



# On a New Form of Rifled Projectile for Smooth-Bore Artillery, Calculated to Obviate the Necessity for Rifling Ordnance

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ON A NEW FORM OF RIFLED PROJECTILE FOR SMOOTH-  
BORE ARTILLERY, CALCULATED TO OBVIATE THE  
NECESSITY FOR RIFLING ORDNANCE.

By Captain J. H. SELWYN, R.N.

IN introducing to your notice this evening a most important and ingenious invention, I am not, as is sometimes the case with those who read papers here on such subjects, liable to the objection or impeded by the consciousness that "self-praise is no recommendation." The discovery or invention has been made by Mr. John Macintosh, and I am only the humble instrument in bringing it forward.

It will not, I hope, be thought tedious if I shortly recapitulate the heads of the existing theory of modern rifled ordnance.

In the search after greater efficiency of artillery which it became necessary to make when the means of defence were augmented by the adoption of iron armour for vessels, the use of elongated shot and shell was resorted to principally in order to obviate, as much as possible, air resistance, by increased weight and diminished diameter of projectile. Thus it was expected that greater range would be secured. But that these elongated bodies might be transmitted at high velocities in a determinate direction, it was supposed to be necessary that they should be made to rotate on their longer axes during flight. To ensure this, the device of grooving or rifling the gun was revived, after having been long abandoned by artillerists, at least for military purposes, and then commenced the battle of the grooves which has been waged with no less warmth and spirit, at perhaps even greater expense, than was once the famous railway battle of the "gauges." It is not my purpose to go into such questions now; it may suffice to say, that in this, as in most other cases, experience is teaching us, day by day, the value of the *least complicated*, the *most simple*, means that can be used, to produce the effect we seek.

It has been shown, by more than one artillerist, how by balancing the projectile scientifically, an equally good effect in keeping it point foremost may be obtained, with that produced by rotation as above described; but other objections have hitherto prevented such methods from coming into use, and we have been, up to the present moment, content to accept the necessity for grooved guns, with short lives—heavy shot with low velocities—and costly projectiles with light bursting charges. The nation has spent a very large sum of money and much valuable time, and now knows considerably more of what ought not, than of what ought, to be done in artillery.

## ELASTIC PADS.

(Angelini's System.)

*Various forms of the material to be used for making Pads.*

Fig. 1.



As Sponge.

Fig. 2.



As Nipples.

Fig. 5.



As Double Tubes.

Fig. 3.



As Tubes.

Fig. 4.



As Dice.

## PADS FOR SADDLES AND PACKS.

Fig. 7.

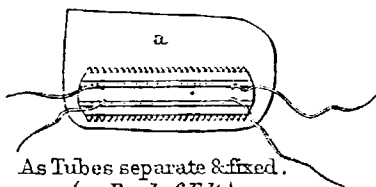
As Tubes separate & fixed.  
(a. Band of Felt)

Fig. 6.

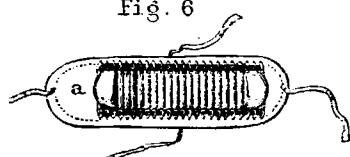
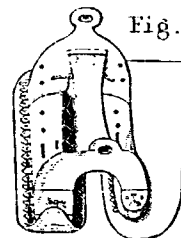
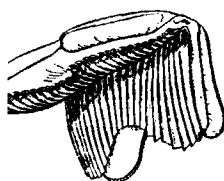
As Tubes cast in one piece.  
(a. Band of Fustian)

Fig. 8.



Military Saddle called Hungarian trimmed.

Fig. 9.



Pack for Mule.

Fig. 10.

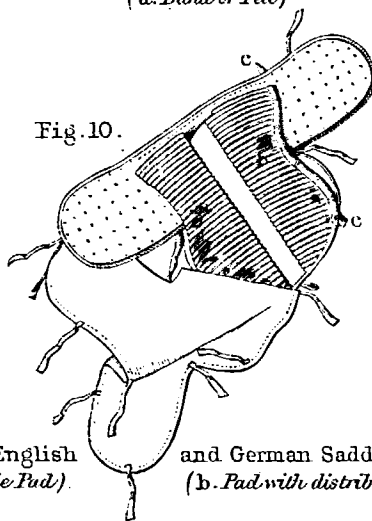
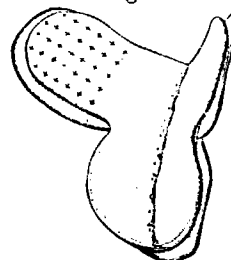
Pads for English  
(a. Simple Pad) and German Saddles.  
(b. Pad with distributor Tube c)

Fig. 11.



English Saddle.

## PADS FOR DRAFT HARNESS.

Fig. 12.

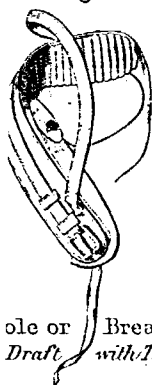
Collar.  
ole or Breast Band.  
Draft (with Trace Bars)

Fig. 13.

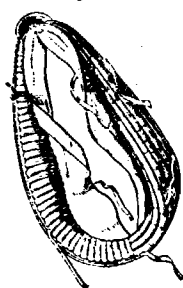
Bricole or Breast Band.  
(For Draft without Trace Bars)

Fig. 14.

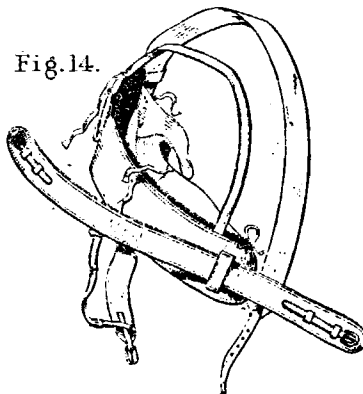
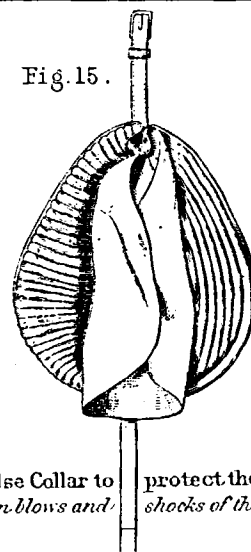
False Collar to  
protect the Horse.  
(From blows and  
shocks of the Collar)

Fig. 15.



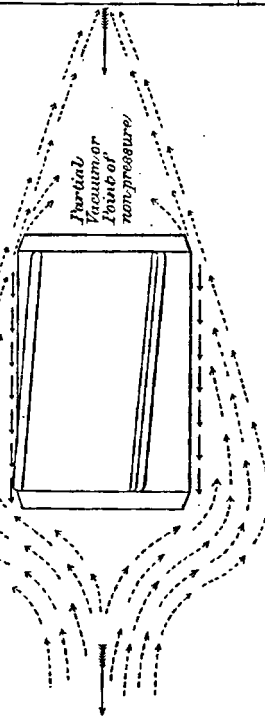
The device of setting a shot or shell in rapid rotation by causing it to unthread a screw in order to get itself out of the gun, is one which must necessarily throw a very considerably increased strain on the piece that is subjected to such treatment. What this strain amounts to, may be better understood by comparing the initial velocities of smooth-bore and rifled guns than by any other method. When the progress of the attack and defence had made evident the necessity for ordnance of enormous calibre and shot of equally increased weight, under such a strain, no mode of manufacture, no metal could be found that would enable a gun to stand the charges of powder theoretically requisite to produce the best effect. So we went from multigrooves to shunts, from shunts to multiforms, and landed at last, eschewing alike complicated breech-loaders and unsatisfactory coils, at smooth-bore muzzle-loading guns with reduced charges, and with very little of the new welding or any other novelty about them. It cannot be denied that whether it be that what we have is not good, or that what is good we have not, there has been no such thing as a really satisfactory result up to the present moment. We have not, we are far from having resolved the question, What are the best forms or material for modern ordnance?

It is under these circumstances that I venture to solicit your attention to a new projectile which may be fired from any of the old smooth-bore guns with a velocity, a range and an accuracy, greater than that obtainable from any rifled gun, at the same time that no more strain need be thrown on the gun than has been the case in the former days of round shot and spherical case. In order to make clear what are the difficulties it is sought to combat, what are the methods of accomplishing the result, I have prepared four diagrams which I will now proceed to explain:—

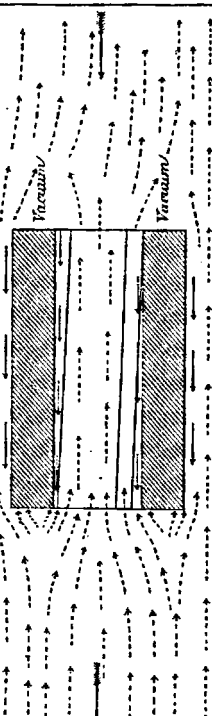
In diagram No. 1, Plate xix, is shown a portion of the path of a spherical shot through the air. The one here represented, for greater convenience, has a diameter of  $12\frac{3}{4}$  inches, and might be fired from the Blakely 640-pr., or any gun of that calibre. Its weight would be about 320lbs. Its velocity might be 2,000 feet per second, or 1,363 miles per hour. Now, when we recollect that the velocity of a hurricane is given as about 100 miles by Telford and others, that the force of this is also given as about 146 lbs. to the square foot, and that this force will increase as the squares of the added velocities, we shall not be surprised to find that the force opposed to such a shot, moving with this velocity, neglecting the reduction for spherical form, would be about 27,000lbs. per square foot. The section of this shot would be about 127 square inches, or 17 square inches less than a square foot. The blue lines which surround the shot are intended to give a rough idea of the way in which the air is thrown aside and meets again; the black arrow showing the direction of the shot's path, and the small red arrows close to the surface of the shot, the air which is supposed to be retained by the effect of friction as an atmosphere carried along with the body in motion. These are repeated in each diagram. In No. 1, it will be observed, that the air after being parted meets again with comparative ease, owing to the spherical shape which is dividing

Flat-headed Shot. 12  $\frac{3}{4}$  Inches Diameter, 644 lbs. weight.

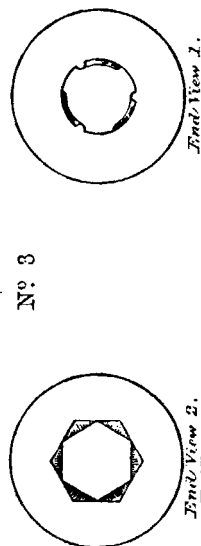
N° 2.



Mucintosh Long Range Shot for smooth bore, hollow cylinder internally rifled, derives its rotation from air passing through during flight.

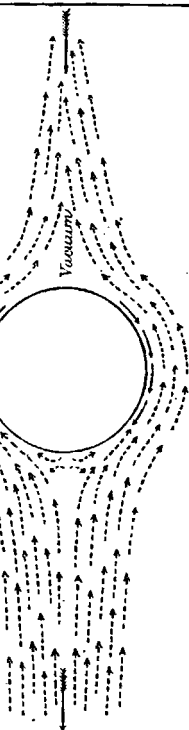


N° 3



Spherical Shot for 600 Ft. weight about 300 lbs.

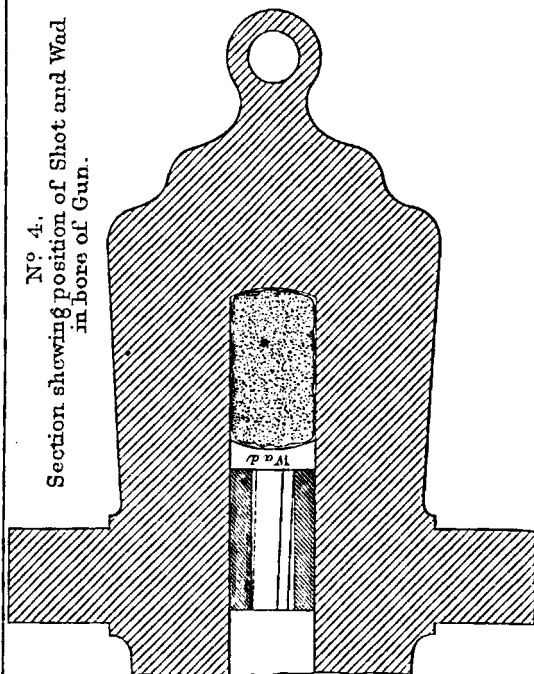
N° 1.



Area of resistance 127.67 sq. In. Velocity say 2000 Ft. per second or 1963 Miles per Hour adverse pressure 58 lbs. per sq. Inch non-pressure over say  $\frac{1}{10}$  of hinder surface.

N° 4.

Section showing position of Shot and Wad in bore of Gun.



it, yet there must be even here a serious addition to the impeding forces, in the shape of non-pressure or partial vacuum behind. The value of this has not yet, so far as I am aware, been determined with any accuracy, but it is clearly a retarding force which ought to be eliminated as far as possible. In diagram No. 2 we see the probable aggravation of both these causes of loss of power, air resistance, and non-pressure, as developed in a flat-headed elongated projectile of 640 lbs., but as the velocity will here be considerably lower, it becomes, so far, proportionally less important. Still, however, it cannot fail to be worth close consideration.

We will now turn to diagram No. 3, which represents a projectile of the same exterior diameter, but different in almost every other respect. This is the new form of projectile proposed by the inventor.

You will see by the models on the table that it is hollow and open from end to end—that it is interiorly rifled and that its walls have a thickness of about  $3\frac{1}{2}$  inches, which is, however, entirely arbitrary. Its length is 20 inches, the same as that of the flat-headed projectile to which we have been referring, and its diameter is also  $12\frac{3}{4}$  inches. Now supposing this to have been fired from a smooth-bore gun (with a charge nearly equal to what would be used with a round shot), having of course a wad or sabot interposed between the powder and its base, as shewn in diagram No. 4, the passage of this projectile through the air would be as represented in diagram No. 3. The internal rifling is shewn in figures B and C of the same diagram—under two forms, hexagonal and ribbed—but it is even doubtful whether we might not do without any rifling or rotation, and still keep the projectile end on by the rapid passage of air through the hollow centre during flight. However this may be, it is certain that with a mean velocity of near 1,000 feet per second and a consequent mean pressure per square inch of about 58 lbs., there will be ample means of causing rotation; of course there will be the square of the pressure at first while the initial velocity is sustained. Now besides this rotation which, as yet, can only be theoretically asserted to exist with these large shot, but which I can shew you by experiment with a small model, there is the advantage, indicated in diagram No. 3, of the diminution of the retarding forces. About 26 square inches have been taken away from the total resisting surface, and the vacuum behind is also absent to the same extent. In practice perhaps even a less weight, less thickness of wall, and therefore more open space may be often safely allowed. But this projectile, weighing about  $\frac{3}{4}$ ths of the 640 lb. flat-headed one, may be fired with a much higher powder charge and will have greater velocity and range, keeping end on, though there be no grooving in the gun and none externally on the shot. There will be also less strain on the gun. It is, however, when we come to consider the application to our old smooth-bored ordnance that the advantages of this invention become most apparent. It is probable that for every rifled gun we have mounted in battery, we have nearly a thousand smooth-bores. Let us take the 68-pr., and particularly the 5 ton solid shot gun. This has

always been highly effective with the old-fashioned shot and shell, still more since hardened shot have been supplied for it. It was no doubt deficient in far-reaching properties, but this projectile would give it a large measure of efficiency at even longer ranges than any rifled gun of equal weight has ever attained. And this, be it recollected, with its lighter sister, is the gun on which our coast defence still mainly depends. At least they would be able to reach the enemy which, as against an enemy with rifled guns, is a hopeless case now. And what numbers of excellent brass field-pieces would find themselves able to compete with the best rifled guns in the field, retaining their magnificent calibre for large round shot, shell, &c., at shorter distances. I shall, of course, be asked what shell it is proposed to use for long range. But to this I am not at liberty at present to reply so fully as I shall be able to do at a later day. The inventor believes that in this form he can produce a shell even more destructive than any that now exist; but whether this be so or not, it is evident that to enable all our old field artillery and all our old iron guns, that are still on the ramparts of many an important possession, behind many a grassy coast defence on our own shores, to enable all these, while retaining all their old powers of offence to fire at least as accurate and as far-ranging a shot as the enemy can bring against them, is not an achievement to be despised or lightly treated. One of the great defects of the whole system of modern rifled artillery, is its utter inefficiency at short ranges. The small diameters of bore which have hitherto been the necessary concomitants of elongated projectiles, making it difficult if not impracticable to get any value out of the canister or grape which is always so formidable a form of missile at close quarters. We do not expect a field-piece, properly so called, to have great powers against armoured ships, but we do require it to possess every known means of annoying uncovered troops; and the power of sending its shot to an immense distance, is, and must always remain a secondary though valuable consideration. Thus for such a purpose it is much better to have a special projectile than a special gun. Then, if we turn to naval guns, what do we find constantly asserted by naval officers—that actions at sea, however they are commenced, must always be decided at short range. There is no doubt whatever in my mind, that whenever a steel smooth-bored gun of large calibre, is fired with a spherical *steel* shot (or one of these new projectiles), and with a powder charge, such as it will then bear with perfect safety, we shall see effects of penetration such as have never been—can never be—obtained from a rifled gun with a shot of equal weight. And if the use of phosphorised copper for field guns can give, as is asserted, equal strength with steel, similar advantages may be there gained while using a metal that can be re-cast with advantage any number of times. Not only so, but our guns might be expected to last very much longer than there is any reason for hoping they may do, under the existing methods of manufacture and grooving.

Whenever the rotation of a heavy body, such as a 600-pr. shot, has to be produced at a high velocity in a short space, no device can ever prevent great strains being incurred in the doing it. Such a case

occurs when we seek to turn a shot by grooves in a rifled gun, of whatever form. Such grooving as Captain Scott's reduces indeed to a minimum these forces, but cannot banish them entirely. And in whatever measure they exist, by so much has the effect sought been diminished, the gun lasting a shorter time, the shot ranging to a less distance. If, therefore, we can accomplish the same object by any change in the form of projectile, even though we find that to take away metal from the centre of the cylinder, is by no means the same thing as taking it from the exterior, as regards diminution of weight, we ought closely to experiment before rejecting an idea which promises such considerable advantages. The experiments hitherto made by Mr. Mackintosh have necessarily been on a small scale. From a smooth-bore musket, charge and other things being equal, he has obtained 300 yards greater range, as much accuracy, and greater penetration, than with the Enfield rifle. He has tried a 6-pr. for penetration with excellent results, but not yet for range and accuracy. It is, however, so easy an experiment, and so inexpensive, requiring only a few shot to be cast for a five ton 68-pr., that I cannot but hope, at an early day, to hear that Government have ordered the trials to be made at Shoebury. Failing this, I believe Mr. Mackintosh will either get some of his friends to make some shot and try them, or, if he can spare the time from his telegraphic and other engineering pursuits, do it himself; but I hope that you will allow I was right in thinking the subject one of sufficient importance and interest, to deserve the efforts I have made to rescue it from the obscurity in which its inventor has for some time past allowed it to slumber.

I have now only, in conclusion, to draw your attention to the fact that this system substitutes a different form of shot for the elongated rifled projectile, capable of giving as little area of resistance to the air, but differently disposed; and that its effect, if thoroughly successful, as I hope it may be, will be to do away with any necessity for rifling, so far as everything except punching armour-plates at long range is concerned. This is one of the least valuable of the qualities of ordnance, if indeed it ever could practically be brought into play, and the gun of the future, must be the strongest, of the largest calibre, not the longest-reaching, of the smallest. I now trust that a discussion on this short paper may give it its value, and with thanks for your patience, have only to express my desire, so far as I am able, to answer whatever questions may be asked on the subject.

**MR. MARRYATT:** There is one question I should like to ask. I do not exactly understand how the wad is to act on the shot. It appears to me that when the charge is ignited it will blow the wad into the hollow cylinder and block it up, and perfectly destroy the rotary motion.

**Vice-Admiral CODRINGTON, C.B.:** There are two questions I should like to ask the lecturer. One is about the penetration. I am satisfied that the penetration caused by a hollow body can never equal the penetration by a solid one—I am speaking now with respect to the penetration of timber or wood. That is one point. The next point is what becomes of the wad? I presume it is a solid metal wad. If so, when the gun is fired, it will be impossible to have troops or friends in advance of the gun. Therefore, I should think it would be rather an impediment to firing in the field.



Rear-Admiral HALSTED : I should like to ask as to the conditions of reality, which at present we have not before us. The merits of the invention are at present assumed. They may become perfectly practical, but at the present moment it is impossible for any person to form any practical judgment upon what will occur upon proof. I quite see the force of the observations which have been made, with regard to the wad, and they are borne out by a circumstance which occurred very recently with regard to the 600-pounder gun. There was a series of experiments made the other day at Shoeburyness with a view of ascertaining whether, from the great diameter of the shot, elongation might not be given to it, as it was not sufficiently long to carry the necessary number of buttons on its jacket to sustain the torsion from the grooves—to elongate it by making the whole rear of the shot hollow. I understand in every case the hollow was blown in by the charge. That mode of elongating shot of large calibre, sufficient to enable it to carry the number of buttons, to give rotation without their being stripped off in the bore of the gun—has failed, so I understand. Therefore the question of the mere piece of wood, as a wad, as I presume it is by its colour on the diagram, has already been put to a proof more critical than it seems capable of sustaining. The whole scheme involves a very serious question—not only of penetration, but, as Captain Selwyn admits, what are we to do for shells? If by this system we cannot use shells, woe betide the ship that can only fire solid shot, while the enemy's ship can return her fire with shell. Mr. Whitworth's 9-inch gun carries a 19 lbs. bursting charge in its shell, and no person having use of such a shell would ever fear solid shot.

Captain HORROX, R.N. : I should like to enquire whether, in the experiments for penetration, any observations were made of the rotation of the shot? We see by the model here, how it rotates : but when the shot has passed from the bore of the gun it would be important to know whether it does acquire the rotation that the lecturer says it does.

Dr. CROFTS : May I ask, is the rotation caused by the action of the powder, or is it obtained by the rush of air antagonistic to the bore of the shot?

Mr. LATHAM : I would ask Captain Selwyn whether experiments have been made with these projectiles in a cross wind. I ask this because in some experiments which I made some three years since, with a view to adapting a tubular projectile to the rifle, I found at first that I got very valuable results. I got a much lower trajectory, as evinced by the difference of elevation, of 100 to 400 yards, and I also got increased accuracy. But on sending some projectiles like these in my hand down to be tried at the ranges of the Grenadier Guards, a very curious circumstance occurred. The wind was blowing from right to left across the range, and on the right hand of the target there was another butt, some 30 or 40 yards distant, at which a number of men were at work on repairs. The wind was blowing very strong and gusty from the direction where these men were, and, of course, under the ordinary circumstances of rifle practice you would fancy that nothing could be safer than that. But the men put up the danger signal, as they found the shots were going in their direction. I tried others on the same plan, and I was led to the belief that with any tubular projectile in motion, the air in passing through it acts like a solid body. One fact I am satisfied of is, that these bullets do sometimes turn round and rush along with their noses against the wind ; and thus strike in the direction of the wind. The principle of the bullet in my hand is very simple. The rush of air should blow out this plug, the rifling being effected, after expansion, by the grooves of the gun. Of course that makes all the difference.

Captain SELWYN : It does.

Commander COLOMB, R.N. : I think, Captain Selwyn, you were not present the other night when a paper was read on the subject of making elongated shots symmetrical, and placing the centre of gravity exactly in the centre of the figure. We were told that that of itself, without anything else, was sufficient to preserve the parallelism of the axis of the shot. I should like to know whether you agree with that view or not. Then, I should like to ask you, whether it is not the case that shot have been tried with outside grooving, to be acted upon by the air in the same manner as this inside groove is? and whether those experiments were successful or not? If

unsuccessful, on what ground should you suppose that the inside grooving would answer where the outside grooving failed?

Captain FIELD: I do not wish to say one word in disparagement of the idea submitted to us. Perhaps the lecturer is aware that the idea is not altogether a novel one; that experiments were tried with smooth-bore round shots some years ago on board the "Excellent," by having three holes placed at certain angles for the air to pass through, as the shot was driven by the charge. Certain experiments were carried out on board the "Excellent," in my own presence, and on that occasion the experiments failed. Still this plan, of course, is different, inasmuch as we have an elongated body.

Captain SELWYN: I may say that I was pretty nearly prepared for every objection I have heard here, except that of Admiral Halsted's, which I will take in its turn. With regard to the first question, as to the wad being blown through the projectile, engineers are perfectly aware that, given any percussive force, they have only to test their material, and to adapt it to the circumstances, and then they will produce the effect. If you look at this model of the 63-pounder you will see the bearing surface of the wad here. It may be made of steel, if you please; it may be made of any possible metal or substance—from Biefeld's material, which is made of fibre compressed—up to steel. There is not the smallest objection to it, as I will show presently, with regard to the troops in the front. Such pressure can never force a wad through, or do much to cut the wad. It will not force it through in any way, even if no thicker than one inch; but if you found it did force the wad through, being one inch in thickness, you have only to make the wad two or three inches thick. There is no possible objection to it, for long range work, such as that. With regard to the penetration of timber or wood it is evident that the penetration of all bodies, subject to the impact of what may be regarded as a punch, is strictly proportioned to the resistance to crushing pressure, due to the velocity first, and to the weight second, disposed on the area with which impact is effected; that is to say, that if the penetration is to be effected with the whole surface of the old projectile, a surface, say, of eighty square inches, if it be necessary to employ 100 lb. on the square inch, to enable that surface to pierce pine, oak, or anything you please, there will be so much the less power required to effect the same penetration with this shot, because you have diminished the number of square inches over which the impact takes place. That is familiarly known in the way of punching boiler plates, and other materials which are now extensively subjected to such engineering processes, and we never fail to find that those laws are absolutely and mathematically true. With regard to what becomes of the wad, the wad very naturally falls off. It is not attached in any way to the shot, and it is not capable of penetrating; it falls off. But it is not proposed to use these projectiles for anything but long range, and as troops would be very unwisely stationed in front of guns fired at long range, and as they never need be so, there is not much fear as to the falling of the wad among them. At sea still less, for if the wad falls into the water, and the shot goes to the enemy, you may be quite content with the effect produced. With regard to Admiral Halsted's objection, it is one of the last I should have expected to hear from him. It is in effect that we ought never to believe anything until we have seen it tried—until we know it is right. In fact, we are not to theorise at all, but we are to wait until everyone knows that a certain effect has been produced before we say, "Excellently well done. This is the right thing; we all know it." I am afraid that if Mr. Whitworth remains contented till that occurs, we shall not see his system go forward, as no doubt it is Admiral Halsted's desire that it should. With regard to the blowing in of the rear end of an Armstrong shell which he alluded to, it was desired to increase the number of buttons in order to obtain the bearing surface, which, unless my engineering knowledge very much deceives me, might have been obtained equally well by resorting to that system of ribbing, as in Captain Scott's projectile, which gives the bearing surface without elongating the shot. With regard to that, I have merely to say that the same law applies to it that applies to the wad. If you make the base of your shot so thin that it cannot resist the crushing pressure brought upon it by the explosion of the powder—13 tons to the square inch before the projectile can be set in motion—then you may expect your shot to be crushed. I should recommend anyone to make the shot a little thicker in

the base, and to try more experiments as to the amount of pressure which iron or steel will sustain before he puts a shot into the gun. As to the shell which Admiral Halsted also referred to, I think he misunderstood what I said. I said that the inventor was preparing a shell, but that he did not wish, at present, to make it known; that he was perfectly confident that he could make a better shell, and a more destructive one, than you have ever had before. Therefore, it is not fair to assume that I have said there is no shell for the gun.

Admiral HALSTED: I beg to say that I said no such thing. I said that until we have the whole thing before us it is only assumption.

Captain SELWYN: The rotation is accomplished entirely by the air force overcome, which must be overcome in all cases. But it is the great difference here, that that force is expended usefully instead of uselessly. It is expended in producing that rotation, which you otherwise have to gain by the strain thrown on the gun, and instead of being expended in retarding the flight of the shot. It is not in any way affected by the explosion of the powder in the gun, which has no other office, and which should have no other office, than to project the shot with the greatest attainable velocity. With regard to the effect of a cross wind, a wind up and down the range, that will be a quantity dependent entirely on the velocity with which the projectile is caused to fly. If, unnecessarily or unwisely, you put the shot into a rifled gun, and thereby obtain, by detention in the gun, a lower velocity, then you will have brought into play one of the opposing forces, which will very likely cause any error you please. But I do not think any experiments tried by one person, which have been a success, should be contrasted with experiments made by another person, which have wanted success, especially when one of the conditions has not been observed. With regard to the symmetrical shot, or rather a shot which has a properly disposed weight; although I had not the pleasure of being present, my attention has been long ago turned to the subject by the gentlemen who have advocated that principle. I have only to say, in answer to the question, that although it does attain the object sought, as I said in my paper, that of causing a shot to go end foremost, without rotating, yet it does not obtain that which we seek also; first of all, great calibre, then the power of firing all projectiles of whatever nature, and the power of firing exceptionally long range shot. This system of hollow projectile leaves the question of calibre and the question of disposal of weight exactly where they were before. The shot is no greater in diameter, it is not incapable of being fired with a higher powder charge, nor does it throw more strain on the gun, inasmuch as the rotation is not accomplished by grooves. They are, necessarily, expensive projectiles,\* because they have to be made with the care which the shot which you are going to throw at your enemy ought to receive. The outside grooving, which I am also aware has been extensively tried, and, at first, with some little success, is liable to objections on account of the very fact which has been referred to, of the wind blowing across the range. The velocity there only accomplishes the rotation by means of the currents of air striking on the outside of an exposed surface, not confined inside the shot as in this instance, where the hollow shot may be said to run on a rod of air, whether it be rifled or smooth. But other opposing currents striking, as in cross winds, or opposing vanes or ribs, and thus giving partial rotation, are always liable to produce error in flight. The round shot with holes is an experiment which has been tried. I have not, I confess, seen the experiment, but it will be obvious to any one who will consider the way in which the shot shown in No. 1 diagram, issues from the gun; a spherical shot rolling along the lower surface of the bore of the gun, setting itself in rotation in exactly the opposite sense to that in which the rifled shot rotates, that is to say, the axis of which is at right angles to the bore of the gun; if you put holes in it the effect of those holes will be, that they will turn about, either to the rear or to the side, just as the disposal of weight incident to the boring out of a certain proportion of the metal may influence it. I should say that they would probably produce a much less correct flight than would be obtained with the ordinary spherical shot, made as homogeneous as possible. I think that I have now answered, so far as I am able, all the objections which I have had the pleasure of hearing; and if I have done

\* Price is £10 per ton.

so feebly, I can only regret that the subject has so bad an advocate. I have to say, in conclusion, that it is folly in any Institution, to put down any theory, or to say it is not worth examination, till you can show its advantages are *nil*. If the plan proposed has such advantages as those I have had the pleasure of stating to you, then, I think, the least we can do is to examine and try all things, and to hold fast to that which is good.

Captain HORTON: I am afraid that Captain Selwyn did not quite understand me. My question was whether it had been ascertained by any experiments that the projectile acquires that rotation in its flight.

Captain SELWYN: An experiment tried with a smooth-bore musket, and with a six-pounder, gave evidence of the punching out of clean, bright, sharp holes, having traces of the spiral action of the projectile through its flight.

The CHAIRMAN: As Chairman I will say nothing myself, but simply direct your attention to the wide range of subjects which is taken in hand by this Institution. It was only three nights ago that I was addressing you on the subject of the preservation of life, and here is my friend, Captain Selwyn, addressing us on the subject of the destruction of life. I am sure you will allow me to convey our thanks to Captain Selwyn for the valuable paper he has read.

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