# RIFLED ORDNANCE: A PRACTICAL TREATISE ON THE APPLICATION OF THE PRINCIPLE OF THE RIFLE TO GUNS AND MORTARS OF EVERY CALIBRE

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Trieste

# RIFLED ORDNANCE:

## A PRACTICAL TREATISE

ON

THE APPLICATION

OF

## THE PRINCIPLE OF THE RIFLE

TO

## GUNS AND MORTARS OF EVERY CALIBRE.

TO WHICH IS ADDED

A NEW THEORY OF THE INITIAL ACTION AND FORCE OF FIRED GUNPOWDER.

(Read before the Royal Society, 16th December, 1858.)

FIRST AMERICAN,

FROM THE FIFTH ENGLISH EDITION, REVISED.

BY

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# PREFACE.

When the greater part of this little work was written, that is to say, in the years 1856–7–8, a very limited knowledge only of the subject of which it treats had been generally acquired; since that time, however, a considerable advance has been made in the science of Rifled Gunnery—and I have thought it better to omit, in this edition, a considerable portion of the matter contained in the former—especially that which had reference to lead-covered projectiles—as obsolete, or likely, ere long, to become so.

The expanding projectiles represented in the Plates of the last edition, were—as there stated—merely experimental, and described for the purpose of illustrating certain principles, rather than with the view of recommending the projectiles for practical adoption. It has always appeared to me that the employment of any system which entailed the use of lead-coated projectiles could only be advocated in the absence of a better, or, until a more satisfactory system could be worked out; though I confess that, at the time this work was written, I saw no way to the solution of the problem. Since then, however, I have succeeded in perfecting a system which, I believe, will be found to meet all the requirements of our Service, without necessitating the use of lead-coated projectiles. This system, being actually under the consideration of the War Authorities, I have not judged it expedient to publish, until it has been thoroughly tested. I may state, however,

that, up to the present time, the results—obtained under most trying conditions—have been highly satisfactory.

The introduction of iron-plated ships of war, and general improvement in the means of defence, whilst rendering the acquisition of a good system for the construction and employment of heavy rifled ordnance a matter of paramount importance, have greatly altered the conditions to be observed for the attainment of the greatest destructive power with these guns.

When the employment of vessels of war built entirely of wood was universal, the most destructive effect would have been produced by the employment of heavy shells fired with necessarily limited velocities; *now*, the attainment of great force of impact and penetrating power has become of much greater importance, and a stronger and heavier description of gun is therefore rendered necessary.

Enough, however, has been done to show that guns of almost any power may be obtained; the only limit to their practical employment being the weight of the gun itself.

Notwithstanding that this has been incontestably proved by experiment, the country—owing to the want of a proper system of rifling for guns of this description—is still without a heavy rifled gun.

When the last edition of this little treatise was published, the only rifled gun which had been actually adopted into our service was the Armstrong field-piece. From the enthusiastic encomiums lavished upon it at the time, I was led, with others, to suppose that the gun we heard of was the first of a series about to be constructed upon a well-matured and approved system; and, as great secrecy was observed on the part of the officials, I awaited with much interest the development of this new and perfect theory.

During the four years which have elapsed, 20-pounder, 40-pounder, 70-pounder, and 100-pounder Armstrong guns have been constructed, but I have awaited in vain for the development of the theory or system which was expected to throw so much light on the science of Rifled Gunnery. At last it was discovered that there never had been any system; but that the chief difficulties, scientific as well as mechanical, were supposed to have been completely overcome by the revival, simply, of the obsolete and objectionable method of loading the gun at the breech; in fact, that we owed the adoption of this method of rifled cannon into our service solely to the mechanical skill displayed in the construction (after numerous experiments) of a cannon of very small calibre, to which the manufacturer, by means of an ingenious breech-loading apparatus, had succeeded in applying the principle of the rifle. Consequently, when guns of a larger size were required, each must necessarily have been the subject of fresh experiment; which may, in some measure, account for the vast expenditure of the last four years.

Still, it is an undeniable fact, that as these guns increase in size their comparative efficiency is not so great as it ought to be. This may be partly attributed to the very erroneous opinions which are generally entertained respecting the quantity of rotary motion required for rifled projectiles of different sizes.

In the absence of a proper theory, "the rule of thumb," as it is called, appears to have been employed in determining the length of turn to be given to the rifling in the Armstrong guns of different calibres; that is, a gun of twice the calibre of another has twice the length of turn, and so on.

Now, as the projectile's stability during its flight depends

entirely upon its receiving a proper degree of rotary motion, the length of the turn for large guns is a most important matter for consideration, and if it is not given in a proper ratio, the efficiency of these guns will be proportionally diminished.

The ratio of increase for the turn in the Armstrong guns is clearly insufficient; and that the inventor himself has some suspicion that it is so, is manifest from the circumstance that, for the heavier guns recently constructed, the comparative length of the projectiles has been considerably reduced. These projectiles require, therefore, a comparatively smaller turn; but they compel the employment (when they are of a given weight) of a gun of large calibre, which (if my experiments in gunpowder are to be depended upon) subjects the gun to a greater local strain; and may partly account for the mishaps which frequently occur with these guns, and for the diminished efficiency of the shot.

The only motive, if there be one, for giving the length of turn in proportion to the calibre of the gun—since there can be no scientific reason for it in connection with the flight of the projectile—must be to diminish the relative force expended in the gun in giving the projectile its rotary motion; but if the Armstrong method of rifling does not admit of the employment of the proper turn for giving a proportional rotary impetus to the shot in the larger guns (see p. 55), it must be radically wrong; as this would prove the existence of excessive friction.

The turn employed by myself, and the still greater one used by Mr. Whitworth for heavy rifled guns, have been stated to be disproportional and excessive; but this is an error. A proper investigation of the subject would convince all who entertain such a notion that, so far from being excessive, the turn I

have used with 7-inch and 9-inch guns is comparatively less than that of the Whitworth musket.

I would here observe that this, in common with every other question relating to dynamical science, cannot be considered a mere matter of opinion, since it admits of the clearest mathematical demonstration.

The absurd practice of reckoning the length of the turn in calibres instead of in feet and inches, doubtless gave rise to the idea that the turn was excessive. A turn of 6 feet, whether in a musket or in a 7-inch gun, gives (with an equal velocity of translation) the same angular velocity to both shot; and, reckoned in this way, whether the turn be short or long, we can at once form some idea of the comparative quantities of rotary motion imparted to the shot; but if the turn is reckoned in calibres, an estimate of the rotary impetus of the shot can only be formed after a long calculation. How absurd it would be considered if the velocity of translation of shot were reckoned in calibres! and yet it is equally absurd to take this course with regard to the angular velocity. The laws which govern rotating projectiles appear to have been sadly disregarded in this matter.

The Armstrong must still be considered an experimental gun. The science of Rifled Gunnery was in its infancy when we adopted this method. The result was, that it put a stop to all progress; in that experiment, since then, has been almost exclusively confined to attempts to improve a method, the faults of which are inherent; instead of being directed to the acquisition of a knowledge of the science which would have led to the formation of a system based upon sound principles.

An additional obstacle to progress exists in the strong party feeling which, unfortunately, has been created; and which has

impressed the public with the idea that, having pledged themselves to this inventor, the authorities are unwilling, or unable, to accept any system which does not emanate from Sir W. Armstrong.

This feeling has gained ground from the circumstance that (his original method not being applicable to large guns) he has been allowed, for several years, and at a great cost, to try and produce a heavy rifled gun (the shunt) upon a principle which must be condemned by all scientific artillerists.

Although, in advocating what I believe to be the cause of science and truth, I have attacked Sir W. Armstrong's principles of rifling, I must do justice to his abilities as an engineer and mechanician. The country is indebted to him for the only successful method of constructing wrought-iron guns; and although I disagree with him in nearly all that relates to the projection of the shot, I can yet admire the ingenuity and mechanical ability he has displayed in carrying out his own views.

In the chapter "On Rifled Cannon," I have suggested that the brass service howitzer should be converted into a rifled field-piece. This was written some time ago; but, since this edition was in the publisher's hands, the trial of a method (proposed by Capt. Palliser) of strengthening the service guns, by placing a coiled tube in a novel manner in the interior of the gun, has been attended—in the case of a 68-pounder gun—with sufficient success to show that it might be applied with great advantage to the brass howitzers, in converting them into rifled field guns; especially as, by this method, an additional length is given to the bore of the gun. This would be preferable to casting the guns over again, as I have suggested; and if all the old brass field guns were recast as howitzers, and the latter were