,

* Précis de l'Art de la Guerre chap. iv. art. 31.
the field speedily becomes obscured, and that it is scarcely possible for a marksman, however expert, whether stationed in line or in square, to single out any object, even at 100 yards' distance. To the rifleman and the skirmisher this observation of course does not apply, as they can in a great measure select their own position; and for them, consequently, a superior arm should be provided. As at present constructed, distant range is only attainable by a somewhat complex arrangement of sights, of such delicate workmanship, that in the rough hands of recruits or even of ordinary troops they would speedily become useless; besides, they require careful and deliberate adjustment and considerable expertness on the part of the soldier.

When it is considered that, at the distance of 1000 yards, a man of ordinary stature presents a mark little more than the twelfth of an inch in height, and even at 800 yards that he only covers a space of the tenth of an inch in altitude (less, in fact, than this letter; I), the difficulty of striking such an object, even when taking very steady aim, will be readily understood by all who have ever practised with the rifle.*

* The French have adopted the following rules for firing, for ranges varying from 100 to 215 yards:—

To hit the middle of the body—at 100 yards aim at the breast; from 100 to 150 yards, at the shoulders; from 150 to 190 yards, at the head; from 190 to 215 yards, aim at the top of the cap.

We deduce from the foregoing rules that a musket ball falls six inches in the first 100 yards, and six inches for each of the succeeding distances laid down, until at a range of 215 yards the fall becomes twenty-four inches.

Men under instruction should be frequently practised at estimating distances. This may be done by causing them to observe what parts of the dress, arms, or person of a soldier, or body of soldiers, cease to be distinctly visible at distances ascertained by previous measurement.
Two separate and distinct classes of weapons are consequently needed: one light, powerful, and effective at 500 yards, without any complication of sights, for regiments of the line; the other, more carefully finished, with sights ranging from 800 to 1000 yards, suitable for rifle regiments and light companies. With regard to the first of these, no improvement will be worth consideration which does not commence with a better system of "stocking." A greater absurdity was never perpetrated, even by the Board of Ordnance, than that of determining that the length of stock for every musket should be the same under all circumstances, whether for tall or for short men. For the former, the stocks, as at present turned out, are at least two inches, and for the latter, fully an inch, too short. Any one, except our strongly prejudiced officials, knows that the efficiency of a fire-arm, depends as much upon the length of stock being suitable to the arm and shoulder of the man who wields it, as upon the straightness or correct finish of the barrel. There ought to be at least three different lengths of stock in the service, and the stock of each man's firelock should be fitted to him with the greatest possible nicety, if good practice be expected. The shorter the stock, the more awkward and unserviceable is the weapon. Then again, the charge of powder for the musket cartridge is at present unnecessarily great, while the annual allowance of ammunition for practice is ridiculously small. If we wish really to instruct men in the proper use of their fire-locks, and to make them good marksmen, the supply of practice ammunition should, under reasonable regulations, be unlimited, and small prizes should be continually offered to the most expert shots.

It is gratifying to find that, since these obser-
vations first appeared in print, this last, as well as some other suggestions, have been found deserving of adoption.

The true value and force of infantry consists in its fire; it is by its fire alone that it is enabled to repel an impetuous charge of cavalry; for a corps, however brave and well disciplined, whether formed in line or in square, could not, supposing their ammunition exhausted, effectually resist for a moment the shock of a body of heavy cavalry in line. The use of the bayonet is altogether secondary—its main utility consists in imparting confidence to the soldier; and a great mistake has been made in exaggerating the importance of "Brown Bess" as a weapon for hand-to-hand encounter, thereby sacrificing many of its principal advantages in distant conflict. For this reason the practice which subsists in our own and in foreign services of using the firelock when in actual warfare, only with the bayonet fixed, is a palpable error: not only does the bayonet in that position interfere with the line of sight, but its weight, acting upon the leverage of the whole length of the barrel, causes a depression at the muzzle, and besides wearying the arm, occasions the loss of a large proportion of shots by causing them to strike the ground long before they reach the object.*

* In 1670 the bayonet was perfected, making, as it were, with the musket, a single weapon, possessing the two-fold properties of a projectile arm and lance. Previously, the bayonet consisted of a steel blade and wooden handle, which fitted into the muzzle of the gun, so that the musket could neither be fired nor loaded while the bayonet was fixed.

Until this defective combination was reformed, by replacing the wooden handle of the bayonet with an elbow and socket, lances continued to be used by infantry for defence against charges of cavalry. For this object the formation of foot-troops
Another frequently reiterated complaint against the English regulation musket was the recoil, which was sometimes intolerable, inducing as it did the men to throw away frequently a third of the powder before loading. By a very simple arrangement, and without adding materially to the weight of the musket, this might be entirely obviated. By reducing the metal in the barrel forward, and increasing considerably that in the breech immediately behind the chamber, the recoil of any gun can be so diminished as to be barely perceptible.

In the construction of the barrels of the old-fashioned musket, the principal defects are the large allowance for windage* and the faulty position of the sights. When these, as is constantly the case, are so fixed that the line between them is not in the same vertical plane as the axis of the barrel, the aim will not correspond with the line of fire, but will incline to one side or the other. This is a matter which requires the most careful adjustment, though in reality seldom attended to.

The reason why, at long ranges, such varying results were obtained from practice with the same musket was the excessive windage. This, in our service, was far too large. A little consideration will suffice to show its pernicious effect. Supposing a gun loaded and held horizontally, it is obvious that the ball will rest on the lower side of the barrel, leaving a space between it and the upper side. The

was in six ranks, four of which were armed with muskets, and the remaining two with lances.

In 1703—thirty years after the improvement in the bayonet—the formation of foot-soldiers was reduced to four ranks, and the lance rejected as a portion of the armament of infantry.

* The velocity lost by windage is nearly directly proportionate to the windage.
moment the powder is fired, the force of the explosion drives the ball alternately against the upper and lower sides of the barrel until it leaves the muzzle; the direction of its flight, consequently, depends in a great measure upon the part of the muzzle on which the ball last impinged, before its departure. So great indeed is the error arising from this cause, that with a musket-barrel firmly held in a rest, I have frequently observed a discrepancy of between three and four feet in different successive shots at a distance of only 300 yards. The answer usually made to this was, that, were the windage reduced, the ball could not be forced down when the barrel became foul. But, where due precautions were used, this was not found practically to be the case.

It is generally supposed by gunmakers that the only accurate mode of testing the shooting powers of a barrel, or of comparing the relative performances of several, is by clamping them immovably in vices after levelling. This, however, is a fallacy, as the shooting under these circumstances will never equal that of the same weapons when fired from the shoulder of a fair marksman availing himself of the assistance of a rest. I have noticed this too frequently to be mistaken, and am inclined, with General Jacob, to attribute the circumstance to the vibration of the metal of the barrel, which probably imparts an irregular motion to the bullet as it leaves the muzzle. When grasped firmly in the hand, this vibratory action of the metal is almost entirely checked.

The most scientific form of rest, is one fitted with delicate adjustments, and capable of being elevated to any angle. The rifle to be tried, is screwed into a polished V-shaped steel frame, which slides backwards longitudinally with perfect ease in a
steel trough, firmly fixed to the bed of the rest, but is incapable of the least lateral motion.

Any successive number of shots may be fired from a rifle thus supported, with the certainty that each bullet leaves the muzzle under precisely similar circumstances, although the barrel can be lifted from the trough, loaded, and replaced after each discharge. The amount of recoil being at the same time determinable with considerable accuracy.

In using a rest of this description no aim is taken; but one shot having been fired at a wall, and at a particular elevation, a number more are fired with exactly the same elevation from the same spot, the mean of the variations, or distance of these shots from each other, affording a very satisfactory criterion of the precision of the rifle.

The only mechanicians with whom I am acquainted, who can be relied upon to construct rests of this description, are Messrs. Holtzapffel. They have had considerable experience on the subject, and thoroughly understand the essential requisites of so delicate an apparatus.

A rest of this sort is absolutely necessary, where the relative qualities of different rifles, or the precision of any one particular arm, has to be determined.
RIFLES.

We now come to the consideration of rifles, and of a superior class of arms. It is generally understood that muskets (matchlocks of course) were first employed at the siege of Arras, in 1414. In 1521 they are said to have been used at the siege of Rhegen, and in the same year were introduced into the English army, to the exclusion of bows and arrows. The flint-lock was invented in 1630, but fifty years elapsed before it was universally adopted.

From the middle of the fifteenth century till 1853 the barrel of the regulation musket underwent little change. It was nothing more than a plain, cylindrical tube, slightly tapering externally towards the muzzle, and was used to project a cast globular leaden bullet. An attempt, it is true, was long ago made to propel from the common musket, a bolt, similar to that used with the crossbow; but its deflection was so great, as to render futile the use of the elongated missile of those days. At the same time, the practice with the round leaden bullet was very indifferent beyond eighty yards, chiefly on account of the prodigious windage found to be necessary with the powder then in use.

A German mechanic, about 1567, first hit upon the plan of grooving the bore of pieces used for
sporting purposes, in a direction parallel to their axes. In so doing he had no other intention than to facilitate loading, the grooves being merely devised for the purpose of containing the products of the combustion of the powder.

No doubt the adoption of this plan was calculated to increase the efficiency and accuracy of the arm from the steadiness it imparted to the bullet in its passage through the barrel. From the number of specimens of firearms still extant in various museums and armouries, it would seem that this system of straight grooving was at one time much in vogue. About the commencement of the seventeenth century an ingenious gun-maker of Nuremberg, Koster by name, first proposed making these grooves describe a circle, or indeed, rather more than an entire circle, between the breech and the muzzle. The ball was purposely cast larger than the bore, to admit of its receiving forcibly the indentations caused by the grooves during the act of loading. Thus originated the most beautiful, and at the same time the most deadly, instrument of warfare ever devised by the ingenuity of man.

It was soon found that a bullet impelled from a barrel of this description, and made to spin during its flight, attained far greater accuracy than one fired from a smooth bore; but more than a century elapsed ere the true reason of this was discovered by Robins, though many quaint and ingenious theories had been meanwhile started on the subject.

Robins proved most conclusively that the spinning of a rifle-ball, like the rotation of an arrow, kept the axis of either in the same direction throughout their flight, and to a great extent prevented the irregularities caused by the inequalities in the substance of the bullet when driven from a shot-gun or
musket. But, strangely enough, Robins, though by far the ablest writer on projectiles who has ever appeared, exercised but a slight influence on his contemporaries.

For three hundred years after the system of spiral grooving had been adopted, there was very little change made in the construction of the rifle. Nor was it in any great favour with our own or any other European government. The difficulty of loading was one of the main objections to its general introduction into military use. The French indeed, actually abandoned it altogether for some years, after having given it a careful trial; and it was only after having had painful experience in Algeria of what the long Arab muskets could effect, that they were induced to experiment largely with a view to enable them to render their rifles then in use, better able to cope with the far ruder weapon, in the hands of the children of the desert.

Much attention has more recently been drawn to this subject in England, and various ingenious expedients have been devised, for attaining still greater precision and for diminishing, if not annihilating altogether, the windage. The first important results were gained by M. Délvigne, an infantry officer in the French service, to whom the merit is due of having devised a mode of rendering the loading of a rifle almost as quick as that of an ordinary smooth-bore. But I will quote part of a very able letter from the pen of Sir Charles Shaw, which appeared in the Times of the 1st of January, 1852, in which it was stated that M. Délvigne had to contend against the ignorance and prejudices of all the civil and military authorities from 1826 to 1837, though he pointed out how the best troops of France had been repeatedly beaten by Tyrolean peasants.
"The loss, however, of officers and men in Algeria," continues the writer, "was so great, that in 1838 the Duke of Orleans, before going to Africa, organized a battalion of the Tirailleurs de Vincennes (then called Chasseurs d’Afrique) to take with him. As an instance of the perfection of this weapon, even in 1838, it may be mentioned that the duke, while reconnoitring, was annoyed at the pranks played by an Arab sheik at a distance of about 650 yards. He offered five francs to any soldier who would knock the Arab down. A soldier stepped out of the ranks of the Chasseurs d’Afrique and instantly shot this Arab chief through the heart. The arches below the County Fire-office at the Quadrant in Regent-street, are distant from the Duke of York’s pillar about 600 yards, so that some idea may be formed of the efficacy of these French rifles. But since 1838 many improvements have been made in M. Délvigne’s rifle and its ammunition. In 1842 there were ten battalions of these tirailleurs provided with what was then thought the perfection of a rifle; but in 1846 great improvements were made. There are now in the French army a force of 14,000 men armed with the ‘1846 model rifle,’ this unerring and murderous weapon, with its cylindro-conique hollow ball. The bullet resembles a large acorn, with its point like the top of a Gothic arch (ogive). The present French musket, ‘fusil de munition,’ model 1840, is fully as good as the musket now used in the British army; and I here give the results of 300 shots from the model rifle 1846 (with solid balls), and of 300 shots from the musket (as good as the British), these 600 shots being fired by the same men at a distance of 656 yards. The targets fired at, were five panels made of boards of poplar wood, each about an
inch thick. The four were placed directly in rear of the first at a distance of a yard from each other. Each panel was 13 feet long and 6 feet high; thus representing a column of sections composed of six men in front (a man in the ranks occupies 22 inches). The model rifle, 1846, put into the target, out of the 300 shots, 127 balls, of which 33 went through the whole of the five panels; and out of the 300 shots fired from the French musket (equal to the British) only 33 balls struck the target, eight of which only penetrated the first panel, and two balls the second. Thus 14,000 French, with their present rifles, could hit a section of six men in front 40 times in 100 shots, while British muskets, from a similar distance, and out of the same number of shots, would hit only 11 times. But, since the late invention of the hollow cylindro-conicke balls by Captain Minie, now used at Vincennes, as precise firing can be done at 1150 yards as I have above stated at 656 yards; and Captain Minie himself will undertake to hit a man at a distance of 1420 yards three times out of five shots. This ball always enters with the point; and if fired at a distance of 1500 yards, will penetrate two inches into poplar wood. Until recently I was myself incredulous; but having gone over the practice ground, I feel quite certain of the truth of what I assert. The ground is marked out for the recruits, beginning at 200 yards from the target, and increasing by distances of 100 yards, finishes at 1150 yards.”

It is hardly requisite to dilate upon this invention at present, inasmuch as it has been considerably modified, if not altogether superseded. The next to which I shall advert is the carabine à tige, or pillar-rifle of Col. Thouvenin, with a cylindro-conical ball. In this rifle a small perpendicular
pillar of steel was inserted immovably in the interior, at the breech. The ball was cast with deep horizontal indentations in its surface, and received, when dropped into the barrel, several sharp blows from the ramrod, the effect of which was to cause the expansion of the bullet by the obliteration of the grooves or indentations. The ball being supported during the operation upon the pillar above described, the powder did not become "mealed" nor caked, and the windage being got rid of, a surprising range was attained. Still in practice many objections presented themselves, and the pillar-rifle soon yielded to the one introduced by Captain Minié. In the barrels recommended by him, the rifle grooves are extremely shallow; and the ball, furrowed externally with very faint horizontal indentations, is cast with a shallow conical cavity, into which an iron cup is fitted. The force of the explosion drives the iron cup towards the centre of the ball, causing in its progress an expansion of the lead, which is thus made completely to fit the barrel accurately. Owing to the increased weight of the ball and the great diminution of windage, the range of these projectiles is extremely great; and the force with which they strike an object, even after a flight of 1000 yards, is truly astounding. They will at that distance, with a charge of \(1\frac{1}{2}\) drachms of powder, penetrate from six to seven inches into heart of oak; and will occasionally do considerable execution, even at 1500 yards. The use of this projectile is, however, open to a grave objection. When the barrel, after a few rounds, gets somewhat foul, the ball frequently becomes firmly wedged in, and the iron cup, driven through the ball, carries a portion of the lead before it, leaving the rest behind in the form of an irregular hollow cylinder, which it often
requires considerable trouble to remove. A variety of expedients were devised for obviating this difficulty, and one at least was tolerably successful. For this purpose a conical plug, composed of a metal considerably harder than the ball, was introduced somewhat loosely into the cavity of the bullet before loading: this answered all the purpose of the metal cup, but was still attended with some inconvenience, and this form of "plug bullet" is now all but obsolete.

In addition to the disadvantage of the Minié rifle already stated, Mr. Wilkinson (the gunmaker in Pall Mall) enumerates the following objections, which by-the-bye would equally apply to most of the improved firearms. He anticipates:—

1st. "Increased difficulty in the manufacture of the balls and cartridges, so that in foreign countries we must wait for a supply from home." As, however, we always have done this, that is not very material.

2nd. "The ball weighing one-half more than the present musket ball, only forty or fifty cartridges can be carried in the place of sixty." But what if those forty cartridges be found more effective than 200 of the old kind?

3rd. "The arm itself, which is rifled with four grooves, is not lighter." In that case no new difficulty appears.

4th. "The charge of powder (2½ drachms) is barely sufficient for the weight of the projectile. Greater elevation also must be given, which is objectionable." From a long series of very careful experiments instituted for the purpose, I have satisfied myself that two drachms of powder are enough to project one of the conical balls above describe (of 24-gauge) with quite sufficient force and precision to a distance of 1000 yards. As for the in-
creased elevation, that must always be proportioned to the length of range desired.

Mr. Wilkinson, in a work published a few years since, inquires whether "long range and accuracy cannot be obtained by simpler means, with a much lighter arm of equal strength, as great a facility of making the balls as for the old muskets; thus, instead of reducing the number of rounds, to give more if required, without adding weight to the soldier."

After some remarks explanatory of the rudimentary principles which influence the movement of all projectiles, he assures us that he has discovered an entirely new system, by which he can combine all the advantages of the carabine à tige, the Minié, and the Swiss methods, and avoid their defects; at the same time reducing the weight of the musket and bayonet from 11 lbs. to 8 lbs., while he retains the previous length of barrel and weight of bullet with greater thickness of metal and increased strength. He accomplishes this by the elongation of the projectile and the reduction of the bore from eleven to thirty-two, thus effecting a saving of 3 lbs. in the weight of the firearm and bayonet, and about 2 lbs. in that of the accoutrements, chiefly from a reduction of the space requisite to contain sixty rounds of the new ammunition.

The proposed bullets are nearly of the form and about the size of a small acorn, with two very oblate spheroids attached to the base, the whole of course formed at one casting. He calls it the "cylindro-ogivale, easy-loading, self-expanding, solid bullet." At the moment of explosion, the expansive fluid thereby generated, striking the bullet with a force of 500 lbs. (supposing the area of the base to be half an inch), causes it simultaneously to collapse longi-
tudinally, and to expand laterally, rifling the cylindrical portion of the projectile as well as the faster part.

Now, admitting the perfect accuracy of Mr. Wilkinson's statements, I am hardly disposed to concede to him the merit of having "discovered an entirely new system," since this is evidently but a modification of the French arrangements. The French inventions already described, together with the hundred and odd registered imitations of them recently brought before the British public, all depend for their effect upon the expansion, by some means or other, of the bullet, either before or at the moment of the explosion, thereby obviating the loss of power from windage, and the difficulty of loading with a tightly-fitting ball. Mr. Wilkinson professes to do no more; the only marked distinction between his projectile and the plug bullet is, that the former is cast in one, the latter in two pieces. Better results cannot be attained by these means than were previously achieved by the plug-bullet; possibly not so good, for, since the explosion will not obliterate the deep furrows on the sides of the ball, they will probably occasion so much friction in passing through the air, as to retard the flight and to cause material deflection.

In order to give some idea of the extent to which this friction, combined with the resistance of the atmosphere, operates, it is only necessary to observe that with the same charge of powder, a ball would travel in vacuo thirty-four times the distance that it actually does in air.

It has become very much the fashion now-a-days for gunmakers and others who know very little of ball-practice, to talk somewhat flippantly of what wonders certain rifles will achieve at 1500 and 1700, aye, and at 2000 yards. I strongly recom-
mend those who are so fond of dealing in such high numbers, to erect a target on some convenient spot, and then deliberately to measure off 1500 yards therefrom. They will be better than average shots if they can then and there make sure of a barn-door half a dozen times consecutively.

If a certain witness before a select committee of the House, on the subject of army and ordnance expenditure (whose report by the way filled an 8-lb. Blue-book), had tried this experiment, he would not have uttered such an absurdity as that “a common Government musket, with an elevation of six deg., would carry from 1700 to 1800 yards!” This individual, if he had ever tried the experiment, would have learnt, evidently with some surprise, that to insure striking a man at 600 yards with the said regulation musket, it is necessary to aim 130 feet above him!

But the days of globular bullets for small arms have passed away; beyond 400 yards they should never be used for “sharp shooting.”

Henceforth the conical missile will alone be employed where precision is needed.

Almost any modifications of these elongated—

“Leaden messengers,
That ride upon the violent speed of fire,”

possess, amongst others, this great advantage over their spherical rivals, that their line of flight ranges lower and approximates altogether more nearly to the line of sight.* For instance, a plug-bullet fired

* If a stone be thrown horizontally from the hand, it is at once observed to fall gradually as it moves forward. This course, or path of the stone, is called its trajectory. So, when a ball is fired from a musket, from the instant that it quits the muzzle it falls gradually towards the earth, and the point farthest from
at a target from a distance of 500 yards, was found to rise at the highest point of its parabolic flight, to 9 ft. 2 in. above the line of sight; a spherical ball discharged from the same barrel and the same rest, rose 19 ft. 5 in., and though fired with equal care, did not strike within 3 ft. 4 in. of the former mark, which was just on the border of the "bull's eye."

Of the Prussian Zündnadelgewehr, or needle-gun, I need say but little: after innumerable trials, it has been found to possess in its present form many palpable defects, and although in skilful hands it is undoubtedly an effective instrument—it is not well adapted for general military purposes. The works require to be continually cleaned after use, besides which there are various other objections which it is not necessary to specify, as this form of arm is no longer here in any favour. The ammunition requisite for this musket, too, is necessarily of a dangerous character, for as each cartridge contains the detonating material, interposed between the powder and the bullet, it is obvious that a projectile of almost any kind passing through a cartouch-box, or an ammunition waggon, would infallibly cause such cartridges to explode with disastrous effects.

One of those who of late years has written a good deal on these matters without apparently possessing much practical knowledge, observes with regard to these weapons, that "The only point to be determined in practice is, whether they fulfil their theoretical indications. Now, the testimony on this subject may be shortly stated as this. In England, authorities say, that if made, they would not answer; the muzzle, in which the line of sight along the musket intersects this path or trajectory, is called the point-blank. The point-blank range of all firearms is much less than is generally supposed.
in Prussia, however, being made and largely employed, they are found to answer."

This, however, is not quite consistent with fact. True it is, that these needle-guns were once made and largely employed in Prussia (60,000 having been issued in four or five years), but all experienced military men are now satisfied that they did not fulfil the expectations originally entertained respecting them, and no country but Germany has been guilty of the folly of adopting them.

Mr. Lancaster has perfected an improved modification of the lock of the needle-gun, and has overcome the defects which existed in the original. Instead of a sharp needle perforating the cartridge, he uses a small blunt bolt, which strikes the copper base of the cartridge containing the fulminating powder. Before reloading, the empty cartridge is withdrawn, leaving the chamber, breech, and indeed the barrel, perfectly unsoiled; but this arrangement is only at present considered applicable to shot-guns.

This is an important invention, and is likely to bring about a complete revolution in the construction of firearms. Of his system of elliptic boring (originally described in an excellent treatise on firearms called Scloppetaria,* published half a century ago, and now revived) I am also able to report favourably, having seen excellent practice made with barrels of that kind at great ranges. The elliptic bore must not be confounded with the old 2-groove; for I have no hesitation in repeating the opinion I expressed when the Brunswick rifle was first introduced, that it was the very worst that had up to that time appeared. Years ago, I pointed out the manifest defects of this rifle. Thousands of them were nevertheless made, and a large number sup-

* The author of Scloppetaria was the late Col. Beaufoy.
plied to the Rifle Brigade; very soon however, my predictions were fully verified, and after the wasteful expenditure of a vast amount of public money, these firearms were very properly discarded. It is from instances such as these, not unfrequently occurring, that people are led to attach so little faith to the proceedings of "our authorities," who seem too often to act upon the principle of giving no heed to counsels that do not emanate from a certain clique.

With respect to Lancaster's general system of boring for smooth barrels, I can speak in very high terms. I have tried his guns repeatedly, and have seen them more frequently still, achieve wonders. The character of his shot-guns is now well known; but there are of course many, both London and provincial makers, who can turn out a first-rate fowling-piece, and one that will do equal execution in the field, at a much less cost. I have, for instance, lately had one made by Daw; that for excellence of material, beauty of finish, as well as for its killing power, could not possibly be surpassed. It might, indeed, be fairly exhibited as a perfect specimen of the very highest English work, and as showing what a first class gun ought really to be.

To revert to rifles, much less difference than might be anticipated will be found in the performance of similar barrels from really good makers, provided they be selected of the same calibre, tried at the same range, and fired under parallel circumstances. It may here be observed, that no comparative trials, for the purpose of testing firearms, are of much value, unless the barrels be supported upon a rest such as that already described, and be moreover loaded with the same charges of powder for all distances. Small arms differ in this essential particular from artillery; the variation, for different ranges with the former,
should only be produced by greater or less elevation of the piece, whereas in great guns, mortars, howitzers, &c., larger or smaller cartridges are allowable, according to circumstances.

I may now briefly advert to the "repeating principle," as applied to firearms in general, but more especially to pistols and rifled carbines. It is to our Trans-Atlantic friends that we are indebted for the perfection of these weapons; for though, more than two centuries ago, various attempts were made to produce a series of successive discharges from one arm without the necessity for reloading, it is to Colonel Colt's perseverance, energy, and mechanical skill that the merit is due of having successfully vanquished all the difficulties that presented themselves in their construction.

Innumerable were the objections he had to contend with at the outset. Many sneered at the idea as preposterous. "They would always be liable to get out of order"—"They would take too long to re-load"—"They would, besides, always be missing fire," &c. Colonel Colt fortunately did not, as many under the circumstances would have done, sit down and wage an idle paper war with his opponents. He set to work and demonstrated that they none of them knew anything of the subject on which they were all so confident. It was, however, natural that prejudice should be roused against such an innovation. No invention of any value was ever yet otherwise received.

As regards the liability of the revolving pistol to get out of order, this was satisfactorily disproved by a severe trial instituted by order of the Board of Ordnance of the United States, who directed a holster pistol to be discharged twelve hundred, and a belt pistol fifteen hundred times, cleaning them
but once a day; after which ordeal neither of the pistols appeared to be in the slightest degree injured.

With respect to the cost of production, as almost every part is formed by machinery, hand-labour being only required in the finishing department, Colonel Colt seems likely permanently to retain in his own hands the business which his ingenuity has created, for he will of course always be in a position to undersell any imitators that may appear. Great security is also obtained from the cause above stated, for we find that upon "proof" only one barrel and one cylinder burst out of 2082. The most perfect uniformity of detail is attained from the mechanism employed; for the several parts of each class of weapon are precisely similar, so that if any become damaged on service, a great number of available arms can be immediately compounded of those which have been partially injured.

The ramrod attached to these pistols consists of a very clever but simple compound lever, which, forcing the ball effectually home, hermetically seals the chamber containing the powder, and by the application of a small quantity of wax to the nipple before capping, the pistol may be immersed for hours in water without the chance of a misfire.

The movements of the revolving chamber and hammer are ingeniously arranged and combined. The breech, containing six cylindrical cells for holding the powder and ball, moves one-sixth of a revolution at a time: it can only be fired when the chamber and the barrel are in a direct line. The base of the cylindrical breech being cut externally into a circular ratchet of six teeth (the lever which moves the ratchet being attached to the hammer), as the hammer is raised in the act of cocking, the
cylinder is made to revolve, and to revolve in one direction only. While the hammer is falling, the chamber is firmly held in its position by a lever fitted for the purpose; when the hammer is raised, the lever is removed and the chamber released.

So long as the hammer remains at half-cock the chamber is free, and can be loaded at pleasure. The rapidity with which these arms can be loaded is one of their great recommendations, the powder being merely poured into each receptacle in succession, and the balls then dropped in upon it, without any wadding, and driven home by the ramrod, which, of course, is never required to enter the barrel.

While carried in the pocket or belt, there is no possibility of an accidental discharge of these pistols. Whenever it is required to clean the barrel and chamber they can be taken to pieces in a moment, wiped out, oiled, and replaced.

The hammer at full cock forms the sight by which aim is taken. The pistol is readily cocked by the thumb of the right hand, a plan in every way far superior to the arrangement whereby the hammer is raised by a pull on the trigger: this is in every respect most objectionable, the pull materially interfering with the correctness of aim, and the scear-spring having the duty of the main-spring to perform as well, is apt constantly to be getting out of order. Not so Colonel Colt's; as regards the purposes for which they are intended, they may be pronounced in every respect perfect.

The following testimony of Major Robert Bruce in favour of Colt's revolvers is quoted from the Report (1854) of the Select Committee on Small Arms. It proves sufficiently their value and efficacy. "I consider," said that gallant officer, "Colt's revolver very far superior to any other we saw at the
Cape during the Kaffir war. That opinion is founded upon its accuracy, and in its not failing in what you require. I have never seen an accident with it, and I have never seen it in discharging become involved in any difficulty. I have seen it fall into the water and returned to its belt without being discharged, and afterwards, perhaps after the lapse of some days, I have seen it discharged most perfectly, without the least failure of any one of the barrels. I have ridden hundreds of miles with a Colt's revolver by my side, and always found that there was an impossibility of the powder shaking out. The lever ramrod Forces down the ball in such a way that no other ramrod could do." Much additional evidence was given to the same effect; in short, no valid objection can be urged against them.

His cavalry pistols are, in fact, pocket rifles. With one of them I once fired from a rest, at the Erith rifle ground, thirty-six rounds at the enormous range of four hundred and ten yards! Six bullets struck the butt at distances varying from thirty to thirty-six inches from the centre of the target, eighteen bullets struck within the circumference of a circle seven feet in diameter, and the other six shots at heights varying from ten to twelve feet above the target—satisfactorily proving the capacity of the weapon for still greater range.

I should add that for this experiment I had no sights adjusted, the elevation was taken altogether by guess. I am convinced however, that, if the requisite sights could be fitted, one might insure very fair shooting, even with these 7½-inch barrels, at 500 yards.

A stock is now supplied with these pistols, which can be attached and detached in a moment.
WOUNDS FROM COLT’S REVOLVERS.

It is an excellent contrivance, and at once converts the pocket arm into a carbine of great range.

COLT’S REVOLVER.

The wound which a conical bullet from one of Colt’s revolvers inflicts is terrific; driving before it, as it does, a cylindrical plug of muscle or bone: the hæmorrhage or shock to the system is so great that death in the majority of cases usually ensues. No one indeed, who has not had some experience with these diminutive rifles, can form any idea of their capabilities. But their reputation is now so thoroughly established, that the inventor may feel secure against the many attempts that have been made to impugn their character. A ridiculous pamphlet, by a Frenchman of the name of Anquetil, lately appeared with this object; but the ignorance of the author and the absurdities he utters are so glaring, that it would be folly to honour them with further notice. A more recent publication by H. Mangeot, a Belgian, is better entitled to consideration, though it contains scarcely any novel information.

"Modern firearms," observes an able writer, "as used for purposes of war, are just now in a transition state. Since the invention of the percussion lock but little attention has been paid in this country to their improvement. The ill-concealed contempt
with which purely scientific attempts are received by
those who make their only boast of being 'practical
men,' is nowhere so prevalent as in England; and
accordingly we find that, while we have remained
stationary, the great Continental military powers and
the United States have not only availed themselves
of each improvement as it appeared, but have stimu-
lated invention by liberal patronage."

It is often a subject of astonishment that, with
the great and acknowledged advantages of revolvers;
and notwithstanding many thousands of Colt's are
in store, so little should have been done, towards
arming and equipping any regiments of cavalry with
an arm which would at once enhance their efficiency
sixfold.

In the action fought in India on the 18th June
(1858), a body of 100 hussars, provided with Colt's
revolvers, effected tremendous execution upon over-
whelming masses of the rebel army, headed by the
Ranee of Jhansi. They left, in a few minutes, 400
dead upon the field.

No man of ordinary sense can doubt, that with
the kind of warfare before us which we shall probably
have to wage in China and India from time to time,
every cavalry man should carry a Colt's revolver as
well as a trusty breech-loading carbine.

It cannot be matter of surprise that Colonel Colt's
invention, bringing in, as I am credibly informed, a
net income of between 40,000£ and 50,000£ a year,
should have called forth a host of imitations both in
England and on the Continent. As many of my
readers may be desirous of learning which of all
the English revolvers is to be preferred to the
rest, I may state that the best, is one now com-
monly vended by many gunmakers, although ori-
ginally the contrivance of a Birmingham lock-filer.
It is so constructed, that, under no circumstances can the flame, at the moment of firing, reach the charges in the adjoining chambers; the hammer, too, is of such a form, that it admits of an uninterrupted line of aim being taken along the barrel. One of these pistols, charged with a quarter of a drachm of powder, will, at 100 yards, send a bullet (of fifty to the pound) through a fir plank one inch and a half in thickness. I believe that Mr. Daw justly claims the merit of having first brought out pistols of the peculiar construction of those now manufactured by him. They are in every respect, beautifully finished, and are spoken of in the highest terms by those officers who have had opportunities of testing their powers in actual warfare.

DAW'S LAST IMPROVED REVOLVER.

Since my first notice of this arm, Mr. Daw has improved it still further. The position and arrangement of the sights, the action of the lock, the very handy form of the grip, and the attention obviously given to various minute but important parts, fairly justify one in bestowing upon it, the most unqualified commendation; though it cannot be denied that in principle, and in many essentials, it bears a close resemblance
to Colt's weapon. General Jacob pronounced it to be the best and most convenient revolver he had ever handled. The wood-cut on the preceding page gives a very tolerable idea of its form and compactness.

Some attention having of late been given to Adams and Deane's revolvers and carbines, it might be expected that I should have devoted some space to them here. I have not however done so, simply because, after careful and repeated trials, I consider them far inferior in every respect to those already described and to be liable to serious objections which cannot be urged against the original arm, the chief merits of which are thus briefly summed up by their inventor:—

"1. They have been thoroughly tested in every country, and from the first rifle fired in Florida, during the India war in 1837, to the present hour, they have always responded to the touch of their owners in the time of danger.
"2. They have an unparalleled force and accuracy.
"3. They do not endanger your eyesight and brain, as do the arms with patent primers, which fly like shells into many pieces.
"4. They do not stick fast, refusing either to open or shut when heated, as some breech-loaders do.
"5. They leave no burning paper in the barrel after a discharge, to blow the next cartridge into your face, as some guns do which open from behind.
"6. They are simple in construction, and easily taken care of.
"7. They are made of the best steel that can be procured, and have the strength to resist the explosive force of gunpowder, while the mongrel imitations and cheap arms clumsily made of cast-iron or inferior materials, are more dangerous to their owners than to all others."
JACOB'S PATTERN RIFLE.

Having thus taken a general survey of the principal modern inventions for increasing the range and power of rifled firearms, I propose now to discuss, somewhat more in detail, those among them more especially entitled to the reader's consideration.

The first then, to which I shall direct attention is the one known as JACOB'S PATTERN RIFLE.*

The lamented officer whose name it bears, had been from his youth a diligent mechanic, and for twenty-five years devoted himself almost exclusively to the prosecution of a long series of experiments with rifles of every kind, and that upon a scale probably never before attempted.

His practice ground was a level plain studded with

* This rifle is manufactured by George H. Daw.
numerous targets and stretching far away into the sandy desert in front of the lines of the Sinde Irregular Horse, near Jacobabad.

The targets, thirteen in number, were massive walls of sun-dried brick almost as hard as stone, and placed so as to afford ranges varying from 100 up to 2000 yards. The 2000 yard wall was 40 ft. high, 50 ft. long, and 3 ft. thick. The surface of each target was marked with circular bull's-eyes, increasing one inch in radius, and raised one foot from the ground, for each hundred yards of increased range.

When to the expense of this gigantic apparatus we add a consumption of powder and lead by the ton, some idea may be formed, not only of the magnitude of these investigations, but of the debt of gratitude due to this energetic officer from his countrymen for services so freely rendered and for researches that have yielded such invaluable results. Their importance can hardly be too highly estimated in a national point of view, and few will deny that some adequate recognition of them should have been conveyed, while there was yet time, to one who had toiled for the public benefit so indefatigably and so successfully in the cause of science.

When first giving expression to this opinion I added—that again and again, alas! more especially in India, had we beheld "our noblest descend into the grave, and had thought it enough to garland the tombstone when we had not crowned the brow, and to pay that honour to the ashes which we had denied to the spirit."

Since those lines were penned, General Jacob has passed away, borne down in the prime of life by incessant exertion in the discharge of duties far too arduous for any individual, though possessed even of an iron frame like his.
Colonel Jacob's first researches were made with a view to determine the best form of rifle, and then to decide on the missile best suited for service.

The old military 2-grooved rifle utterly failed, but a 4-grooved rifle (the ball having two bands cast upon it at right angles to each other) was found to be wholly free from the defects of the 2-grooved and many-grooved barrels. The ball always followed the sweep of the grooves; the gun was easier to load than a common firelock; in performance nothing surpassed it. So great and obvious indeed were its advantages, that General (then Colonel) Jacob in 1846 freely offered it to the Indian Government. It was however rejected, for the sapient reason that the 2-grooved rifle had just been adopted by the "Authorities" at Home, and consequently that what had been selected for the Royal army, must of necessity be deemed good enough for the Company's troops!

Notwithstanding this rebuff, our unwearied experimentalist was not discouraged; having ascertained the best description of rifling for the barrel, he went on to devise the best kind of bullet to be projected from it. He soon found that no globular ball could be depended upon beyond 300 or 350 yards. A conical ball, with a globular spheroidal base and heavier than the former bullet in the proportion of 3:2, was next tried. Singularly enough, this missile only requires a charge of powder in the inverse proportion to its weight, i.e., three drachms being necessary for the light ball, two suffice for the heavier conical bullet.

This will be found to hold good
with rifles of every calibre; the reason being, that as the form of projectile is improved, the resistance offered by the air is proportionably diminished.

The conical ball long maintained its superiority, yielding excellent practice at 600 and even 800 yards. Matters had advanced thus far when the Minié bullet was announced. It was expected to yield great results, and was carefully and extensively tried at Jacobabad for months together, but it proved a complete failure. It never even came up to the conical ball above alluded to, and was found to be liable to the defect already noticed, which caused me long ago to lay it aside. The iron cup, fitted into the hollow at the base, is constantly apt to be blown through the bullet. In its original form it must therefore be necessarily condemned.

Various modifications of the expansion principle were then successively tried at the Jacobabad rifle ground, and after some hundreds of thousands of experiments, many of them attended with very curious and unexpected results, the annexed form proved to be in every way perfect;
it had been originally made slightly concave at the base, as represented in this woodcut.

Perfect shape for rifle balls. A B, 2 diameters. C D, 2 diameters. A C, 2 1/2 diameters. B D, 1 1/2 diameter. From E to F the ball is cylindrical; from A to E it is defined by arcs of circles described from the centres C, with the radius C A.

This projectile is accurately effective up to 1200 yards, probably to much greater distances. The effect of its shape in overcoming the resistance of the air is so great, that after a flight of 1200 yards, its progressive velocity is but little diminished, and

Rifle shell formed exactly as one above, but cast with a deep hole at the smaller end, in which is fixed a copper tube filled with detonating powder. The shells and balls are now found to answer best when made quite flat at the large end, the cylindrical part being increased in length to 1 1/2 diameters. This form is represented on the adjoining page.
even at 1400 yards the percussion shells made of the above shape explode well.

These percussion rifle shells were termed by General Jacob "the most formidable missile ever invented by man."

Whatever merit however, may be due to him for the perfection of his rifle, neither these elongated missiles nor the rifle shells are so recent an invention as he probably imagines. Captain Norton (of the gallant 34th Regiment) must be considered the original inventor of the application of the percussion principle to shells of this kind, he having successfully experimented with them as
far back as 1823. In 1824 he completed an elongated rifle shot and shell, the former precisely upon the principle of the Minié ball.

Captain Norton, indeed, has for more than thirty years advocated the elongated form of shot for the rifle, and has also demonstrated that a solid leaden, acorn-shaped shot fired from a common rifle will expand for half its length from the base, but will not carry its point foremost during the whole of its flight, unless the centre of gravity be in the fore part of the shot, a fact of great importance.

It can, moreover, be satisfactorily proved that upwards of a quarter of a century ago, Captain Norton actually devised and freely offered to the Government, though unfortunately in vain, almost all the improvements that have recently been brought forward, and some of them adopted as novel inventions.

I have made this digression with no view to detract in the slightest degree from the real merit of General Jacob's invention; the General no doubt was not cognizant of Captain Norton's previous claims; but I think it right to put upon record these simple facts, in fairness to a brave Peninsular veteran, whose many interesting and important discoveries have never been properly appreciated. The percussion tubes for the Jacobite rifle are made of copper, and fit into the fore part of the shell. Each tube, about the thickness of a quill, and three-quarters of an inch long, is closed at one end, terminating in a cone that contains the fulminating powder: the rest of the tube is filled with fine gunpowder, stopped with a cork or plug varnished over. The position of this tube in the shell will be at once understood by reference to the woodcut given at the bottom of page 54.

The Norton rifle shell, introduced thirty years ago, produced the same effect by similar means.
The shell was oblong, with projections to fit the grooves of the barrel, the percussion powder, inserted into the shell itself, being retained there by a wooden plug which projected from the anterior part of the missile. As long ago as 1839 I made and fired hundreds of them, and never knew one to fail nor to explode in the rifle. Their effect when they burst in timber is terrific, not one whit less so, than those of General Jacob, who says that two good riflemen provided with them, could annihilate the best field battery of artillery now existing, in ten minutes.

The end of the ramrod should of course be hollowed, so as to press on the lead only, while loading. The solid lead at the base, on firing, causes the shell to fit the barrel tightly by its lateral expansion, and its range is as great as that of the solid shot.

The inventor affirms that the army which should first secure the adoption of these missiles, would obtain as great an advantage as the exclusive possession of firearms would have secured a century ago. One result at least is certain, they would tend to render all field artillery to a great extent useless.

Should any one be desirous of experimenting with such formidable missiles, it may be advisable to state that a 32-gauge rifle (529 of an inch in diameter, that of the shell being 524) will suffice for any purpose. A correct range of more than a mile can be obtained with one of these shells propelled by two drachms of powder. I may also add that Mr. Daw (57, Threadneedle-street) the manufacturer of the Jacobite rifle, supplies the tubes; the moulds for shot and shell,* and, in short, all the matériel required.

The following is a description of the rifle recommended by the General, as combining all the advan-

* Mr. Daw has contrived by far the best mould that has yet been produced; it is extremely simple, and the bullets turned out
tages that have been suggested by his long experience and many experiments:

"Double—32-gauge—4-grooved—deep grooves (of breadth equal to that of the lands), to take four-fifths of a turn in the length of the barrel—barrels the best that can be made, twenty-four (24) inches long, weight of pair of barrels alone about

from it are almost as perfect as those formed by compression. The annexed figure represents its form.
six pounds, not less; the ends of the lands to be rounded off at the muzzle—patent breech—no side vents—first sight exactly parallel to the bore—the muzzle sight being raised if necessary for this purpose—four points to be inserted inside the barrel near the breech for tearing open a blank cartridge when rammed down whole—full stock, well bent, of the best heart walnut wood, attached to barrels by bands—best plain case-hardened mountings—folding sight attached to the barrel twenty inches from the muzzle, five (5) inches long, secured by spring below, protected by projecting wings when lying flat on the barrel, the slide of this sight to be well secured by springs at its back, so as never to work loose—the slide to come down quite low on the sight, the top of the sight and bottom of its slot to be notched. The sight, &c., to be strongly made and nicely finished, marked and engraved for distances, say up to 1500 or 2000 yards—leaf sights, folding flush for 100 and 200 yards—muzzle sight to be fine. Best locks, strong mainsprings, and heavy cocks. Half cock half an inch above nipple (not less). Triggers easy to pull, plenty of play in the cocks, external vents in nipples to be small—six spare nipples of each of size to fit Eley's No. 13 and No. 26 caps—one mould for balls, and two for Jacob's shells,* flat ended, two-and-a-half (2½) diameters long—moulds to be made of good steel, to open in the middle of one pair of bands—the balls and their bands of size and depth to fit the barrel nicely, but easily with a patch, exact diameter of bore in thousandths of an inch .529—of shell or ball .524—plugs of shell moulds to fit Jacob's shell-tubes ('long 16-gauge,' as made by Eley)—plugs or

* I strongly recommend, in lieu of this, the new and very simple form of mould lately devised by Mr. Daw, and represented on the opposite page.
cores of shell-moulds to have wooden cross-handles. Best double edged straight sword, with blade thirty inches long, to attach to rifle by ring round the muzzle of both barrels, as well as by spring socket, with scabbard and belt complete—(scabbard of strong wood, covered with leather, with case-hardened mountings riveted on)—all properly fitted into gun-case (two small ammunition pouches on the belt—one to hold powder-flask, or blank cartridges and caps, the other balls, patches, turn-key). The sword to be made with good steel, or case-hardened iron, half-basket hilt. Short powder-flasks of copper covered with hog-skin—charges $2\frac{1}{4}$, $2\frac{3}{4}$, 3 drachms—spare tops with charges of 2, $2\frac{1}{4}$, $2\frac{3}{4}$ drachms—stout steel ramrod in the gun with deep hollow head, so as not to press on the shell tubes in loading—the rod below the hollow head not to be filed away too much, as, if thin, it is liable to split on the iron balls. Grip of ramrod at both ends to be well roughened. Stout spare ramrod with knob handle and deep hollow head—brass tube of the length of the barrels for loading with powder, when cartridges are not used—patch punches ($1\frac{1}{2}$ inches)—small stores, cleaning apparatus, &c. &c., as usual, fitted into a rough stout roomy case. The rifle to fit into the case when put together, stock and barrel—the partitions in the case to be very strongly fixed by screws, &c., all of the best quality as to usefulness; strength and durability to be especially considered—appearance only, of little importance.

"Strong leather sling, to attach by good steel loops and screws—rifle to fit into case with the sling attached.

"There should be proper receptacles in the gun-case for some shells or balls, caps, patches, &c.; the partitions, &c., to be fixed without the use of any glue.
"A pair of scissors, pair of pliers, a corkscrew, and a knife—a ladle and a shallow melting-pot, in gun-case—plenty of turn-keys and screw-drivers, oil bottle, &c., all very strong and good, and serviceable for hard work.

"Eley's percussion tubes for Jacob's rifle shells long 16-gauge, primed at the points with detonating powder, and filled with gunpowder."

General Jacob states that "the double rifle is found to perform better than the single." This I confess myself at a loss to understand. Speaking from personal experience, the result of many thousand experiments, I certainly had arrived at a different conclusion. Nor was I surprised at the circumstance, because every pair of rifle barrels, in order that one sight should serve for both, must converge more or less; consequently at some point, however remote, the lines of trajectory of the two barrels must inevitably cross.

At distances of 300, or perhaps 500 yards, the lateral deflection may not be very material, but when we come to ranges of 800 or 1000 yards, how are we to reckon upon the accurate performance of double barrels?

Or, supposing that the barrels do not converge, and that the longitudinal axes of each are strictly parallel, still, the sights being between the respective barrels, the direction they give to the two bullets cannot but be influenced by that circumstance, and the aim can hardly be so true as when taken by sights fixed on the upper surface of the barrel.

Double-barrelled rifles are no doubt triumphs of the gunmaker's art, but it is almost too much to expect that they can often exhibit the precision of a single barrel at extreme distances. Whether a double or a single-barrelled rifle be determined upon, it should be borne in mind, in order to obtain
the full benefit of Jacob's principle, that great weight is absolutely essential, and that there should be as much metal in a single as in a pair of barrels. Thus a single barrel, or a pair, of 16-gauge, should respectively weigh, when finished, 10 lbs.; 24-gauge, 7 lbs.; 32-gauge, 6 lbs.; 48-gauge, 5 lbs.; 64-gauge, 4 lbs.

The following table, prepared with much care, will be found to give accurately, up to the thousandth of an inch, the dimensions corresponding with the gauge numbers commonly in use:

---

A Table showing the diameters, in thousandths of an inch, of gun-barrels and of the leaden balls corresponding to the several gauge numbers, together with the weight in grains of each ball.

<table>
<thead>
<tr>
<th>Gauge No.</th>
<th>Diameter of bore in thousandths of an inch</th>
<th>Diameter of bullet in thousandths</th>
<th>Weight of leaden ball in grains</th>
<th>Gauge No.</th>
<th>Diameter of bore in thousandths</th>
<th>Diameter of bullet in thousandths</th>
<th>Weight of leaden ball in grains</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>.996</td>
<td>.991</td>
<td>1460</td>
<td>21</td>
<td>.612</td>
<td>.607</td>
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<td>6</td>
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<td>.938</td>
<td>1237</td>
<td>22</td>
<td>.605</td>
<td>.600</td>
<td>324</td>
</tr>
<tr>
<td>7</td>
<td>.892</td>
<td>.887</td>
<td>1047</td>
<td>23</td>
<td>.598</td>
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<td>.813</td>
<td>.808</td>
<td>792</td>
<td>25</td>
<td>.580</td>
<td>.575</td>
<td>285</td>
</tr>
<tr>
<td>10</td>
<td>.787</td>
<td>.782</td>
<td>717</td>
<td>26</td>
<td>.572</td>
<td>.567</td>
<td>271</td>
</tr>
<tr>
<td>11</td>
<td>.759</td>
<td>.754</td>
<td>644</td>
<td>27</td>
<td>.565</td>
<td>.560</td>
<td>263</td>
</tr>
<tr>
<td>12</td>
<td>.739</td>
<td>.734</td>
<td>594</td>
<td>28</td>
<td>.559</td>
<td>.554</td>
<td>255</td>
</tr>
<tr>
<td>13</td>
<td>.727</td>
<td>.716</td>
<td>551</td>
<td>29</td>
<td>.551</td>
<td>.49</td>
<td>248</td>
</tr>
<tr>
<td>14</td>
<td>.705</td>
<td>.700</td>
<td>515</td>
<td>30</td>
<td>.546</td>
<td>.541</td>
<td>237</td>
</tr>
<tr>
<td>15</td>
<td>.687</td>
<td>.682</td>
<td>476</td>
<td>31</td>
<td>.541</td>
<td>.536</td>
<td>231</td>
</tr>
<tr>
<td>16</td>
<td>.673</td>
<td>.668</td>
<td>447</td>
<td>32</td>
<td>.536</td>
<td>.531</td>
<td>225</td>
</tr>
<tr>
<td>17</td>
<td>.659</td>
<td>.654</td>
<td>420</td>
<td>33</td>
<td>.496</td>
<td>.491</td>
<td>183</td>
</tr>
<tr>
<td>18</td>
<td>.649</td>
<td>.644</td>
<td>401</td>
<td>34</td>
<td>.472</td>
<td>.467</td>
<td>153</td>
</tr>
<tr>
<td>19</td>
<td>.636</td>
<td>.631</td>
<td>377</td>
<td>35</td>
<td>.467</td>
<td>.462</td>
<td>147</td>
</tr>
<tr>
<td>20</td>
<td>.625</td>
<td>.620</td>
<td>357</td>
<td>36</td>
<td>.424</td>
<td>.419</td>
<td>109</td>
</tr>
</tbody>
</table>
Of course the weight of the missiles varies materially with their form. For instance, a spherical bullet adapted for a rifle of 24-gauge, weighs 291\(\frac{3}{4}\) grains, while a solid projectile for the same barrel, of the form shown at page 56, weighs 754 grains, or 7 grains more than a ball fitted for a 12-gauge gun.

It may possibly be found advisable to vary slightly the charge of powder in order to suit the guns of different makers, but 2\(\frac{1}{4}\) drachms (avoird.) is stated by General Jacob to be the proper quantity for his 24-gauge gun. When once the sights have been regulated, and the proper charge ascertained, it ought never to be altered, since it is obvious that any change either in the quantity or the quality of the powder renders nugatory all the trouble previously bestowed on the adjustment of the sights.

In April, 1856, a report upon these rifles, signed by the Adjutant and Deputy Adjutant-General of the Indian army, was made to the Secretary to Government (Military Department), Bombay. It states that "at ranges from 300 to 1200 yards the flight of the shell was always point foremost, and the elevation at the extreme range inconsiderable. The shells which struck the butt invariably burst with full effect; and practice was made by the many officers who attended, at distances which could not have been attained with any other missile. The result was convincing—that before a small body of marksmen armed with such weapons, no battery of artillery could long hold its ground. A box filled with powder was exploded by a shell fired at 300 yards; and from the effect of the shells on the butt, it was evident that the same result would have been attained at the greatest range from which the practice was made, viz., 1200 yards, as the shells on
exploding at such distances tore out large fragments of the wall."

Had the report stopped here, it would have been well, but unfortunately "the Authorities," utterly misconceiving the principle adopted in the construction of this implement of war, advised that "rifle shells and bullets of the form recommended by Lieutenant-Colonel Jacob be brought under the special attention of the Home authorities, for they can be equally well adapted to the Enfield-Pritchett rifle, now being introduced generally into the Royal army." (!)

Of course this notion is altogether erroneous, for the precise reason assigned by General Jacob, that, "these missiles cannot be used effectively from a long thin piece like the Enfield rifle," the metal of which is liable to great vibration. "A short stout barrel is essentially necessary for accurate distant practice." The above blunder affords another instance of the little value that can be attached to official reports, and shows that not always is "cuilibet professori in arte suâ credendum."

These rifles require peculiarly constructed sights, the elevations varying with the distance from the muzzle at which the sight is placed. For instance, at 15 inches from the muzzle, the elevation of the sight for 2000 yards, will be 4.342 inches; at 16 inches, 4.089 inches; at 18 inches, 5.297 inches; at 20 inches, 5.878 inches; while if the sight be placed 22 inches from the muzzle, the sight for 2000 yards will have to be raised 6.402 inches. The sights for intermediate distances vary proportionately.

In practising at long ranges, and with the sights raised very high, it is no longer possible to fire from the shoulder; in such cases the butt of the stock must be held firmly against the right breast. General
Jacob devised a plan for diminishing the recoil of heavy rifles. This desirable end he endeavoured to attain by inserting in the stock, a powerful spring under the heel-plate, which works longitudinally upon two steel bars. It certainly takes off from the shoulder much of the jar necessarily resulting from large charges of powder, but is not so effective as increasing the thickness of the metal at the rear part of the breech. If about twice the usual quantity of iron be interposed between the chamber and the false breech, the recoil of the most ponderous rifle will be found not to exceed that of an ordinary fowling-piece.

Before closing this division of my subject, I may add here the result of some experiments, showing the average duration of the flight of some of the shells, 24-gauge, $2\frac{1}{2}$ inches long, weighing 615 grains, and of the form represented at page 55. The charge of powder was $2\frac{1}{4}$ drachms.

**Time in Seconds and Thousandths of a Second.**

<table>
<thead>
<tr>
<th>Yards</th>
<th>Seconds</th>
<th>Yards</th>
<th>Seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>0.325</td>
<td>1100</td>
<td>4.030</td>
</tr>
<tr>
<td>200</td>
<td>0.650</td>
<td>1200</td>
<td>4.500</td>
</tr>
<tr>
<td>300</td>
<td>0.975</td>
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</tr>
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<td>400</td>
<td>1.300</td>
<td>1400</td>
<td>5.500</td>
</tr>
<tr>
<td>500</td>
<td>1.625</td>
<td>1500</td>
<td>6.000</td>
</tr>
<tr>
<td>600</td>
<td>1.975</td>
<td>1600</td>
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</tr>
<tr>
<td>700</td>
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</tr>
<tr>
<td>800</td>
<td>2.750</td>
<td>1800</td>
<td>7.950</td>
</tr>
<tr>
<td>900</td>
<td>3.160</td>
<td>1900</td>
<td>8.670</td>
</tr>
<tr>
<td>1000</td>
<td>3.600</td>
<td>2000</td>
<td>9.400</td>
</tr>
</tbody>
</table>

With a 4-grooved single rifle, No. 8 gauge, weighing 14 lbs. 8 oz., and with shells of the same form,
but weighing 3 oz. 8 drs., and with a charge of 4 drs. of powder, the time of flight was as follows:

<table>
<thead>
<tr>
<th>Yards</th>
<th>Seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>700</td>
<td>2·380</td>
</tr>
<tr>
<td>800</td>
<td>2·785</td>
</tr>
<tr>
<td>900</td>
<td>3·203</td>
</tr>
<tr>
<td>1000</td>
<td>3·620</td>
</tr>
<tr>
<td>1100</td>
<td>4·900</td>
</tr>
<tr>
<td>1200</td>
<td>4·570</td>
</tr>
<tr>
<td>1300</td>
<td>5·600</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Yards</th>
<th>Seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>1400</td>
<td>5·610</td>
</tr>
<tr>
<td>1500</td>
<td>6·140</td>
</tr>
<tr>
<td>1600</td>
<td>5·710</td>
</tr>
<tr>
<td>1700</td>
<td>7·300</td>
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<tr>
<td>1800</td>
<td>7·900</td>
</tr>
<tr>
<td>1900</td>
<td>9·510</td>
</tr>
<tr>
<td>2000</td>
<td>9·120</td>
</tr>
</tbody>
</table>

From these tables we deduce that the average rate at which a rifle ball travels is about 7½ miles per minute, or, supposing it capable of undiminished continuance, about 450 miles per hour. During that same interval the earth travels 68,000 miles; so that the velocity with which we fly through space is rather more than 150 times greater than the highest speed we can give to a rifle ball!

I lately took an opportunity of testing during unfavourable weather, a rifle upon Jacob’s principle, made for me by Mr. Daw.

The annexed diagram represents the result of 40 rounds, fired at a range of 400 yards. I am glad to be enabled thus to do justice to the maker, by putting upon record a proof of the excellence of his workmanship. The trial having been made from a fixed rest, the precision attained, obviously proves the accuracy of the barrel.

Of the many rifles that have been sent me, from time to time, for trial, I have not found one that could be compared to the particular one here alluded to.

The barrel of this rifle is only 24 inches in length, the gauge of the bore being 32.
Target, 6ft. by 2ft.; 8in. bull's-eye.

DATE.
24th December, 1859.

NAME.
Hans Buxk.

DISTANCE.
400 yards.

WEATHER.
Clear, Calm.

NO. OF ROUNDS FIRED.
40.

NO. OF HITS.
40.

DESCRIPTION OF RIFLE.
Jacob's, made by
G. H. DAW,
Threadneedle-street,
London.

DESCRIPTION OF AMMUNITION.
56 gns. Powder.
Curtis and Harvey's No. 6.
Conical ball, flat base.

OBSERVATIONS.
All fired from rest.

ANGLE OF ELEVATION.
1° 10'.
It is only perhaps fair to Mr. Daw, to give publicity to the following fact, which of itself establishes, if need were, the excellence of his materials and workmanship. On the 12th of November, 1859, at the practice ground at Kilburn, a rifle, reported to have cost seven guineas and bearing the name of a well-known advertising house, but no proof-mark, burst in the hands of its owner, who had inadvertently loaded with two cartridges, though, as he alleges, without leaving any intervening space between them. So complete was the destruction, and to such a distance were the lock and lock-plate blown, that it was a marvel that at least one life had not been sacrificed. Fortunately, no one was injured. The vendor of this rifle was subsequently prosecuted at the instigation of the Gunmaker's Company, and convicted of selling unproved arms. So satisfied was I that such an accident could not have occurred, had the barrel been of proper quality, that, selecting at hazard, one of Daw's four-guinea rifles (one of the common Enfield pattern), I had it loaded and fired with two regulation charges, a clear space of four inches having been purposely left between the apex of the first and the base of the second bullet. This tremendous trial the barrel actually stood, without any injury, beyond a slight bulge, not perceptible externally, and scarcely amounting to the thousandth of an inch, at the part where the second bullet was placed!

The rifle is at present in my possession, and may be seen by any one, desirous of satisfying himself of the enormous strain which a gun-barrel of really good quality will resist.
THE ENFIELD RIFLE.

The reader having now been enabled to form a tolerably correct idea of Jacob's pattern rifle, its form, peculiarities, and capabilities, I proceed to make some observations on the Enfield or Enfield-Pritchett Rifle, the weapon at present in general use throughout the service.

It is scarcely more than ten years, since steps were seriously taken by our military authorities to devise an improved weapon for the general use of the army. Trial was first made of what was then termed the Minié musket, using a cylindro-conical projectile, fitted with an iron cup, to produce expansion. Soon after, a long series of elaborate experiments were commenced, similarly conducted, and indeed similar in all respects to those which had long previously been going on at Vincennes. The ultimate result of these trials led, as is well known, to the adoption in 1854 of the Enfield rifle, known in the service as "the pattern, 1853." It will be seen, therefore, that both in the selection of the arm and bullet, as well as in the establishment of the School of Musketry at Hythe (instituted in 1853), we were really doing little more than following in the footsteps of our neighbours. This rifle is quite as strong as the French regulation arm, but its calibre is less. It is, however, lighter and
better balanced. In many respects it is a beautiful weapon, especially if contrasted with its predecessor. Some time will probably elapse ere a better military implement of destruction will be perfected, or at any rate one better adapted for the use of the "line."

The rifling is effected by three grooves, cut slightly deeper at the breech than at the muzzle, and making one complete revolution in 78 inches. The barrel is 3 feet 3 inches long, * diameter .577, weight 4 lbs. 2 oz.; total weight of arm with bayonet, 9 lbs. 3 oz.; length 6 ft. 1 in.; without the bayonet, 4 ft. 7 in. The regulation charge of powder is 2 ½ drachms (F.G.), the weight of the bullet 530 grains: of 60 rounds of ammunition, 5 lbs. 3 oz. 11 dr. Total weight with bayonet scabbard, 14 lbs. 11 oz. 3 dr.

This rifled musket can, it is said, be turned out at Enfield at an expense of about 3/. 4s. When supplied by contract it costs somewhat more.

An ordinary marksman can make good practice with it at 800 yards, but in the skilled hands of a more experienced shot, still greater range is attainable.

The manufacture of this arm is proceeding at Enfield at the rate of between 1700 and 2000 per week, but the demand as yet far exceeds the supply.

The raw material for the barrels first makes its appearance at the factory in the form of slabs about ½ an inch thick, and 12 inches long, by 4

* The barrel of the short Enfield is only 2 ft. 9 in. in length. The trajectory of this rifle for 820 yards is 2° 57'; for 1850 yards 10° 50'. In a range of 500 yards, it has been said the height of the trajectory is 15 ft., or about double that of Whitworth's rifle; but according to another, and perhaps more accurate calculation, that of the Enfield has been shown to be 15'01 ft., and of Whitworth's 13'18 ft. The elevation of the Enfield being 1° 32'; that of the Whitworth 1° 15'.
broad. In forging these, care has been taken in the manufacture to make the short square fibres of the iron cross and re-cross at right angles. These pieces of metal are first heated and bent into short tubes, somewhat resembling rough draining tiles. In this state they are again heated, and, while white hot, passed between iron rollers, which weld the joining down the middle, and, at the same time, lengthen each tube about 3 inches. They are again heated, and again passed between rollers of a smaller gauge, which lengthens them still further; and this process is repeated altogether 12 times in about 2 hours, when the barrel at last assumes the form of a rod about four feet long, having a bore down the centre about a ¼ of an inch in diameter. The muzzles are then cut off, the "butts" made up, and the process of welding on the nipple lump (to sustain the nipple) commences. This is a difficult operation, and requires considerable quickness, care, and skill. To ensure rapidity of striking while the metal is at a bright red heat, the breech, with the cone-seat attached, is held in a steel die under a small hammer worked by steam, striking 400 blows a minute, and under which the metals are united in the closest possible manner.

The forging being thus completed, the barrels pass from the smithy to the boring-shops, where the operation of boring (exclusive of rifling) is repeated five times. The barrels being arranged horizontally, and the first-sized borer been drawn upwards from breech to muzzle, not forced down, as the bend of the boring rod would in that case render it difficult to attain absolute accuracy. The second boring is effected with rapidity, the third slowly; when the barrel is finished to within three-thousandths of an inch of its
proper diameter. The outside is then ground down to its service size. The next process is to straighten the barrel after the worm for the breech-piece has been tapped. This straightening is one of the roughest portions of the whole process. From the very soft nature of the iron used, and the want of substance of the metal itself, a slight blow is enough either to bend the barrel, or else so to dent it, as effectually to destroy all precision in shooting. Thus, in the various stages just detailed, notwithstanding the greatest care, the barrel is almost always found to require subsequent correction. This is accomplished by hand; a skilled workman looking through the tube, and tapping it with a light hammer wherever it appears to him to need such adjustment.

Yet rude and unsatisfactory though this operation appears, it is found to give satisfactory results, even when the accuracy attained is tested to the thousandth of an inch. It is questionable, however, whether any good is really thus done to the barrel at all, or whether the end in view would not be accomplished more perfectly by machinery.

Altogether the barrel undergoes 66 distinct operations, and after having been bored out for the fourth time, its strength is tested by a proof-charge of one ounce of powder and one ball. Very few fail under this ordeal; the majority indeed will bear, uninjured, the explosion of $2\frac{1}{2}$ ounces of powder, and the discharge of 11 or even of as many as 13 balls.

The next step is to fit the nipple-screw, nipple, and breech pin. The barrel having been then bored for the fifth time, polished internally and externally, and carried to the finishing shop, has still to pass through ten more stages ere it is ready to be stocked. The next important step is the
rifling. In this particular arm the grooves are comparatively broad and shallow, with a pitch of half a turn in the length of the barrel. The depth of the rifling is 0.5 at the muzzle, and 0.13 at the breech, the width of each groove being 3/16ths of an inch. There are at Enfield 16 rifling machines, each of which turns out 26 barrels daily. Each groove is cut separately, the bit being drawn from the muzzle to the breech.

After rifling, the barrel is again proved with half an ounce of powder and a single ball. It is then sighted, trimmed-off, milled, leveled, browned, gauged, and at last finished to such a degree of accuracy that the steel gauge of .577 of an inch passes freely through, while that of .580 will barely enter the muzzle. Browning is the last operation; and this process, the object of which is to protect the metal from rust, and the eye of the soldier from glare, occupies a week more than the entire manufacture of the rifle; that is to say, four weeks. After the "browning" is completed, though not till then, the gaugers can instantly detect the slightest imperfect welding or the smallest flaw in the metal manufacture, when the barrel is summarily rejected, and the workman under whose hands the flaw took place is fined 3s., whether the imperfection be discovered at the commencement of the process or when all is finished. The defective barrels, marked in the manner already described, are sold as old iron, but still in the form of finished barrels, and this accounts for the appearance of such pieces in the market.

The regulation projectile, formed by compression of very pure lead, is a modification of the Minié; smooth at the sides, and having a boxwood plug
instead of an iron cap fitted into a cavity at its base. But even this plug (originally suggested by General Hay) may be dispensed with, without any very great diminution in the accuracy of the fire. Indeed, Mr. Pritchett, who has turned out many thousands of these muskets, and has devoted great attention for many years to the perfecting of them, recommends that no plug should be used, but that a small hollow only be left at the end of the bullet, just sufficient for its lateral expansion.

The bullet, from this construction, is obviously heavier towards the apex than those devised by General Jacob. The point has no tendency to divest itself of its initial direction; a very slight "spin," therefore, is all that is necessary to keep it in a right course; there is thus no need either for deep riflings nor for a very thick barrel, though in length it ought to exceed Jacob's rifle by at least fourteen inches.

The Minié bullet will not admit of being impelled by a heavy charge of strong powder, nor should its velocity be imparted suddenly. In either case the soft metal, unable to resist the shock, is blown out of shape and jagged, or the direction of its flight is rendered wild and uncertain. For the above reason it is, that the Minié rifle has been frequently found to act more satisfactorily with weak, foreign powder, than with that of the best English makers.

The 39-in. regulation barrel satisfies well enough the required conditions, and enables a comparatively feebler power to act cumulatively upon the bullet before it quits the muzzle.

It is considered by many that the force of this missile towards the foremost end is not well adapted to overcome the resistance of the air, and that this
defect is increased rather than rectified by the diminution of its specific gravity towards the base. The bullet being nearly 100 grains lighter than one of Jacob's (while the bore and the charge of powder are the same), the momentum and the range must of necessity be less. Yet the heavier bullet could not be successfully substituted for that supplied with the Government arm. The resistance of such a bullet would be so great, that the over-strained barrel would no longer afford even tolerable practice.

"Under the operation of this irregular elastic action of the metal of the barrel," says Gen. Jacob, "the heavy end of the bullet is almost certain to get foremost, or it may even fly about sideways; in fact, its flight must be altogether irregular; for it is only by the steady, quiet action of a rapid spiral motion that these balls remain in their unnatural position of point foremost."

There is one great advantage which the short will always maintain over a long barrel, and that is in the greater quickness with which the sight can be brought to bear upon the mark, especially if that mark be moving, while the effects of want of steadiness, and of accidental deflection at the moment of pulling the trigger, are diminished in proportion to the reduction of the time that the bullet is under the guidance of the barrel. If the barrel be but long enough to give the ball the full benefit of the propelling power, and at the same time to impart the requisite rotation on its longitudinal axis, anything further must be detrimental; because, as a moment's consideration will suffice to show, the bullet may have taken its departure from the shorter tube ere the position of the marksman's shoulder can have changed.

But, while advocating the adoption, where prac-
ticable, of short barrels—and they are absolutely essential if we would give Jacob's principle a fair trial—I am not insensible to the fact that there are strong, not to say insuperable, objections against their introduction throughout the army. It is questionable whether for troops generally, the diminished efficiency of the bayonet, and the great liability of accidents to "front file" men in rapid firing, would not counterbalance many advantages. As it is, they have a musket, the range of which is quite as long as is requisite, since it will easily pick off a man at 800 yards, while its volleys, tell with deadly effect upon masses, at from 1500 to 2000 yards.

This rifle loads readily, balances well, and is not too heavy to be manageable by any man of ordinary stature and strength. Its greatest defects are the weakness of the barrel, and the shortness and excessive straightness of the stock. Were the stock slightly more curved in the grip, and of greater length, the efficiency of the arm would be considerably enhanced. Nor could there be any rational objection to the making of the stocks of all new muskets from one and a half to two inches longer, as the regimental armourer could very soon reduce any that might need shortening, to suit short-armed or diminutive men.

But every one who knows anything about rifles, cannot fail to have observed that, under any circumstances, better shooting is almost always made with a long-stocked, than with a short-stocked weapon.

The Enfield rifle musket possesses the following great advantages over some of its predecessors:—

1. A saving of 3 lbs. in the weight each soldier has to carry, without diminishing the number of rounds in his pouch, and notwithstanding that each of the new bullets weighs about 30 grains more than the old spherical shot.
2. Increased strength in the weapon itself, as also greater precision in the shooting.

3. Improved quality of the lock and mode of attaching the barrel to the stock.

4. Lock ring for the bayonet instead of loops and pins.

From the following tables, showing the trajectory of this musket, it will be seen that, in a flight of 300 yards, the greatest rise of the projectile above the line of aim does not exceed 3 ft. 7 in.:

**ONE HUNDRED YARDS.**

<table>
<thead>
<tr>
<th>Distance from the muzzle</th>
<th>50</th>
<th>75</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height of the bullet</td>
<td>9</td>
<td>6 1/8</td>
<td>0</td>
</tr>
</tbody>
</table>

**TWO HUNDRED YARDS.**

<table>
<thead>
<tr>
<th>Distance from the muzzle</th>
<th>50</th>
<th>75</th>
<th>100</th>
<th>125</th>
<th>150</th>
<th>175</th>
<th>200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height of the bullet</td>
<td>11 1/2</td>
<td>14 1/2</td>
<td>19</td>
<td>21</td>
<td>20 1/2</td>
<td>10 1/2</td>
<td>0</td>
</tr>
</tbody>
</table>

**THREE HUNDRED YARDS.**

<table>
<thead>
<tr>
<th>Distance from muzzle</th>
<th>50</th>
<th>75</th>
<th>100</th>
<th>125</th>
<th>150</th>
<th>175</th>
<th>200</th>
<th>225</th>
<th>250</th>
<th>275</th>
<th>300 yds.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height of the bullet</td>
<td>17 1/2</td>
<td>26 1/2</td>
<td>33</td>
<td>40 1/4</td>
<td>42 1/2</td>
<td>43</td>
<td>39</td>
<td>32</td>
<td>24</td>
<td>14</td>
<td>0 in.</td>
</tr>
</tbody>
</table>

During a long series of experiments instituted for the purpose of testing the relative advantages of different kinds of projectiles for the regulation rifled musket, it soon became obvious that those would be preferable for general use in which anything like a cup or plug should be dispensed with. “Compound ammunition” for target practice may not exhibit many disadvantages, but in actual service and in the rough hands of soldiers it is open to numerous objections. The bullet proposed by Mr. Pritchett is unquestionably the best suited of any yet pro-

* It is most probable that at this point of greatest elevation the penetrating power of all projectiles is at the maximum.
posed for the Enfield gun, as its form is simple, it expands readily, and requires neither cup nor plug. The diameter of this bullet is .550 inch, its length .960 inch, and its weight 590 grains.

Should the reader be curious to know at what cost to the country the Enfield factory for the fabrication of this and other small-arms has been established, the following details may be interesting:

The buildings alone cost 91,618l.; the machinery, 68,653l.; stores, 48,692l.; salaries, 7048l.; and wages, 135,132l. The total (from the year 1854 to the present time, 1858), with some few other items, amounting to 352,583l.

But in order to prove that the above expenditure has not been made in vain, and that this rifle in cool hands is capable of great achievements, I quote the following passage from Lord Raglan's despatch, descriptive of the memorable fight at Balaklava, as affording one among many instances of the value of the arm turned out at Enfield. The fact should be indelibly recorded, not only in justice to Lieut. Godfrey's presence of mind and gallantry, but as serving to show that a single rifleman may even at 600 yards silence artillery. By similar means, using only Norton's or Jacob's rifle shell, instead of the common bullet, a handful of men could without much difficulty demolish the ammunition of a field battery, and that too without being themselves exposed even for a moment; for a rifleman soon acquires the art of loading and delivering his fire while entirely concealed from view.

"The 4th Division," writes his lordship, "had advanced close to the heights, and Sir George Cathcart caused one of the redoubts to be re-occupied by the Turks, affording them his support; and he availed himself of the opportunity to assist
with his riflemen in silencing two of the enemy's guns.

"That service was accomplished by Lieut. Godfrey (1st Battalion Rifle Brigade), who proceeding in advance of his battalion with a few men, under the cover of a ridge, made such excellent shooting at the Russian gunners (at 600 yards)—the men handing him their rifles as fast as he fired—that, in his own words, 'We got the credit of silencing them. None of our men were hurt, though at one time the shot came through us pretty fast and thick.'"

Lieut.-Colonel Dixon, the Superintendent of the Government Small-Arms Manufactory, at Enfield, thus briefly sums up the principal points to be noted in this arm:

"1. That the grooves are limited to three.

"2. No greater spiral allowed than is necessary to keep the bullets in the grooves.

"3. The most perfect facility of loading.

"4. The expansion into the grooves, so ensuring the necessary rotation, is effected at the instant of the inflammation of the charge of powder, in consequence of the 'upsetting' of the lead, assisted possibly by the wooden plug which closes the orifice at the base of the bullet, but which no doubt prevents any collapsing of the sides of the bullet when leaving the barrel, a circumstance which would otherwise happen, and thus disfigure its shape, and act prejudicially in other respects. The advantages on the side of the plug are, besides the above, the less frequent fouling of the barrel; in fact, the grooves are cleaned out and lubricated after every shot.

"5. The calibre of the arm .577 allowing of a bullet of sufficient weight to do all that is required of it, but not so heavy as to prevent 60 rounds being carried well by the soldier."
"6. The shooting of this arm as a line infantry weapon is most superior; and when carefully made throughout, corresponds to every requirement of the best instructed infantry soldier.

"7. At long ranges—that is to say, up to 1000 yards, though only sighted to 900*—the arm makes very good practice, and thus becomes qualified for a rifle-arm for special corps.

"If to all this be added, that the arm is one easy to be made, and that the ammunition is of a form capable of being turned out in large quantities very rapidly, it would appear that the Committee have not been far out in their judgment or sagacity in the selection of such a weapon.

"The above points, many of which concern the manufacture of the arm, were of vital importance at a period when it was of the utmost consequence to obtain a rapid supply; for had any complexity, either in the form of barrel or bullet, interfered much with the manufacture, it would have been almost impossible to have armed all our troops with it during the late war."

In June, 1855, an interesting experiment was made with the Enfield rifle at Hythe, to ascertain the effect of a platoon of skirmishers firing upon a battalion of infantry in column.

Two targets were placed for the purpose; one in rear of the other, at a distance of 50 yards apart, in order to represent the front and rear companies of a column, supposed to be 700 strong. The front target was of iron, in order that balls striking it might not pass through to the second. A company, extended as skirmishers, were marched out in front of the target, one subdivision being ordered to fire

* The Pritchett-Enfield rifle is sighted to much greater distances.
ten rounds of cartridges from a halt, at a distance, unknown to them, of 820 yards; they were then directed to advance, firing, until they had expended ten rounds more; then to halt and again fire ten, at a distance of 550 yards from the target, and also unknown to the men. The second subdivision was next ordered to fire 10 rounds from this last distance of 550 yards; then to retreat, firing, till they had again fired ten; then to halt and fire ten: these distances being the same as in the first case, and all unknown to the men.

The number of bullets fired was 1050; of this number 379 struck the first, and 238 the second target. Fifty-eight per cent. of the whole number therefore struck the two targets, representing the head and rear of the column. For the Enfield rifle musket at 600 yards, the dangerous space is 60 yards; at 800, 40 yards. This experiment was useful for the purpose of showing what would be the effect upon a column, in which the rear could be struck by bullets that passed harmlessly over the head of the column. (See Fig. 2, page 170.) In firing upon a column, a bullet undoubtedly will often take effect somewhere in the mass, even should an error be committed in estimating distances.

In May, 1856, another experiment was tried at Hythe, to ascertain the effect of the fire of a company of skirmishers upon a field-piece of artillery, with its attendant, men, and horses.

The firing party consisted of 60 men, of whom only 23 could be considered well instructed in musketry practice. The target represented the men grouped round the gun, as they would have been when going into battery; six horses were in harness, and one carried an officer. There were three
drivers, eight gunners, and one mounted officer—in all, twelve men and seven horses; the figures representing both men and horses were of life size. The ammunition waggon was represented by an iron target, upon which were traced the outlines of six horses; but the drivers and gunners were not delineated on that target.

The company were extended as skirmishers at a distance (unknown to them) of 610 yards, and after the command "commence firing," continued firing for two minutes only, when the call "cease firing" was sounded.

Two rounds per man (120 in all) had been expended. The result was as follows:

<table>
<thead>
<tr>
<th>Gun and Limber</th>
<th>Number of horses struck 6, balls struck 22</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammunition waggon 50 yards in rear</td>
<td>Number of men 7, &quot; 7 &quot;</td>
</tr>
<tr>
<td></td>
<td>Number of horses 4, &quot; 8 &quot;</td>
</tr>
<tr>
<td></td>
<td>(No men represented with the ammunition waggon.)</td>
</tr>
</tbody>
</table>

Total number of balls struck 37

A second fire was delivered at 810 yards in the same manner, except that it continued for three minutes. The men of the front rank fired three cartridges, those of the rear two.

<table>
<thead>
<tr>
<th>Gun and Limber</th>
<th>Number of horses struck 5, balls struck 16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammunition waggon 50 yards in rear</td>
<td>Number of men 6, &quot; 8 &quot;</td>
</tr>
<tr>
<td></td>
<td>Number of horses 5, &quot; 10 &quot;</td>
</tr>
<tr>
<td></td>
<td>(No men represented with the ammunition waggon.)</td>
</tr>
</tbody>
</table>

Total number of balls struck 34

It would seem therefore that the pains bestowed in the selection of this arm have not been expended in vain. At any rate there is no probability for the present, of any further change, though some sapien
individuals are actually to be found, proposing a return to Brown Bess, as the Queen of Weapons! Even so did Lord Orrery, in his *Treatise on the Art of War*, addressed to Charles II., in 1677, warmly advocate the abolition of firearms, and the adoption once more of the English pike instead! In later times, too, a military writer of some eminence, and one whose experience should have taught him better, inveighing, in the true spirit of noodledom, against the rifle as a military weapon, is loud in his praises of "the bayonet, the bayonet!—the proud red uniforms, with the musket and the bayonet!"

But why, forsooth, should we not have hearts as brave and arms as strong, under the far more appropriate green or grey?—and why, in the name of all that is rational, cannot as keen a glance be sent along a rifled barrel, with its boundless range, as over the feeble smooth bore, even with its boasted bayonet attached? And yet how frequently do we find twaddle like this, prevailing for years together over the manifest teachings of common sense!
COLT'S REPEATING RIFLE.

I have already (at page 42) adverted to the principle of repeating fire-arms, as introduced and successfully carried out by Colonel Colt, in the manufacture of his celebrated pistols. The rifles he has more recently produced are similar in construction, equally handy, but of course are more effective still than the smaller arm. They are of different patterns, and vary in bore and length—the barrels being respectively 18, 21, 24, 27, and 30 inches long, according to the purposes for which greater or less range may be required. Their power, efficiency, and applicability to military use have been severely tested and satisfactorily proved; in addition indeed to previous contracts, the American Government have lately ordered several thousands for the equipment of a picked body of men—the Secretary of War having reported upon this particular arm in the following eulogistic terms:

"The only conclusive test," says he, "of the excellence of arms for army purposes is to be found in the trial of them by troops in actual service. Colonel Colt's arms have undergone this test, and the result will be found, in some measure, by reports of General Harney and Captain Marcy, who used them in Florida against the Indians. These reports relate only to 'the rifle,' but are clear and satisfactory; and as that arm has been much less used than the pistol in our service, they become important.

"With 'Colt's pistol' the country is perfectly familiar. It is
agreed on all hands, by those who have used them in the field, that it is altogether superior to any other, and in fact it has now become essential to the public service. A board of officers, recently assembled to consider the best mode of arming our cavalry, made a report, showing the present appreciation of the arm by officers of the army standing deservedly high for their services, experience, and intelligence.

"I have the honour to be, very respectfully,
"Your obedient servant,
"John B. Floyd,
"Secretary of War.

"Hon. James A. Stewart, House of Representatives."

The following is the report last alluded to:—

"The board examined three specimens of Colt’s pistol-carbine, of the following length of barrel respectively, twelve, fifteen, and eighteen inches, and Colt’s pistol with a barrel seven inches long with a breech attachment.

"To test the accuracy of fire, a number of shots were fired from all these arms at the following ranges:—At one hundred yards and at three hundred yards, at five hundred yards from the three specimens of the pistol-carbine, and at two hundred yards from the pistol with breech attachment.

"The result of these experiments was entirely satisfactory to the board as to the accuracy of fire of the arms under examination.

"To test the penetration of these arms, a target of seasoned white pine boards (2 ft. square), one inch thick, with an interval of one inch and a quarter between the boards, was used. The shots were fired thirty yards from the target.

"The carbine with 12-inch barrel penetrated 9 boards.
"The carbine with 15-inch barrel penetrated 8½ boards.
"The carbine with 18-inch barrel penetrated 9 boards.
"The pistol with breech attachment penetrated 7½ boards.

"The board consider Colt’s pistol-carbine, Colt’s pistol with breech attachment, superior for our cavalry service to any arm with which they are acquainted.

"The board recommend the adoption of Colt’s pistol (with the breech attachment) and ammunition for the cavalry service; and that each trooper be furnished with two pistols, adjusted to the same breech, the barrel of each pistol to be eight inches long, of the calibre of the army revolver.

"The board recommend that one pistol be worn on the right
side of the soldier, in a pouch attached to the sabre belt, and the
other in the holster on the right side of the saddle; and that the
breech attachment be carried in a suitable pouch attached to the
left side of the rear of the saddle."

I may here take occasion to observe that Mr. C. F. Dennet, well known in connexion with Colonel Colt, has lately introduced a most useful as well as ornamental pistol holster, combined with a cartouch pouch, both attached to the same belt, which is made of black patent or other leather, the whole being waterproof. The receptacle for caps and cartridges consists of a japanned metal box and lid, inclosed in a pouch, the flap of which is fitted with a tongue to button on to the stud. When the pouch is intended for Cavalry, the suspending straps are passed through loops on the ends of the pouch, and secured by buckles underneath. When worn by Infantry, Artillery, or travellers, it is run on to the body-belt. By this simple arrangement there is a reduction of weight for man and horse of no less than eight pounds. The only arm required upon this system is Colt’s revolver, in lieu of the heavy cavalry pistol and the cumbersome carbine and cross-belt. Again, with the old belts the obnoxious pipe-clay is an eternal source of annoyance, whereas the black patent leather, to be cleaned, has only to be rubbed over with a moist rag. Many English regiments now in India, as well as the Poonah Irregular Horse, have, I am informed, been thus equipped; if this be so, it shows an amount of intelligence on the part of “the Authorities” in India which has not been too often displayed in their proceedings. Before dismissing this subject I may add that this holster-belt affords the most secure and effective way of carrying a pistol so as to have it at all times ready for instant use. No officer, nor
indeed will any man having occasion to travel armed, use any other form of belt, if he has once had experience of this.

But to return to Colt’s repeating rifle, an engraving of which I annex. It will be seen that its appearance is neat, while, as regards weight and portability, it is not one whit more cumbersome than the obsolete military rifle of former days. By a very simple arrangement the cylinder containing the chambers can, after firing, be instantaneously detached and replaced by a loaded one, so that a dozen rounds may be delivered with the utmost requisite rapidity.

In its internal construction, this rifle, as well as the latest made pistols, differ somewhat from those of earlier make. The catch which causes the breech-cylinder to revolve, instead of acting against ratchet teeth cut on the cylinder itself, works in grooves cut in its circumference in such a manner that a pin, by traversing the grooves, not only makes the cylinder rotate, but also locks it when required. This is an obvious improvement.

The Government of the United States has taken great pains to test the comparative value of dif-
Colt's Rifle.

Different breech-loading arms, and the result of their investigations may be briefly summed up in the words of Colonel May, one of the principal members of the scientific board instituted for the above purpose. He expressly states that, having in view not only Sharp's rifle but all others that have been used in the American Cavalry service for the last twenty years, he considers Colt's rifle "far superior to them all in every respect."

Lieutenant Whitmoutgh Porter, R.E., in his admirable little work, "Life in the Trenches before Sebastopol," gives a statement highly to the advantage of Colt's revolvers. "My subsequent experience in the trenches before Sebastopol, led me decidedly to the opinion that Colt's arms were, on the whole, superior to those of any other maker. In the first place, I consider them less liable to accident; in the next place, they are more simple in construction, and less likely to get out of order, and, what is more, should they become defective, are more easily repaired. The necessity of re-cocking the pistol or rifle after every discharge, which is held by many to be a defect, and the avoidance of which has been the object of other makers, is, to my mind, a decided advantage.

"In a hand-to-hand mêlée (such as the nocturnal sorties of the Russians exactly were) a man is very apt to waste ammunition, in the hurry of the moment, in a case where he has the power of firing several shots in rapid succession. Where, however, it becomes necessary to re-cock the pistol, the operation, brief though it be, gives time for determining where the next bullet may be most advantageously bestowed."

I can add that the above is the opinion universally
expressed by all the officers in the Crimea with whom I happened to be personally acquainted. The usual reply I have received, on asking their opinion of different revolvers, has been, "Oh! no one in his senses would ever dream of going into action without one of Colt’s revolvers."
LANCASTER'S ELLIPTIC RIFLES.

Of all the modifications of the principle of rifling, that have been brought out in this country, in America, and on the Continent, none can be said to exceed in simplicity the one now commonly known as Mr. Lancaster's system of elliptic rifling. I say commonly known, because it is in fact merely the revival of a very antiquated system, alluded to and accurately described in "Scloppetaria" (p. 87) as "a very old invention quite obsolete" more than half a century ago.

A problem, the solution of which has long been a scientific puzzle, has been the reduction of windage to a minimum, without too great a concomitant increase of friction. With the old, many and deeply-grooved rifle, if by any means we could have annihilated the windage, we should at the same time most probably not only have greatly augmented the friction, but we should have cut or furrowed the ball to such an extent that the resistance of the air against its roughened surface would have been increased so considerably that no equivalent advantages would have been gained.

In the elliptic rifle, this difficulty is satisfactorily combated. A section of the bore is in fact so slightly oblate, that without the application of a
gauge its eccentricity is hardly perceptible. The "twist" found by experience to be most advantageous, is one turn in 32 inches. The most convenient diameter of bore 0.498 in., is suitable for all purposes, the length of the barrel being 32 in.; while an eccentricity of 0.01 in. in half an inch is found amply sufficient to cause the bullet to spin on its axis to the extreme verge of its flight. Fig. 1 represents accurately the appearance of the muzzle of this rifle.

It is not very material whether the bullet, which should be of the softest lead, be cast with or without a cavity at the base, though, upon the whole, a slight hollow is perhaps advisable, as represented in the sectional view annexed (Fig. 2, and in the view of the base seen at Fig. 3). In either case its lateral expansion at the moment the gun is fired, is enough to compel it to fill the barrel perfectly—in fact, to seal the tube hermetically till the projectile has
passed the muzzle. The bore being as smooth as that of a shot gun, the increase of friction is not great, and the bullet speeds upon its errand, without being in the slightest degree jagged or indented. The precise form of the fore part of the Lancaster bullet, whether acute or obtuse, is not of primary importance, though it is essential that it should fit the barrel accurately. For this purpose, each bullet after having been cast, is struck through a steel gauge or "swedge," which, correcting any superficial irregularities, gives to every bullet precisely the same external form.

The length of the bullet found to answer best with these rifles is one 2½ diameters in length, with a windage of four or five thousandths of an inch—that is to say, just sufficient to allow of its being rammed easily home when covered with very thin greased paper. It then has the appearance denoted in Fig. 4. It matters little, where the centre of gravity of these bullets is situated, nor do the defects, incident to all cast bullets, appear to affect the precision of their flight. The chief objection urged against this rifle is its occasional uncertainty.

I have now before me a report from Lieut.-Col. A. Lane Fox (the Chief Inspector of Musketry at Malta), dated 1st June, 1857, giving an account of practice made by the 1st and 17th Companies of Royal Engineers with the Lancaster carbine; in their hands, a superior weapon to the Enfield rifle, with which the remainder of the garrison was armed.

Previously to the commencement of this course of experiments the men had hardly ever fired with the old musket, and never with the rifle. It should be premised, too, that the sights they used had not been correctly adjusted.
After constant firing, with a view still further to test the merit of the arm, ten of those who had proved themselves first-class shots were selected to fire sixty rounds each, at 400 yards, without cleaning their rifles.

The practice extended over two days, the men firing at stated periods and piling arms in the sun during the intervals. It was found, on the conclusion of the second day, that the fire was rather more concentrated than on the first, when the arms were clean, and that there was no greater difficulty in loading the last round than the first. During the trial the men were ordered to wet the cartridges in their mouths, whenever the slightest roughness was felt in loading, and this simple precaution had in every instance the effect of immediately removing what little fouling had accumulated. By this means some of the later rounds were observed to slip down the barrel by the mere weight of the ramrod.

The results of these experiments were considered by the officers present to have established the fact that, with the Lancaster arm, the solid Pritchett bullet has not the penetrating power which it possesses when fired from the Enfield musket. With the view to test the relative merits of the two kinds of missile, No. 1 Company was supplied exclusively with the Pritchett bullet, and No. 17 with the cup-ball ammunition. The former obtained the best final classification, the latter the highest average; neither, however, showing any marked superiority over the other.

On this point Colonel Lane Fox observes that, "considering the many advantages which a solid bullet must have over a compound of any description, I am strongly in favour of the Pritchett bullet,
the defects of which have never come under my observation during the many thousand rounds fired under my superintendence. If it have the defect ascribed to it of not expanding sufficiently in the barrel, this defect would be more prejudicial to the Lancaster elliptical bore musket than to any other description of rifle."

This is now, however, a point of little moment, as the purchaser of one of Lancaster's rifles has only to use the proper bullet supplied by that maker in order to insure the most perfect precision of which this arm is capable. He will thus also obviate all possibility of the ball's "stripping" or leaving the barrel without following the volute of the spiral. Whenever this occurs with the Lancaster rifle it will probably be found to be attributable to the use of ammunition not suited for that particular arm.

The following carefully prepared return exhibits the practice at Malta, in 1856, of the two companies of Royal Engineers above alluded to, with the Lancaster elliptical carbine, .577 bore, as contrasted with the practice conducted at the School of Musketry, Hythe, with the Minié and Enfield rifles, since the opening of that establishment in April, 1854, to April, 1857:—

**Two Companies of Royal Engineers at Malta, armed with the Lancaster Elliptical Carbine, .577 bore.**

| Non-commissioned officers and men | Average points per man obtained in the undermentioned practice | Number in 1st class at the conclusion of course | Percentage of 1st class shots
<table>
<thead>
<tr>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>As a company in 3rd class, each man firing 20 rounds</td>
<td>File and volley firing 10 rounds per man</td>
<td>10 rounds per man</td>
<td>10 rounds per man</td>
</tr>
<tr>
<td>189</td>
<td>17.98</td>
<td>11.75</td>
<td>7.50</td>
</tr>
<tr>
<td>3rd</td>
<td>18</td>
<td>147</td>
<td>77.77</td>
</tr>
</tbody>
</table>
Report of Non-Commissioned Officers and Men who underwent Instruction at the School of Musketry, Hythe, including the Practice of Non-commissioned Officers trained for the Corps of Instructors in Musketry.

From April, 1854, to May, 1855.

<table>
<thead>
<tr>
<th>Non-commissioned and men.</th>
<th>As a company in 3rd class, each man firing 20 rounds per man.</th>
<th>File and volley firing, 10 rounds per man.</th>
<th>Skirmishing.</th>
<th>Total, describing merit of firing.</th>
<th>3rd.</th>
<th>2nd.</th>
<th>1st.</th>
<th>Percentage of 1st class shots.</th>
<th>Arm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>97</td>
<td>11’63</td>
<td>7’63</td>
<td>3’61</td>
<td>2’35</td>
<td>25’26</td>
<td>28</td>
<td>61</td>
<td>8</td>
<td>Minié</td>
</tr>
<tr>
<td>143</td>
<td>10’75</td>
<td>7’22</td>
<td>5’63</td>
<td>3’09</td>
<td>28’29</td>
<td>48</td>
<td>88</td>
<td>6</td>
<td>Mart.</td>
</tr>
<tr>
<td>20</td>
<td>12’35</td>
<td>8’05</td>
<td>3’10</td>
<td>3’15</td>
<td>28’65</td>
<td>4</td>
<td>12</td>
<td>4</td>
<td>Minié</td>
</tr>
<tr>
<td>122</td>
<td>12’21</td>
<td>7’69</td>
<td>4’15</td>
<td>3’39</td>
<td>25’38</td>
<td>35</td>
<td>49</td>
<td>98</td>
<td>Minié</td>
</tr>
<tr>
<td>162</td>
<td>15’33</td>
<td>8’25</td>
<td>2’93</td>
<td>2’69</td>
<td>29’20</td>
<td>85</td>
<td>85</td>
<td>50</td>
<td>Enfield</td>
</tr>
</tbody>
</table>

Ditto, from May, 1855, to May, 1856.

<table>
<thead>
<tr>
<th>Non-commissioned and men.</th>
<th>As a company in 3rd class, each man firing 20 rounds per man.</th>
<th>File and volley firing, 10 rounds per man.</th>
<th>Skirmishing.</th>
<th>Total, describing merit of firing.</th>
<th>3rd.</th>
<th>2nd.</th>
<th>1st.</th>
<th>Percentage of 1st class shots.</th>
<th>Arm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>130</td>
<td>14’44</td>
<td>8’88</td>
<td>4’60</td>
<td>2’73</td>
<td>29’28</td>
<td>15</td>
<td>92</td>
<td>13</td>
<td>Enfield</td>
</tr>
<tr>
<td>164</td>
<td>15’0</td>
<td>8’70</td>
<td>4’31</td>
<td>3’32</td>
<td>31’34</td>
<td>13</td>
<td>108</td>
<td>72</td>
<td>Enfield</td>
</tr>
<tr>
<td>173</td>
<td>18’66</td>
<td>9’10</td>
<td>4’53</td>
<td>3’37</td>
<td>33’66</td>
<td>15</td>
<td>97</td>
<td>61</td>
<td>Enfield</td>
</tr>
<tr>
<td>128</td>
<td>18’36</td>
<td>9’86</td>
<td>4’73</td>
<td>2’99</td>
<td>35’94</td>
<td>2</td>
<td>69</td>
<td>67</td>
<td>Enfield</td>
</tr>
</tbody>
</table>

Ditto, from May, 1856, to May, 1857.

<table>
<thead>
<tr>
<th>Non-commissioned and men.</th>
<th>As a company in 3rd class, each man firing 20 rounds per man.</th>
<th>File and volley firing, 10 rounds per man.</th>
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<th>Total, describing merit of firing.</th>
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</tr>
</thead>
<tbody>
<tr>
<td>164</td>
<td>17’10</td>
<td>9’88</td>
<td>4’45</td>
<td>3’73</td>
<td>35’14</td>
<td>3</td>
<td>89</td>
<td>73</td>
<td>Enfield</td>
</tr>
<tr>
<td>135</td>
<td>18’19</td>
<td>9’47</td>
<td>5’37</td>
<td>4’83</td>
<td>37’86</td>
<td>4</td>
<td>52</td>
<td>79</td>
<td>Enfield</td>
</tr>
<tr>
<td>143</td>
<td>18’84</td>
<td>10’48</td>
<td>5’04</td>
<td>4’64</td>
<td>38’98</td>
<td>2</td>
<td>59</td>
<td>82</td>
<td>Enfield</td>
</tr>
<tr>
<td>163</td>
<td>17’24</td>
<td>9’90</td>
<td>4’13</td>
<td>4’13</td>
<td>37’52</td>
<td>2</td>
<td>55</td>
<td>96</td>
<td>Enfield</td>
</tr>
</tbody>
</table>

Of the ammunition used with the Lancaster carbine at Malta, half was of the solid Pritchett bullet and half of the cup-ball ammunition. At Hythe the ammunition used during the last year was entirely that fitted with the wooden plug, which has recently superseded the other two kinds.

From these tables it will be seen that, during three years' practice at Hythe, the highest percentage of first-class shots with the Enfield rifle never amounted to 63 per cent., while at Malta, with the Lancaster carbine, the percentage amounted to nearly 78, for out of 189 men (previously unskilled
in the use of any kind of firearm), all but 20 were, in a few days, ranked in the first class.

We cannot but admit that this report establishes a high character for the Lancaster rifle. It is free from many objections that were formerly urged against rifles generally, and it is almost impossible that the barrel should lead after any amount of firing. It is readily cleaned, and, for sporting purposes, it has this advantage over every other denomination of rifle, that it can upon emergency be used with good effect as a shot gun.

I have stated above, that so far as the principle is concerned, it is a modification of the 2-grooved, but at the same time a modification that obviates all the objections to which that system was open. General Jacob is evidently under a misapprehension in this matter. He calls the elliptic bored "only the 2-grooved rifle in disguise," and adds that, "if the shoulders of a 2-grooved rifle be removed, you have the Lancaster rifle; but, by the removal of these shoulders, the friction, if the twist be considerable, becomes enormous. The ball and the bore are not quite round, but nearly so; wherefore, as the ball is compelled to follow the twist of the bore, it acts like a 'cam,' and endeavours to burst the gun. The heat developed by the friction must be very great, and the tendency of the gun to burst, or the shell to crush, also very great."

Having given the matter very close attention, I am enabled confidently to state that the whole of this supposition is founded in error. I do not indeed think that the General can ever have tried the Lancaster rifle; but rather suppose that he has been induced to put these opinions upon paper from what he has heard and read, rather than from what he has actually seen. So far from the friction
being "enormous," it is less than that generated in any other kind of rifle. It is also utterly impossible for the bullet to act destructively on the barrel in the way suggested.

No doubt many were led to distrust the Lancaster principle from the failure of some of the early attempts to project shells from some of the guns of heavy calibre. The blame, however, in those cases, really rested with the shells, which were originally made in two pieces, welded or brazed together. By the force of the explosion in the chamber of the gun, flame was driven through flaws in the imperfectly united metal, and the shell of course often exploded in, or at the muzzle of the piece. Had the shells been properly made, this could not have happened.

On the 4th of August, 1858, some further experiments were conducted on the Chatham marshes, near St. Mary's Creek, expressly for the purpose of testing the comparative range and accuracy of the Lancaster and Enfield rifles.

The arms made use of on the occasion, were Lancaster's elliptical rifle, of the same construction as that used by the Royal and East India Company's Engineers, and the ordinary Enfield rifle in use by the troops of the Line and at the School of Musketry, Hythe. The persons selected to make the trial were several non-commissioned officers belonging to the Royal Engineers and an equal number of non-commissioned officers chosen from the depôts of the East India Company's regiments attached to the 2nd Battalion, each of whom had undergone a regular course of instruction in the theory and practice of the rifle. Twenty rounds of ball cartridge were supplied to each. The practice commenced at 350 yards, the distance being gradually increased to 600
yards. The result of the trial again proved most conclusively the superior accuracy of the Lancaster over the Enfield rifle, although the skill of the contending parties was as nearly matched as possible. The practice of the non-commissioned officers was allowed to be very good, the target at 500 and 600 yards being repeatedly struck, and the general accuracy of the firing such as to elicit unqualified admiration. At the termination of the trial it was ascertained that the non-commissioned officers of the Royal Engineers, with the Lancaster rifle, had gained the large number of 17 out of 20 "points," while the number of "points" made by the non-commissioned officers of the 2nd Battalion, with the Enfield rifle, was only 13-88. The finest practice which took place during the trial was that made by Colour-Sergeant Barrow, Royal Engineers, and Colour-Sergeant Gosling, 52nd Light Infantry, each of whom made the astonishing number of 21 "points."

Mr. Lancaster has lately brought out a very neat breech-loading carbine, from which satisfactory results may be justly anticipated. It bears some resemblance to Prince's, hereafter described; but there is this difference between the two,—in Lancaster's the barrel is immovable in the stock, and the cartridge is inserted into a moveable chamber; the cock, too, is under the barrel and before the guard.

A few days later than the experiments above recorded, the final trial between the Lancaster and Enfield rifles took place at Chatham.

A number of skilled non-commissioned officers from the 3rd Battalion of the Line were provided with the Enfield, and a like number of non-commissioned officers belonging to the Engineers with the rifle arm.
Each man had twenty rounds of ammunition. The targets were fixed at different distances varying from 350 to 600 yards.

The Lancaster evinced its superiority from the first, and maintained it throughout the trial; at the close of which it was found that, out of the twenty rounds, the average number of "points" made by the Royal Engineers was 15.66, the non-commissioned officers of the Line only averaging 8.0. Sergeant Cann, R.E., made the finest practice of the day, gaining the unprecedented number of 23 "points."

The result of the whole series of experiments is, that the Lancaster rifle gained 15.88 "points," the Enfield rifle only 12.62; showing a very decided superiority in favour of the Lancaster weapon.
WHITWORTH'S RIFLE.

During the late war the range of the Enfield rifle proved so far superior to that of the weapons in vogue amongst the Russians, that they freely admitted its tremendous power; but when, for various reasons, private manufacturers in England confessed themselves unable to furnish the supply required at that period by Government, within the prescribed limits of cost and time, it was found that the Board of Ordnance was itself unable to cope with the difficulty. The absurd system of contracts to which that body had so long had recourse, together with the pernicious combinations at Birmingham, resulted only in the complete disorganization of the gun-making trade. The Ordnance Board was accordingly compelled to apply to Parliament for the means of establishing on its own account, a small-arms manufactory on a scale suited to the requirements of the country. No sooner was the project known, than the master gun-makers at Birmingham offered it every opposition. A Select Committee was appointed to investigate the matter, and their deliberations gave birth to a massive blue-book of 506 pages, weighing four pounds avoirdupois.

The Committee sat from the 9th of March to the 12th of May, 1854; during which interval they
asked no less than 7933 questions. It might have been supposed that so laborious an investigation would have elicited some valuable information: I must confess, however, that after having bestowed most diligent attention on this heavy folio, I have found but little to repay the labour of perusal.

Perhaps the most interesting intelligence it supplies, is that imparted by Mr. Whitworth, the celebrated machinist at Manchester. He proved the possibility of measuring sizes, mechanically up to the millionth of an inch, and then demonstrated that until the present time no steps had been taken to test, by means of difference gauges, the accuracy of the interior of gun-barrels—a matter upon which their correct performance so entirely depends.

He asserted, with perfect truth, that, till that plan had been adopted, no conclusions on which any dependence could be placed were attainable for determining the true form of bore; adding that, if a Government factory for small arms were established without this knowledge, the results would be illusory and unsatisfactory.

Among gun-makers there was no unanimity on the subject; and as the matter was sufficiently important, Mr. Whitworth volunteered, if his expenses out of pocket were defrayed, to conduct gratuitously a series of experiments for the sole purpose of elucidating the above question.

The proposal was accepted; a sum, as it is reported, of 12,000£ was granted; and a gallery 500 yards in length was erected in Mr. Whitworth's grounds at Manchester, so contrived that a series of experiments can be carried on and registered under precisely the same conditions.

The projectile in its flight is protected against atmospheric currents, and by a simple arrangement
of paper screens, its exact course from the point of delivery to the target can be accurately observed. By preserving a uniform temperature at the end of the gallery where the gun is fired, and by certain appliances with reference to the recoil, guarantees are obtained that each shot shall be taken under similar circumstances. The gun is fitted accurately into a frame resting upon a perfectly level plane, and the recoil must take place in a line precisely parallel to the axis of the gun, and can be calculated to a nicety. Again, when the object is to prevent any recoil, there is no difficulty in doing so. The target travels to any point in the gallery on a tramway, and the distances are marked on the wall, in order to determine the exact range.

Mr. Whitworth, moreover, took the following means for obtaining an accuracy never before attempted in the bore of fire-arms. The regulation size being .577 of an inch, he adopted that as his standard; and bringing into requisition his extraordinary accuracy of mechanical execution, he made a series of "difference gauges," representing successive variations above and below this standard, each stage of increase or decrease being exactly the 5000th of an inch. A degree of precision in the bore was thus acquired, the extent of which may be best estimated when it is borne in mind that the most expert Birmingham manufacturers for Government have never reached a higher standard than the 350th of an inch. By the means thus indicated Mr. Whitworth readily ascertained that the most highly finished barrels hitherto produced were devoid of all truth, and contained inequalities which could not but detract largely from their precision when fired. In some the bore was found conical in one direction, cylindrical in the opposite—all were more
or less irregular. Proceeding to further trial in the shooting-gallery, he found the evidence of his gauge fully confirmed by the uncertainty in the flight of the projectile. He then prepared two barrels, one 10 inches, the other 20 inches long, which, though not absolutely perfect in their fire at first, soon gave tolerably satisfactory results, and proved that the course adopted was the right one.

These experiments naturally drew Mr. Whitworth's attention to the whole subject of small-arms and artillery, and induced him to take out several patents; but he has placed the whole of them freely at the disposal of Government.

The great peculiarity of Mr. Whitworth's rifles consists in the polygonal form of the bore, the gauge number of which is about 48; the length of barrel being 39 inches, and pitch of rifling, one turn in 20 inches; so that the bullet makes nearly two complete revolutions before its departure from the muzzle: though he has made some, in which the ball makes six or seven complete turns in the barrel.

The projectiles, as shown in the annexed wood-cut, are conical for about the length of half a diameter from the foremost end, and hexagonal for the remainder of their length (or 2½ diameters), the sides of the hexagon having an inclination, corresponding precisely with those of the bore. The interior of the barrel is bored and rifled with a degree of precision not long ago considered unattainable, and the exact fitting of the projectile is secured beyond the possibility of error.

How far this weapon can be manufactured upon an extensive scale, at a cost at all comparable with that of the Enfield
GREAT RANGE OF WHITWORTH'S RIFLE. 105

rifle, remains to be shown; but if it can always be
made to exhibit such superiority over that arm, as
was displayed during a trial of the two at Hythe, in
April, 1857, the Government would be amply justified
in securing the future services of such an implement,
even at a much enhanced outlay.

I understand that a first-rate rifle of this construc-
tion costs thirty five guineas, and that the price of
plain regulation arms is from twelve to fifteen
guineas.

From those who were present at Hythe on the
occasion above alluded to we learn, that the efficacy
of Whitworth's to that of the Enfield rifle, was
estimated in the proportion of nearly 20 to 1. At 1880-
yards (or 120 yards more than a mile) it drove its
bullets into the target, when the Enfield made no hits.
at 1440. As regards accuracy, the Whitworth, at
1100 yards, was nearly on a par with the Enfield at
500; and, when both had a range of 500, the
superiority of the Whitworth was in the proportion
of 3 to 1. With the regulation charge of powder it
propelled a bullet through thirty-three half-inch
elm planks, and the missile was then only stopped
by a solid block of oak behind. The Enfield,
under similar circumstances, only penetrated twelve
of these planks.
MAJOR NUTHALL'S RIFLE.

THIS gallant officer, for three-and-twenty years has been on active service with his regiment in India, and entertaining always a strong predilection for the rifle and for rifle shooting, has had numerous opportunities of witnessing the serious imperfections of the Enfield. For some time past his endeavours have been unremitting, to produce a weapon which shall at once be free from the objections pertaining to the regulation arm, and yet maintain all its advantages; this he considers he has now fully accomplished, and he expresses his readiness to present it for the adoption of all Volunteers.

One great defect in the Enfield is, that after firing from 10 to 15 rounds with the .568 bullet, about 15 per cent. of the men, find it almost impracticable to load; the barrels (owing to foulness) refusing to receive the cartridge, and this defect the Government have since remedied by reducing the bullet to .550, an alteration which has materially impaired the accuracy and range of the piece, and left it with its original objection as to foulness, should a more nicely fitting bullet be reverted to.

The object of the Major’s invention has been, so to reduce the friction between the barrel and the projectile, as to ensure certain ease and facility in loading (even with the .568 bullet), and yet preserve
accuracy in shooting; and this he has attained,—first, by making the inner surface or bore of the barrel perfectly smooth; and secondly, by adapting the projectile to the arm, so that only two fine belts of lead rest upon the bore; but that this may be more fully understood, I will describe it.

In the ordinary mode of grooving rifles, sharp angles are left between each groove and "land." These create great friction with the projectile, both in loading and discharging. The "lands" also being broad and flat, as in the three-grooved Enfield, add to the friction, and tend to resist the expansion of the bullet.

He removes these objections by rounding off the "lands" into the grooves—that is, making them a series of convex and concave curves, the bore assuming a beautiful appearance to the eye, for the smoothness and evenness with which the "lands" and grooves blend into each other.

Heretofore the word "lands" has served to designate those parts of the smooth bore, left in their original state after the process of grooving has been completed. By the new system, a peculiar cutter is required to round off these "lands," care being taken to remove all points on the original-surface, so that a fine round bold bearing is obtained between the barrel and projectile, which contributes to the expansion of the latter, by easing off and moulding the lead into the grooves.

This form of constructing the interior of arms is considered entirely new, and may be applied to any regular figure, that is to say, to any figure having the grooves in exact proportion to each other.

Stonehenge, in his recent work *On the Sporting Gun and Rifle*, states that this mode of grooving is identical with Boucher's; but Major Nuthall thus
distinguishes between the two. "Boucher, at page 46 of his work, says: 'The cutter should be just a fifth of the circumference of the bore, and very shallow, and care taken not to go so deep as to effect the five points of the original surface, where the bullet is seen to touch the sides, leaving the bore without any sharp edges.' Now cut longitudinally through a piece of barrel thus described, and a piece as described by myself, so that in place of a cylindrical surface a flat one will present itself. It will be clear, that whilst in the one case each concave cut, however fine, has preserved the five concave points in the original surface, in the other, each bold convex cut has removed and rounded off these points, rendering the contour of Boucher's, a series of linked segments, and of mine an unbroken waved line.

"The adaptation of the bullet to reduce friction is effected by reducing only the cylindrical portion of the bullet to .550, retaining the dimensions of the original bullet .568 at the base and spring of the cone, so as to preserve its axis coincident with that of the barrel and yet prevent windage, the reduced portion of course being relieved from friction on the barrel. But this bullet need not be used except for fine practice, the rifle being equally well adapted for the Government ammunition as the Enfield."

The prominent advantages of this mode of rifling arms, it is contended, are: first, that whilst the "lands" from their peculiar shape, serve to facilitate the expansion of the bullet by moulding it into the grooves, they answer also (after the expansion) as so many lines upon which the bullet traverses with the least possible friction; secondly, in loading, any accumulation of dirt is necessarily driven aside, and carried forward at each discharge; and lastly, though it should only be equal to any other,
its adoption will secure to the volunteer an original and serviceable weapon, in place of the chance of getting a 39-inch rejected barrel cut down and "Brummedge" up, as too many have been.

This form of grooving has received the approval of some of the most scientific men in London; and Major Nuthall has already been requested by General Boileau, late Chief Engineer in Bengal, to send him a supply of rifles on this principle for India. The General, whilst recently staying at Hythe, had one of Nuthall's common army rifles with him, and received an offer of ten guineas for it from a gentleman there. Mr. Robert Loder, of the High Beeches, Sussex, also writes:—"I am pleased to be able to tell you that your rifles were more approved of upon trial than Lancaster's, and I have ordered two by to-day's post for a Rifle Corps here."

To place beyond doubt the advantage of Major Nuthall's system, it was applied to the barrel of an old "Brown Bess." On trying which, at 500 yards, out of 20 shots not one missed the target, and 16 out of 20 were found within a circle of 3 ft. 9 in. diameter. Major Nuthall considers with me, that better shooting is obtained with a tightly-fitting bullet, well lubricated, and without a patch, than with the ordinary bullet and patch. The composition he recommends, consists of 11 oz. of bee's-wax, and 1 oz. of purified petroleum, (to be obtained at Price's candle works, Lambeth). The bullets must be dropped hot into this from the mould, or they must be subsequently heated to 300° or 350° Fahr. It is useless to apply any lubrication at a lower temperature.
GENERAL BOILEAU'S RIFLE.

General Boileau, who has devoted much attention to the subject of rifling, has arrived at the following conclusion, regarding the movement of an elongated bullet in the barrel of a rifle.

His impression is, when the bullet is expanded by the first impulse of the exploded powder so as to take the exact form of the bore, and to enlarge to the full calibre of the ungrooved portion of the barrel; that when commencing its onward course, it meets with considerable obstruction from the upper portion of the grooves. He considers that as it proceeds forward it is twisted on its axis, by the continued action of this resistance, and thus receives a spinning motion (from right to left), which continues to the extreme verge of its flight. If the resistance were exerted by what he distinguishes as the lower portion of the grooves, he conceives that the twist given to the ball would be in a reverse direction, and that instead of acquiring a spinning motion, the bullet would inevitably "strip."

If this view be correct, and I am strongly inclined to adopt it, it follows as a necessary consequence, that in obeying the action of the upper portion of the grooves, which action is continually tending to produce a turning of the bullet on its longer axis, there is an equally continuous effort of the bullet, (resulting from this twisting motion) to relieve
itself from contact with the lower part of the grooves, and this General Boileau considers to be the case, whatever be the form of the grooves. In other words, it is the upper portion of the grooves alone that produces the spiral motion, the lower side of the groove being altogether inoperative.

He is of opinion, therefore, that if the grooves in the Enfield rifle were cut away on one side, as shown in the accompanying figure, instead of being

left square in the usual manner, they would be equally effective, and there would be no tendency of the bullet to strip.

The amount of pressure caused by the tendency of the bullet in its spiral motion to turn away from the lower side of the grooves may not be very considerable; still there is every probability that the mode of action is, for the reasons assigned, as above stated, and that it does exercise a pernicious tendency.

In the Whitworth Rifle, which has been found not only to possess the longest range, but also the lowest trajectory, and greatest penetration of any rifle excepting Jacob's; the movement of the ball in the barrel is probably precisely that above described and as indicated in the annexed engraving.

As soon as the ball begins to move forward, it meets with resistance from the sides of the hexagon, which are inclined to the axis of the bore. A motion from right to left is the obvious result. The consequence no doubt is, that the six shoulders
of the ball press against the upper parts of the six sides of the barrel, while the lower part of the sides of the projectile are by this twisting motion deflected, or turned away, from the lower parts of the sides. This will be understood by a cursory inspection of the sketch.

The amount of relief may be so small, as not to amount to an actual separation of contact, but it is more than probable, that even that slight diminution of pressure is important, both to the range and the precision of the projectile.

General Boileau thinks that Major Nuthall's rifle will—for reasons which apply specially to his particular form of grooving—produce a good spin in the ball, and he even goes so far as to say that he believes Major Nuthall's plan of grooving to be by far the most scientific that has yet been brought out.

The above considerations have induced me to give the accompanying sections of a barrel, exhibiting a form of grooving, which, if General Boileau's theory be well founded, will produce the greatest amount of spin in the ball with the least amount of friction.
The figure in the centre of each wood-cut, represents the size and form of the interior of the barrel, the outer circles being intended simply to render the illustration plainer.

The arrangement proposed is to adopt a 40 bore (0.498 inch) with six grooves. There will, of course, be as many "lands," each 0.08 inch wide, which will give for the six, 0.48 inch, or nearly half an inch of the original bore, a quantity quite sufficient to preserve the calibre. As regards the dimensions of the grooves, they are to be 0.015 inch deep at their greatest depth, their width being determined by that of the "lands." They will be of an oval form, sloping away to nothing at the next "land," as shown in the woodcut. I should observe that in the above engraving, the external circles are only intended to exhibit, on a magnified scale, General Boileau's system. The two figures in the centre are correct in size, and show the appearance of the bore of a rifle made upon this principle.

This mode of constructing the grooves is certainly very philosophical, and can be productive of no bad effect. It secures a "nip" on the bullet in its progress through the barrel in the very part where the effect in producing a twisting motion will be most complete, while it relieves the bullet from all unnecessary friction at that part where the effect of such resistance would produce a reverse motion, and its inevitable consequence, the "stripping" of the bullet, an accident, as is well known, of no uncommon occurrence with ordinary rifles.
PRINCE'S BREECH-LOADER.

Having already expressed my conviction that the breech-loading system will, from its many obvious advantages, entirely supersede the old method of muzzle-loading, and it ought most certainly to do so, I proceed to call attention to one of the simplest and handiest breech-loading rifles that has yet been tried.

Mr. Prince has been experimenting for many years with the view to bring this kind of gun to perfection, and the success he has attained leaves little more to be desired.

His rifled carbine is well adapted for cavalry, as it can be loaded and fired easily with one hand; it is light, compact, and in external appearance differs very slightly from the common weapon now in use in the service.

His rifled musket adheres closely in pattern to the Enfield, and carries the regulation ammunition.

The woodcut on the next page accurately represents that portion of the arm in which its peculiarity consists.

The upper figure shows the chamber closed and ready for firing the lower one exhibits it open, preparatory to the insertion of the cartridge, which is put in entire, and though made of two folds of paper, to resist wet, as well as the wear and tear of the
soldier's pouch, is easily and infallibly penetrated by the fire from the cap.

It will be seen that in front of the guard is a small lever, terminating in a knob, kept in its place and locked, by a little bolt attached to the bow of the
guard. In order to load, the stock being firmly grasped under the right arm, the catch is released, and the knob attached to the lever is drawn to the right, and almost simultaneously pushed forward: The lever being firmly connected with the breech end of the barrel, the whole of the barrel is thus slipped forward in the stock, to the extent of about three inches, disclosing a steel cone, provided on either side with inclined planes, forming a segment of a screw, and locking tightly into slots at the breech end of the barrel. The cartridge is dropped into the open space at the extremity of the cone, the lever is depressed, pulled backward, and then pushed into its place. The barrel and cone are thus tightly locked together, and until they are in this position the gun cannot possibly be fired. It is therefore obvious that in strength and security this rifle is not inferior to any of the old make.

The rapidity with which it can be loaded and discharged, is more than sufficient for any possible emergency, since it admits of six rounds being fired in 46 seconds. At a trial at Hythe, Mr. Prince fired 120 rounds in less than 18 minutes, and surely it is not easy to imagine any exigency of modern warfare requiring a soldier to deliver his fire much oftener than once in nine seconds.

Of course the principle, patented by the inventor, can be adapted to any kind of rifling; that, however, which Mr. Prince prefers, is a five-grooved bore, rather deeply cut, the twist being three-quarters of a turn in three feet. This rifle certainly is a very perfect arm, and exhibits great precision at the longest ranges. As there is but little recoil, and none of that strain or exertion on the part of the marksman inseparable from the use of all muzzle-loaders, the
hand has no tendency to become unsteady after a long morning's practice.

It will be seen from the following testimonial, that several London gunmakers, who have had opportunities of witnessing the efficiency of this rifle, speak highly of its valuable qualities.

COPY OF TESTIMONIAL FROM LONDON GUNMAKERS.

"We, the undersigned, being actuated by no other motive than a desire to see the most effective weapon in the hands of our soldiers, and having beyond that no interest whatever in Mr. Prince's breech-loader, do hereby attach our names for the purpose of attesting our belief that its principle is beyond comparison the best we have seen for a breech-loading gun, and in our opinion quite free from those practical objections existing in all the breech-loaders previously introduced.

"From its extreme simplicity, we also deem it well adapted to withstand the exposure to wet and to rough usage incidental to a military weapon, while the cartridge itself being waterproof, adds to its superiority.

"John Blanch and Son, 29, Gracechurch-street.
John Blissett, 322, High Holborn.
B. Denyer, 131, Holborn.
George Fuller, 280, Strand.
J. Greenfield and Son, 10, Broad-street.
John Manton and Son, Dover-street.
Moore and Woodward, 64, St. James's-street.
Parker, Field, and Son, 233, Holborn.
Henry Tatham, 37, Charing Cross.
Henry Wilkinson, Pall Mall."

As regards the accuracy of a rifle of this kind, it is sufficient to state that, at a recent trial of various arms at the Victoria Regimental Practice Ground, Mr. Prince, with a rifle of very small bore, put sixteen shots in succession into a small sheet of note-paper at 100 yards, and twelve into a sheet of fools-
eap at 200 yards. In the first case the shots averaged 1\frac{3}{4} inches from the centre, in the second experiments 4\frac{1}{2} inches.

"In one of the early trials (1855) made before Colonel Hay, at the Hythe School of Musketry," says the author of a recent elementary treatise on firearms, "a carbine of Mr. Prince's was fired in competition with the Enfield Rifle, fifty shots being fired from each at 300 and 600 yards respectively. At the latter distance a private soldier shot both guns, and Sergeant Hines of the 90th at the shorter distance. At the longer range, the shooting of the two arms, despite the greater length of barrel of the Enfield Rifle, was about equal, Prince's carbine striking the target forty-eight times, the Enfield forty-seven, out of the fifty shots. Though a strong head wind blew at the time, scarcely a shot fired, but would have told on a small detachment of men; while, at the 300 yards, the accuracy of fire from the carbine was greatly superior to the Enfield, every shot from the breech-loader, inclusive of seventeen bulls'-eyes, being within a radius of three feet diameter, and those from the Enfield within six and four feet.

"By way of comparing the relative faculties of the two arms in the matter of rapidity of fire, Sergeant Hines then fired the Enfield rifle for fifteen minutes successively, loading and firing as quickly as possible. Thirty-five shots were thus fired from the Enfield, all striking the six-yard-square target, but variously distributed over the same. Mr. Prince himself then loaded and fired his breech-loader for five minutes only, taking time for a much more deliberate aim than Sergeant Hines with the Enfield; but in that five minutes he delivered twenty-four shots, every one of which would have struck the
figure of a man. To make up the number of 150 rounds, Mr. Prince then fired from a rest at 200 yards, to prove that neither quick firing, nor the carbine remaining uncleaned, detracted in the least from its shooting qualities."

Prince's cartridge, which may be used either with a muzzle or with a breech-loader, is a very valuable and ingenious invention. Though formed, as already stated, of strong paper, through which the flash of the cap passes with certainty, yet the paper is entirely consumed during the explosion, leaving no residue whatever behind.

To prepare paper for this purpose, the best material to select, is strong unsized paper (white blotting paper will answer very well). Mix together 2 parts of strong sulphuric acid and 5 parts of fuming nitric acid, of the specific gravity of 1.5. Immerse the paper for about two minutes in the mixture, then wash it thoroughly in running water, till every trace of acidity is removed. When dried, the paper will, if properly prepared, be found converted into a tough material, resembling parchment, and on ignition will leave no perceptible ash.

I am informed that the paper may be purchased, ready prepared, at 421, Oxford Street.
TERRY'S BREECH-LOADING RIFLE.

This rifle in some respects externally resembles Prince's, but the principles in either case are essentially distinct. In Prince's the whole of the barrel moves forward; in Terry's it is fixed, and the admission of the cartridge is effected through an opening at the base of the breech. Above the lock, and flush with the barrel, is a lever, which being raised and drawn with a half-turn to the rear, gives immediate access to the receptacle for the charge. A thick felt wad, saturated with grease, is fixed to the bottom of the cartridge, for the purpose of lubricating the barrel after each discharge. The wad, before the ignition of the powder, rests against the end of a small cylinder which projects into the barrel, and thus serves to break the recoil. I have not had many opportunities of judging of this gun, which possibly may admit of further improvement. A carbine on this construction (577 bore), sent to me for trial, did not load with the same facility as one of Prince's rifles, nor was its accuracy of fire at all comparable to that of the latter weapon.

More than a century ago, Robins, in his Treatise on Gunnery (p. 337) described a rifle constructed to load much on this principle, and somewhat prophetically adds, "Perhaps something of this kind, though not in the manner now practised, would be
of all others the most perfect method for the construction of these sorts of barrels." I merely cite this quotation to show that there is nothing very novel in the contrivance of a breech-loader having a chamber with a side-opening.

A breech-loading rifle carbine, capable of being converted in a moment into a pistol, the invention of Mr. Terry, of Birmingham, was tried on board her Majesty's ship *Excellent*, under the superintendence of Capt. Hewlett, C.B.; from May 10 until the end of last July (1858), 1800 rounds were fired from it with unprecedented accuracy at various ranges, and that too without cleaning the weapon, which, notwithstanding, gave no recoil. In testimony of this severe ordeal, Captain Hewlett handed the following certificate to the inventor:

"This is to certify that I have seen 1800 rounds fired from this rifle without cleaning.

"July 20, 1858.

"H. R. Hewlett."

The rifle missed fire but twice in the 1800 rounds, and, whether discharged by officer or man, eighty-six per cent. were "hits." The rifle was subsequently taken to the camp at Browndown, and its capabilities exhibited before the troops and instructors in musketry of the 15th Foot (Lieutenant Cuthbert), the Royal Marine Light Infantry (Major Lowder). The practice at 700 and 800 yards was marvellous, notwithstanding a very powerful wind. Its advantages over the old pieces are, three pounds less in weight, and five shots to one in time of firing, with a tremendous range, and yet without any necessity for cleaning out, under about a couple of thousand rounds.
WESTLEY RICHARDS' BREECH-LOADER.

Not long since, a breech-loading carbine was forwarded to Hythe by Mr. Westley Richards, and it has, as I am informed, given great satisfaction, General Hay having expressed his approval of it in terms of warm commendation. This arm has been subjected to very severe trials, and appears to have passed most creditably through them all. Major Nuthall thinks very highly of this form of breech-loader. On the 25th of October, 1859, he witnessed some experiments at Birmingham with two carbines on this construction. The bore of each was .450 inches, and its internal form octagonal. The rifling, like Whitworth's, completing 1 turn in 20 inches. The balls used, weighed 400 grains, and were fired with 55 grains of F. G. powder.

At 400 yards, with an elevation of 1° 21', out of 40 rounds, the hits did not average 7.8 inches from the centre of the mark.

The carbines were fired from a rest of the most accurate construction, but the aiming was difficult, as the day was stormy and unfavourable.

Colonel Wilford says;—"the weapon manufactured by Mr. Westley Richards is a perfect wonder. I saw a small carbine, weighing only 5½ lbs. fire better at 800 yards than the long Enfield."
LEETCH'S BREECH-LOADER.

James Leetch, a gunmaker, in Margaret-street, has produced a very simple, ingenious, and perfectly safe breech-loading rifle; one, moreover, with which a military regulation cartridge can be readily used. It can also be fired with any of the special cartridges at present before the public, or with loose powder and ball. It admits of being rifled on any principle that may be selected, and it certainly is a very efficient arm, little likely to be put out of order by the roughest treatment.

The opening for the admission of the charge is in front of the chamber, consequently the shooter has all the security that the solidity of the breech can impart, between himself and the explosion—no unimportant consideration, in some cases.

I have seen many rounds fired with great accuracy from one of these breech-loaders, and have noticed no defect either in the principle or in the workmanship. On one occasion at Woolwich, when 130 rounds were fired in rapid succession by order of the sub-committee of small arms, the cartridge was in no instance found too tight for the cylinder; there was no difficulty in loading, nor a single miss-fire; no grease was found requisite after the first shot, and there was only a slight deposit of powder at the bottom of the cylinder. The thermometer at the time stood at 79°, and the day was dry and hot.
This breech-loader (for which Captain Norton's gossamer cartridges are peculiarly adapted) has been reported upon favourably by the authorities at Woolwich on several occasions, and one whose experience on matters of the kind is entitled to deference, thus expresses himself upon the subject:—

"Among the numerous breech-loaders which have recently been brought before the notice of the public and of the military authorities, this one is entitled to a prominent place. The mechanical arrangements are exceedingly simple and effective; so much so, that it has been already very favourably reported upon by those most competent to judge of its merits. . . . . But this invention may fairly be quoted as an additional proof, if such be wanted, that the impulse which the late war has given to the ingenuity of our mechanics, has already placed at the command of our military authorities weapons, of a kind which would, with their own bravery, give our troops a decisive and easy superiority over any foe that could be brought against them in the field. That is all that civilians can be expected to do. If the army has not the benefit of such improvements, the responsibility rests heavily with its chiefs."

The price of this arm is from £8 for a plain military weapon to £25 for one more elaborately finished.
FOREIGN RIFLES.

We may now proceed to consider briefly some of the principal varieties of rifled arms in use in other countries.

The military authorities of France, have probably devoted more attention to the perfection of small arms than those of any other Power, and the results attained in the course of the long series of experiments, that have been conducted for years past at the different French schools of musketry, at Vincennes, Toulouse, Grenoble, and St. Omer, have added many new facts to science.

The class of elongated projectile, to which attention was chiefly directed, as soon as the results attained by that of Captain Minié were known, comprised every variety of the balles à culot. These, as their name implies, depended for their efficiency upon a cup, a disc, or plug, of some material, inserted into the base of the bullet, driven forward by the explosion, and thereby completely filling the grooves of the rifling, and reducing the windage to a minimum.

M. Faucompré, a captain of artillery, was one of the first, ten years since, to suggest the inutility of the cup or plug. He produced a bullet, not very unlike the Enfield, which gave occasionally good practice. The cavity at its base, on being expanded by the explosion, rendered all lateral escape of gas
impossible. But, for reasons which it is not requisite to detail, the uniform action of the gas, in the required direction, could not always be relied upon, sometimes the bullet was torn to pieces, part only being projected; at others, a considerable portion of the force of the powder made its way round one side of the bullet, when of course its flight became irregular and uncertain, proving that it was not suited for military purposes. The conclusion arrived at, therefore, after innumerable trials with this and other bullets of a like kind, was in favour of those that were provided with plugs to regulate the expansion, at the same time that apprehension was felt, lest at any time on foreign service a difficulty should arise from inability to procure these accessories. However, to test this point practically, ammunition, like that recommended by Faucompré, was issued to four regiments, but several advantageous modifications of his principle were at the same time introduced. The trial, upon the whole, was not deemed unsatisfactory. In 1853, three more regiments were supplied with cartridges of the same kind, and comparative experiments were instituted by these troops, for the purpose of deciding upon the relative merits of this and of other varieties of projectiles.

After many months' investigation, preference was given on the whole to the rifle without the tige (or stem for supporting the bullet during the act of loading), in combination with the plug bullet; in comparison with the tige rifle and oblong bullet; either of them, however, proved far superior to the old smooth-bored musket and globular projectile.

At the same time, the plug was considered objectionable, and it was thought that the bullet would be liable to injury, if roughly handled in quantities, when
unprovided with the plug; while the necessity, for using with the rifle from which it was projected, a sight requiring great elevation was stated by officers to be likely to give rise to much inconvenience.

Lieut. Nesler, with a view to remedy these inconveniences, submitted for trial, a bullet designed to be fired from a smooth barrel, and without receiving any rotation upon its axis. The projectile, which was of very peculiar form, weighed 463 grains, and was fired with a charge of one-fifth of its weight of powder.

From its shape, it moved uniformly and steadily, in the direction of the motion of translation, but its range was not more than 500 metres, and at that distance its penetration was inconsiderable. At 270 yards its accuracy was double that of an ordinary spherical ball; at 440 yards it had the same accuracy as the round bullet at 270; and at 540, one-half the accuracy of the round ball at 270.

It was used for some time in the early part of the Crimean war, but as it obviously could not be regarded as a perfect projectile, experiments with the plug ammunition were resumed, and they gave rise to what was called the "bullet of the Guard." It weighed 555 grains, and the charge of powder used with it was 62 grains. Compared with the plug bullet, its precision was nearly the same, while it was less liable to injury from the explosion; up to 660 yards, its trajectory was flatter, it consequently required less elevation to be given to the rifle.

A new impulse was now given to the researches that had long previously been instituted, for the
purpose of discovering the most perfect form of small arm projectile. The Minister of War, in 1856, issued an order, prescribing the requisite conditions.

1. No plug, wedge, nor cup was admissible.
2. It was to be applicable to all existing small arms.
3. Its weight was not to exceed 556 grains.
4. Its range, precision, and power of penetration, were not to be less than those of the oblong ball.
5. The loading must be simple and easy, and, finally,
6. It was not to be liable to tear, to strip, nor to lead the barrel.

A special commission was appointed, with a view to solve this problem, and they began by classifying the subjects submitted for their consideration; namely, the exterior shape of the bullet, and the form of the internal cavity.

Few of my readers would care to follow up the long course of laborious experiments instituted by this commission, nor would they be edified by perusing, even in a tabulated form, the merits of the many different bullets suggested for approval. It will suffice to describe the one finally fixed upon, as the most perfect, or at any rate, most nearly fulfilling all the prescribed conditions.

Its total length was .8465 inch; the conical part being .4724 inch; and the cylindrical portion .0787 inch from the base of the cone, terminating .1575 inch from the base of the cylinder. Its width is .1181. The cavity .551 inch deep; is triangular at the base, terminating in a point. On the base of each side of the triangle is a semicircular cavity, slightly countersunk.
One great defect of this bullet, however, is tolerably manifest on inspection, and that is, its extreme liability to injury. In addition, its precision is not equal to that of the plug bullet, over which its only advantage seems to be the fact that it weighs a few grains less.

In April, 1857, it was announced that—

1. All small arms for infantry were to be reduced to one uniform length, that of the Voltigeurs.

2. That they were to be rifled with 4 grooves .02758 inch wide, and .00788 inch deep, with an uniform twist of 1 turn in 6 feet.

3. That the back-sight should be fixed, the height being determined so as to give a convenient point-blank range.

4. That as the fire of infantry ought not to exceed 660 yards, it would be sufficient, if a bullet were fixed upon, with which precision and penetration could be secured at that range.

5. That the bullet should not be composite—should not exceed 494 grains in weight, and should have as low a trajectory as possible.

The bullet last described, nearly answered all these conditions; but it was still liable to be easily crushed or deformed. Before remedy ing that defect, the next step taken was to determine the height of the new back-sight. The rifled musket of the Guard appearing the one best suited of any, for infantry, was selected, and a fixed rear-sight of .97 inch high was adopted. The sight of the rifled musket in use in the infantry of the line was found to need only an elevation of .78 inch. It was then thought advisable to determine the position of the trajectory, with reference to the new line of sight.
The following table was subsequently drawn up, as giving the mean of numerous experiments:—

<table>
<thead>
<tr>
<th>At the distances (in yards)</th>
<th>54½</th>
<th>82</th>
<th>109</th>
<th>131</th>
<th>164</th>
<th>191</th>
<th>219½</th>
<th>245</th>
<th>273</th>
<th>300</th>
<th>322</th>
</tr>
</thead>
<tbody>
<tr>
<td>Above (inches)</td>
<td>13·7</td>
<td>15·9</td>
<td>22·8</td>
<td>22·4</td>
<td>20</td>
<td>13·3</td>
<td>3·5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below (inches)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10·6</td>
<td>27·5</td>
<td>48</td>
<td>83·7</td>
</tr>
</tbody>
</table>

The greatest elevation of the trajectory of this rifle above the line of sight, is therefore 22·8 inch, the point-blank range being about 225 yards from the muzzle. At 275 yards, then, it is permissible to aim at the waist of a man, and only at greater ranges is it necessary to have recourse to the expedient of placing the thumb across the barrel, by way of a make-shift sight.

But though the regiments above specified have no elevating sights to their rifles, the Zouaves, Chasseurs, and other special corps, are provided with them. They use the *tige* rifle (total length 49½ inches), pattern 1846. It carries a cylindro-conical bullet, furrowed with three grooves round the cylindrical part, and weighing 733 grains; 69·4 grains of powder are used to propel it. To the muzzle is fitted a yataghan-shaped sword bayonet (22½ inches long), from which the one used with our short rifles has been copied.
The following table will convey a correct idea of the power and accuracy of this arm:

(The width of the target fired at was 2.19 yards.)

<table>
<thead>
<tr>
<th>Distances in yards</th>
<th>Height of elevating sight in inches</th>
<th>Time of flight in seconds</th>
<th>Height of target at the various distances in yards</th>
<th>Per centage of hits (first-class marksmen)</th>
<th>Radius of circle in inches containing half the balls</th>
</tr>
</thead>
<tbody>
<tr>
<td>184</td>
<td>0.29</td>
<td>0.50</td>
<td>0.54</td>
<td>54.50</td>
<td>7.08</td>
</tr>
<tr>
<td>246</td>
<td>0.56</td>
<td>0.78</td>
<td>0.54</td>
<td>40.50</td>
<td>9.42</td>
</tr>
<tr>
<td>329</td>
<td>0.56</td>
<td>1.06</td>
<td>1.09</td>
<td>46.50</td>
<td>13.17</td>
</tr>
<tr>
<td>437</td>
<td>0.70</td>
<td>1.44</td>
<td>1.63</td>
<td>46.50</td>
<td>18.89</td>
</tr>
<tr>
<td>546</td>
<td>1.23</td>
<td>1.86</td>
<td>2.19</td>
<td>23.70</td>
<td>24.41</td>
</tr>
<tr>
<td>658</td>
<td>1.95</td>
<td>2.37</td>
<td>2.73</td>
<td>26.50</td>
<td>30.70</td>
</tr>
<tr>
<td>765</td>
<td>1.23</td>
<td>2.97</td>
<td>3.29</td>
<td>18.90</td>
<td>43.30</td>
</tr>
<tr>
<td>985</td>
<td>1.55</td>
<td>3.67</td>
<td>4.37</td>
<td>19.70</td>
<td>57.97</td>
</tr>
<tr>
<td>1093</td>
<td>1.92</td>
<td>4.35</td>
<td>5.47</td>
<td>23.90</td>
<td>78.37</td>
</tr>
<tr>
<td></td>
<td>2.83</td>
<td>5.07</td>
<td>6.56</td>
<td>17.40</td>
<td>90.73</td>
</tr>
</tbody>
</table>

The rifle in use by the infantry of the line is of the pattern 1854. It has 4 grooves, decreasing in depth towards the muzzle. The twist is uniform. One turn in 6 feet 6 inches. Its calibre .68 inch; length without bayonet 4 feet 8 inches; with bayonet 6 feet 2 inches. Total weight with bayonet 10 lbs. 2 oz.; weight of ball 494 grains; charge of powder 77 grains.

The ball is hollow, containing a triangular cavity. The back-sight is fixed. To aim at 200 yards or under, the fixed sight is used; but beyond that, the soldier places his thumb across the barrel, and sights over the nail; or for greater elevation still, sights over the joint of the thumb.

The object of withholding the elevating sight from general use in the French army, is said to be, to prevent waste of ammunition; as, when under excitement, soldiers are apt to fire at ranges far beyond that of their rifles.
In the course of the experiments above adverted to, it was found that bullets of various construction had different initial velocities. The velocity, for instance, of the Delvigne bullet, computed at the moment of leaving the muzzle, was 469 yards per second; while the cylindro-conical ball quitted the tête rifle at the rate of 341 yards only (or 128 yards less) per second.

The following statement exhibits in a tabular form the comparative rates of these two bullets, during their subsequent flight.

<table>
<thead>
<tr>
<th>Distances in Yards</th>
<th>164.04</th>
<th>218.72</th>
<th>282.08</th>
<th>437.44</th>
<th>546.96</th>
<th>656.16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time of flight of round ball (516.88 grains). Delvigne.</td>
<td>0.42&quot;</td>
<td>0.74&quot;</td>
<td>1.29&quot;</td>
<td>1.75&quot;</td>
<td>2.61&quot;</td>
<td></td>
</tr>
<tr>
<td>Time of flight of cylindro-conical bullet, same calibre (725.69 grains).</td>
<td>0.50&quot;</td>
<td>0.69&quot;</td>
<td>1.13&quot;</td>
<td>1.44&quot;</td>
<td>1.80&quot;</td>
<td>2.37&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Distances in Yards</th>
<th>765.52</th>
<th>874.88</th>
<th>994.24</th>
<th>1093.60</th>
<th>1202.96</th>
<th>1312.32</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cylindro-conical bullet, (725.69 grains.)</td>
<td>2.97&quot;</td>
<td>3.67&quot;</td>
<td>4.55&quot;</td>
<td>5.07&quot;</td>
<td>5.81&quot;</td>
<td>5.71&quot;</td>
</tr>
</tbody>
</table>

N.B.—The Delvigne rifle was not fired beyond 546 yards.
AUSTRIA.

After a series of experiments, Austria finally adopted, in 1853, rifles for the whole of her infantry. The Chasseurs are provided with carbines, or short rifles, and the infantry of the line with rifled-muskets. All regiments use one description of cartridge. Some of the Austrian carbines have the tige, others have not. The first are given to the non-commissioned officers, men of the third rank (who are taught to act as skirmishers), and to the best marksmen of battalions. The rifles are fitted with elevating sights graduated up to 1000 yards. Those (without tige) have elevating sights graduated up to 770 yards only. These two descriptions of weapon differ only in the tige and elevating sight.

The tige, in the Austrian carbine, is used simply to support the ball, and thus preserve the powder from being caked or crushed; it is not meant at all to assist the blow of the rammer in expanding the bullet, according to the original intention of its inventor, into the grooves. The ramrod of the Austrian, like that of the Bavarian carbine, is carried separately.

The range and accuracy of the Austrian short rifles provided with tiges are very remarkable. At a range of 820 yards, 95 per cent. of the bullets struck a target 55 feet long and 6 feet high; at 984 yards, 65 per cent.; at 1230 yards, 49 per cent. When 100 rounds were fired at 246 yards, 100 bullets were found to have struck within a circle of 6 inches diameter; at 1640 yards, the projectile has been known to pierce three deal boards, each
upwards of an inch thick, placed a foot apart, one in the rear of the other.

The rifled musket (pattern 1855), differs from the short rifle or carbine, in length of barrel, twist of grooves; in having no tige, and in carrying the ordinary bayonet. It has a graduated sight up to 245 yards; those of the men in the third rank are graduated up to 820 yards. The rifled musket is supplied to the infantry of the line, and to what are termed the "frontier regiments" (Greuzers). The carbine with tige has four grooves of uniform depth; the width of the grooves being equal to that of the lands; the twist is one turn in 5 feet 2 inches; the calibre, .54 inch, about equivalent to our 31 bore. The sword-bayonet attached to this carbine is 23 inches long, broad and flat, like our own and the French. For several inches near the point, both edges are sharp, after that but one is sharpened. The entire length of the arm, with bayonet, is 66.5 inch; length, without bayonet, 43.5 inch; total weight, with bayonet, 11 lbs. 1 oz; without bayonet, 8 lbs. 6 oz. The charge of Austrian powder is 61 grains; the weight of the ball is precisely 450 grains. The barrel of the rifled musket is longer, and the grooves have a less sharp twist than the carbine.

The following table exhibits the relative penetrative powers of the round and of the cylindroconic balls.

The planks were of seasoned poplar, 1.02 inch thick; placed 18 inches in rear of each other; the charge of powder used to propel the round ball,
was 123.5 grains; for the cylindro-conical, 69.5 grains only, were employed.

<table>
<thead>
<tr>
<th>Range</th>
<th>Target</th>
<th>Number of planks pierced</th>
</tr>
</thead>
<tbody>
<tr>
<td>427 yards</td>
<td>6 ft. 6 in.</td>
<td>1</td>
</tr>
<tr>
<td>Musket, round ball, 120 fired.</td>
<td>Struck.</td>
<td>4</td>
</tr>
<tr>
<td>Penetrated.</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>487.44 yards.</td>
<td>Target 6 ft. 6 in.</td>
<td></td>
</tr>
<tr>
<td>Tige rifle, cylindro-conical ball, 120 fired.</td>
<td>Struck.</td>
<td>63</td>
</tr>
<tr>
<td>Penetrated.</td>
<td>63</td>
<td>55</td>
</tr>
<tr>
<td>656.16 yards.</td>
<td>Target 13 feet.</td>
<td></td>
</tr>
<tr>
<td>Tige rifle, cylindro-conical ball, 120 fired.</td>
<td>Struck.</td>
<td>20</td>
</tr>
<tr>
<td>Penetrated.</td>
<td>20</td>
<td>16</td>
</tr>
<tr>
<td>874.88 yards.</td>
<td>Target 19 feet.</td>
<td></td>
</tr>
<tr>
<td>Tige rifle, cylindro-conical ball, 120 fired.</td>
<td>Struck.</td>
<td>13</td>
</tr>
<tr>
<td>Penetrated.</td>
<td>11</td>
<td>7</td>
</tr>
</tbody>
</table>

**PRUSSIA.**

In 1847, Prussia adopted for the Chasseurs, a carbine with *tige*. The bullet is cylindro-conical, with two grooves, as shown in the engraving; its weight, 490 grains; charge of powder, 50 grains. The elevating sight (two leaved) is graduated up to 700 yards. The cartridge contains only the powder, the ball being entirely separate, and kept greased about the cylindrical part. The grooves are shallow, and of uniform twist, from breech to muzzle, making one turn in 3 feet 1 inch. In 1848, a breech-loading needle rifle, with four grooves of uniform depth, and with a twist, making one turn in 42 inches (called
Zundnadelgewehr), was (as already mentioned at page 39) issued to the Guards. The elevating sight of this arm is graduated to 490 yards; up to this range its fire is tolerably accurate, but beyond that distance it is very uncertain. The weight of the bullet, which in form is ovate or egg-shaped, is 451 grains; charge, 65 grains; the total weight, with the bayonet, is 11 lbs. 4 oz.; initial velocity of the bullet when fired with 62 grains of powder, 1027 feet per second. In 1855, the infantry regiments not provided with this needle rifle, were armed with rifled muskets having an elevating sight, which is partly fixed and partly moveable; it admits of being lowered upon the barrel either to the front or towards the breech. The fixed part of the sight enables aim to be taken for distances from 150 and 300 yards; the moveable part is fitted with a sliding bar, which is very apt to work loose, and become useless. To fire at 400 yards, the sight is erected, the slide being lowered, and aim is taken through the notch in its centre; at 600 yards, aim is taken through the upper edge of the notch, and at 800 yards, through the notch on the upper edge of the moveable arm of the sight; while at 850, 900, 950, and 1000 yards, the eye must be directed through the notch on the upper edge of the slide; the slide being so adjusted that its inferior edge shall be on a line with the engraved figures indicating these distances. The rifled musket has five grooves of uniform depth, and, with a twist, making one turn in 4·50 feet; the ball is fitted with a conical plug; its weight is 705 grains; and that of the charge of powder, 79 grains; total weight, with bayonet, 10 lbs.

Recently the sharp-shooters of the regiments of the Guard, and two battalions of Chasseurs of the Guard, have been supplied with a breech-loading needle rifle, similar to the one already in the service,
but the bullet (represented in the margin) is of a different form, resembling more those on the Lorens or Austrian system. The hollow in the base is intended merely to contain the fulminating composition, and not for purposes of expansion. The elevating sight admits of being lowered either backwards or forwards.

RUSSIA.

The Russians have, for some time past, used a two-grooved rifle weighing 11.2 lbs. very similar to the one we wisely abandoned some years since. Several of their light infantry regiments are furnished with it. It carries a cylindro-conical bullet, weighing 772 grains. The charge of powder used with it is 71 grains. The bullet has, as shown in the woodcut, two projections at the side, so that it is, in fact, a Jacob bullet, with 2, instead of 4, wings on the cylindrical part, to fit the grooves of the rifle. A carbine with tige, has been introduced into the Russian service since the Crimean war, but its merits do not entitle it to much consideration. Its calibre is .7 inch; its projectile is cylindro-conical; weight, 705 grains. It has a groove surrounding it at the cylindrical part near the base.

The infantry of the line are now armed very generally with a rifled musket, like the French; and carrying a cylindro-conical bullet, hollowed at the base, but without either plug or cup of any kind.
SARDINIA.

The carbine of the far-famed and gallant Bersaglieri has eight grooves, of uniform depth and twist, making one turn in 17 inches. The chamber is .44 inch in diameter, cylindrical, and forming a continuation of the bore, the calibre of which is .65 inch; just above the chamber there is a curved shoulder, on which the bullet (a cylindro-conical and solid one, weighing 530 grains) rests. The charge of powder is only 54 grains. The total length of the arm with bayonet, is 6 feet 1 inch. The bayonet is 23½ inches long. The rifle and bayonet weigh together 11 lbs. 6 oz. The elevating sight is formed of moveable leaves.

In 1854 a rifled musket with tige was adopted into the Sardinian service; its weight with bayonet is 10·4 lbs., total length 6 feet 1 inch, calibre 0.68 inch. It has four grooves of uniform twist, one turn in 5 feet, and decreasing in depth from the breech to the muzzle; it has an elevating sight, similar to that of the French, and graduated up to 800 yards; the bullet weighs 700 grains, is cylindro-conical and solid, and has three grooves on the cylindrical part. The charge of powder is 63 grains.

SWITZERLAND.

The Swiss have been surpassed by few nations in the number and variety, as well as in the success, of their experiments with small arms.

In 1847, a commission was specially appointed, to examine and report upon the relative merits of the oblong and spherical bullets, as well as to determine
upon the most perfect form of rifle that could be devised. This commission experimented with many kinds of rifles, but decided unanimously in favour of the elongated bullet, though they felt some hesitation in coming to a decision as to the respective qualities of the tige and chambered rifles; they accordingly directed two rifles, for the purpose of further experiment, to be made, one with tige, the other with a chambered breech.

The inquiry was resumed, the following year, with numerous rifles, including the two suggested by the previous commission, together with a new one, made while the trials were proceeding.

The result was the rejection of both the tige and the chambered rifles, and the adoption of the arm that had been made by their order. Several of this pattern having been issued experimentally to a few corps; and conflicting reports having been made respecting them, the commission was again summoned, and directed to make further investigation; whereupon a rifle and bullet, proposed by Colonel Wurstemberger, of the Federal artillery, was, together with many others, subjected to severe trial. The range and accuracy of the new rifle were both deemed so satisfactory, that the commission recommended unanimously its adoption for riflemen. This rifle has eight grooves, of uniform depth and inclination, the sum of the grooves being equal to that of the "lands." The twist makes one turn in 3 feet; the calibre is .41 inch; length of ball 1.0039 inch; weight 257 grains; charge of powder 62 grains.

At 818 yards, this rifle placed 66 per cent. hits in
a target 4 feet by 6, and the entire hundred balls, at the same distance, were contained in a space 13 feet by 10. The commission ascertained by actual experiment, that in rifles of very small calibres the accuracy diminishes rapidly at extreme ranges.

This rifle, adopted for the carbiners, is now universally known as “the Federal rifle, model 1851.” It is provided with an elevating sight, graduated from 200 up to 1000 yards. It is attached to the side of the barrel in a peculiar manner, being fitted into a groove made in the metal of the barrel. It is retained in its place by a small screw. The ramrod is so constructed, that it can only drive the bullet down to the powder, but not upon the powder; and it is prevented, by a projection at 2.9 inch from the head, from forcing it further, or crushing the powder.

The “Federal rifle” has been somewhat modified for the use of the Chasseurs, to whom it was issued in 1856. The number of grooves was reduced to four; the turn of the rifling was extended to 27 inches, in lieu of 17, and the barrel was elongated 3 inches. The bullet was slightly reduced in height, but its weight was not altered, nor was any change made in the arrangement of the sights, except that, for the new arm, they were only graduated to 660 yards. The “Federal rifle” is slightly superior, both in range and precision, to the Chasseur rifle.

In 1855 a trial was made in Switzerland of the relative merits of these two rifles, as also of the Enfield, the Belgian, the Prussian, and the Baden, rifles. The result of these experiments, as recorded
The comparative merit of the arms is expressed by means of the curve

(Scale in the 60th part)

2. Swiss Chasseur.
3. French Rifle à Tige. 1846.

---

The lower figure represents the relative trajectories.

A Swiss Federal Rifle, with Wurtemberger Bullet.
B Bavarian Rifle, with Tige.
C Swiss Federal Rifle, with Round Ball.

t Height of Infantry.
u Height

DIAGRAM SHOWING THE REL
7. Schleswig-Holstein Rifle.

\[
\begin{align*}
&\text{492} \quad 574 \quad 656 \quad 738 \quad 820 \\
&\ 656 \ 
\end{align*}
\]

\[
\begin{align*}
&\text{820} \\
&\ 820 \\
\end{align*}
\]

of the trajectories of the different rifles.

ES.

D Swiss Federal Rifle, with Wurstemberger Bullet.
E Bavarian Rifle, with Tige.
F French Rifle, with Plug Bullet.

\[
\text{\textit{s}} \ 	ext{Line of Sight.}
\]

\textbf{MERIT OF VARIOUS RIFLES.}
at the time, showed a decided superiority in favour of the two Swiss rifles.

At 654 yards, the Enfield made 40 per cent. of hits in a target 9 feet by 12. At 818 yards, the "Federal rifle" placed 96 per cent. in a target 8 feet square, and the entire hundred bullets in a target 10 feet by 13. The Belgian rifle, at 818 yards, made 20 per cent. of hits in a target 13 feet by 20. The Baden rifle 61 per cent. in a target 9 feet by 30. The "Federal rifle," at 990 yards, put 85 per cent. of its bullets into a target 19 feet by 10. At 1308 yards it put 47 per cent. in a target of the same dimensions. The (Swiss) Chasseur rifle made 30 per cent. of hits in the same target. These experiments* satisfied the commission that the two Swiss rifles were greatly superior to all the others, both in range and accuracy. The Federal rifle with bayonet weighs 10·7 lbs. The Chasseur rifle with bayonet, 9·9 lbs. The length of the former with bayonet, 69·1 inches (length of bayonet alone, 20 inches). The Chasseur rifle is 71·9 inches long. The recoil of the two Swiss rifles, owing to the solidity of the barrels, is less than that of any other European rifles.

**SAXONY.**

In Saxony, the Chasseurs carry a tige rifle, with four grooves of uniform depth and twist, the twist being one turn in 20 inches. These rifles are issued also to two non-commissioned officers, and 16 men, in each company of infantry of the Line, who act as skirmishers. The weight of the bullet is 358 grains, charge of powder 78 grains.

*The diagram annexed, represents the results of a long series of experiments, instituted in Switzerland, to test the power and precision of seven different rifles.
SWEDEN.

The Swedes have a short rifle, provided with tige and chamber, eight grooves of uniform depth and twist, of one turn in 40 inches; the bullet is an exact imitation of the one originally used by the French. This rifle has an elevating leaf-sight, graduated up to 460 yards. This arm is at present only supplied to eight men per company, in the infantry of the Line, and to twelve per company, in the Chasseur regiments.

The Norwegians have a similar rifle to this. The Swedes have two breech-loading rifles; one of them has been in service for many years; it carries a bullet, like the French, weighing 772 grains. The other, adopted in 1851, has six grooves of uniform depth, completing, like the Enfield, one turn in 6 feet 6 inches; the bullet weighs 402 grains; charge of powder 77 grains. The infantry of the Line use rifled muskets, that carry the hollowed Belgian bullet.

BELGIUM.

The Belgians have adopted the French tige carbine of 1846 for their Chasseurs, their Line infantry being armed with the rifled musket. The Chasseur rifle has a solid cylindro-conical bullet, with three grooves around the cylindrical part. The diameter of the cylinder at the base of the cone, is .66 inch, at the base of the cylindrical part it is slightly less. The total length of the bullet is 1.14 inch; of the conical part .74 inch; it weighs 756.5 grains, and requires a charge of powder of 62 grains. The ball of the rifle musket is the one known as the Peeters'
ball. It is cylindro-conical; the cylindrical part is hollow, and has three grooves around it. In the hollow is a conical projection, extending back from the bottom of the cavity, towards the external orifice. This projection, called a "noyau" is concentric with the ball, and is intended to prevent the sides of the bullet from bursting, by moderating the force of the explosion. It is supposed also, in some degree, to maintain the centre of gravity of the ball, in the line of the axis of the piece. This bullet measures 1·19 inch in length. The cone is 74 inch, the diameter of the cylinder at its base (66 inch) is somewhat greater than it is at the base of the cone, at which point it is 65 inch. The diameter of the cavity at its orifice, is 45 inch, at the bottom, 29 inch; the weight of the bullet, 725·5 grains, and of the charge of powder, 85 grains.

The elevating sight for this rifle is the same as that of the French for the same description of arm. The sight of the Belgian rifled musket is composed of an upright piece of metal, working on a hinge or joint; this upright, with its joints, gives three lines of sight. The sight is graduated up to 650 yards.

Experiments at the camp of Beverloo in 1851, with the rifled musket, with an angle of elevation of 1° 12', and with the tige carbine, elevated to 1° 2', gave an extent of "dangerous space" of 124 yards for the first, and 105 yards for the second arm. The distance, in both cases, was 328 yards, against a target 18 feet by 6 feet. The per-centage of bullets that struck, was 51 for the first, and 49 for the second arm. At 492 yards, the same target, but at the angle of elevation given to the first, was 1° 50' and to the second, 1° 51'. The "dangerous spaces" were 44 for the first, and 42 yards for the second;
per-cent age of hits with the tige rifle 37, and for the second 25. At 658 yards, against the same target, and at an angle of elevation for the former, of 2° 41', and for the latter, of 2° 48', the total dangerous space for the two arms was found to be 32 yards. At this distance the short rifle displayed a superiority over the musket to the extent of 10 per cent. At 820 yards, at the same target, with angles of elevation 3° 30', and 4° 5', respectively, the per-cent age of hits was 13 and 7. In these experiments the rifled musket proved superior; in subsequent experiments, however, it was beaten by the carbine. In point of practical efficiency, however, the difference is very slight.

A bullet from the rifled musket, at a range of 656 yards, penetrated a deal plank to the depth of 2·9 inches; one from the short rifle, 3 inches. It has been proved practically, that any bullet penetrating 0·62 inch into deal, will inflict a dangerous wound upon an animal. In the above experiments, with targets 18 feet by 12 feet, at distances of 820 and 656 yards, and with the angles of elevation above stated, the per-cent age of hits was, 20 and 12, 41 and 46, respectively.

The figure of a man was represented on the target, and the troops were directed to aim at it. At 328 yards the figure was struck by the rifled musket 16, and by the carbine 14 times; at 492 yards, 6 and 2 times; at 658 yards, 2 and 3 times; at 750 yards, once only, and that by the rifled musket.

In October, 1853, some comparative experiments were made at Beverloo with the Enfield rifle and the Belgian rifled musket, its own regulation-cartridge being used with each. At 750 yards, at a target 18 feet by 9 feet (the angles of elevation for the Enfield, being 2° 54', for the Belgian musket 3° 8') out of 50
shots fired, 10 of the former, and 42 of the latter, struck.

At 600 yards, the angles of elevation for the Enfield being 2° 7', and for the Belgian rifle 2° 21', out of 30 rounds fired, 24 and 29 hits were respectively made. At 400 yards (the angle of elevation for the Enfield being 1° 21', and for the Belgian rifle, 1° 37'), out of 30 rounds from each, 26 and 29 hits were counted. At 300 yards (the angles being 1° 6', and 1° 8') of 20 bullets fired, the whole struck. This experiment, supposing the trial to have been fairly conducted, proves the present Belgian rifled musket to be superior to our regulation arm. At 600 yards, the "dangerous spaces" for cavalry and infantry for the two arms were estimated respectively to be 32 and 36 yards for cavalry, and 21 and 26 yards for infantry. The penetration into beech plank was stated to be 4 inches, in the case of the Enfield; that of the Belgian being slightly greater.

The initial velocity of the Enfield was computed, on this occasion, to be 1118 feet, that of the Belgian 1022 feet per second. The bullet of the Belgian Chasseur carbine is said to have an initial velocity of 1007 feet per second.

SPAIN.

In the autumn of 1858, a rifled musket carrying the Peeters' (Belgian) bullet was served out to the Spanish infantry of the Line. Six years previously, rifled muskets with plug bullets had been issued to the Chasseurs. This rifle has 4 grooves, making one complete turn in 58 inches; the bullet weighs 447 grains, and the charge of powder is 70 grains.
HANOVER.

The Hanoverian infantry have two kinds of rifles. The non-commissioned officers of the Line and the non-commissioned officers and soldiers of rifle regiments, have a *tige* rifle, with seven grooves of uniform depth and twist, making one turn in 43 inches. The ball is cylindro-conical, it weighs 448 grains, and its charge of powder is 74 grains. In the light infantry, the men have a rifled musket; the non-commissioned officers a *tige* rifle. They have also a *tige* carbine, with eight grooves, progressive in depth, but with a twist the same as that of the *tige* rifle.

BADEN.

A proposal was made in 1841 to the Federal Government by a Swiss officer, of the name of Wild, to adopt a carbine of his invention. Experiments with this arm gave it a certain notoriety, and caused it to be adopted in some of the German States, especially in Baden; in that duchy ten men per company were supplied with it experimentally. One peculiarity of this rifle, was the number of the grooves, which varied from 10 to 16. They were shallow, and had a very slight inclination to the axis of the piece. The bullet is spherical, and is enclosed in a dry (ungreased) patch; the windage is considerable, hence this arm is easy to load. After each discharge, water is poured into the barrel from a copper vial, in drops. By this means, 100 rounds can be fired without any necessity for cleaning the barrel. The accuracy of this weapon was equal to that of the generality of such arms twenty years ago. The bullet and patch were carried with the cartridge that contained the powder, but the bullet and powder were not in contact. This arm was retained
in Baden till 1853. In that year the infantry of the Line were supplied with rifled muskets and plug bullets of a cylindro-conical form, and having three grooves round the cylindrical part, in which was a deep cavity. At 820 yards these rifled muskets have been known to place 39 per cent. of bullets in a target 25 feet by 6 feet. The barrel has five grooves of uniform depth and twist, making one turn in 52 inches. The elevating sight, copied from that of the Chasseurs, is graduated up to 820 yards. The Chasseurs carry a rifle, differing from this musket, in having grooves, progressive in depth, towards the muzzle. The bullet is solid; the elevating sight is precisely similar to that of the rifled musket. The weight of the bullet for the rifled musket is 590 grains; charge of powder, 69.5 grains. The sight of the Chasseur rifle resembles that of the Swiss. The sights of both the above rifles are regulated up to the same distances

BAVARIA.

Tige carbines were issued to six battalions of Chasseurs in 1854. The barrels have four grooves of uniform depth and twist, making one revolution in 60 inches. The elevating sight is both ingenious and peculiar, being arranged so as to correct the “drift” of the ball. The slide enters a slit on the left side of the upright part of the sight, and, in following this slit, deflects the line of sight more and more to the left, the higher it is raised. The rammer has one end hollowed, in order to fit the apex of the bullet; at the upper end is a wooden knob to be grasped in the hand and to give a purchase in ramming the bullet home; this rammer is not carried in the ordinary way, but detached, as the Austrian Chasseurs carry theirs.
At 1000 yards, 15 per cent. of hits have been made in a target 18 feet by 9 feet. This bullet is made by compression, like the Enfield, and weighs 675 grains; the charge of powder is 66 grains.

WURTEMBERG.

In the army of Wurtemberg, 10 men per company are armed with a short rifle, upon Captain Wild's system. It has 12 grooves of uniform depth, with a twist, making one turn in 34 inches. The bullet, spherico-conical, is covered with a patch of thin fustian, and is tied to the cartridge, which contains a charge of 92 grains of powder.

BRUNSWICK.

The two-groove system, slightly modified, is still in vogue in Brunswick. The grooves of this rifle are deep at the breech, but gradually diminish in depth up to a certain point, where the edges gradually disappear, leaving the remainder of the bore smooth and elliptical. Three kinds of bullets are here used, one being oval, the other two spherical.

The oval, and one of the spherical, are fired with a patch; the other spherical ball is fired without any patch, and is called a balle roulante. Of late, the two spherical balls have been chiefly employed; one with a patch, the other without. The charge of powder in the latter case is slightly heavier. The sight is elevating, and of the leaf kind.

DESSAU.

In the Duchy of Anhalt Dessau, a rifle musket was adopted in 1855, of the same pattern and calibre as the Austrian. The projectile is also of Austrian
GERMAN RIFLES.

Origin, of the system known as that of Lorens. The bullet (cylindro-conical) has one deep groove round the base of the cone, and weighs 463 grains. The charge of powder is 77 grains. This rifle is said to possess great accuracy and range.

ELECTORATE OF HESSE.

The two brigades of the army of Hesse, received in 1855, rifled muskets with chambers. The bullet is that already referred to as Peeters'. It is slightly bevelled at the base, so as to fit closely on to the chamber. The grooves are four in number, and of uniform depth and twist, making one revolution in 74 inches. The weight of the bullet is 608 grains.

GRAND DUCHY OF HESSE.

The army in the service of the Grand Duke, was provided, in 1855, with two rifles; one for the infantry of the Line, the other for riflemen. These arms have each five grooves, the sum of the lands being equal to that of the grooves. Their depth is uniform throughout; the weight of ball is 625 grains; charge of powder, 69.5 grains. The weapon supplied to the riflemen is rather shorter than the musket. The elevating sights on both arms are graduated and adjusted up to 650 yards. The one used by the riflemen is of the Swiss model; the spherical bullets are fitted with plugs to ensure their expansion.

MECKLENBURG.

The Mecklenburg infantry were armed, in 1851, with a rifle, having both a chamber and tige; the chamber
is in the form of a truncated cone; the tige for half its length, is cylindrical, then square, and rounded at the extremity, the bullet (weighing 442 grains) is cylin dro-conical. The cartridges contain 56 grains of powder.

NAPLES.

The rifles used in the Neapolitan army closely resemble the Swiss. The bullets are hollow at the base, but without plug or cup.

NASSAU.

Tige rifles were issued to the Nassau rifle regiments as far back as 1848. They are made with 5 grooves diminishing in depth towards the muzzle. The grooves make one complete turn in 52 inches; the weight of the bullet is 722 grains; of the charge of powder, 69 grains. In 1853, a rifled musket, without tige, but carrying the French cylin dro-conical plug bullet, was substituted for the one above described, which it resembles in all respects, except in having no tige.

OLDENBURG.

In 1832, this government adopted the two-grooved system of rifling, but, latterly, the spherical belted ball has been superseded by a hollowed cylin dro-conical bullet, with three grooves at the base of the cone. The bottom of the cavity is protected by paper, to diminish the action of the explosion. In 1847, the rifle with tige and conical chamber was adopted. The tige is cylindrical, and pointed at the top. The barrel, slightly thinner at the breech than at the muzzle, has four grooves of uniform depth and twist; the latter making one turn in 80 inches. The ball weighs 421 grains, and requires a charge of 47 grains.
AMERICAN RIFLES.

HOLLAND.

The Chasseurs of the Dutch army, have for many years used a tige carbine, rifled with eight grooves of uniform depth, making one turn in 38 inches. The ball is cylindro-conical, with one deep groove, around which a greased thread is tied. The elevating sight is formed with leaves; the ball weighs 494 grains; and the charge of powder, 61 grains. In 1855 a rifled musket was adopted for the whole of the infantry.

UNITED STATES.

The Government of the United States, like that of almost every European power, has of late been much occupied in endeavouring to improve all kinds of small arms; and after a long course of elaborate experiments, conducted under the direction of officers well informed, theoretically and practically on the subject, have adopted rifles and rifled muskets for the entire infantry. The following are the rifled muskets and rifles at present in use in the United States army. The rifled muskets, patterns 1822 and 1842, .69 inch calibre. A rifled musket, pattern 1855, .58 inch calibre. A rifle, pattern 1841 (altered), calibre .58 inch. A new rifle, pattern 1855, .58 inch calibre. The whole of these arms are three-grooved, and have the same twist—namely, one making a complete revolution in six feet, and, like the Enfield, decreasing gradually in depth from the breech to the muzzle. The bullet used is the same for all. It is cylindro-conical, hollowed at the base, and furrowed with three grooves around the cylinder. It is unprovided with plug, cup, or wedge. The bullet for the rifled muskets, patterns 1822 and
1842, weighs 730 grains; the charge of powder 70 grains. The weight of bullet for the other arm is 500 grains; charge of powder 60 grains.

The barrel of the new rifled musket is 40 inches long; that of the new rifle 33 inches. The total length of the new rifled musket with bayonet is 73.85 inches; of the new rifle with bayonet 71.8 inches. The weight of the barrel of the new rifled musket 4.28 lbs.; of new rifle 4.8 lbs. Total weight of new rifled musket with bayonet 9.90 lbs.; of new rifle with bayonet 12.98 lbs.

The new rifled musket, fired from a fixed rest at 1000 yards, gave out of 120 shots a mean vertical deviation of 55.9 inches, and a mean horizontal deviation of 25.5 inches. The rifle, 1841 (altered), at the same distance, and fired under similar circumstances, gave with the same number of shots, a mean vertical deviation of 58 inches, and a mean horizontal deviation of 25.2 inches. In both cases, the bullet and charge of powder were similar.

The altered muskets of 1822 and 1842 patterns, fired at the same distance, and, with the same elevation, gave, out of 50 shots a mean vertical deviation of 61.2 inches, and a mean horizontal deviation of 26.4 inches. Weight of bullet 780 grains; charge of powder 70 grains.

From the above experiments it appears, therefore, that at 1000 yards, the new rifled musket is the most accurate arm in the American service. At 200 yards, the highest point of the trajectory of the new rifled musket (with a charge of 60 grains) was 19.6 inches. At the same range, that of the altered musket of 1822 and 1842 (with 70 grains of powder) was 20.9 inches; at 500 yards, with what is termed the Harper's Ferry rifle (using a charge of 50 grains powder, and a bullet of 400 grains), the highest point of the trajectory was 150 inches.
At 300 yards, the highest point of the trajectory of the new rifled musket, is 40 inches.

At 1000 yards, the angle of elevation for the new rifled musket is 4° 15′; that of the Harper's Ferry rifle 4° 30′; of the altered musket of 1822 and 1841 4° 50′. At 500 yards, the angles of elevation are respectively 1° 30′, 1° 45′, and 1° 50′; the bullet and charge being of regulation size and weight. The above angles were taken as the mean, after firing 50 shots, at each range. The initial velocity of the new rifled musket is 963 feet per second; of the altered Harper's Ferry rifle, 914 feet per second.

The initial velocities of the spherical balls under the old system were as follows:—musket with 110 grains powder, 1500 feet per second; rifle with 70 grains powder, 1750 feet per second. The recoil of the new rifle musket, expressed in feet, is 7·08 feet; that of the altered Harper's Ferry rifle, 6·88 feet.

The American rifles and rifled muskets admit of creditable comparison with those of European make. In external appearance they much resemble our own, which have no doubt served as models to work from. It does not appear that, either in range or accuracy, the Americans can yet equal the Swiss.

The American army rifles are used without any patch, though that appendage to the bullet is almost universally employed, in private target practice, and by the back-woodsmen.

From this short description of the various descriptions of rifle now in use throughout the world, it will be seen that the smooth-bored musket and spherical ball have been entirely superseded by the rifle, and by the elongated bullet.

It is also obvious, from the numerous varieties of grooved arms and projectiles now in use, and notwithstanding the centuries that have elapsed since the first adoption of the system of rifling, that its
principles are not yet so thoroughly understood as to enable us to say that of all those, described in these pages, any one particular form is absolutely faultless or incapable of improvement.

There is, amongst other matters, much discrepancy of opinion on the question of calibre; librating, as it does, between the Swiss as the smallest ( 0.41 inch), and the Swedish or largest, which is 0.74 inch. In the number of grooves there is still greater diversity; in Brunswick, Oldenburg, and Russia, the two-grooved rifle is yet in use; in Wurtemburg, on the other hand, we find one with 12 grooves. These numbers 2 and 12, represent the extreme limits in military weapons; but the majority of those most in favour do not exceed three or four grooves. The number most generally adopted is four; rifles with eight are the next most numerous. With respect to the shape of the grooves there is great want of uniformity. Some are cut with sharp edges, others have them rounded off; the base of the groove being flat in some cases, concave in others. Nor is there less difference in the turn of the grooves. The longest is that used in Oldenburg, where a twist of 6 feet 8 inches finds advocates. The Sardinians have adopted the shortest, one of 17 inches only. In America, France, and Belgium, the grooves are all progressive in depth; in Spain, Nassau, and Hanover, one rifle only has progressive grooves, the rest being all uniform.

In some countries, as in England, America, and Switzerland, the rifles have neither tige nor chamber, and in others they are fitted, as has been seen, with both. This is the case in Prussia and Sardinia. Some rifles, as the Austrian, Belgian, and the French, have a plug breech, fitted with a tige.

The longest rifle is the Prussian needle breech-
VARIETIES OF THE RIFLE.

loader, its total length, with bayonet, being 6·4 feet. The shortest are the Bavarian and Austrian tige rifles, of 5·57 feet.

The Swedish rifle with tige is the heaviest; without bayonet, it weighs 13·7 lbs.; the Bavarian (with tige) is the lightest, its total weight with bayonet, being 9·1 lbs.

Equal diversity prevails as to the best form of rifle projectiles. There is a great variety, not only in the form, but in the weight, of the bullets used in different armies. They may, for the most part, be divided into two general classes, the solid and those containing a cavity. Of the solid, there are many kinds, some with three shallow grooves around the cylindrical part, as the French and Belgian; others with two deep grooves, as the Austrian, or with one deep groove, like the Dutch.

The bullets with cavities are numerous; of these, one only, the Enfield, is devoid of grooves round it.

In America and elsewhere, we meet with a hollow ball with three grooves surrounding the cylindrical portion. In some countries besides England, plugs are used with the hollowed bullet; in others, no plug, cup, or wedge, is found, as in the United States, France, and Prussia.

The Belgian, or Peeters' bullet, is remarkable from the conical projection with which it is provided inside the cavity; that of the French, having a triangular cavity (as shown at page 128), with one groove round the cylinder, is also peculiar.

In England, the United States, Switzerland, and Austria, one bullet only is used throughout each service. Our own (the Enfield*) is hollowed, while

* In addition to the Enfield, the Lancaster is, as already stated, used by some regiments, more especially the Engineers; there are also 3 varieties of carbine, and 2 or 3 different sea service rifles, but they need not be taken into consideration here.
the American, Swiss, and Austrian are solid. In Sardinia two kinds of bullet are employed, both solid; in France, Russia, Belgium, and Prussia, both hollow and solid balls are in use. Generally speaking, solid bullets are used with *tige* and chambered rifles; those with a cavity, and with or without plugs or cups, are adopted for rifled muskets without *tige* or chamber.

The heaviest charge of powder is that adopted in Wurtemberg (viz. 92 grains); the bullet is sphericonoidal, and it is enclosed in a patch. The lightest charge is that adopted in Oldenberg, being only 47 grains. The French and Belgian solid bullets are fired with less powder than the hollow bullets used in those countries; usually, however, heavier charges are used with the hollow bullets.

In point of weight, one of the heaviest is the Russian solid bullet, weighing 772 grains, and requiring a charge of 71 grains of powder. The lightest is the Swiss, 257 grains, charge 62 grains.

At the same time it may be observed, that the Swiss have the heaviest charge of powder in proportion to the weight of lead propelled. The bullet is enclosed in a patch, is not pressed down upon the powder, but has a slight interval preserved between it and the powder; this rifle exhibits the greatest accuracy, precision, the longest range, and smallest recoil, of any foreign rifle.

The following table (prepared by Lieut. Wilcox) shows the principal varieties of bullet, with their weights, charges of powder, and number of grooves, as also the twist of the rifles from which they are severally fired.
<table>
<thead>
<tr>
<th>Country</th>
<th>Solid Powder</th>
<th>Description of Rifle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>Lorens 450</td>
<td>Tige carbine and rifle musket.</td>
</tr>
<tr>
<td>Baden</td>
<td></td>
<td>Rifled musket.</td>
</tr>
<tr>
<td>Bavaria</td>
<td>675</td>
<td>Tige carbine.</td>
</tr>
<tr>
<td>Belgium</td>
<td>758</td>
<td></td>
</tr>
<tr>
<td>Dessau</td>
<td>Lorens 463</td>
<td>Tige carbine and rifled musket.</td>
</tr>
<tr>
<td>England</td>
<td>738</td>
<td>Enfield rifle.</td>
</tr>
<tr>
<td>France</td>
<td></td>
<td>Tige carbine.</td>
</tr>
<tr>
<td>Hanover</td>
<td>448</td>
<td>Rifled musket.</td>
</tr>
<tr>
<td>Hesse (Duchy)</td>
<td></td>
<td>Tige carbine.</td>
</tr>
<tr>
<td>Hesse (Electorate)</td>
<td></td>
<td>Rifled musket.</td>
</tr>
<tr>
<td>Holland</td>
<td>404</td>
<td>Rifled musket with chamber.</td>
</tr>
<tr>
<td>Mecklenburg</td>
<td>442</td>
<td>Tige carbine, rifled musket (1853).</td>
</tr>
<tr>
<td>Nassau</td>
<td>723</td>
<td></td>
</tr>
<tr>
<td>Norway</td>
<td>772</td>
<td></td>
</tr>
<tr>
<td>Oldenburg</td>
<td>421</td>
<td></td>
</tr>
<tr>
<td>Prussia</td>
<td>451</td>
<td></td>
</tr>
<tr>
<td>Russia</td>
<td>772</td>
<td>Zummügelgewehr.</td>
</tr>
<tr>
<td></td>
<td>705</td>
<td>Rifled musket.</td>
</tr>
<tr>
<td>Sardinia</td>
<td>580</td>
<td>Two grooved rifle.</td>
</tr>
<tr>
<td>Sweden</td>
<td>402</td>
<td>Tige carbine.</td>
</tr>
<tr>
<td>Switzerland</td>
<td>237</td>
<td>Rifled musket.</td>
</tr>
<tr>
<td>Spain</td>
<td></td>
<td>Bersaglieri rifle, chambered.</td>
</tr>
<tr>
<td>United States</td>
<td></td>
<td>Rifled musket, with tige.</td>
</tr>
<tr>
<td>Wurtemberg</td>
<td></td>
<td>Tige carbine with chamber.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rifled musket.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Federal rifle.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chasseur rifle.</td>
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<tr>
<td></td>
<td></td>
<td>Rifled musket.</td>
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<tr>
<td></td>
<td></td>
<td>Rifled musket.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Carbine. (Wild's system.)</td>
</tr>
</tbody>
</table>
GENERAL OBSERVATIONS.

The foregoing pages give a sufficiently accurate description of the different modern rifles, in the perfecting of which the greatest amount of scientific knowledge and of mechanical skill has been displayed. There may doubtless be others capable of very respectable performance, but they do not demand any special consideration.

In the selection of a particular arm, reference must be had to the service for which it is destined, because it is difficult to devise a weapon that shall be equally suited for military purposes, for a Scotch deer-forest, for an Indian jungle, and for match-shooting at a target. The following description, however, which I give as the result of long and attentive consideration of the subject, will enable any one to provide himself with an implement tolerably well calculated for general use.

With respect to the choice between muzzle-loaders and breech-loaders, I am quite satisfied that the latter will eventually carry the day.* The best

* Every rifleman of any experience with whom I have ever conferred on the point, fully coincides with me in this opinion. Captain Norton, a very competent authority, says, "Breech-loaders must soon supersede any arms that load at the muzzle, because, by loading at the breech, each cartridge is inserted with all the grains of powder effective; but in loading at the muzzle,
principles on which they can be constructed may not yet have been discovered, but I have no more doubt of their advantages over the muzzle-loaders than I have of the superiority of percussion over flint guns.

One of the best forms of breech-loading rifle hitherto made is probably Prince’s. At any rate, till something better is devised, we may rest well satisfied with his system of loading. Any requisite rapidity of fire may be obtained by its means; a missfire is all but impossible. The heaviest rain cannot affect these guns. After many hundred rounds they are almost as clean as at first; if accidentally fouled or rusted, they admit of being thoroughly cleaned in two or three minutes; the state of the barrels can always be inspected; the weight and inconvenience of the rod and pipes is got rid of, and the bullet is always properly inserted in the barrel, the axes of the two being coincident, while the hand is never strained or rendered unsteady by the exertion of ramming a ball home; as an additional advantage too, the piece can be readily loaded in a recumbent, or, indeed, in any position in which the shooter can be placed.

I do not wish to speak disparagingly of the breech-loaders of other makers, but I have as yet seen nothing preferable to those Daw has lately perfected for shot-guns, nor better than Prince’s for rifles, though Leetch’s are scarcely inferior to them.

If, then, the rifle decided upon, is to be a breech-loader, the bore should not under any circumstances much exceed half an inch, or at any much of the powder becomes non-effective from adhering to the barrel in its passage down, and is in consequence formed into a paste in ramming home.” There are, in addition to this, many still more valid reasons in favour of the above opinion.
rate, should not be larger than 24-gauge, i.e., .582 in. (for very fine shooting at moderate ranges, a barrel of 60-gauge, or even of 90, is better still); the barrel or barrels of the best steel or homogeneous iron, not more than 2 ft. 8 in. long, weighing from 7 to 8 lbs., for no good shooting can be expected at long distances from a light barrel. Let the breech contain double the thickness of metal usually given, between the chamber and the false breech,* if the gun be a muzzle-loader; and if a breech-loader, see that this point be specially attended to in its construction; it is one, to which few gunmakers give any heed. There should be no side vents. If not an elliptic-bored rifle, one with four grooves is in my opinion preferable to one with any greater or less number. Let the ends of the "lands" be rounded off towards the muzzle, the stock of the best black walnut (well seasoned), full long, and moderately bent; too much care cannot be bestowed on fitting the stock accurately to the shoulder; the mountings plain, case-hardened and blued; folding-sight to be attached to the barrel, 20 in. to 24 in. from the muzzle, unless the telescope-sight hereafter described be preferred; the locks should be of the best possible workmanship, mainspring to pull from 9 to 10 lbs., scear-spring to draw 5 lbs., trigger to draw not more than 3 lbs., half-cock 2 in. above the top of the nipple; nipples to be moderately large and smooth externally; bullets to be conical, flat at the base (it matters little practically whether they be obtuse or terminate in a

* Mr. Whitworth has patented a very ingenious plan for diminishing greatly the disagreeable effects of the recoil. At the moment the gun is fired, the explosion causes the breech to recede by means of a screw motion, which breaks much of the force of the concussion that would otherwise be felt by the shoulder.
AND APPARATUS.

sharp point); windage from 4000ths to 5000ths of an inch (not more). If a muzzle-loader, the rod of tough beef-wood, not less than 5-16ths in. thick; in that case, also, there should be a brass tube of the length of the barrel, for loading with loose powder when cartridges are not employed; two patch punches; four screw-drivers; two nipple-keys; eight spare nipples; oil bottle; lock vice; powder measure; boxes for caps; two powder flasks; spare sling for rifle; cleaning apparatus; small stores, &c.; melting ladle; grease-box; supply of tubes for shells; spare lock screws and two spare mainsprings; a mould both for bullets and shells.

The whole apparatus to fit compactly into a strong dovetailed oak case, having a solid leather or tarpauling cover to slip over that. Such a weapon, with all the et ceterus I have enumerated, need not cost more than from 35 to 40 guineas, if made solely for work, without any regard to external show. Thus provided, and with a good supply of ammunition in his pouch, our rifleman need not be dismayed should he have occasion to converse with his enemies at the gate. He ought also to do good execution in a Highland forest, and to shoot respectably at a target up to 600 or even 800 yards. In order to do this, however, a most important preliminary will be, the accurate adjustment of the sights. This is a very tedious and laborious process, seldom properly attended to by the maker; it should therefore be diligently tested by the purchaser. For this purpose, a rest that is perfectly immovable should be used, such as the trunk of a tree, a stone or brick wall, a post firmly secured to the earth, or a strongly made tripod stand. On or against a support of this kind the rifle should be held firmly, not screwed nor fixed in any way, unless
in a wooden vice, the jaws of which are thickly lined with cloth, cork, or felt. Should this precaution not be attended to, the vibration of the barrel will be so great as entirely to preclude all accuracy in the shooting.

From forty to fifty rounds should now be fired at 100 yards (not so rapidly as to cause the barrel to heat), under circumstances as nearly as possible identical, with precisely similar charges of powder, and with bullets of equal weight. When this has been done, the altitude of the lowest sight may be determined, and the piece of steel composing it filed down nearly to that level, the exact centre being marked either by a hair-line cut with a diamond, or with a fine watch-spring saw. A perpendicular gold line meeting this at right angles, and drawn on the back of the sight as a guide to the eye, will be found of much assistance while shooting. With respect to the form of sights, I look upon the one known as the nick or "V sight" to be one of the worst. The best, are those indicated by a fine line of gold, inlaid in the direction of the axis of the barrel; the muzzle-sight being, when viewed in the same direction, almost as fine as a knife-edge. It should be capable of very nice lateral adjustment. The disc sights, through which a view of the muzzle-sight is taken by means of a minute hole, cannot be recommended; for if the sun should happen to be shining upon the barrel, the glare of light through this small aperture is very embarrassing. It can be obviated in some measure, it is true, by means of a shade over the more distant sight; but this is an appendage that could hardly be used anywhere except at target practice. Some difficulty may possibly be found at first in bringing the gold line above described to bear upon the object aimed at; but a good shot will
soon prefer it to every other description of sight. When the first sight has been correctly adjusted up to 100 yards, a similar process must be repeated at each distance up to which the others are to be graduated. The difficulty of the process will be found to increase greatly with the extension of range, and the sight for 500 yards and upwards, should be tested most carefully at considerable intervals before this very delicate task can be considered properly completed.

Telescope sights have long been in use in America, the best being those made by one Morgan Jones, of Utica, N.Y.; the price he charges is from 20 to 25 dollars. The appearance of the rifle thus fitted is represented in the annexed cut.

The outside diameter of the tube containing the lenses (having a magnifying power of about 10 or 12 linear) is about 1/6ths of an inch. The metal composing it is 1-20th of an inch thick, and the length about 3 feet. It should be made of sheet steel, accurately true. Towards the muzzle the tube rests in the groove in which the muzzle sight slides, but in such a manner as to allow of the elevation of the telescope at the opposite extremity, which, if the rifle be a breech-loader, must be supported on a saddle at the point where the elevating sights are fixed, and must be provided with an elevating and depressing screw, or a long wedge-shaped piece of brass.
This kind of sight can hardly be used except with a heavy rifle of small bore, in which there is little vibration; it obviously does not admit of being applied to a barrel intended for rough work, but it is admirably suited for target practice. With a rest, and at any range for which the rifle is suited, it will enable an ordinary marksman to shoot with far greater precision than he can hope to attain in any other way.

In the figure above given, the aftermost support of the telescope is represented attached to the barrel; this is only necessary where the rifle loads at the breech. It is far better, should the telescope be fixed to a muzzle-loader, to have the tube supported by a graduated stem (with adjusting screw) let into the grip of the stock. The longer the telescope, the better it will be found to act; the eye-piece should be slightly funnel-shaped, terminating with an india-rubber ring, to prevent injury to the eye from the recoil, and in the tube there should be a sliding piece, with two steel hair wires crossing each other at right angles. In using the instrument, after it has once been adjusted, all that is necessary is to bring the intersection of the two wires over the centre of the bull's-eye. Its action, indeed, is precisely analogous to that of the "finder" of an astronomical telescope. Unless fitted with an erecting eye-piece, it has the effect of inverting every object, but the shooter will soon overcome any difficulty arising from that cause. The lenses cannot be too securely fixed, and between the tube and its supports there should be a thin layer of cork, leather, or of india-rubber, to diminish the jar of the explosion.

This addition to the rifle is not, however, by any means to be generally recommended, nor is there
much advantage in its application to any but what may be termed the toy-rifles, used by the Swiss and the Americans at their shooting matches.

With arms of that description, it may be considered the best method of sighting with which we are at present acquainted. I may here mention, to avoid disappointment, that no telescope sight will at all answer, that is not fully as long as the barrel to which it is applied.* Such an instrument possesses this great recommendation, that when once properly fitted, it can be removed at a moment's

* Professor Piazzi Smyth, in a paper read at the meeting of the British Association in 1850, advocated the adaptation of telescope sights to rifles. He pointed out the great inconvenience of ordinary sights, the use of which entails the necessity of bringing three objects situated at unequal distances into an exact line. From the very fact of their distances being so unequal, it is impossible that the unaided eye should perceive them with equal distinctness. The shorter the barrel the greater becomes this difficulty, from the want of proper radial length between the breech and the muzzle-sights. Besides these difficulties, the learned Professor adverted to the annoyance which every rifleman must have experienced at times from the radiation of bright sunlight from the muzzle-sight. He proposed to obviate all these evils by the application to the barrel of a short telescope (about a foot long), furnished internally with cross wires. By this means he rightly maintained that:—there were but two objects to be dealt with, the cross wires and the image of the object aimed at, both at the same distance from the eye:—that the accuracy in aiming depending on the power of the telescope, the shortest barrel would be thus rendered equal to the longest:—that the system of wires being in view at once, afford a convenient scale for estimating intermediate distances: finally, that the wires could not be affected by any phase of sunshine. Professor Smyth did not advert to the American arrangement, a modification of which has been above described, and is far nearer perfection than the one suggested by him; nor was he aware, as he stated at the meeting, that Captain Davidson, of the Bombay army, had carried the subject much further than himself, aided by Dickson, a gunmaker, and Adie, an optician, both of Edinburgh.
notice, and replaced by the ordinary sights. For the purpose above specified, such is its utility that, attached to a really good rifle, and with the further assistance of a proper rest, it will, on a calm day, enable an indifferent shot, to throw every bullet into a circle of two inches in diameter at 200 yards, and into a circle of nine inches diameter at 450. Any aberration beyond that, in either case, may be considered as attributable either to defective loading or to want of skill on the part of the marksman.
SELF-RECORDING TARGET.

Many attempts have of late years been made to devise a feasible plan whereby the position of each shot upon the target can be recorded without the intervention of a marker.

The present system is clumsy, expensive, and inconvenient, and its adoption is frequently attended with casualties, which I have known, on two occasions, to result in the death of the unfortunate markers, although in each instance protected by an iron-plated house.

Lieutenant Chevalier, of the 1st West India Regiment, has patented a very ingenious and effectual mode of constructing a target which answers perfectly all the exigencies of the case. He dispenses entirely with the services of a marker, and yet enables the shooter to note unerringly, by means of a small dial at his side, the exact position of every hit he may make, at whatever range he may be practising. It is immaterial, too, whether the target be stationary (as usual), or made to traverse the line of flight of the projectile; it will in either case record with unimpeachable fidelity the striking of the bullet upon any section of the target.
It is unimportant of what size the target may be, or whether composed of iron, steel, or other material; the surface is divided into a central division, or bull's-eye, and any convenient number of surrounding parts. At the place of firing, a small portable target, or signal-board, is set up, the face of which is divided into the same number of divisions as the practice target. Each of the divisions of the large target and of the small signal-board are connected by means of a very small electric conducting-wire, and the whole number of wires are in separate connexion with a battery.

Each part of the large target is in a state of insulation from the galvanic battery until struck or hit, when immediately a "circuit," or electric connexion, is made, and a current of electricity traverses the wire, corresponding with that division or part, immediately causing a signal-needle, or pointer, upon the division, or corresponding part, to deflect or vibrate.

Thus the necessity of markers, or signal-men, is entirely obviated, and the individual firing, sees by merely glancing at the indicator, which part of the target he has hit; this enables him at once to correct any defect in his aim, and the register of the hits will thus be most faithfully kept.

As it will be obviously unnecessary for any one to be nearer the target than the firing party, no accident can occur; neither will it be necessary to cease firing occasionally, for the purpose of recolouring the target, as the indicator must show every hit with faultless precision.

Nothing can be more simple than the mode of increasing or diminishing the distance. At each station a small box, containing the requisite number of wire connexions, is deposited in the earth, and it
is only necessary to attach these wires to the indicator, which is just as portable as any ordinary table clock. The operation of connecting the wires can be performed in less than a minute.

Lieutenant Chevalier has also devised a simple plan for arresting the flight of a bullet as soon as it touches the ground; ricochets can by this means be entirely prevented.
EXPLANATION

OF THE

FIGURES ON THE OPPOSITE PAGE.

In order to render the matter in the following chapter more clearly intelligible, I have introduced the annexed woodcut, of which the following is a description:—

Fig. 1 represents the trajectory of the Enfield rifle at different distances, and is intended to show the necessity of aiming accurately when the rifle has a high trajectory.

In Fig. 2, a representation is given of a detachment marching uninjured under fire, which, owing to the elevation of the trajectory, is taking effect further in their rear.

In Fig. 3, the line A D indicates the axis of the rifle; A C the line of sight; and A B the trajectory or path described by the bullet.

E F is a horizontal line, on which the shooter is supposed to be standing.
HOW TO USE THE RIFLE.

I will now presume that the reader, having provided himself with a weapon suitable to his particular purpose, is desirous of becoming proficient in its use. It may, therefore, be satisfactory to him to be informed at the outset, that any man who has no defect in his eyesight and is not more than ordinarily nervous, can, by dint of practice, become a good rifle shot. The keener his eye, the steadier his hand, and the sounder his judgment, so much less will be the difficulty he will experience.

He will do well to master the rudimentary theoretical principles of projectiles, which, so far as will be sufficient for the present purpose, are readily comprehensible.

Nothing can be devised better for this end, than the course of instruction pursued at the Hythe School of Musketry, as the results attained at that admirable institution satisfactorily attest.

The teacher first commences his course by explaining the construction of the barrel, showing that its upper surface does not lie in the same direction as the bore. He then proceeds to show that the axis of the barrel is an imaginary line along the centre of the bore. It denotes the course taken by the centre of the bullet whilst under the influence
of the exploded powder, and the distance and direction in which it is guided in its flight.

The line of fire is the direction in which the bullet would fly, and with a uniform velocity, were it not impeded by the resistance of the atmosphere and drawn down from it by the force of gravity.

The atmosphere consisting of a multitude of small particles, cannot be moved aside by the bullet, without imparting to it some degree of reactionary force, and so reducing, at every moment, the velocity of its flight.

The force of gravity commences to act upon the bullet as soon as it quits the muzzle, drawing it towards the ground with greater velocity, the longer it is exposed to its influence.

These two distinct motions, the one increasing as the other diminishes, cause the bullet to move in a curved line, called the "trajectory." For a short distance, in consequence of the great velocity of the bullet in its forward motion, and the comparatively slight influence of gravitation, the course of the bullet scarcely deviates from the line of fire, but the curve increases more and more in proportion as its distance from the muzzle increases.

The next thing taught, is, that if the axis of the piece be directed upon an object, the bullet will never hit it, but will always pass below it; by experiment, it has been found that at 100 yards it will pass about one foot five inches below it.

To hit a mark at 100 yards, it will therefore be necessary that the line of fire should be directed to a point 1 foot 5 inches above the mark; in which case the trajectory, conforming to the movement of the line of fire, will also be raised 1 foot 5 inches, and the bullet will strike the object.

To aim with accuracy, it is necessary that the
sights should be carefully aligned between the eye and the mark. If the sights, however, on the upper surface of the barrel were so constructed as to be in the same direction, or parallel to the axis, it would then be necessary at 100 yards to aim 1 foot 5 inches above the mark; but, in so doing, the eye would lose sight of the object, and would besides be uncertain as to the correctness of the elevation. The height of the lowest back-sight of all rifles is, therefore, so arranged that when aim is taken straight upon an object at 100 yards, the axis of the piece receives the necessary degree of elevation.

As at the distance of 100 yards, and indeed at all other distances, the line of fire must be directed as much above the object as the bullet passes below the line of fire at those distances, and in order that correct aim may be taken at the mark at all distances, the back-sight is made capable of adjustment, so that it is thus available for all ranges.

The effect of wind must also be attentively studied; when blowing from the right, it will blow the bullet towards the left of the mark, and vice versa. When from the front, it will slightly reduce the speed of the bullet, and when from the rear increase it, causing in the first instance a reduction, and in the latter an increase of the range. A front, or rear wind does not, however, produce so much effect as a side wind; the pupil, in short, must be guided entirely by his own experience in making allowance for wind, as no fixed rules can be laid down for his guidance. If the wind, for instance, be blowing from the left, he must aim a little to the left of the mark; if he find that the shot still strikes to the right, he must make a little more allowance for the next shot.
When these various matters are properly understood, there will be little difficulty in comprehending the causes of uncertain firing with the old smooth-bored musket, nor the means by which these defects have been obviated by the introduction of rifled barrels.

The chief cause of error, in the smooth-bored musket, as I have already explained, was the excess of windage.

The elongated bullet now used with the rifle musket, besides being better adapted by its shape, for passing through the air, is so contrived that in its passage out of the barrel all windage is done away with. It enters the barrel easily, but on the explosion taking place, the pressure of the air in front, and the force of the explosion behind, have the effect of dilating the cylindrical portion of the bullet, so as to make it fit the barrel tightly, precisely in the same way that compressing an india-rubber ball at the opposite ends would widen its other diameter, and so enlarge its lateral dimensions.

By this means windage is completely abolished, and the whole force of the explosion acts upon the bullet in the same direction, giving it increased velocity, at the same time avoiding any of those irregularities which take place during the passage of a spherical bullet through a smooth-bore barrel.

But besides these irregularities tending to give the spherical bullet a wrong direction, there is another cause calculated to influence it during its flight. If a bullet were passing through the air, and by some accident had a hollow or unevenness on one side, this would receive the pressure of the atmosphere in a particular direction, tending to divert the bullet from its true course.

The present elongated regulation bullet would be
equally, if not more, affected by any such unevenness on its surface if fired from a smooth barrel, but when fired out of a rifled barrel, any error arising from this cause is corrected.

The rifled barrel contains three or more spiral grooves, constructed in such a manner that the groove on the left side at the breech makes a half turn over the barrel, and appears on the right side of the muzzle, and the other grooves make a half turn in the barrel, passing over like a female screw from left to right.

When the bullet expands by the explosion of the powder, it is not only made to fit the barrel tightly, but its cylindrical surface is moulded into the grooves in such a way that during its passage through the barrel it is constrained to turn with the grooves, and so receives a spinning movement round its longer axis, which continues during the remainder of its flight. This not only prevents rotation in any other direction, but is in itself a rotation calculated to ensure accuracy of flight, by constantly presenting any imperfection of surface to the air in opposite directions.

The only object of rifling a barrel is to correct the flight of the bullet; it is altogether a fallacy to suppose that it produces either greater range or velocity.

The pupil having formed some idea of the laws which regulate the flight of projectiles, and having mastered the rules laid down for his guidance at the moment of firing, must now learn that the accuracy of his fire is not dependent on these causes alone, but also on the attention paid by him to the adjustment of the sights.

Very few rifles when they come from the maker are accurately sighted as to elevation, the marks
denoting the height to which the sliding bar should be raised for different distances are seldom exactly in the right place, nor are they always in the proper line. If the back-sight be too much to the right, the rifle will carry to the right, if the fore-sight is to the right, it will carry to the left; these defects must be rectified either by aiming in the contrary direction, or by having the sight altered.

If the pull of the trigger be too hard, it will alter the direction of the arm whilst firing. This is easily remedied.

The explosion of the powder when it drives the bullet out of the barrel, communicates at the same time a certain motion, called recoil, to the arm itself. The bullet quits the muzzle in the direction of the line of fire; the recoil taking place exactly in an opposite direction. Now, the stock being bent downwards to enable the eye to glance along the barrel, the point of resistance (that is the shoulder) is consequently beneath the line of recoil, hence the explosion has a tendency to throw the muzzle up, and thereby send the bullet high. The lower the point of resistance the more the rifle will fly up, and for this reason the centre of the heel plate, and not the toe of the butt, should be firmly pressed to the shoulder.

When the sun is shining from the left, it lightens up the left side of the fore-sight and the right side of the notch of the back-sight. In taking aim, one is sometimes apt to be guided by these brilliant spots instead of by the real centres of the notches, and the result is that the axis will be directed to the right. When, on the other hand, the sun is on the right, we are liable to aim too much to the left.

If an object fired at be in motion, whether it be a man walking or a horse galloping, it must necessa-
rily pass over a certain distance between the moment of discharge and the time the bullet reaches it. If it be moving from left to right, or from right to left, the aim must be taken a little to the front of the object in question, but how much, must depend on the rate at which it is moving, as well as on the distance, and the consequent time the bullet will take to travel. Experience must guide the judgment in this matter, as no fixed rule can be laid down.

It has been ascertained that if the rifled musket, pattern 1858, be fired with the elevation due to 600 yards at an object 570 yards off, the bullet will strike 2:38 feet above the mark; if the musket be fired with the same elevation at the distance of 680 yards, the bullet will strike 2:54 feet below the mark, showing that an error of 30 yards in the appreciation of distance would cause the figure of a man to be struck either in the head or feet, according as the error happened to be under or over the correct distance. When firing with the 800 yards sight, the bullet will take as much as 68:50 yards to fall half the height of a man, owing to the trajectory of 300 yards being less curved than that of 600 yards. At 800 and 900 yards, the curve being still greater, the same fall would take place in passing over a much shorter distance, consequently the greater the distance the greater the necessity for determining it accurately. As, however, we cannot always be certain of distances in the field, it is preferable when practising, to give the first shot an elevation rather under than over the correct one; the shot will then strike the ground before reaching the object, and may possibly hit in its ricochet. By watching the effect of this shot, which may generally be ascertained by observing the dust thrown up when the bullet strikes the
ground, we can adjust the sliding bar by raising it higher or lower, according as the first shot has struck short of or beyond the object.

Simple or superfluous though it may appear, one of the first lessons should consist of the following practice at a target about 18 inches in diameter, and at a distance of ten or twelve paces. Having put a small copper thimble, or a percussion cap from which the composition has been removed, upon the nipple, the pupil should raise the rifle (previously cocked) steadily to his shoulder, and, while closing the left eye, look intently with the right, along the first sight to the more distant one, the gaze being fixed upon the mark however, and not on the sight, and the muzzle being raised above the bull's-eye.* The rifle should now be steadily lowered, and at the instant that the more distant sight covers the centre of the bull's-eye, the motion should be arrested, the centre of the heel-plate, as above directed, firmly pressed against the muscle of the shoulder, and the trigger simultaneously pulled. All delay is bad, when once the aim has been clearly got. After the cock has fallen on the nipple, the eye should still look, for the space of a second at least, as fixedly as before upon the target, noting carefully the deflection on each occasion. Easy as this may seem, it will be found that, to do it without flinching, and without an involuntary wink, requires some considerable practice. When that amount of proficiency is attained, the same process should be repeated with caps, proceeding gradually to the use of a few grains of powder, increasing the charge to two or three drachms. When the slightest tremor is no longer felt at the critical moment of the ex-

* A much better aim can be thus taken than by the ordinary method of raising the rifle to the mark.
plosion, a bullet, with a very small charge of powder, may be ventured upon. By degrees the shooter will find himself acquiring confidence, and having repeatedly struck the target at a dozen yards with half a drachm of powder, he will find the same feat practicable enough at 20, 50, and, finally, at 100 yards, with 1 drachm or 1½ drachms. Having proceeded so far, he will do well to continue working daily at the latter range for some weeks, until he can make certain of raising his rifle to the "present," and of striking the bull's-eye almost at the same moment. He may then progressively extend his distance by 20 or 25 yards at a time, till he has reached the extremest limits at which good shooting can be calculated upon.

He may consider himself somewhat above an average shot, when, at 50 yards, he can feel sure of making twenty hits all within a circle of 5 inches diameter; at 100 yards, within a circle of 10 inches; at 200 yards, within a circle of 20 inches, and so on, up to 1000 yards; at that range, if he can be certain of putting ten bullets in succession within a circle of 8 feet diameter, he will do as much as any one need hope to achieve. I am told, however, by those who have witnessed the feat, that General Hay, the Superintendent of the School of Musketry at Hythe, can stand with his back to the target, and wheeling suddenly round, at the same moment, deliver his fire and be tolerably certain of striking the bull's-eye within three feet of the centre, at 1100 yards! In order that the difficulty of such a performance may be properly appreciated, I annex a small wood-cut, representing the exact apparent size, at eleven hundred yards, on a clear day in this climate, of a target 25 feet square, with a 6-feet bull's-eye marked upon it. The minute figure at the side
of the target gives the appearance of a man six feet high at the same range.

There are many apparently trifling and non-essential points to be attended to in rifle-shooting, which a tyro is little apt to heed. These I shall now proceed to enumerate. A very important matter to be kept in mind while practising at the target, is the charge of powder. It cannot be too strongly inculcated that, after careful trial, the proper charge for a particular rifle having been once determined upon, that charge ought never to be diminished or increased even by a grain. When the greatest possible accuracy is required in shooting, it is well worth while to weigh each charge in a delicate balance, and subsequently to enclose it in a small dry glass or metal tube, carefully securing it with a cork or stopper. If this process be deemed too tedious, a small brass charger should be used, slightly "heaped" each time that it is filled; it should then be tapped gently at the bottom, so as to shake off the superfluous grains, leaving the measure exactly filled. Care should be taken that no extraneous matters get mixed up with the powder, as every particle of that sort, however small, will diminish more or less the momentum of the bullet, causing it to strike low, for, besides displacing a certain bulk of powder, any extraneous matter of the kind prevents the due and regular ignition of the charge.

Of all the different descriptions of cartridge now in vogue, few will be found to excel those of Captain Norton, called the Gossamer, or Seamless Cartridges. They are neat, handy, and compact. He invented them originally in 1835, but has perfected them more recently. As now manufactured, they are formed of thin tough paper, covered with cotton net. In making them, the paper is first placed
with its centre on the point of a mandrel or former, and the net in the same manner over the paper; both together are then pushed into the tube-mould, the ends are drawn down, and the mandrel withdrawn; the powder (or guncotton) is then put in, and the ends of the paper and net are tied up. In preparing it for Sharp's breech-loader, Capt. Norton places a little guncotton first in the lower end of the cartridge, and gunpowder over the cotton; the fire from the cap is sure to fire the cotton, but not always so sure of firing the gunpowder through the thin paper. On firing this cartridge, the net is carried out of the barrel of the gun, and resembles a fine brass wire net, no residue whatever being left in the barrel of the gun. This cartridge ought forthwith to be adopted into the service.* It would materially tend to improve the shooting for one thing, as the exact charge would then be sure to be put into the barrel.

It has frequently been remarked that, when using a loose charge, the best shooting was at the commencement of the practice, when the flask was full. This arises from the common habit of filling a flask when about three parts empty. The dust, smaller grains, &c. thus collect at the bottom, and the force of each latter discharge is proportionally feeble.

The bullets require also considerable attention; there is some little art in casting them properly, even in holding the mould at a proper angle to the lip of the ladle; but as any apparatus like the machinery at Woolwich, for compressing them, would be too costly for private individuals, and as the only effectual substitute, a fly-press, would be too cumbersome, we must still be content with the old system of running them into brass or gun-metal.

* These cartridges are procurable at Leetch's, 68, Margaret-street, Regent-street, W.
moulds. The lead for the purpose should be as pure as possible (good pig-lead is the best); it should not be over-heated, and yet if not sufficiently hot, the ball will be irregular and full of cavities. There is a particular temperature, only to be ascertained after a little experience, at which the lead flows freely. It is well, when casting a quantity, to have a ladle containing 10 or 14 lbs. kept at this heat, using a much smaller one to fill the moulds, which should be provided with a long "get," or channel for the lead to pour through. The moulds should invariably be made to fill from the base. When a number of bullets have been cast, they should each be successively struck through a steel gauge of the precise intended diameter; or, what is still better, having been previously oiled, they should be placed in a polished steel die, of the precise dimensions of the perfect bullet; a steel cylinder, accurately fitting the cylindrical portion of the die, should then be applied to the base of the bullet now filling the upper part of the die, and struck sharply with a light hammer or mallet. The bullet will thus be compressed, and many internal inequalities it previously had, will be removed, besides which, its external surface will be smoothed or polished—no unimportant consideration.*

It has been found that if there be any cavity or irregularity in a bullet, it will in its flight, invariably deviate towards that side where the centre of gravity rests when the bullet is placed in the barrel. If the centre of gravity be to the left, the aberration will be to the left, and vice versa. If the centre of

* Major Nuthall has lately patented by far the neatest and most perfect instrument yet devised, for swedging bullets. It works admirably, takes little room in a gun case, and can also be used for turning in the ends of the shot cartridges for breech-loaders.
gravity be above, it will cause an increase of range, if below, it will diminish it.

Having gone through this process, the bullets should be carefully weighed and sorted; those that turn out to be of the standard weight being placed in a box by themselves, and reserved for special occasions, those of medium weight being kept apart, while the lightest of all may be either re-melted or used for ordinary shooting. Any bullet that has been cast in a perfectly cold mould should be rejected, as it is pretty certain to contain many cavities in the interior and on the surface. It is a good plan before casting, to stir a little grease into the molten lead, and then with the blade of an old knife to remove any dross or rubbish that may be floating on its surface, which will thus be left bright and clean. Each successive casting renders the metal harder, and in that case, as also if there be even a slight admixture of tin, solder, or zinc in the lead, it is quite unfit for the manufacture of projectiles for accurate shooting.

The best material for patches is old lawn or old cambric; previous to use, it should be lightly greased all over on one side with spermaceti ointment, spread over it with a palette knife, and folded until it forms a square rather larger than the intended patch. In this state it should be pressed under a heavy weight between two boards for some hours; then by means of a sharp punch* and mallet, fifteen or twenty patches may be cut by a blow at once. In using them it is only necessary to lay one, greased side downwards, upon the muzzle, to place the base of the bullet upon its centre, and then to push the two gently into the barrel. One end of the loading-rod, having

* The diameter of the punch should be rather more than double that of the base of the bullet.
a cavity exactly fitting the upper part of the bullet, should now be applied, and the bullet pushed home at one thrust, without any blow or violence. There is no difficulty in this if the bullet fit properly and the bore be clean; but no violence should on any account ever be used, as besides notching and indenting the bullet, it is almost certain to cause a deflection of its axis, and besides that, to cake the powder in the chamber. The instant the bullet is felt to have reached the powder, the rod should be withdrawn—no second stroke, however light, should be given. Nothing is more common, both in the use of shot-guns and rifles, than to see the shooter ramming and thumping at the charge, as if desirous of compressing it into the smallest compass. This is a great mistake; the force exerted by the powder will always be greater if the grains be left uncrushed than if they be mealed or caked together. Of course no space must be left between the bullet or the wad of the shot-gun and the powder; they should rest evenly upon its surface.

The foregoing remarks apply only to muzzle-loaders; in the breech-loader, the charge accurately weighed or measured, being contained in a cartridge, the powder and ball are both infallibly introduced into the receptacle intended for them in a proper state and position.

American riflemen attach much importance, at shooting matches, to wiping out the barrel after every discharge. For this purpose the shooter is provided with a number of pieces of rag (the material preferred being "cotton flannel"), each about 2 inches square; one of these being twisted round a rod kept for the purpose, is passed up and down the barrel after each shot, care being taken never to use the same rag twice until it has been thoroughly washed.
In England so much nicety is not considered essential even in match-shooting, but there can be little doubt that the occasional removal of the products of combustion is very desirable.

In America also, those who make a profession of match-shooting, in order to ascertain the strength and direction of the wind, commonly use a number of small flags made of twilled cotton, 6 feet long and 2 inches wide, hemmed at both edges, and fastened to the tops of poles 7 feet high; these are stationed at about 50 yards apart, nearly in a line between the shooter and the target. There is considerable art, combined with judgment and memory, in the use of these flags. In my opinion, however, all adventitious aids should be rejected from target practice if they are such as cannot be made available in actual service. It is of little advantage for a man to be able to hit a mark with moderate, or even with unerring precision, if he can make no use of his skill against an enemy, or is powerless to strike down a bounding stag at 100 or 150 yards.

It will frequently occur, either from a derangement of the sights, a high wind, or some other accidental circumstance, that in the course of a day's shooting a preponderance of shots will be found to strike a point to the right or left, above or below the object aimed at; this generally will be found to arise either from an accidental displacement of the muzzle-sight, or from a current of air blowing across the line of flight of the ball. To rectify or obviate this in the former case, the piece of steel which supports the sight, and slides in a dovetail cut upon the barrel, at right angles to its length, ought to be finely graduated in tenths and fiftieths of an inch; it should move freely to the right or left by the aid of a small screw...and the marksman should ascertain by re-
peated experiments, at different ranges, how great a deflexion of the bullet, one way or the other, is caused by moving the sight one of these divisions. Supposing the breech-sight to be three feet distant from the muzzle-sight, and the latter to be moved one-fiftieth of an inch to the right of the line of aim, it is obvious that the bullet then fired will be as many times 1-50 inch to the right of the previous bullet as there are yards in the range fired over; thus, at 600 yards, this will amount to four inches. In a similar manner it will be found of advantage to have the breech-sight finely graduated, for lateral adjustment, and the effect of the variation of each degree calculated for various distances.

When the wind blows in gusts or puffs across the line of fire, it is very difficult to make even fair practice; the best plan to ascertain the average strength of the wind on such occasions, is to fire half a dozen trial-shots, aiming from a rest, carefully and exactly at the bull's-eye: observing the effect of the wind on the six bullets, measure the distance of each shot from the point aimed at, and divide that by six. The quotient will be the distance of the point, in an opposite direction from the bull's-eye, at which aim ought to be taken to counteract the effect of the wind.

The "bead-sight," however great its advantages for target practice, is hardly so well adapted for general use as the "knife-edge" sight for the muzzle of a rifle. It consists, as its name implies, of a minute bead or ball of steel, supported upon a slender needle-like stem. It must of necessity be covered over by an arched shade, or the slightest touch would bend or break it off, whereas the "knife-edge," if properly filed, and of sufficient length in the line of the barrel, will stand much rough usage
without great risk of being materially damaged. The exact centre of the upper surface of the barrel should be ascertained with mathematical precision, and it is well to have it indicated by a line about an inch in length, cut with a diamond, and filled in with gold wire.

With a heavy rifle, the left hand should be held well forward, about 10 inches in advance of the guard, and not close to the lock, as with a shot-gun—the left elbow nearly under the barrel. A hook to the after-part of the guard will be found a useful help to the right hand in firing either from the shoulder or a rest.

As regards the position of the marksman when firing, the left side should be advanced a little towards the target, the left foot supporting the weight of the body, the right foot not too far back. The heel-plate of the rifle should be firmly pressed against the deltoid muscle of the shoulder—not in the American fashion, against the biceps of the right arm. Just before the muzzle-sight is made to cut the centre of the bull’s-eye, the breath should be held; in pulling the trigger, the forefinger alone should act, the arm and wrist being stationary, and there should indeed be no movement whatever of the body until the precise result of the shot has been noted. Nothing accustoms the shooter more to steadiness than this habit of holding the rifle to the shoulder after he has delivered his fire.

When the day’s practice is over, the rifle should be cleaned at once, and not put away either loaded or foul. It should never be washed out with water, but simply be wiped thoroughly with successive pieces of oiled rag, and lightly oiled inside and out. Purified neat’s-foot oil should alone be used for lock or barrel. It is not a difficult
matter to prepare. Having obtained the clearest and freshest that can be procured, shake up a small quantity, say half a pint, with a quarter of an ounce of animal charcoal, filter it twice, then take the filtered oil, pour it into a flat white glass bottle, drop into the bottle a few strips of sheet-lead, previously scraped or rubbed bright, and place the whole for a few weeks on a shelf exposed to a strong sunlight. At the end of that time all the impurities will have subsided, or be found adhering to the lead, and the clear liquor, now as colourless as water, may be poured off and reserved for use.

The best practice-target is one made of cast-iron, about six feet high, 24 inches wide and two to three inches thick. Nothing can be much worse than those issued by the Ordnance Department for the army; they consist of an iron frame, covered with white cotton, and divided by black lines into three equal compartments, upper, centre, and lower, the centre division having a bull's-eye eight inches in diameter in its centre, surrounded at two inches' distance by a circle an inch broad. Erected generally on an open ground, with no object behind to detach them from the surrounding scenery, and of so flimsy a texture as to be speedily torn to rags, it soon becomes impossible to observe where they have been hit. Were they made of stout canvass, with cartridge paper pasted over them, and that renewed as required, they would be far better in all respects, and would then last for a long time.

The French use a similar target, 6 ft. 6½ in. high, by 22 in. wide, the centre being indicated by a circle about seven inches in diameter; the horizontal divisions, however, show the degrees of elevation or depression required for different distances in firing. Their advanced soldiers use a plain target only,
The bull's-eye in the centre is eight inches in diameter.
having no other mark but the circle, and for platoon or division firing their target is six feet square; besides these, they have one made movable, running upon wheels to and fro in front of the firing party.

Where a solid iron target cannot be obtained, one constructed of stout oak planks, covered with sheet iron, or a deal packing-case, 6 ft. by 2 ft., and 2 or 3 ft. thick, tightly filled with "cotton-waste," will answer the purpose very well, and the latter one will have the advantage of preserving the bullets, which are usually shattered to pieces against cast iron.

Whatever target is adopted, it will be found advisable at each time of practice, to make use of a card bearing a printed representation of the target, like the one represented at page 133, and divided to scale in a similar manner. Upon this, each shot can be pricked off, and an accurate register may thus be kept of every day's performance.

When some proficiency has been acquired at target practice, the next important lessons are those by which the power to estimate distance accurately is acquired. For this purpose the little instrument (made by Holtzapffel, of Charing-cross), used by the School of Musketry at Hythe, is an excellent help; it may be useful to bear in mind, too, that with the regulation rifle in hand—

At 100 yards, the sword-bar covers a man six feet high from the feet to the shoulder;
At 150 yards, it will cover him to the tuft of the shako;
At 200 yards, the swivel screw-head will cover a man to his shoulder;
At 250 yards, to the tuft of the shako.

It is well also to remember that at 50 yards a man six feet high is diminished to an inch; at 100, to
half an inch; at 200, to a quarter of an inch; at 400, to one-eighth of an inch.

When the beginner can not only shoot tolerably from the shoulder, but has acquired the knack of estimating distances, he should vary his practice by firing in different attitudes—as lying on the face and back, kneeling or sitting. In some of these postures, great steadiness will be gained by passing the sling of the rifle over the left arm and elbow, and when firing in a recumbent position, by passing the sling over the right foot, and pressing firmly against it; in that case the butt of the stock cannot be held to the hollow of the shoulder, but must be made to rest upon the chest while taking aim.

In rifle-shooting most persons find it easier to aim with the right eye alone than with both eyes open; the latter, however, is a far better mode of shooting at moving objects and at short ranges, and the art is not difficult to acquire after some few trials. The chief requisite is to bend the neck, holding the head well over, and pressing the cheek firmly against the stock, so that the muzzle-sight shall be exactly opposite the centre of the forehead. The young rifleman should not merely content himself with firing now and then at a target in the summer, he should practise as well in stormy weather, in rain, and during snow. By that means he will learn how to make allowance for the force of the wind, which always exerts much influence over the direction of the bullet, especially at long ranges, and also for the peculiar refraction caused both by rain and snow. It will be found, too, that it is more difficult to shoot with accuracy over water and over tracts of swampy land than over level sands or sward.

It is not advisable for a beginner to change his weapon; having once made his selection of a par-
ticular arm, tested the adjustment of the sights, and accustomed himself to the pull of the trigger, &c., he should continue to work sedulously with it until he has perfect command over it.

If the rifle be found to throw its shots continually to the right, the breech-sight should be moved gradually to the left, and the muzzle-sight to the right, and of course the reverse of this operation will be necessary to cure the opposite evil. But, when once adjusted, the sights should be as little touched or tampered with as possible. A very common cause of bad shooting is the excessive stiffness of the trigger. I do not much advocate the use of hair-triggers, as they are apt to get easily out of order, and I consider that an ordinary trigger, requiring a pull of from 2 to 4 lbs., is preferable on every account. There is a kind of trigger which may be of service to those who object to the sudden liberation of the tumbler occasioned by the one commonly in use; its action, from the curvilinear form of that part which presses against the sear, is gradual, and it may be used with advantage by those whose aim is apt to be disconcerted by what may be termed a sudden or a jerking pull. It is the invention of Captain Harris, of the Royal Marines.

In letting the lock down from full to half-cock, let it be an invariable rule to allow the cock to descend almost upon the nipple, and then to raise it to the half-cock till the click is heard. Never, under any circumstances, cock a rifle until the moment before you intend to fire it; but remember that it is far safer, at all times, even to carry a loaded gun at full-cock than with the cock down upon the cap—a practice which is annually a more fertile cause of fatal accidents than any other, except that still more
stupid and senseless habit of pointing a gun at another person in joke.

Two golden rules on this subject should ever be borne in mind:—

Never point a gun, whether loaded or not, at any animal whose life you have not deliberately resolved to take.

Never take the life of any creature that is harmless when alive and useless when dead.

In order that the learner may become a really good rifle shot, it is advisable that he should understand not only the rudimentary principles of the laws of projectiles, but also the purpose for which the system of rifling was introduced; with this view I have annexed at the end of this volume a list of authors who have treated the subject scientifically.

It is hardly necessary to repeat that every missile, whether forcibly projected from a gun-barrel, or in any other manner impelled through the air, is partially arrested by the power of gravity and by atmospheric resistance; the first of these causes operates in lowering the line of flight, the second diminishes its speed, and the two together, generate the curved line which constitutes the path of the bullet. Besides this, however, every cast bullet has certain irregularities on its surface and in its internal structure, of themselves sufficient through the resistance of the air to make it deviate from the line of aim. The rifle grooves, if properly cut, give the bullet a rotary motion upon its axis, and maintain that axis, coincident with its line of flight. Each irregularity therefore in its structure, is by this means presented in regular succession to the action of gravity and of the air during its entire course. Every rifle bullet has thus two distinct motions, a for-
ward motion given by the explosion of the powder, and a spinning motion imparted by the spiral grooves through which it has passed. The force of gravity will act upon it in proportion to its mass, and its surface will be opposed by the air in proportion to its diameter and to the square of its velocity. The grooves of the rifle should only therefore, have such a twist as will set the bullet spinning on its axis without too greatly increasing its friction against the sides of the barrel. If the twist be too great, it will not only do this, but will cause the ball, during its flight, to offer its various irregularities too rapidly to the action of gravity and of the air.

Chapman, an intelligent American writer on this subject, states that at 220 yards, a rifle 90-gauge, the barrel 85 diameters long, and projecting a flat-ended conical bullet weighing 140 grains, with about 60 grains of powder of moderate strength, and with a gaining or increasing twist, ending at one turn in 42 inches, will send its bullet with less variation in a side-wind than any other combination of calibre and twist. To produce the greatest effect at 440 yards, the calibre should be 80 to the pound, the twist ending at one turn in 39 inches, and for a range of 660 yards a calibre of 70 to the pound will be requisite, with a twist ending at one turn in 36 inches. We cannot consequently expect any rifle, however carefully the sights may be adjusted, to perform with equal precision at all ranges.

For very great distances a heavy bullet becomes indispensable, because if we suppose two bodies of different sizes, but of equal density, to be moving through the air, and starting with the same velocity, the smaller will lose its momentum sooner than the large. A 60 or a 90-gauge rifle may perform beauti-
fully up to 300 yards, but at ranges of 700, 800, or 1000, it could not for a moment compete with one made, for instance, on General Jacob's principle, carrying a 1\frac{1}{2} oz. ball, unless indeed the bullet were formed upon Lancaster's pattern, whereby not only is all windage dispensed with, but a minimum surface is opposed to the air, and the projectile becomes, in fact, a short, blunt leaden arrow, or bolt.

In a perfectly calm atmosphere, bullets of 90-gauge may make good practice at a somewhat long range, but even a light breeze will be sufficient to sweep them far out of their proper course. The reason being simply that the momentum of a small bullet diminishes so rapidly as to render it incapable of maintaining its proper line of flight. It may, therefore, be assumed as an indisputable fact, that for such ranges as 800 or 1000 yards, a small bore is comparatively useless.

From what has been just stated, it will readily be understood how it is, that rifles of different calibres perform so variously at long ranges. Not only, too, should the bore of a rifle be adapted to the distance at which it is chiefly intended to be used, but the twist should always be attended to with that view. For short ranges a long twist will suffice—nay, is preferable to a short and rapid twist, though that is essential for a heavy bullet at a long range, in order to enable it to maintain its spin up to the extreme verge of its flight. Of course this rapid twist has the effect of increasing the friction, and thereby retarding the velocity; but that defect is more than compensated by the superior accuracy thus attained. Again, the grain of the powder used in a large barrel, at a long range, ought to be coarse, while that employed for propelling a bullet from a small bore should be moderately fine.
It is impossible to prescribe a particular form of bullet which shall be equally well adapted for every rifle. Regard must be had, in each individual case, to the bore, the length or rapidity of the rifling, as also to the length of the barrel. But, generally speaking, that projectile will be found to answer best, which is of conical form, with a flat base, and with a smooth external surface. It was only after the two great principles enunciated by Robins had lain dormant for a century, that men began to give them the attention they so justly merited. These are, that all projectiles should be of an elongated form, and that their centre of gravity should be thrown invariably well forward. It cannot be too frequently repeated that, by attention to these two points, and by the diminution of the windage it is, that the great superiority of modern arms has been achieved.

The result of my experience strongly inclines me to prefer that form of bullet which, within due limits, approaches most nearly to the character of an arrow. Some, indeed, that I have had made of box-wood, similar in shape to the old bird-bolt—the anterior part formed, of course, of lead*—have attained marvellous ranges; and I am in hopes of being enabled shortly to perfect a missile of this description, combining the rocket principle (to come into operation as the projectile power derived from the rifle fails), which shall attain a still greater range than anything that I have yet tried. The result of numerous experiments with projectiles of this description has proved the perfect feasibility of the plan; the only point yet remaining to be determined,

* Captain Norton recommends a compound bullet of this kind, made partly of lead and partly of willow-wood, for very long ranges. Its construction is extremely simple.
is the best chemical preparation for insuring the prolonged range. Captain Norton has recently exhibited a rifle shell of very ingenious construction. It is made of lead, and hollow; in external form resembling fig. 2, p. 83, the internal cylindrical cavity, being however filled by a zinc screw, which projects through the apex, the head of the screw forming the base of the shell. This obviates many of the objections to the use of lead alone, as it materially strengthens the bullet, and gives it far greater penetrating power than it could otherwise possess. Specimens of this, and many other of Captain Norton's valuable inventions, have been deposited by him, and can be inspected at the United Service and also at the Kensington Museum; they will repay careful examination, and deserve to be attentively studied.

One of his more recent and most admirable inventions is an elongated rifle shot cast on to its wooden plug.

"As far back," says he, "as the year 1823, I cast my elongated rifle shot and shell so as to have the centre of gravity in the fore part. I had not, at that time, ever heard of the celebrated Robins; the first time I ever heard of him was in the year 1824. All writers on the rifle now advise that the centre of gravity should be in the fore part of the shot; I have effected this in many ways. The accompanying engraving shows the shot when cast, and also the wooden plug on its pin to support it centrally in the mould. This shot is best adapted for
breech-loading rifles; the pressure in passing through the barrel is only on its shoulder and base, the centre portion receiving no pressure, and is coated with the lubricating ointment.

I now conclude this branch of my subject, and I trust satisfactorily to the reader. At any rate, I have endeavoured to fulfil the object proposed at the outset, and have given a concise, and I trust intelligible description of the various modifications of the rifle principle now in vogue. I have indicated in a few pages the results of the investigations of men who have devoted many toilsome years to this complicated but interesting subject, and finally, I have given such information as is requisite to enable any one unskilled in the use of the rifle to provide himself with a proper weapon—pointing out, moreover, the means by which proficiency in its use may be attained. The province of the instructor extends no further; the rest must depend almost entirely upon the aptitude and diligence of the pupil himself. In the art of rifle-shooting, more perhaps than in any other, long and constant practice is needed, in order to attain excellence; and even after the learner has outstripped most of his competitors, he will find that, in order to maintain that sympathy between the hand and the eye, which is the secret of success, he ought never to allow many weeks, or even days, to elapse without an occasional hour's work at the target.
PRELIMINARY INSTRUCTIONS IN FIRING,

As Taught at the Hythe School of Musketry.

Having in the preceding Chapter embodied the substance of the theoretical principles of projectiles, as taught at the above institution, I have thought it might be useful, to some at least of my readers, to be presented with a summary of the excellent system of instruction in firing, as well as in judging distances, as there inculcated.

TARGET DRILL.

1. For this exercise the traversing rest is used to support the firelock; or else three stakes tied together near the top, and supporting a bag of sand about 4½ feet from the ground, answer the same purpose.

2. A squad never exceeds ten men at a time at each rest; it is formed in a single rank, each man having his own firelock. The instructor first explains the principles of aligning the sights on an object, confining the attention of the squad to the following simple rules:

1st. That the sights do not incline either to the right or left.

2nd. That the line of sight is taken along the centre of the notch of the back-sight and the top of the fore-sight, which is made to cover the centre of the target.
3rd. That the eye is fixed steadfastly on the mark, and not on the barrel or fore-sight, which latter will be easily brought into the alignment if the eye be fixed as directed. Particular attention is directed to this rule, for beginners are apt to fix the eye on the fore-sight instead of the mark, in which case the latter can never be distinctly seen, and the difficulty of aiming is greatly increased.

4th. That in aiming, the left eye is closed.

3. The instructor then explains the difference between fine and full sight in aiming; the former being when the line of sight is taken along the bottom of the notch of the back-sight, the fine point of the fore-sight being only seen in the alignment as A: the latter is when the point of the fore-sight is taken in alignment with the shoulder of the notch of the back-sight, as B.

4. As these two methods of aiming cause a slight difference in the angle of elevation, it is necessary the soldier should understand that the ordinary rules for aiming are intended to apply to half-sight, which means that the alignment is taken with the summit of the fore-sight at half-distance between the shoulder and bottom of back-sight, as C.

5. As some firelocks carry higher, and others lower than the average, allowance can be made for this defect by aiming with full sight when the musket is found to carry low, and by aiming with fine sight when it carries high; when, however, no such defect is observed in the practice with the firelock, the men are invariably taught to aim at half-sight.

6. Having explained the foregoing rules, the in-
structor causes each soldier to take aim at an object of the same size as the bull’s-eye used in practice, at every distance of 50 yards from 100 to 900 yards: viz.

From 100 to 300 yds.—Bull’s-eye, 8 in. in diameter.
From 350 to 600 yds. " 2 ft. "
From 650 to 900 yds. " 4 ft. "

7. After each man has aimed, he steps aside, that the instructor may see if the aim have been correctly taken; should he observe any error, he causes the next man to advance and point out the defect; the error, however, is always corrected by the man who has aimed.

8. To vary the practice, the squad is occasionally exercised at intermediate distances (as 425 yards for example), and is also made to aim at a soldier placed in front of the target, or at a group of men.

Position Drill.

9. The position drill differs from the platoon exercise; the latter comprehending the positions of loading and firing in the ranks, in which the soldier is instructed by the adjutant, whereas in the "position drill" the attention of the instructor of musketry is confined exclusively to the essentials of good independent firing.

10. For this drill the squad (never exceeding ten men) parades in marching order, and is formed in single rank at one pace apart, and is placed at a convenient distance from the target; the instructor then orders the squad to fix bayonets and proceed with the "position drill," first in slow time standing, according to the instructions hereafter detailed; and as it is considered that too much pains cannot be taken to ensure that each man takes a deliberate aim
at some specified object whenever he brings his firelock to the "present," if no natural object presents itself for the man to aim at, several small bull's-eyes are marked on the barrack wall,—

1st. Load. According to regulation.

2nd. Ready. Adjust the sight and proceed according to regulation.

3rd. Present. At this word the firelock is brought at once to the shoulder, the centre part of the heel plate being pressed firmly into the hollow of it with the left hand, which grasps the piece at the "swell," the right hand holding it at the "small," the right elbow raised (but, when firing in platoon, not so much as to impede the aim of the rear rank man), the muzzle inclining to the bottom of the object and the forefinger of the right hand extended along the side of the trigger guard, the left eye being at the same time shut.

"Two." The recruit now raises the muzzle steadily until the fore-sight is aligned through the back-sight with the object on which the right eye is fixed, the second joint of the fore-finger being on the trigger, and the breathing restrained.

"Three." The trigger is "pinched" rather than pulled with the second joint of the fore-finger, by a steady pressure, without the slightest motion of hand or elbow, the eye being kept still fixed on the object, as in the preceding motion.

"Four." The rifle is brought down to the capping position and the flap shut down, at the same time the right foot is brought to the position in which it was placed before,
coming to the ready; a pause of slow time is counted, and the recruit comes to the position of “prepare to load.”

4th. Load. According to regulation.

11. The whole squad having thus been put through the drill in slow time, and the position of each man corrected, the instructor orders it to continue the motions of loading and firing independently, each man aiming at a specified mark. The most minute attention is now given to each man’s position when at the “present,” and more especially that the firelock is pressed firmly to the shoulder with the left arm, and that the trigger is pulled without the slightest jerk, and with the motion of the fore-finger only, the eye being fixed upon the mark during and after snapping the lock. In this drill the instructor frequently places himself in front of the squad at five or six paces distant, and causes each man successively to aim at his right eye, in order to ascertain that he obtains the alignment quickly and correctly, and that his aim is not disarranged by pulling the trigger; this is of the utmost importance.

12. When the men have been sufficiently exercised in the position of firing standing, they are put through the drill in the kneeling position with unfixed bayonets, going through it at first at slow time, according to regulation, observing the several points to which the attention is called in the foregoing remarks.

Judging Distance Drill.

13. In order to apply the rules of firing laid down for the rifle, it is necessary to know the distance which separates a man from the object he is firing at.

14. In firing for instruction, the target is generally placed at known and measured distances; but before
the enemy the distance being unknown, it is necessary to judge the distance quickly and exactly, in order to regulate the elevation of the piece accordingly.

15. In order to teach the soldier to estimate distances by the eye, he is instructed according to the following rules in the first instance, before he passes on to the method contained in the "Judging Distance Practice."

16. The instructor causes a line of 300 yards to be measured accurately; this line is divided into equal parts of 50 yards each, by perpendicular lines.

17. At the extremity of each of these perpendicular lines the instructor places a soldier standing at ease, and facing the squad he is about to instruct.

18. It will be observed that each of these soldiers is placed at a greater distance from the line of 300 yards, in proportion as he is distant from the point where the squad commences their instruction, in order that each soldier may serve in turn as a point of distance for the squad to make observations on.

19. The instructor points out successively to the men the different parts of the figure, arms, accoutrements and dress, which they can still perceive distinctly on the soldier placed at 50 yards' distance, and also those parts that they can no longer perceive clearly at this distance, and questions the men one after the other on the observations they make on what they see. Eyesight is not the same in all. Every soldier is directed to impress upon his mind the appearance of the man placed at 50 yards.

20. The instructor, then, by moving the squad to the right, places it in front of the soldier at 100 yards' distance, and causes each man to make observations of the same kind as on the man at 50 yards, desiring him also to make comparisons between the two men placed at these two distances.
21. The instructor then passes on to the other distances, proceeding in the same manner as for the first two.

22. He endeavours above all to point out to each recruit, according to the observations he may make, the differences that exist between the men placed at the six different distances comprised in the subdivisions of 300 yards, pointing out at each distance what parts of the figure, dress, and equipment are clearly perceivable, those that are seen confusedly, and those that are no longer visible.

23. The instructor next causes the men to take notice of the position of the sun, and state of the atmosphere and background while making their observations, that they may be accustomed to alterations in the appearance of the several objects.

24. The men placed as points, are from time to time, relieved; for which purpose the squad usually consists of at least double the number of men employed as points.

25. When all the men of the squad have made a sufficient number of observations on the different points designated, and when these observations are well fixed on their minds, the instructor proceeds in the following manner to the estimation of distances comprised within the limits of 300 yards.

26. After having marched the squad on to different ground from that on which the appreciation of distances has taken place, the instructor forms them into single rank, and sends a man to the front, marching him by means of the bugle diagonally to the right and left, and occasionally at the double, in order that the rest of the squad may not count his paces; then at any convenient distance within 300 yards, he will command "Halt," when the man faces the squad and "stands at ease." He then orders...
the men to observe the soldier facing them, and to estimate the distance, recollecting the observations previously made on the men placed at measured distances.

27. The instructor then calls each man separately to the front and questions him, noting down his answer,—which must be given in a low tone of voice, in order that those following him may not be influenced by his opinion.

28. Every man adjusts the sight of his firelock to the distance he judged.

29. When the men have all given their answers, the squad proceeds to measure the correct distance by advancing towards the man judged from, the instructor placing himself in the centre, the men counting the number of paces, the instructor only counting them aloud.

30. The men are taught to measure the distance in the following manner: at every 120 paces they double up one finger of the right hand to mark 100 yards, commencing again 1, 2, 3, and so on. When at the end of any division of 100 yards the remaining distance appears to be within 100 yards, they commence counting by tens of yards by doubling up a finger at every twelve paces. The correct distance is, however, ascertained by actual measurement with a cord, for which purpose two or three men follow immediately in rear of the squad.

31. The instructor, in repeating this exercise, takes care as much as possible to conduct it in different directions, and under different states of the atmosphere, that the recruit may become habituated to the diversity of circumstances in which he has to act.

32. The men, after having been drilled up to 300 yards, continue the exercise up to 600 yards; first at
fixed points at every 50 yards from 350 to 600 yards, and subsequently at unknown distances. In exercising the men at great distances, the squad is usually separated into two equal parts, facing each other. After every man has judged the distance which separates them, they advance towards one another, each party measuring half the distance: by this means much time and walking are saved.

33. The number of drills to be devoted to this exercise are arranged as follows:—

Four drills, at fixed points to 300 yards.
Three " at unknown distances up to 300 yards, each drill to consist of four answers.
Two " at fixed points from 300 to 600 yards.
Three " at unknown distances, from 300 to 600 yards, each drill to consist of four answers.

**JUDGING DISTANCE PRACTICE.**

The following course of judging distance practice has to be gone through annually by every soldier, and, when practicable, is carried on by the sections not occupied in firing, when at target practice.

A cord of the length required for the practice (divided into parts of five yards each, with the distances of each division from the end so marked as to be distinguished only on close inspection) is stretched in any convenient direction, care being taken to vary the ground as much as possible for the several practices.

One or more men, when judging at 300 yards only, but beyond that distance a section of not less than eight or ten file, is stationed at the end, or at any other part of the cord that may be directed, to serve as objects to estimate from.

The answers of each man are recorded in a register
kept by a non-commissioned officer of a different company to that under exercise.

The strictest silence is observed throughout the practice, the men are prevented from consulting together in judging their distance, and, in giving their answers, must speak in a low tone, so that they may not influence in any way the judgment of each other.

The commander fixes on a point at any uncertain distance to commence the practice, to which he marches the section or party, halting at about ten paces either to the right or left, and facing the objects; he then arranges the non-commissioned officers who are to keep the register, three paces to the front of their several sections, to prevent if possible the answers, when given, being heard by those in rear; these non-commissioned officers then call in succession upon each man of their sections, who is required to judge the distance in yards, and give his answer, which is then immediately noted down in the register.

As the commander always selects a division of five yards at which to halt the section or party, the men are cautioned to complete a division of five yards in giving their answers.

When all the answers of each section or party have been noted down, they are read over to the men, and any error is at once corrected; after which the commander refers to the cord, and states aloud to the men the correct distance, which is at once noted at the top of the column, the number of points obtained by each individual being at the same time registered and made known.

In each practice the men are exercised at four different stations. When the section has been exercised at one station, it is moved to another in a
manner that precludes the possibility of any clue to the actual distance being obtained.

At the conclusion of each practice the number of points obtained by each man is read over to the men; and the register, when completed by filling up the column "total points" and "duplicate total points" (which is always done on the practice ground), is signed by the non-commissioned officer who has kept it, and by a non-commissioned officer of the company exercising, and countersigned by the officer instructor, who also places his initials to the "duplicate total points," which are then torn off and given over to the non-commissioned officer instructor of the battalion; the company instructor retaining the register, the total points of which he invariably transcribes into the company’s judging distance practice return, immediately on his return to barracks.

When there are casuals, the column duplicate total points is not to be filled up in the register, which is only intended to receive the initials of the parties before-named, and be handed over to the non-commissioned officer instructor of the battalion.

When the casuals are to make up their judging distance, the company instructor goes to the non-commissioned officer instructor of the battalion for the register of the section to which they belong, and after the same has been completed, the signatures are attached in full; the register is then kept by the company instructor, the non-commissioned officer instructor of the battalion receiving the duplicate total points.

Any casuals who are in arrear more than two practices will not be further exercised in the "period" in which their company or class is engaged.

The practice of judging distance, like the target practice, is divided into three periods, each period con-
sisting of four practices. The third class practise as far as 300 yards, the second to 600 yards, and the first as far as 900 yards.

The value of the men's answers by points in the several classes in judging distance will be registered as follows:—

3rd class, or when judging distance between 100 and 300 yds. } Within 5 yards, 3 points.

   " 10 " 2 "
   " 15 " 1 "

2nd class, or when judging distance between 300 and 600 yds. } Within 20 yards, 2 points.

   " 30 " 1 "

1st class, or when judging distance between 600 and 900 yds. } Within 80 yards 2 points.

   " 40 " 1 "

It may be observed that, if the first or second class be brought to judge within the distance of an inferior class, which, in order to test the proficiency of the men, ought frequently to be done, the points are then only counted agreeably to the conditions laid down for these classes.

**FIRST PERIOD.**

Every man commences the yearly course of practice in the third class, and is exercised therein at sixteen different distances in four practices.

At the conclusion of these practices the columns in the company judging distance practice return are summed up, and receive the signature of the captain of the company to verify its correctness, as also of the officer instructor who has previously compared it carefully with the "duplicate total points" in his possession.

All those men who obtain sixteen points pass into the second class, the remainder recommence the practice of the third class.
SECOND PERIOD.

Each company is now told off into two classes and into sections, and the practices continue in that order, each class being exercised at sixteen different distances in four practices.

At the conclusion of the practice in the second period, the columns of this period in the company judging distance practice return are summed up and signed by the captain and officer instructor as before.

All those men who in the practice of the second class obtain sixteen points pass into the first class, the remainder repeat the practice of the second class. The test for passing from the third to the second class is the same as in the practice of the first period.

THIRD PERIOD.

The company is now told off into three classes, and into sections as before, and each class exercised at sixteen different distances in four practices.

The second class is composed partly of men who repeat the practice of the second class, and partly of those who have passed out of the third class in the second period.

At the conclusion of the practices in the third period, the columns of this period in the company's judging distance practice return, are added up and signed as directed for the first and second periods. A final classification is then made, and the man who, in the practice of the first class, obtains the greatest number of points, receives the battalion prize as the best judge of distance. Should two or more men obtain the same number of points, the prize is awarded to that man who has obtained the greatest number of points throughout the whole practice.
INSTRUCTION OF RECRUITS.

Every recruit, before being allowed to join the practice of the battalion, is put through the foregoing course, with the exception of the judging distance practice, under the close superintendence of the officer instructor and his assistants.

In the remaining drill the instructor at first causes the recruit to aim at a small mark on the wall of the yard or barrack room, and confines his attention to those rules laid down under the head of aiming drill.

After the recruit has been well grounded in the various exercises under the head of drill, and before he is allowed to fire ball, he is practised in snapping caps and firing blank cartridge to give him steadiness and accustom him in some measure to the explosion of the gunpowder and recoil of the piece.

Caps are then used; after which, each recruit is made to fire two or three rounds singly, then a few rounds in file firing and volleys. Should the instructor experience any difficulty in teaching any of the recruits to aim, or in practice find any man shooting badly, he distributes three or four caps to them, and, having placed a lighted candle on a table or stand at eight or ten paces in front of the squad, he makes each man advance in succession to such a distance from the light that, when aiming, the muzzle may be about a yard from it, and after going through the motions of loading and putting on the cap, the man will fire, aiming at the wick of the candle, when, if the aim is properly directed, the candle will be blown out.

After all these exercises have been gone through, the soldier is considered competent to join the practice of his battalion; but any man who concludes
his practice as a recruit after the target practice of his battalion has commenced, does not fire with his battalion until the ensuing year.

An index of preliminary drills is kept by the non-commissioned officer instructor of the battalion for the recruits, as also a target practice return recording their practice.

**Prizes.**

Prizes are awarded at the conclusion of the whole practice, subject to such arrangements as may be directed or approved by the Field-Marshal Commanding-in-Chief.
The following Table shows the Number of Drills or Practices, in the Instruction of Musketry, which every Non-commissioned Officer and Soldier of the Battalion must go through annually, as well as every Recruit, before he joins the Practice of the Battalion.

<table>
<thead>
<tr>
<th>Preliminary Drills</th>
<th>N.C. officers and soldiers</th>
<th>Recruits,</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of drills or practices</td>
<td>No. of rounds</td>
<td>No. of drills or practices</td>
</tr>
<tr>
<td>Theoretical principles</td>
<td>6</td>
<td>...</td>
<td>According to the discretion of the officer instructor</td>
</tr>
<tr>
<td>Cleaning arms ......</td>
<td>6</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Target (Aiming drill drill (Position drill)</td>
<td>6</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Snapping caps, and blank cartridges ...</td>
<td>...</td>
<td>...</td>
<td>20 According to the discretion of the officer instructor</td>
</tr>
<tr>
<td>Judging distance drill</td>
<td>12</td>
<td>...</td>
<td>Blank cartridges.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Practices</th>
<th>Ball cartridge</th>
<th></th>
</tr>
</thead>
</table>
| Preliminary firing; one round to be fired from a rest at the several distances to 300 yds. | 5 | 20 | By the officer instructor. (N.B. These 20 rounds are to be recorded in a register, but not in the company's practice return.)
| 1st period | 5 | 20 | In the company under the captain of companies, and recruits by the officer instructor. |
| 2nd period | 6 | 20 | 6 | 20 | By the officer instructor. |
| 3rd period | 5 | 20 | 5 | 20 | Ditto. |
| File firing and volleyes | 1 | 10 | 1 | 10 | In the companies by their captains, recruits by the officer instructor. |
| Skirmishing practice | 2 | 20 | 2 | 20 | Ditto. |
| Judging distance practice | 1st period | 4 | ... | ... | 4 | ... | ... | 4 | 20 | Ditto. |
|                         | 2nd period | 4 | ... | ... | 4 | ... | ... | 4 | 20 | Ditto. |
|                         | 3rd period | 4 | ... | ... | 4 | ... | ... | 4 | 20 | Ditto. |
| Total ....... | ... | 90 | ... | 110 | |
THE VOLUNTEER SERVICE.

The rifle, being especially the weapon with which all regiments of Volunteers are, or ought to be armed, I took occasion, in the original edition of this work, (published in June, 1858,) to offer some observations as to the expediency of forming, upon a permanent basis, a Volunteer Army upon such a scale as should henceforth secure the country from all chance of foreign aggression.

The idea was very generally adopted, the arguments I then adduced, here and elsewhere, were considered, by a large majority of the community, to be entitled to far greater consideration than I had anticipated, and the result has been the rapid organization of nearly 100,000 men, whom we now find banded together in one common cause, and presenting such an aspect as to have elicited alike the astonishment and admiration of Europe.

Not many months ago nothing could indeed have been more humiliating than the state of the defences of the country, at the very time that the then Chancellor of the Exchequer was heard to state that "our pacific relations with France were not a question of weeks or days, but of hours," and when the Admiralty, as the First Lord actually affirmed, in his place in the House, were altogether in ignorance of the tremen-
dious exertions that France was making to outnumber the fleet and outvie the Navy of England.

In order to prove to the British public what preparations really were in progress across the Channel, I took the trouble to visit successively all the naval ports and arsenals of France, and I published, side by side with a classified list of our own Navy, an accurate, and indeed the only, catalogue of French men-of-war, that has been circulated for many years past.

The sensation which that volume* produced, both here and on the Continent, conclusively showed with what secrecy the policy of our neighbours, in augmenting their maritime power, had been carried out.

It was very certain that France had nothing to fear from us. We should certainly not be likely to invade her, even were her armaments far less formidable. The only combat to which Great Britain invites the world is the battle of trade—the only struggle, the race of commercial steam-ship lines. We have never attempted to dictate to France, either with respect to her foreign policy or her internal regulations. An attack from England can never, therefore, be dreaded by France. After the close of the Russian war, we dismantled a large portion of our ships, and sent their seamen adrift without compunction. Some one in the House of Commons uttered a few economical platitudes, and the blatant representatives of noodle-dom at a political soirée, voted precaution unnecessary. Suddenly we learnt how France had laboured during the last few years. She has been quietly, steadily, and energetically putting herself in order, apparently to contest the supremacy of the

seas. Her ships, her ports, her guns, her sailors, her stores of ammunition and British steam coal, all prove this beyond a doubt, and her naval officers do not scruple to say so. If you mess with a British regiment, or dine on board a British man-of-war, you hear no burning aspirations uttered, to cross swords with the Gaul or to invade France. Who ever heard a British officer declare that he panted for such an opportunity of distinction? In France it is quite different. There, the constant theme and topic among military and naval men is, "How can England best be conquered?" There is not a shadow of doubt about the matter. But let us for a moment inquire what the means at the disposal of France actually now are, and what it is proposed to make them. The list of the French navy is really an astounding document. It commences with fast screw steam ships-of-the-line, of which there are nine, one of 130 guns, and eight of 90 guns. There are six fast screw frigates, ranging from 58 to 34 guns; seven fast corvettes; fourteen fast avisos or armed despatch boats, from 260 to 120 horse-power. Then come five ships-of-the-line, with auxiliary screws, of 114 guns each; eight ditto of 90 guns; and eleven of 80 guns. Next are nine frigates, with auxiliary screws, of from 58 down to 37 (the smallest number of) guns. There are two corvettes and three avisos, with auxiliary screws. Next, five floating batteries, with screws. Twenty screw gun-boats, of which twelve carry four guns and eight carry two, swell the list. Then follow eight screw gun vessels, and nineteen armed steam transports, with auxiliary screws. The French paddle steamers are as follows: Nineteen steam frigates of from eight to twenty guns, nine steam corvettes, fifty avisos, and fourteen steam tenders.
Such, briefly, then, is the French navy at this hour. We need not trouble ourselves with sailing ships, of which there is a mighty array, because for war purposes their day is past; but it is to the development of the steam navy that the nation has, for years back, devoted itself with such extraordinary energy. The whole naval power of the country, too, is unfortunately far more readily available than our own, while the supply of able seamen and of men trained to the great gun exercise is, by the admirable system of *inscription maritime*, almost unlimited. Of course, if we could always reckon upon receiving due notice before a declaration of war, we could more than supply all this. Unfortunately, that is, in all probability, just what we shall not have. French officers who are in the habit of canvassing the subject on all occasions admit this freely. In 1858 a Commission, consisting of experienced naval officers, was appointed by the Emperor to revise the organization of the navy; from their report it appears that, in the course of this present year of grace, 1860, the French Government will have a steam fleet which, with a proportion of large transports, will enable them, if requisite, to move an army of 60,000 men, with all its horses, ammunition, and materials, together with one month's provision for the whole, on the shortest notice; and that, before August next, they will have afloat, and in perfect order, a fleet of 40 screw ships of the line, 6 iron-plated frigates, 30 screw and 19 paddle frigates, and 46 steam transports of the class of the Calvados! Yet, as already stated, the First Lord of the Admiralty avowed that it was only in July, 1858, that the Admiralty first became aware of the advanced state of the French Marine! Such a thing would appear incredible but for the ignorance and the apathy so constantly shown by men too
frequently the mere creatures of party nomination, whose chief is not brought up to his business, and who of late years have seldom time to settle down into their places, before they have to give way to a fresh combination to destroy the Ministry from whose advent to power their official appointments date.

The French Commission of 1849–51 held its 200 sittings preliminary to the “reconstruction” of the French navy, which has since taken place. The language in the report of this Board, of which M. Dufaure was President, was extremely significant respecting England. “The first point we have to determine,” it observes, “is the number of line-of-battle ships we can and ought to have afloat the moment that war is announced.” It then adds, significantly enough, “on this point we have at least certain data. Our enemy is well known. It can only be England.” With this idea fully impressed upon their minds, the Committee came deliberately to the resolution that “20 frigates of the first class should be provided with steam power, so as to give them the greatest attainable speed; and that, of the 38 ships of this denomination then afloat, as many as possible should be fitted with propellers, in order to convoy fast transports, laden with troops. No more sailing transports were to be built, but 20 steamers of large dimensions, capable of carrying 1000 men, with all their equipments, were forthwith to be commenced” (46 are now nearly completed). “Speed,” observed the Commissioners, “is the best weapon against an opponent better equipped, and having many weak points to protect. It is the indispensable requirement of that party whose resources are the smallest, who is less powerful afloat, and whose national character displays the greatest amount of daring. . . . .
Were a war to break out with England, we will imagine a fleet composed of vessels of the first class, and capable of putting to sea; such a squadron need only have sufficient auxiliary steam power to overcome occasional difficulties. England would necessarily have to watch such a fleet, and must, therefore, keep no inconsiderable portion of her own naval power far removed from their own depôts of fuel, while ours would be nearer home. If, then, we had a few vessels of considerable speed lying in wait in our various ports, England would be compelled to send out men-of-war to convoy her store-ships, though not a single French cruiser showed herself. These convoys would necessarily be sailing vessels, as steamers can only carry their own coal; they would therefore be perpetually liable to surprise. A large number of swift steamers would thus be necessary, and France would readily be able to maintain a continued system of alarm, by simply adopting an inexpensive principle in the structure of her vessels.” But France has adopted both plans. She has an ample number of first-rates and of swift frigates. She has constructed engines to the amount of nearly 40,000 horse-power. She has completed Cherbourg; has erected Government works on a stupendous scale, not only at Cherbourg, but at Toulon, Brest, l’Orient, and elsewhere; and has organized all her navy departments in the most complete manner. Steam coal is her chief want, but she has two years’ store already, and is increasing it sedulously daily. In addition to this, France has made sailors and marine gunners of her men. She has set to work studiously to repair her errors during the last war. Unquestionably steam and arms of precision, as the French call them, are more favourable to them than to us, since they will go far to
neutralize some of the peculiar advantages we formerly possessed afloat.

Without venturing, then, to discuss here the probability of an European war, we cannot help asking, for what purpose has France been steadily collecting together so tremendous an armament as she now has at her disposal? There is a deliberation and a method about this movement which leads to the conviction that it covers some important design. She has unquestionably gathered up her colossal strength, and would appear, even to the most stolid, to be on the eve of some vast enterprise, in the prosecution of which, that strength is to be put forth to the utmost. I am far from wishing to appear to attribute to her present ruler any covert designs against this country, but any one who really knows anything of the state of the feeling of the community at large throughout France, is well aware that the most deadly hostility to England pervades all classes, and that little pains is ever taken to conceal it. It will probably be from sheer inability on the part of the Government to keep this animosity in check, that the next rupture will take place.

But, irrespectively of the above considerations, in the event of any great European convulsion, let it commence where it may, it is scarcely to be expected but that England, should she not be engaged in it at first, will sooner or later be involved. Surely then, without the smallest desire of exciting unnecessary alarm, it is not unreasonable to consider what her position would be, were her tranquillity menaced. With the plain fact before us, that in addition to her navy, France has, at this moment, an army of 627,000 men, all well-armed, thoroughly trained, and, for the most part, well-inured to war, it is pretty evident that it is hopeless for us to
attempt to maintain a standing army that could cope with such an one as that to which I have alluded. We are driven then to rely, in no small degree, upon the militia, both for repelling invasion as well as for repressing internal commotion.

This surely is not a promising state of things; for, whatever respect one may entertain for the Militia as a body, and more especially for some distinguished regiments, it must be conceded at once, that from their very nature, forces of this kind must, in many important essentials, be inferior to troops of the line. To mention one, among many reasons why this should be so, I may instance the practice of drafting volunteers into the line as soon as they have become proficient in their drill, leaving the deficiencies to be filled up by raw recruits. Volunteer regiments, on the other hand, selected from a proper class, would, in case of invasion, for most purposes, be eminently superior to both.

No country in the world can boast of such materials for levies of this description as our own; and, were but sufficient encouragement shown, and a proper stimulus given to their formation, there is not a doubt that at least any requisite number of efficient regiments might always be forthcoming. To be of use, however, the nucleus of each, with a proper staff of officers and supplies of arms in accessible depôts, should, at any rate, be sedulously maintained; they would then have the capability of rapid expansion to their full complement, upon the occurrence of any adequate emergency. They would be worse than useless, unless several companies of each were properly equipped and drilled in time of peace, and unless they were then, to a certain extent, inured to that discipline which must necessarily be exacted from them when called out.
Nothing, of course, would be more unwise or impolitic on the part of Government than to sanction the indiscriminate arming and drilling of large bodies of men. Much tact and judgment should be exercised in the selection of recruits. The value of a volunteer corps depends entirely upon the class from which it is drawn. The men composing it should, without exception, be those who, by birth or position, have a stake in the country; whose loyalty is beyond question; who would have the strongest possible interest not only to repel aggression, but to maintain tranquillity, and to defend and uphold all established institutions.

History is replete with examples of the prowess of Volunteers even when opposed to hardy veterans. We need, however, go no further back than to the American war, or that in later times still, in Mexico—to the memorable stand made by the Tyrolese against Napoleon's choicest troops; to the deeds of valour achieved by the German student Volunteers in 1813-15. The memory of those valiant bands still forms the theme of many a soul-stirring narrative, and the names of those who led them will live so long as the nations, for whom they fought, survive.

All who duly weigh this matter must indeed admit that volunteer regiments, if properly constituted, would prove the very best adjunct to the defence of the country that she could possess. But their adoption on a grand scale need not interfere at all with existing militia arrangements. Use the militia for what they are worth, but do not neglect to accept, in addition, the services of rifle Volunteers. Let the Government but once give them due encouragement, and place them upon a proper footing, and I will answer for it, that there will be no complaint of a dearth of the best elements out of which alone such
regiments should be formed. There is no lack yet in England of good men and true; would it not then, be the most egregious folly, to fail to make a proper use of that gallant spirit which, after all, is the only safeguard for such a country as ours.

The very motives which actuate Volunteers in subjecting themselves to discipline and to the hardships and perils of war, would of themselves impart a higher tone and inspire a degree of laudable emulation on the part of any paid forces with whom they might be co-operating. The zeal thus generated, the enthusiasm thus excited, would enhance the value of all volunteer reinforcements far beyond their numerical addition, to any division with which they might have to serve.

Numberless pamphlets, published by able military men in France, have pointed out over and over again how this little island can be successfully invaded! All that can be done in the way of fortification is to protect the dockyards and arsenals, it is the wildest absurdity to pretend to do more; but it should ever be borne in mind, that there are no such ramparts as the hearts of brave men, well disciplined, and eager to be led against their country's foe.

I say emphatically, well disciplined, because, without proper training, the most indomitable valour, together with every other qualification, becomes worse than useless. It cannot be too strongly impressed upon the mind of every recruit, that upon this point all his efficiency depends. A few trained men, accustomed to act together, relying upon their own individual skill, and able to confide in their comrades, may be led without hesitation against a mere host, however armed, many times numerically superior to themselves. At the same time, I may add, that the discipline of a volunteer regiment need
not be severe, and the whole of the rifle drill, together with tolerable proficiency at the target, is usually mastered in a few weeks by recruits of the intelligence of those who swell these ranks.

The following remarks which appeared some months since in Fraser's Magazine are so true and so apposite that I cannot forbear from introducing the quotation:—

"What England wants for home protection (as auxiliary to our mere mechanical rank and file in the field) is your patriotic home guerilla force, lining hedges, popping from pits and tree tops, galloping from point to point, and blazing away at foragers, skirmishers, and outposts, from shooting ponies; so thinning off the foe marvellously, and making him, to his bitter astonishment, 'small by degrees and beautifully less!' Let cannon meet cannon by all means from the opposite heights, and regiment regiment in the open plain; but, for real loss to an invading army, post me 500 quick-sighted and quick-footed amateur rifles, in their own well-known woods, and see how they'd pick off all the sous-lieutenants, and colonels, and artillerymen a mile away.

"To my mind these are ticklish times, and nobody can tell how soon the next nine days' wonder, successive on the Crimea, and Persia, and China, and the Sepoy mutiny, and Naples, and America, may not be a piratical dash at Portsmouth or Southampton, and half a dozen counties laid waste in the after-process of clearing the land of these locusts. Louis Napoleon is helpless to prevent it, if his army wills; and so is the Parisian bourgeoisie, and all others our friends, if we have any, in Europe. It behoves us, like wise householders, to protect ourselves in case of need; to get weapons, and ensure the men who know how to use them; and I've shown you that there's no
need to go to any expense in the matter beyond what local resources will supply. If government, not yet wise too late, chooses to encourage the idea by grants of waste lands, or prizes, or the loan of instructors, or even by the use of some idling ordnance stores (for a little flying artillery would be a good supplement here and there, where wide downs or the seaboard give a range), all well and good; but, beyond this, let not the chilling breath of governmental office damp our patriotic powder, nor constraining red tape tie down our energies."

Who is there too, who does not cordially reciprocate the manly sentiments so eloquently expressed by one of the ablest and soundest writers of modern times:—

"I have," said Sydney Smith, "a boundless confidence in the English character: I believe that they have more religion, more probity, more knowledge, and more genuine worth than exist in the whole world besides; they are the guardians of pure Christianity, and from this prostituted nation of merchants (as they are in derision called) I believe more heroes will spring up in the hour of danger than all the military nations of ancient and modern Europe have ever produced."

The *Times*, in adverting to this subject too, lately observed: "The fact is, that the unerring judgment of mankind tells them that mere standing armies and fleets are not a sufficient defence of nations. A mere artificial organization, which may be demolished by a campaign, a pestilence, or a tempest—which some event, like an Indian mutiny, may cause to be wholly transported from the land it was raised to defend—does not give a fit security to the people, who may at any moment be deprived of its services. There can be only one true defence of a nation like ours—a large and permanent volunteer force, sup-
ported by the spirit and patriotism of our young men, and gradually indoctrinating the country with military knowledge. We are the only people in the world who have not such a force in one form or another. There are the Americans at 3000 miles distance from Europe, and without an enemy or a rival on their own continent. Yet they keep up a Militia which can muster several hundred thousands strong, and on some occasions New York wears the aspect of an European metropolis, such is the parading, drumming, and firing. The result of this is to be seen in the confidence they have in their own strength, though without either Army or Navy, according to our notions of such forces."

The value of these levies is apt to be much underrated by those who have had but little experience in actual warfare, and whose knowledge of history is small. The records of the past, however, sufficiently show, that the valour and enthusiasm of such men, when duly disciplined, have often proved more than a match for the bull-dog courage and endurance of even veteran paid forces.

In that dire struggle in the Cevennes, between 1702 and 1704, during which it is computed that 50,000 picked troops fell; (although the insurgents never had at any one time more than 3000 under arms), all the skill and generalship of four successive marshals of France, could scarcely achieve a single victory over a handful of mountaineers.

To a body, chiefly consisting of rifle Volunteers, it was, that Burgoyne and an entire British army, composed of the finest troops in the world, surrendered at Saratoga in 1777.

The indomitable prowess of Volunteers again prevailed in 1781, when Lord Cornwallis and another English army were compelled to lay down their
arms. The deeds of valour performed by the German student Volunteers in 1813–15 are too well known to need recital here. Again, the whole might of Russia, with half a million of troops at her beck, in a long and sanguinary war, extending over thirty years, hardly accomplished a success worth recording, against the hardy Volunteers of Circassia.

Can it for a moment be presumed then, that in this England of ours, less chivalrous feeling really exists, than has been actually evoked in other countries when the need arose? It must not be forgotten, however, that spirit, and daring, and gallantry, however great, unless properly trained and disciplined, are of little worth. The present is the time for the formation of the nuclei at least of such corps as have been alluded to. Let those who feel themselves qualified for the duties, continue to come forward, and her Majesty will speedily have at her disposal as noble an army as the world has ever produced.

Be it remembered, too, that these corps cost the State nothing; that they interfere with no established institutions; and above all, that they engender and foster a spirit of loyalty, obedience, and order, which, after all, is the only true safeguard of nations.

With regard to the value of military drill on the rising generation, the following observations of the Provost of Eton (Dr. Hawtrey) are so extremely apposite, that I feel no apology is necessary for giving insertion to them here:—

He said "the instruction in elementary drill had so recently commenced at Eton, that it was impossible to do more than give expression to the hopes which were entertained as to the result. But on the occasion of a visit to Oxford, he was informed
that so far from having the effect, which many had supposed, of withdrawing young men from their studies, it had been found that those who took the lead in the volunteer movement were precisely those who were remarkable for their classical and other attainments, and that those who held aloof from it were almost universally those who had acquired a fatal habit of sauntering, and were equally indifferent to intellectual as to manly exercises. He had also heard that it had decreased very sensibly the foolish and frivolous expenses connected with the University, and that many of the tradesmen by whom these expensive habits were encouraged, lamented extremely that the rifle movement had ever taken place. Reliable information had reached him that a salutary effect had likewise been exercised upon the discipline of the University itself, particularly at Christ Church. Another place at which he had an opportunity of judging of the effects of drill was at the Windsor School, where this custom had been established from its very foundation, and had proved efficacious in producing orderly habits as well as great physical improvement, which uniformly tended to moral improvement; for the better the condition of the body the greater would be the fitness of the mind for any great intellectual exertion. He entertained grave objections to anything in the nature of a strictly professional education, for he believed that the only way in which a school could be useful, was in laying an elementary foundation which would fit a young man to take up a profession subsequently, and in preparing him physically and intellectually for the career on which he might afterwards decide to enter. If, therefore, he believed that the system of elementary drill, as now established at Eton with his hearty consent, had
any tendency to convert the school into a military college, he should oppose himself to it with equal determination. The number of boys at present (Feb. 1860) receiving instruction voluntarily in these exercises was about 280; and he might add that, with a view of maintaining the system of graduated advancement which distinguished the schools of this country in so remarkable a degree from those of the Continent, the class had been confined in the first instance to those boys holding the higher positions in the school."

Some feeble-minded elderly gentlemen among our "authorities" have, it is said, been known to tremble at the danger of training, what they are pleased to call the "lower orders," and even to shudder at the thought of putting arms into their hands, forgetting that every time a Militia regiment is disbanded several hundreds of trained troops are dispersed, who would find no difficulty in re-assembling, if mischievously disposed, nor in quickly providing themselves with arms. But the men who are found to come forward as Volunteers are of a far superior class to Militia soldiers, and will always be for the most part, by birth and education, gentlemen.

If the prowess of volunteer corps has over and again been sufficiently proved under the old system of warfare, what may we not anticipate of them, when armed with a weapon, individual proficiency in the use of which will alone ensure future success in the field?

That our native superiority over the French, in the use of firearms, remains to us in the present day, the experience of any one who has engaged in la chasse across the Channel will attest; and this native superiority, it should be the object of every one who wishes thoroughly and inexpensively to guard our
coasts, to endeavour to develop. When her power to carry the bayonet was more to be relied upon than the other properties of “Brown Bess,” great proficiency could only result from constant drill. All that is necessary to render tolerably effective a body of men armed with the best form of rifle that can be procured, is an attendance (consistent with the occupations of most individuals) sufficient to teach them to move together, to know the bugle calls, and, above all, to become good shots.

What “the cloth-yard shaft and gray goose-wing” effected, when guided by an English eye and an English hand at Cressy and at Agincourt, the rifle bullet will do, in any future contest, more especially where the opposing army will have to advance through a country where each lane and hedge-row would be lined with its own “guerillas.”
APPENDIX.

SIMPLE METHOD OF CALCULATING
HEIGHTS AND DISTANCES.

An easy mode of accurately determining the heights and distances of objects being often required, the following will be found useful, when the requisite instruments are at hand. The eye of the rifleman should, however, be disciplined to calculate without the intervention of any instrument, the height or distance of any object from 50 up to 1500 or 2000 yards.

HEIGHTS.

1. To ascertain the height of an object by its shadow.

   Set up vertically a rod of known length, and measure the length of its shadow upon a horizontal plane; measure the length of the shadow of the object of which the altitude is required. Then by the property of similar triangles:

   As the length of the shadow of the rod is to its altitude, so is the length of the shadow of the object to the altitude of the object itself.

2. To ascertain the height, when there is no shadow.

   Place a rod (equal in length to the height of the eye) vertically at such a distance from the foot of the object to be measured, that the observer, when lying upon his back with his feet against the bottom of the stick, may
see the top of the rod and of the object in the same line. Then by the proportions subsisting between similar triangles, the height can be ascertained without difficulty.

3. To ascertain the height of an object (the distance of which is known), by means of the tangent scale of a gun.

Lay the gun for the top of the object, the height of which is required, then raise the tangent scale until the top of it and the notch on the muzzle are in line with the bottom of the object; then by similar triangles, as the length of the gun is to the length of the raised part of the tangent scale; so is the distance of the object from the gun to the height required.

4. To ascertain the height of an object, by means of a portable barometer and thermometer.

Observe the altitude (B) of the mercurial column in inches, tenths, and hundredths at the bottom of the hill or other object, the height of which is required.

Observe also the altitude (b) of the mercurial column at the top of the object. Observe the temperature on Fahrenheit's thermometer at the times of the two barometrical observations, and take the mean between them. Then \[ 55,000 \times \frac{B - b}{B \times b} \] is the height of the hill in feet, for the temperature of 55 degrees on Fahrenheit. Add \( \frac{4}{25} \) of this result for every degree, which the mean temperature exceeds 55 degrees, and subtract as much for every degree below 55 degrees. This will afford a fair approximation when the height of the hill is below 2000 feet.

D.I.S.T.A.N.C.E.S.

5. To ascertain the distance from an object by means of two rods.

Take two rods of unequal lengths, drive the shorter
into the ground, say close to the edge of a river; measure some paces back from it, and drive in the other, till, on looking over the tops of both rods, you find your sight intersects the opposite bank. Pull up the first rod, measure the same distance from the second rod, in any direction the most horizontal, and drive it as deeply into the ground as before. Then, looking over them again, if you observe where the line of sight terminates, you will have the distance required. This method is only applicable to short distances.

6. By means of the tangent scale of a gun, the height of the object, at the required distance, being known.

Lay the gun by the line of metal for the top of the object, then raise the tangent scale till the top of it and the notch on the muzzle are in line with the foot of the object, and note what length of scale is required.

Then by similar triangles:

As the length of the raised part of the tangent scale : the length of the gun :: the height of the distant object to the distance required.

Thus, supposing the height of the object to be nine feet, the length of that part of the tangent scale which is raised three inches, and of the gun six feet, the proportion will be—

As 3 : 72 :: 108 : 2592 inches, or 216 feet.

7. By means of the brim of a hat, or peak of a cap, to measure the breadth of a river.

Place yourself at the edge of one bank, and lower the brim of your hat or the peak of your cap till you find the edge of it cuts the other bank, then steady your head by placing your hand under your chin, and turn round gently to some level ground on your side of the river, and
observe where your eyes and the edge of the peak again meet the ground; measure this distance, which will be very nearly the breadth of the river.

**Sound.**

Sound travels uniformly at the rate of about 1100 feet per second, in a still atmosphere, and at a medium temperature. At the temperature of thirty or thirty-two degrees, the velocity is about 1120. The approximate velocity under different temperatures may be found by adding to 1100 half a foot for every degree (of Fahrenheit) above the freezing point. The mean velocity may be taken at 370 yards per second, or a mile in 4½ seconds. Hence, if the time during which sound is in motion be multiplied by 370, the result will give the corresponding space in yards, or dividing any space in yards by 370, will give the time occupied by sound in passing uniformly over that space. If the wind blow at the rate of from twenty to sixty feet per second in the direction in which the sound moves, the velocity of the sound will be proportionately augmented; if the direction of the wind be opposed to that of the sound, the difference of their velocities must be taken. It is a curious fact that the velocity of sound is not affected by its intensity, the smallest sound moving as rapidly as the loudest.

*To ascertain the distance of any object by the report of firearms.*

Multiply the number of seconds which elapse between the time of seeing the flash and hearing the report by 1100, the product will be the distance in feet, with sufficient accuracy for ordinary purposes. If greater nicety be required, the velocity and direction of the wind, and state of the thermometer, must be taken into account.
Sound will be louder in proportion to the density of the air. Water is one of the best conductors of sound; it travels along the surface of water nearly twice the distance that it will over land.

**MOTION, FORCES, ETC.**

Body is the mass, or quantity, of matter in any material substance; and it is always proportionate to its weight or gravity, whatever its figure may be.

Density is the proportional weight or quantity of matter in any body. It is that property directly opposed to rarity by which a certain quantity of matter is contained in a body under a certain bulk.

Velocity is an affection of motion, by which a body passes over a certain space in a certain time.

Momentum is the power or force in moving bodies; it is always equal to the quantity of matter multiplied by the velocity.

Force is a power exerted on a body to move it or to stop it. If a force act constantly, it is a permanent force, like pressure, or the force of gravity; but if it act instantaneously, as a smart blow of a hammer, or for an imperceptibly short time, it is called impulse, or percussion.

A motive force is the power of an agent to produce motion.

Accelerative or retardive forces are those by which velocity is accelerated or retarded.

The change or alteration of motion by any external force is always proportional to that force, and in the direction of the right line in which it acts.

If a body be projected in free space, either horizontally or obliquely, by the force of the gunpowder, or by
any other impulse, it will by this motion, in conjunction with the action of gravity, describe the curved line termed a parabola, which is the section formed by cutting a cone, with a plane parallel to the side of the cone.

The momentum, or energy of a body falling through the atmosphere, is the mass or weight multiplied by the square root of the height it has fallen through, multiplied by 8.021.

Thus a one ounce ball, falling from a height of 400 feet, would strike the earth with a momentum of

\[
\text{oz. feet.} \quad \text{oz.} \quad \text{lbs.}
\]

\[
1 \times (20 \times 8.021) = 160.42 = 10.026
\]

By experiments to ascertain the effect of Carnot's vertical fire, it was found that four ounce balls only penetrated one-twentieth of an inch into a deal board, and from two to three inches into meadow ground.

Amplitude signifies the range of a projectile, or the right line upon the ground, subtending the curvilinear path in which it moves.

The time of flight of heavy shot and shells is equal to the time a heavy body would take to descend freely from the highest point described by the curve of the projectile.

To find the time of descent:

Divide the given height or altitude by \(16\frac{1}{3}\), and the square root of the quotient will be the time required. Thus, if the altitude is 1200 feet, and the time of descent is required—

\[
1200 \div 16\frac{1}{3} = 74.51, \text{ the square root of which is } 8.637, \text{ the time required.}
\]

According to the parabolic theory, the greatest range of a projectile is when the angle of elevation is 45
degrees, or half a right angle, and the ranges are equal at angles equally above and below 45 degrees. In projectiles moving with velocities not exceeding 400 feet per second, the parabolic theory will give nearly accurate results; but in cases of great velocities, that theory is quite inadequate, without bringing other elements into the aid of additional calculation. So great, indeed, is the resistance of the air to projectiles of considerable velocity, that some of those which in the air, range only two miles, would, in vacuo, range upwards of thirty. The effects of this resistance of course vary according to the velocity, the diameter, and the weight of the shot.

It has been ascertained that the greatest range (instead of being constantly that obtained by an elevation of 45 degrees, as shown by the parabolic theory) will be found at all intermediate degrees between 45 degrees and 30 degrees (with ordinary charges about 42 degrees), but varying with the velocity and the weight of the projectile. Large shells with small velocity range farthest when projected at an elevation of 45 degrees or thereabouts; while with small shells the greatest velocities are got with an elevation of about 30 degrees. However, no true rules for practical gunnery have yet been established independently of the parabolic theory; we must consequently, for the present, be content with the results of some one certain experimental range and time of flight with a given angle of elevation, and then by help of these and the parabolic theory we can determine the like circumstances for other elevations, availing ourselves of the following rules:—

1. To find the velocity of any shot or shell. It has been found empirically that, with shot of mean windage, and powder of mean strength, a charge of one-third the weight
of the ball gives an initial velocity of about 1600 feet per second; to find, then, the velocity given by any other charge, we must divide three times the weight of the charge by the weight of the ball, and multiply the square root of the quotient by 1600; the product will be the velocity in feet, or the space the shot passes over in the first second.

From observations on the velocities of shot the following results have been obtained:—

1. The time of the flight of a ball is nearly as the range, the gun and elevation being the same.

2. The velocities decrease as the distances increase. This arises from the resistance of the air, which retards the progress of the shot, in a proportion slightly more than the squares of the velocities.

3. Very slight advantage is gained, in point of range, by increasing the charge more than is necessary to attain the object, the velocities given by large charges being soon reduced to those by moderate charges; those, for instance given by half the weight of the shot are reduced to an equality with those by one-third, after passing through a space of little more than 200 feet.

4. Hardly any benefit is derived from increasing the length of guns, the velocity given by long guns of 22 calibres being reduced to an equality with that of short guns of 15½ calibres with similar charges, after passing through the following spaces, viz.:—

With half the weight of the shot, about 285 feet.

" one-third " " 200 "

" one-fourth " " 150 "

" one-sixth " " 115 "

5. The resistance of the air against balls of different diameters with equal velocities is almost proportionate to the squares of their diameters.
6. A very considerable increase of velocity may be acquired by a decrease of windage, from one-third to one-fourth being lost by the windage of one-twentieth the diameter of the bore.

8. The velocity increases with the charge up to a certain point peculiar to each gun, but by increasing the charge beyond this point, the velocity gradually diminishes. The recoil, however, is always increased by an increase of charge.

14. The depths to which balls of the same size penetrate into wood, with different velocities, are nearly as the squares of the velocities. Balls of different sizes will penetrate to depths proportionate to their diameters; therefore a larger ball will not only make a larger hole, but will also penetrate farther than a small one with the same velocity.

15. By experiments at a mean range, it has been ascertained that in common earth, dug up and well rammed, a musket ball buries itself 17in.; a six-pound shot, from 3½ft. to 4½ft.; a nine-pound shot, from 6½ft. to 7ft.; a twelve-pound shot, from 8½ft. to 10ft.; an eighteen or a twenty-four-pound shot, from 11½ft. to 13ft.

For further information on this subject the reader is referred to the Artillerist's Manual, a very useful little work, from which most of these formulas have been selected.

USEFUL NUMBERS.

Circumf. of a circle whose diameter = 1 = \( \pi = 3.1415927 \)

Area of ditto = \( \frac{\pi}{4} = 0.7853982 \)

Diameter of a circle whose area = 1 = \( \sqrt{\frac{4}{\pi}} = 1.128379 \)

Surface of a sphere whose diameter = 1 = \( \pi = 3.1415927 \)
Solidity of the same \[ = \frac{\pi}{6} = 0.523598 \]

Diameter of a sphere whose solidity \[ = 1 = \frac{3\sqrt{6}}{\pi} = 1.2407010 \]

360 degrees expressed in seconds \[ = 1,296,000 \]
12 hours expressed in seconds \[ = 43,200 \]
24 hours expressed in seconds \[ = 86,400 \]
Number of English yards in a French metre \[ = 1.0936331 \]
Number of English feet in a French metre \[ = 3.2808992 \]
Number of English inches in a French metre \[ = 39.37079 \]
Number of English feet in a French foot \[ = 1.0657654 \]

Weight of a cubic foot of pure water in pounds avoirdupois, the barometer being
30 deg. and the thermometer 62 deg. \[ = 62.3210606 \]

Length in inches, of a pendulum, vibrating
seconds at Greenwich \[ = 39.1393 \]
Number of cubic inches in an imp. gallon \[ = 277.274 \]
Number of feet in a statute mile \[ = 5,280 \]

in a geographical or nautical mile \[ = 6075.6 \]
Length of a ° of long. at London in yds. \[ = 75.011 \]

in yds. \[ = 1,250 \]
in yds. and ins. \[ = 20yd.30in. \]

Equatorial deg. of latitude in English feet \[ = 362,732 \]
Length of a deg. of lat. at London, in yds. \[ = 121,666 \]
Geographical mile in latitude 50\frac{1}{2} deg. in statute miles \[ = 1.152 \]
Sca league in lat. 50\frac{1}{2} deg., in statute miles \[ = 3.456 \]
Mean circumf. of the earth in English miles \[ = 24,856 \]
Mean diameter of the earth in Eng. miles \[ = 7,921 \]
Force of gravity at Greenwich in ft. per sec. \[ = 32.1908 \]
in in. per sec. \[ = 386.2894 \]
APPENDIX.

The initial velocity of shot from 6-pounder and 12-pounder guns, with charges of $1\frac{1}{4}$ lbs. and $2\frac{1}{4}$ lbs. respectively = 1,450 ft. per sec.
The initial velocity of canister and spherical case-shot from field howitzers, with the service charge, about = 1,000 ft. per sec.
That of shells from howitzers = 1,175 ft. per sec.

MISCELLANEOUS RULES.

Length of an arc = No. of deg. $\times$ rad. $\times$ 0.0174532925.
Circumference of circle = diameter $\times$ 3.1415926535.
Area of circle = diameter$^2$ $\times$ 0.78539816339.
Parabola area = $\frac{3}{2}$ of base $\times$ height.
Paraboloid cube = $\frac{1}{6}$ base $\times$ height.

Powder and shot are weighed by avoirdupois weight.
$27\;\frac{1}{2}$ grains = 1 drachm
16 drachms = 1 oz.
16 ounces = 1 lb.
and the following table is given, that this may be clearly distinguished from other weights:

<table>
<thead>
<tr>
<th>Grains</th>
<th>Troy.</th>
<th>Apothecaries</th>
<th>Avoirdupois</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td></td>
<td></td>
<td>$27\frac{1}{4}$</td>
</tr>
<tr>
<td>480</td>
<td></td>
<td></td>
<td>$437\frac{1}{2}$</td>
</tr>
<tr>
<td>5760</td>
<td></td>
<td></td>
<td>7000</td>
</tr>
</tbody>
</table>

= 1 dwt.
= 1 scruple.
= 1 drachm.
= 1 ounce.
= 1 lb.
FORMULA

FOR DETERMINING

THE INCLINATION OF THE GROOVES OF A RIFLE
TO THE AXIS OF THE PIECE.

We must, in the first instance, imagine the barrel rolled out into a plane. The groove will, of course, still have the same inclination that it had in the cylinder (though this has not been sufficiently attended to in the engraving annexed), and this is the leading principle in the investigation of the formula.

Let Fig. 1 represent the cylinder.
Fig. 2 the cylinder rolled out.
Fig. 3 represents the groove for a length of barrel $l$, commencing at $a$ and ending at $b$, which will be indicated as $\frac{n}{m}$; that is, supposing that the whole circumference $QQ$, or $2\pi r$ to be divided into $m$ equal parts; from the horizontal line $a$ measuring along the circumference, there will be $n$ such parts.
FORMULA.

The circumference then being divided into \( m \) equal parts, one part is \( \frac{2r\pi}{m} \) inches and tenths long—\( m \) such parts; consequently, that portion from \( a \) to \( b \), is equal to \( \frac{n}{m} \frac{2r\pi}{m} - a\ b \), and is precisely the same length whether an arc as seen at Fig. 3, or as seen in Fig. 2 in the developed cylinder. Now, in Fig. 2, we find as adapted to our calculation that \( \tan \angle = \frac{b' - b}{a\ b} \) where \( b \ b' = l = \) length of the barrel \( a\ b = \frac{n}{m} \frac{2r\pi}{m} \), the twist of the groove being \( \frac{n}{m} \) as above detailed, consequently—

\[
\tan \angle = \frac{l}{m} \frac{2r\pi}{2rn\pi} = \frac{lm}{m}.
\]

Application of the formula to the Enfield Rifle. Length of barrel 39 inches—length of breech-screw \( 734 \) inches; length of rifled part or \( l \) 38.266, and 0.577 calibre, or 2 \( r \); half a turn in the above length \( = \frac{n}{m} \tan \angle = \frac{ml}{2rn\pi} \)

\[
\log 2 = 0.3010300 \\
38.266 = 1.5828100 \\
-0.8838400 \\
-0.2583253 \\
1.6255147 + 10
\]

\[
\text{Log. } 1 = 0 \\
\log 0.577 = 1.7611758 \\
\log \pi = 0.4971495 \\
0.2583253
\]

\[
\log \tan \angle = 11.6255147 \\
\log \tan \angle = 11.6223777 = 88^\circ 38' \\
31370 \\
60 \\
88^\circ 38' 35'' = \text{which is the angle of the inclination of the groove of the Enfield Rifle.}
\]
A SHORT ABSTRACT

OF THE

Laws at present in force relating to Volunteer Corps, whether Infantry or Cavalry.

Acts previous to 44 Geo. III. c. 54, repealed by that Act so far as they refer to Yeomanry and Volunteer Corps.

The Acts having reference to Volunteer and Yeomanry Corps were consolidated by the 44th Geo. III. c. 54. The following are the principal provisions of this Act, which is at present in force:

By § 3, Her Majesty may continue the services of all corps of Yeomanry or Volunteers accepted before the passing of that Act (5th June, 1804), and may also accept the services of any corps of Yeomanry or Volunteers that may be formed after the passing thereof, such corps respectively being formed under officers having, or who shall have, commissions either from her Majesty or any Lieutenant of a county, or any other person or persons who may be specially authorized by her Majesty for that purpose, upon such terms and conditions, and under such regulations as have been or shall be approved by her Majesty in regard to such corps. And her Majesty may disband or discontinue the services of any such corps, or any portions of such corps, whenever it may seem expedient to her Majesty to do so. Provided always that the services of all corps of Yeomanry and Volunteers accepted before the passing of that Act shall be deemed to be continued under the provisions thereof, unless her Majesty shall signify her intention of disbanding or discontinuing the services of any such corps by any order to be communicated by her Majesty's principal Secretary of State.

By § 4, Effective members of Yeomanry or Volunteer corps are exempted from service in the Militia or other additional forces, except in the case of corps whose offers of service specify that no such exemption would be claimed, and no such exemption is to extend to any greater number than the established number of such corps.

§ 5. Only those are to be deemed effective members who have attended muster or exercise, properly armed and accoutred, if cavalry,
four days, if infantry, eight days at the least in the four months immediately preceding the return required by the Act, and who have been duly returned by the commanding officer as effective members, and as having taken the oath of allegiance.

§ 6. Contains an exception when there has been a delay in supplying arms.

§ 7. The commanding officer may grant leave of absence, and such absence shall not prevent the member so obtaining it from being returned as effective, provided that during the next four months he serves as many days as shall make up for the whole period of eight months, if he is in the cavalry, eight—if in the infantry, sixteen—days' exercise. If he does not complete this, he is to be struck off the list of effective members, and to be returned in the muster-roll as non-effective.

§ 17.* Persons so returned as effective may be balloted for the Militia, and immediately on their ceasing to be returned as effective, they are liable to serve.

§ 8.† It is sufficient, to render a man effective, that he attend during the whole year, if in the cavalry, twelve—if in the infantry, twenty-four—days within one period, or two successive periods of four months next before the return.

§ 9.‡ Commanding officers are to make a return on the first day of every April, August, and December to the clerks of lieutenancy of the numbers of men in the corps, and of the number of supernumeraries, distinguishing between the effective and the non-effective members, of the persons who have entered the corps since the last return, of those who have been absent on leave, and of those who have been discharged from or have quitted the corps since the last return; and where any arms have been required by such corps at the expense of her Majesty, and have not been supplied, such circumstance is to be stated at the foot of the return. The commanding officer is also to send in to her Majesty's principal Secretary of State, and to the general officer commanding the district, if any, accurate returns of the effective and non-effective men in the form of the usual military returns.

§ 10. Commanding officers are required to give certificates to effective men residing in other places, which shall entitle them to exemptions therein.

§ 11. Field officers and adjutants of Volunteer corps, and persons serving in Yeomanry or Volunteer cavalry, are exempted from duty for horses used at muster and exercise, and also persons providing them; and all effective members of Yeomanry or Volunteer corps from the hair-powder duty.

§ 12. No corps is to be entitled to exemptions unless the com-

* Amended by 53 Geo. III. c. 84, § 4.
† Amended to 6 days in the year, 2 days in each 4 months, or 5 successive days, 56 Geo. III. c. 39, § 1.
‡ The returns are to be sent in once a year, within 14 days of Aug. 1, 7 Geo. IV. c. 58, § 2.
manding officer certify in the muster-rolls that it has been, or has been ready to be, inspected.

§ 13. No toll is to be demanded for any horse ridden by any person in any corps of Yeomanry, or by any field or staff-officer of Volunteers going to exercise, &c., dressed in uniform, and armed and accoutred.

§ 15. Commanding officers making false returns, or giving false certificates, are subjected to a penalty of 200l. for every offence.

§ 20. Every person enrolled is to take the oath* of allegiance, which may be administered by any deputy-lieutenant, justice of the peace, or commissioned officer of the corps.

§ 21. Adjutants, serjeant-majors, and others who are receiving constant pay, are subject to the Mutiny Act and to the Articles of War; every court-martial in such case is to be composed wholly of members taken from the Yeomanry or Volunteer establishment, and no punishment is to extend to life or limb, except when the corps is called out in case of an invasion.

§ 22. In all cases of actual invasion, or appearance of an enemy in force on the coast of Great Britain, or of rebellion or insurrection arising or existing within the same, all corps of Yeomanry or Volunteers shall, whenever they shall be summoned by the lieutenants of the counties in which they shall be respectively formed, or their vice-lieutenants or deputy-lieutenants, or upon the making of any general signals of alarm, forthwith assemble within their respective districts, and shall be liable to march according to the terms and conditions of their respective services, whether the same shall extend to any part of Great Britain, or be limited to any district, county, city, town, or place therein; and all persons then enrolled in any such corps, not labouring under any infirmity incapacitating them from military service, and not holding a commission or serving in any of her Majesty's other forces, or in any other such corps of Yeomanry or Volunteers, and actually joining such corps, who shall refuse or neglect to join their respective corps, and to assemble and march therewith, upon any such summons or general signal of alarm, as aforesaid, shall be deemed deserters, and shall be subject to punishment as such; and all such corps of Yeomanry or Volunteers, and all officers and non-commissioned officers, drummers, and private men therein, shall, upon and from the time of such summons or of such general signals of alarm being made as aforesaid, and until the enemy shall be defeated and expelled, and all rebellion or insurrection then existing within Great Britain shall be suppressed (the same to be signified by her Majesty's proclamation), continue and be subject to

* The following is the form of oath:—"I, A— B—, do make oath, that I will be faithful and bear true allegiance to her Majesty, her heirs and successors, and that I will, as in duty bound, honestly and faithfully defend her Majesty, her heirs and successors, in person, crown, and dignity against all enemies, and will observe and obey all orders of her Majesty, her heirs and successors, and of the generals and officers set over me. So help me God.

"Sworn before me, C— D—, this — day of —, 1859."
all the provisions contained in any Act of Parliament then in force for the punishment of mutiny and desertion, and for the better payment of the army and their quarters, and to any Articles of War made in pursuance thereof in all cases whatever.

§ 23. Whenever any corps of Yeomanry or Volunteers shall, with the approbation of her Majesty, signified through her principal Secretary of State, voluntarily assemble or march to do military duty upon any appearance of invasion, or for the purpose of improving themselves in military exercise, except in the case hereinafter specified as to corps of yeomanry cavalry, or shall voluntarily march on being called upon in pursuance of any order from the lieutenant or sheriff of the county, to act within the county or adjacent counties for the suppression of riots or tumults, all such corps of Yeomanry or Volunteers shall in all such cases, from the time of so assembling or marching as aforesaid, and during the period of their remaining on such military duty, or being engaged in such service as aforesaid, be subjected to military discipline and to all the provisions of any Act then in force for the punishment of mutiny and desertion, and for the better payment of the army, and their quarters, and to any Articles of War made in pursuance thereof.

§ 24. Her Majesty may put such corps under the command of such general officer as she shall appoint; but such corps shall be led by their respective officers, and no effective member shall be liable to be placed in any other regiment.

§ 25. No officer of Volunteers is to sit on the trial of any officer or soldier of the other forces, and contrariwise.

§ 26. All officers in corps of Yeomanry or Volunteers having commissions from her Majesty, or lieutenants of counties, or others who may be specially authorized by her Majesty for that purpose, shall rank with the officers of her Majesty's Regular and Militia forces, as the youngest of their respective ranks.

§ 27. Commanding officers of Yeomanry or Volunteer corps, when not on actual service, may discharge members, not being commissioned officers, for disobedience of orders, &c.

§ 28. When the regulations of a corps do not provide for any case of misconduct under arms, the commanding officer may disallow the day on which the party misconducted himself as a day of attendance.

§ 29. Persons misconducting themselves during exercise may be ordered into custody for the time during which the corps remains under arms.

§§ 30 and 31. Persons enrolled as Volunteers may quit their corps, except when called out in cases of invasion, &c., except the persons receiving the constant pay of their rank. None can quit, however, without notice of their intention to quit, nor till their arms, &c., shall have been delivered up, and all fines paid, unless by enlisting in her Majesty's forces or being enrolled in the Militia.

§ 33. Persons thinking themselves aggrieved by the commanding officer refusing to strike their names out of the muster-rolls, may
appeal to two deputy-lieutenants, or one and a justice, who may
determine the same.

§ 36. When Volunteers are assembled on summons of the county
lieutenant, &c., or on a general signal of alarm, the receiver-general
of the duties under the commissioners for taxes in England, and the
collector of the cess in Scotland, are to pay to the captain of the troop
or company two guineas for the use of every Volunteer in such troop
or company who shall so assemble, and, when voluntarily assembled,
the Treasury may order a guinea for each to be paid in like manner.
The captains are to account to the men for money, and not to draw
any for the use of men not desiring it.

§§ 37 and 38. Volunteers, when assembled on invasion, &c., are
entitled to receive pay, and to be billeted as other forces, and their
families are entitled to the same relief as the families of Militiamen.

§ 39. After the defeat and expulsion of the enemy, and after the
suppression of any rebellion or insurrection, the Volunteers are to be
returned to their respective counties, and a guinea paid to each man
willing to receive it.

§ 40. Commissioned officers disabled in service, are entitled to
half-pay, and non-commissioned officers and privates to Chelsea
Hospital; and widows of officers killed in service to pensions for life.

§ 41.* Half-pay may be received by adjutants and quartermasters
on taking the oath that they have not any place or employment of
profit, civil or military, under her Majesty.

§ 42.† Commanding officers may appoint places for depositing arms
and accoutrements, and persons to take care of them; and the deputy-
lieutenants shall view them; and the expense shall be paid in England
by the receiver-general of the county.

§ 44. In case any man shall sell, pawn, or lose any arms, accou-
trements, clothing, or ammunition delivered to him, or shall wilfully
damage any such arms or accoutrements, every such man shall, for
every such offence, forfeit and pay a sum not exceeding forty shillings,
and if not paid, the party may be committed.

§ 46. When corps of cavalry shall be desirous of assembling under
the command of their own officers, the county-lieutenant, with the
approbation of her Majesty, may make an order for that purpose, and
an order to any justice of the county, who shall issue his precept for
billeting the non-commissioned officers and privates as her Majesty's
forces may be billeted; but corps so assembled shall not be subjected
to the mutiny laws.

§ 47. The Acts for billeting her Majesty's forces extend to such
corps when billeted.

§ 48. When the lieutenant has fixed the day and place of exercise
for Yeomanry or Volunteer corps, he is to certify the same to the
Secretary-at-War.

* An officer on half-pay, however, does not forfeit it by reason of his holding a
commission in the Yeomanry, and receiving pay as such, 57 Geo. III. c. 44, § 2.
† By the Secretary of War, 7 Geo. IV. c. 58, § 4.
§ 50. The property in subscriptions, arms, &c., is vested in the commanding officer for all purposes of indictments or suits.

§ 51. If subscriptions or fines be not paid, a justice of the peace may direct double the amount to be paid, which may be levied by distress.

§ 56. No future rules or regulations are to be valid or binding on any corps of Yeomanry or Volunteers, unless submitted to the principal Secretary of State, and not disallowed by her Majesty.

§ 58. The acceptance of a commission in any corps of Yeomanry or Volunteers does not vacate a seat in Parliament.

§ 60. Provisions relating to corps are to extend to independent troops or companies.

---

BY THE TURNPIKE ACT,

3 Geo. IV., Cap. 126, Sec. 32, it is specially enacted that no toll shall be demanded nor taken—

"For any carriage conveying Volunteer infantry, or for any horse furnished by or for any person belonging to any corps of Yeomanry or Volunteer cavalry or infantry, and rode (sic) by him in going to or returning from any place appointed for and on the days of exercise, inspection, or review, or on other public duty, provided that such person shall be dressed in the uniform of his corps, and shall have his arms, furniture, and accoutrements, according to the regulations of such corps at the time of claiming the exemption."

Should any toll-keeper demand toll from a Volunteer, under the circumstances above specified, he is liable to a penalty not exceeding five pounds for the offence.

Volunteers in uniform, are of course, like other soldiers, privileged to pass toll free over any bridge or through any bar upon a public highway.
REGULATIONS

FOR

A RIFLE CLUB,

NOT INTENDED TO BE ENROLLED FOR MILITARY SERVICE.

1. That any candidate must be proposed by a member and be balloted for by the committee.
2. That each new member on receiving notice of his election shall immediately pay into the hands of the treasurer the sum of one guinea entrance fee, and one guinea as a yearly subscription; every succeeding subscription to become due on the 24th May, annually.
3. That no person be considered as continuing a member who is more than two months in arrear, nor be allowed to fire for prizes, until his subscription shall have been paid up in full.
4. Each member to attend in a rifle undress; and it is imperative that all uniforms be made according to the regulation-pattern of the society, which, with the accoutrements, may be seen by applying to the treasurer.
5. That the committee consist of seven members, to be elected annually; the committee retiring to return one from among themselves to act for the ensuing year: the remaining six to be elected by the society at large, on the first day of shooting after the 24th of May.
6. The second and last Mondays in each month to be considered the society's regular shooting days; the second for practice, and the last for the medals. The distances to be fired from, for the first and second medals, to be as follows:—Six shots from the rest at 300 yards, six from the rest at 250 yards, six from the shoulder at 200 yards, and six from the shoulder at 150 yards; but all new members to fire the whole of their shots from the rest the first six times of their attendance.
7. If two or more members be equal in their number of shots, they shall fire for ten minutes, at distances to be fixed on by the member or members of the committee present; when he who shall place the greatest number of shots in the target will be declared the winner. The medal to be finally presented to him who shall have won it six times.
8. The rest to be placed first at the longest distance, and advanced progressively towards the target, excepting only when the state of the weather prevents it; in which latter case, the rule shall be reversed, the question (if any) to be decided by a majority of the members present.

9. The members, when preparing to fire, shall arrange themselves in a line, at least six yards in rear of the proper distance-mark.

10. Every member, in going to the distance-mark to fire, to pass by the rear of the company, and return the same way, and no member to be allowed to fire from any but the regular distance-marks.

11. Any member who shall fire any extra shot or shots at the target, or allow any other person to fire with his rifle, before the regular shooting for the day shall be over, will have all such shots accounted misses, and entered upon the register accordingly.

12. Every shot fired by a member from the rear of the line, whether accidentally or otherwise, and every waste shot, unless fired into the ditch, shall be accounted a miss, and entered accordingly.

13. That Lieutenant Busk's "Rifle-target Registers" (published by Messrs. Routledge) be used on all occasions, and be filed by the secretary so as to record not only the practice made, but the proficiency of each member.

14. The time for commencing firing, is eleven o'clock a.m., and any member who may come upon the ground after firing has commenced, must lose as many shots as there shall have been rounds fired at the time he enters the field.

15. Every member who shall not be ready to take his turn in firing must be passed, and no one can be allowed to fire out of his turn, on account of any shot that he may have lost.

16. No two members can be allowed to fire out of one rifle for prizes.

17. That any member considering himself aggrieved, or having anything to propose for the good of the society, shall make the same known, in writing, to the secretary, who shall report it to the committee.

18. That in case of any disputed shot, the disputants, in the company of a third person, shall immediately proceed to the target, and decide the same.

19. That the first and third Tuesday in each month, from the 1st of April to the 30th of September, be appointed as practice days, one member of the committee being required to attend. The firing to commence at three o'clock, p.m.
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