# PHILOSOPHICAL TRANSACTIONS.

*Munday, June 3. 1667.*

The Contents.



## *Experiments for Improving the* Art *of* Gunnery.

*The better to determine the three Grand* Desiderata, *in the* Art *of* Gunnery viz. 1. *The* Point-blank *distance.* 2. *The* Quantity *of* Powder *for the just Charge of any* Peece. 3. *What* Gun (*for Size, Bore, Weight, Metal,* &c.) Shoots Farthest: *The following Experiments are proposed and directed, by Sr.* Robert Moray; *to give occasion to such as are Curious in this Art, to improve the same, as they shall have opportunity. Who we cannot but suppose will be so generous, as to impart the Successes and the Events of their Tryals of this kind to the* Publisher *of these* Transactions; *for further Improvement and Use.*

TO Know, how *Far* a Gun Shoots *Point-blank* (as they call it) that is, so near the Level of the Cylinder of the *Peece*, that the difference is either not discernable, or not considerable: On a fit plat-form, place and point the Gun at a Mark, as large as the Bullet, some 50. 60. or more Yards distant, so as the under-side of the Mark may be in the same Level or I.

Line with the under-ſide of the Cylinder of the Peece. Then, between the Gun and the Mark at ſeveral places, place pieces of Canvas, Sheets of Paper paſted together, or the like, upon Stakes fixt in the ground, ſo as the under-ſide, being level with the Horizon, may juſt touch the Viſual line, that paſſeth from the Eye to the upper-ſide of the Mark; when the Eye is placed in the Line, that paſſeth from it to the upper-ſide of the Cylinder of the Gun; the Canvas being ſo broad and long, that, if the Bullet paſs through it two or three foot higher than the Level of the Mark, or of either hand, the hole it makes, may make it known, how much it flieth higher than the Level of that place. Such piece of Canvas, *&c.* may be placed; *one*, at half the diſtance between the Gun and the Mark; *another*, half-way between the firſt, and the Mark, *&c.* And if it be found, that even at ſo ſmall a diſtance the Bullet falls lower than the Mark, if it touch not the Canvas, the Gun may be next time raiſed a little, and ſo on, till the Bullet hit the Mark, or as high as it: And if at firſt it fall as high as the Mark and cut the Canvas, the Mark and Canvas may be brought neerer the Gun, till it needs be done no more: Afterwards the Mark may be removed to greater and greater diſtances, till, to hit the Mark, it fly higher, than ſome or all the interpoſed Canvaſſes: And thus the Experiment is to be repeated and varied at pleaſure.

II. To know, what *Quantity* of *Powder*, is the *juſt* Charge of any Peece, ſo as it maketh the fartheſt Shot, and fires totally.

1. Raiſe the Gun to a *mean* Random, as of 20 or 25 degrees, and Shoot with the *ordinary* Charge of Powder, in ſome convenient ground, where the fall of the Bullet may be eaſily ſeen, and having made a Shot, meaſure the diſtance with a Chain, between the hole made by the Bullet, and the Muzzle of the Gun.

2. Then, inſtead of a full Charge of Powder uſed in the firſt Shot, take $\frac{1}{16}$. part leſſe, or ſome ſuch proportion, for the next tryal; doing all things elſe as before.

3. For a third, fourth, or more tryals, diminiſh ſtill the Quantity of Powder by $\frac{1}{16}$. at a time, till the Shot be conſiderably Shorter, than at firſt.

4. Then take $\frac{1}{16}$. more than the firſt Charge, and do all things elſe as before, and ſo continue more tryals, increaſing ſtill the Quantity of Powder in the ſame proportion, every new tryal, till you find the increaſe of the Charge does not make the Peece

Shoot

Shoot further: Only over-Charge not ſo far, as to endanger the Gun.

5. The right Charge found, the beſt Random is to be ſought by trying all Randoms, by degrees at a time.

To know, *What Gun Shoots fartheſt*; III.

1. A Gun, to be prepared of *Culverin-Bore* (as being held the beſt for Shooting far,) but much longer (double the Ordinary length may do well;) is to be placed as in the former Experiments, and charged with the Ordinary Charge of a *Culverin*, or rather with that Quantity, which by the former Experiments ſhall be found the beſt; and being Shot, the fall of the Bullet is to be markt, and diſtance meaſured, as hath been ſuggeſted.

2. Then try leſs, and more Powder in her, as before.

3. Then cut off two inches of the Muzzle with a Saw, and try as before, doing every thing in the ſame manner: And ſo cut off ſtill for new tryals, till the Shot begin to fall ſhorter than before.

4. The ſame may be done with Guns of different Bores.

*Advertiſements.*

1. The way to accommodate the Canvas, *&c.* propoſed for finding out the *Point-blank-diſtance*; is *firſt* to pitch two ſtakes of the juſt height of the upper-ſide of the Cylinder of the Peece, ſome 6 or 8 foot aſunder, in the ſtreight line between it and the upper-ſide of the Mark, by a long Ruler, having one end in the Peece, after the Peece is duly point at the Mark; and then, by the Eye looking over the Stakes to the upper-ſide of the Mark, or rather by a *Teleſcope*, the Paper or Canvas interpoſed may be let down, or placed juſt ſo, as the undermoſt-ſide may ſeem to touch the upper ſide of the Mark, to one that looks at it from the top of the firſt Stake. I.

2. If this way of Experiment be made for further diſtances and raiſings of the Peece, as high as conveniently may be above the Level, and the diſtances meaſured as hath been intimated; and then all Randoms above theſe likewiſe tryed and meaſured, the diſtance of an Object, to be Shot at, being known, and other neceſſary cautions, beneath to be mentioned, carefully obſerv'd, good Gunners may with great confidence undertake to hit the Mark, be the diſtance what it will, ſo it exceed not the reach of the Gun.

II. 1. The Experiments here propoſed, are to be made in Guns of all *Sizes*, *Bores*, *Weights*, *Metals*, &c.

2. Three or more Shot to be made with every different Charge, and at every ſeveral tryal, that the certainty may the better appear.

3. The firſt Shot being Meaſured and marked, the reſt may all be Meaſured from it, or from one another, to ſave labour.

4. The Gun is to be pointed, placed, and ordered every time in one and the ſame place and poſition, aiming ſtill at the ſame Mark, or pointing ſtill in the very ſame Line or *Azimuth*; that ſo all the Shot may fall in the ſame Line, as near as is poſſible.

5. The Powder muſt be *exactly* weigh'd, every time the Peece is charged, leſt it having been weigh'd long before, the weight may be alter'd; though Experiment may be made with Cartridges and without.

6. The Powder and Bullet is to be rammed home *equally* at *every* Shot; though the looſer the Powder lye, it fire the better.

7. When the *right* Charge of a Peece is found, that makes the fartheſt Shot in the ordinary and plain way of Charging, Monſieur *de Sons* contrivance of a *Wedge* may be tryed, to make it Shoot farther; which is a piece of Board, ſo long, as being thruſt home to the Breech of the Peece at one end, the other may reach farther out than the outſide of the Bullet, being ramm'd up to its place; broad about an Inch, and thin ſo far as the Wadd before the Bullet reaches on the out-ſide; *there* it is to have a Shoulder, from which forward to the end, it is to be cut a ſloap like a Wedge, being of ſuch thickneſs, as that at the place, where the Center of the Bullet is to be, it may make it ſtick ſo faſt, that the Powder finding more reſiſtance may at length drive it out with the greater violence.

8. Another of this nature is a Wooden *Tampion*, like a piece of a Cylinder, big enough to fill the hollow Cylinder of the Gun, the length ſomewhat more than the Diameter of it and hollow'd towards the Bullet, ſo as to fit it; and *either* flat, or (which is better) hollow likewiſe towards the Powder, and ſerving inſtead of a *Wadd*. Theſe and ſuch others will probably render the effect of the Powder greater, than otherwiſe it would be.

9. The *Strength* of the *Powder* muſt be examin'd by a *Powder-Tryer*, that raiſeth a Weight, ſuch an one as has been contrived by Mr. *Hook*, and is made by Mr. *Shortgrave*, Operator to the *Royal Society*.

10. The

10. The Powder uſed in a Set of theſe Experiments, ought to be all of the ſame goodneſs.

11. The ſame Bullet is to be made uſe of, if it can be had, till the Figure of it be marred; otherwiſe another as near of the *ſame* Size, Shape, and Weight, as is poſſible.

12. The ſtrength of the Wind, is to be obſerved at *every* time of Shooting; which may be done by an Engine, made by the lately nam'd *Operator*.

13. Obſerve alſo the Poſition of the Wind, with a Fane and Compaſs at every Shot.

14. Note alſo, at what *Azimuth* the Mark ſtands from the Gun.

15. Take preciſe notice, what effect the Wind hath every time upon the Bullet, in carrying further, in hindering, or turning it aſide.

16. Note the Figure, dimenſions, and Weight of the Gun, Carriage and Wheels.

17. The plat-form to be very Levell.

18. The Wheels to be at every Shot placed in the very ſame place and poſition, to avoid inequalities.

19. Every thing to be *exactly* recorded in a Book, as alſo every Accident and Obſervation.

20. After all other Experiments are made, every Peece may be tryed with the right Charge of Powder, laying every time more and more Weight upon the Carriage; and at laſt fixing the Gun ſo, as it may not recoyle at all, obſerving every time how far the Bullet goes, and how much leſs Powder than the full Charge will ſerve to Shoot the Bullet, when the Peece is fixt, as far as the whole Charge does, when it recoyls freely.

21. Care is to be had, that the Experiments with the *Wedge*, *Tampion*, and the like, made for encreaſing the force of the Powder, and the fixing of the Peece, do not endanger it.

III. 1. The Long Guns are to be made without any *Ring* about the Muzzle.

2. The pieces cut of from the Muzzle, to be alwayes laid on the Carriage, when new ſhots are made, or their weight of Lead in a convenient Figure, that the recoyl may ſtill be the ſame.

3. The Quantity of Powder, that Shoots furtheſt in an *Ordinary Culverin* being known, there needs no Variation of it in the Long one.

*Anſwer*