III. *The* Report *of the* Committee *of the* ROYAL SOCIETY *appointed to examine ſome Queſtions in* Gunnery.

Read Nov. 4. 1742. DR. *Jurin* having propoſed * Two Queſtions in Gunnery to be examined, the SOCIETY was pleaſed to appoint a Committee for that Purpoſe.

The Queſtions were,

1. *Whether all the Powder of the Charge be fired, before the Bullet is ſenſibly moved from its Place?*

2. *Whether the Diſtance to which the Bullet is thrown, may not become greater or leſs, by changing the Form of the Chamber, though the Charge of Powder and all other Circumſtances continue unchanged?*

At the Meeting of the Committee it was propoſed to divide the Firſt Queſtion into Two Parts.

1. *Whether all the Powder of the Charge be fired?*

2. *Whether all the Powder that is fired, be fired before the Bullet is ſenſibly moved from its Place?*

As to the Firſt Part of the Firſt Queſtion, *the Committee are of Opinion, that all the Powder of the Charge is not fired.*

They found their Opinion upon the following Experiments:

Pieces of Paper uſed for Hangings were laid cloſe together upon the Ground, to the Breadth of Ten Feet, in the Line of a Fowling-piece, between it and a Frame of Ten Feet ſquare, covered over with Paper. Upon pointing the Piece towards the Middle of the

* *June* 24 1742.

Frame,

Frame, and *diſcharging* it ſeveral times *with* and *without Ball*, ſome Powder was always collected, but mixed with a great deal of Dirt.

It is however to be obſerved, that in Two Experiments made the 22d of *July*, near the Artillery-Ground, before the Preſident and ſome of the Fellows of the SOCIETY, with a finer ſort of Powder, in a Barrel of Three Feet Nine Inches in Length, and Three-fourths of an Inch Bore, with Twelve Penny-weight of Powder the Firſt time, and Twenty-four Penny-weight the Second time, without Ball or Wadding, no Powder could be found ſcattered on the Paper laid before the Piece, nor ſticking to a Board at the Diſtance of about Ten Feet, againſt which the Piece was pointed. But when the ſame Powder was fired in a ſhort Barrel of Five Inches Two-tenths of an Inch in the Chace, either with or without Ball, ſome Quantity of Powder was always collected.

Other Experiments were afterwards made before the Committee, by firing a Fowling-piece charged with Five Penny-weight of Powder, againſt a Sheet of whited-brown Paper, at the Diſtance of Two or Three Yards; the Paper was found pierced with ſeveral Hundred Holes, and the Jags of the Paper appeared on the Backſide. In a ſecond Trial with Ten Penny-weight, the Paper had more Holes in it. A third Trial was made with Five Penny-weight of Powder and Ball, and then few Holes appeared in the Paper. In a fourth Experiment made with a ſhort Screw-barrel Piſtol, with a Charge of One Penny-weight two Grains of Powder and a Ball, ſeveral Holes were found in the Paper *.

* That the Paper in theſe Experiments was pierced by the unfired Powder, appears, becauſe ſeveral Grains were found lying behind the Frame, to which the Paper was fixed, and ſome few ſtuck in the Paper.

But the Irregularities in this manner of collecting the Powder unfired, giving reaſon to ſuſpect, that ſome Powder eſcaped Sideways, beyond the Paper laid to receive it, it was propoſed to have a Machine made, which being cloſe every-where but at the End where the Muzzle of the Piece was to be placed, might thereby hinder the Powder from being diſſipated. Such a Machine was contrived by Mr. *Ellicot*, and by him preſented to the Committee, being a Frame of Wood in Shape like a truncated quadrangular Pyramid; at the ſmaller End was a Board to receive the Shot, and the Four Sides of the Machine were covered with thick Paper ſtrongly paſted together, and ſo prepared as to prevent its taking Fire. This Machine, ſupported by Props, was placed upon one of its Angles, the Carriage for fixing the Barrels was placed cloſe to the greater Baſe, which was left open. The Reſult of the ſeveral Experiments were as follows:

The Three firſt Experiments were made with a Barrel Eight-tenths of an Inch Diameter of the Bore, and the Length of the Chace Five Inches Two-tenths of an Inch. The Charge each time was Six Penny-weight of Powder without Ball; the Quantities of Powder collected were reſpectively, One Penny-weight Nineteen Grains; One Penny-weight Twenty-one Grains; and One Penny-weight Twenty Grains.

Three other Experiments were made with the ſame Piece, and with Twelve Penny-weight Charge, without Ball. The Quantities of Powder collected were Four Penny-weight Eighteen Grains; Four Penny-weight Two Grains and an half; and Four Penny-weight Twenty-two Grains.

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The next Three Trials were with the ſame Piece, the Charge Six Penny-weight, with a Ball weighing One Ounce Four Penny-weight, being a Mixture of Lead and Tin, and fitting the Piece exactly.

The Quantities of Powder collected each time were reſpectively, One Penny-weight Five Grains; One Penny-weight Five Grains; and One Penny-weight Eleven Grains.

The laſt Three Experiments with the ſame Piece, were made with a Charge of Twelve Penny-weight, the Weight of the Ball as before; and the Quantities of Powder collected, were found to be One Penny-weight Twelve Grains; One Penny-weight Nine Grains; and One Penny-weight Eight Grains and an half.

The Waddings uſed in all theſe and the following Experiments, were of thick Leather cut round, to fit the Bore of the Piece.

The Committee then proceeded to examine what Alteration might ariſe from a greater *Length of Chace*. The Experiments in this Caſe were made with a Barrel Three Foot Nine Inches in Length, and Three-fourths of an Inch in the Bore; the Charges of Powder, and Weight of leaden Balls, were as before.

In the Firſt Three Experiments with Six Penny-weight Charge, without Ball, the Quantities of Powder collected were Three Grains; Nine Grains; and Nine Grains, reſpectively. In the Three next Experiments, with Twelve Penny-weight Charge, without Ball, the Quantities of Powder collected were Thirteen Grains; Nine Grains; and Sixteen Grains and an half. The Three following Experiments were with Six Penny-weight Charge and a Ball. The Powder collected was Two Grains; Three Grains; and Two Grains.

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The laſt Experiments were made with Twelve Penny-weight Charge and Ball, as before; the Quantities of Powder collected from Two Diſcharges were reſpectively, Two Grains; and Four Grains and an half. The Frame being broke, a third Experiment could not be made.

The Powder collected after the ſeveral Diſcharges, was put into ſeparate Boxes; it ſeemed much bruiſed, and mixed with Dirt. Yet ſeveral of the Parcels being tried, fired with brisk Exploſions; and ſome of the Powder collected from the Experiments with the ſhort Barrel, amounting to Six Penny-weight Sixteen Grains, being put into the long Barrel, and fired with Ball, went off with a ſtrong Report; and the Ball pierced the Deal-board, at the End of the Frame, and penetrated Two Inches deep into an Elm-plank placed to receive the Balls.

Some Gentlemen, preſent at theſe Experiments, ſuſpecting that Part of the Powder might eſcape at the open End of the Frame; the ſhort Barrel was fired with Twelve Penny-weight of Powder and Ball, as before; through a very large Funnel, the Quantities found, after Three Diſcharges, were ſeverally, One Penny-weight Two Grains; Sixteen Grains; and Fifteen Grains.

Whereas upon removing the Funnel, and diſcharging the Piece, as before, One Penny-weight Eleven Grains was collected, agreeably to former Experiments; it ſeems that the Funnel had a like Effect as lengthening the Piece.

Some Experiments were alſo made with the ſhort Barrel, filled up with Lead, ſo as to leave but Three Inches and Three-fourths of an Inch for the Chace, the Piece being

being then charged with Twelve Penny-weight of Powder and Ball, as before; the Surface of the Ball was but Eight-tenths of an Inch within the Mouth of the Piece, and the Powder collected, after Three Diſcharges, was reſpectively, Two Penny-weight Two Grains; One Penny-weight Seventeen Grains; and One Penny-weight Eleven Grains.

The Barrel being further filled up, ſo as to leave but Two Inches Eight-tenths for the Chace, and charged as before, the Ball riſing about One-fifth of an Inch beyond the Mouth of the Piece, the Powder collected, after the Diſcharge, was Two Penny-weight Six Grains. Upon a Second Trial, the Ball being as much within the Mouth, One Penny-weight Sixteen Grains was collected. And at the Third Trial, the Ball being level with the Mouth, Two Penny-weight Six Grains were again found.

The Committee alſo cauſed ſome Experiments to be made of the Effect of a *Touch-hole* near the Fore-part of the Charge. They found upon diſcharging the ſhort Piece of Five Two-tenths of an Inch Chace, the Charge Twelve Penny-weight and Ball, as before, the Touch-hole being near the Fore-part of the Powder; the Quantities of Powder, ſeverally collected, were One Penny-weight Seven Grains and an half; One Penny-weight Six Grains; and One Penny-weight Four Grains. And upon a Diſcharge made with a little more Powder, which filled the Barrel exactly to the Edge of another Touch-hole, the former being ſcrewed up, the Quantity collected was One Penny-weight Nine Grains.

The Effect of firing with *heavy Slugs* was alſo examined: The Weight of the Slugs and Quantities

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of Powder collected, were as follows; the Charge in the ſhort Barrel being Twelve Penny-weight:

Diſcharge.	Weight of Slugs.			Powder collected.	
	Ounces.	*dwt.*	*gr.*	*dwt.*	*gr.*
I.	2.	13.	0.	1.	3.
II.	2.	11.	14.	0.	17.
III.	2.	12.	0.	0.	8.
IV.	5.	5.	6.	0.	13.
V.	5.	3.	0.	0.	8 $\frac{1}{2}$.

The Powder uſed in all theſe Experiments, made before the Committee, was preſented to them by Mr. *Walton*, and is ſuch as he makes for the King's Service. To aſcertain as nearly as poſſible, that the Powder had not undergone any conſiderable Alteration by Damps or otherwiſe, a Standard Experiment was previouſly made at every Meeting, with the ſhort Barrel charged with Twelve Penny-weight of Powder, and with a Ball of Twenty-four Penny-weight; and the Quantity of Powder collected was from One Penny-weight Eight Grains, to One Penny-weight Twelve Grains; which is as great a Regularity as can well be expected. This Powder of Mr. *Walton* being *ſifted*, and divided into a *fine* and a *large Sort*, the following Diſcharges were made with Twelve Penny-weight of each, and Ball as uſual:

Diſcharges with fine Powder.	Powder collected.	
	dwt.	*gr.*
I.	1.	4.
II.	0.	21.
III.	0.	12.

In this Third Experiment the Bullet, not being ſo exactly turned as the others, was rammed down with great Force.

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Diſcharge with large Powder.	Powder collected. *dwt.*	*gr.*
I.	1.	11.
II.	1.	16.
III.	1.	21.

And the Powder being bruiſed in a Mortar, and ſifted through a Lawn Sieve, the Charge and Ball being as before, what was collected after Three Diſcharges, was One Penny-weight Ten Grains, One Penny-weight Eight Grains, and Seventeen Grains.

Mr. *Watſon* having had two Parcels of Powder delivered to him, the one freſh, and the other collected after Diſcharges with Ball, gave an Account of the Quantity of Nitre he had ſeparated from them, *viz.*

Separated from Nine Penny-weight of freſh Powder	*dwt.*	*gr.*
Nitre . .	6.	2.
Reſiduum	2.	7.
Loſs . .	0.	15.

From Nine Penny-weight of Powder collected after having been diſcharged with Ball	*dwt.*	*gr.*
Nitre . .	4.	18.
Reſiduum	2.	15.
Sand, *&c.*	0.	11.
Loſs . .	1.	14.

Twelve Grains of the Powder gathered and put into ſeparate Boxes, after firing with Ball out of the ſhort Piece, as before-mentioned, being fired in the exhauſted Receiver, ſunk the Mercurial Gage from Twenty-nine Inches One-tenth to Twenty-three Six-

tenths. And the ſame Weight of freſh Powder being fired in the ſame manner, ſunk the Gage to Twenty-two Inches Three-fourths; the Difference being $\frac{85}{100}$ or $\frac{17}{20}$ of an Inch.

From theſe Experiments the Committee are of Opinion, that the Firſt Part of the Firſt Queſtion, *Whether all the Powder of the Charge be fired?* is ſufficiently determined in the *Negative*.

As to the Second Part of the Firſt Queſtion, Whether *all the Powder that is fired, be fired before the Bullet is ſenſibly moved from its Place?* the Committee are of Opinion, *That the Bullet is ſenſibly moved from its Place, before all the Powder that is fired, has taken Fire.*

This, indeed, has not been determined by any direct Experiment, but ſeems a Conſequence of the Determination of the Firſt Part of the Queſtion, that the Whole of the Charge is not fired.

For let it be conſidered, that from the Moment any Part of the Powder within the Barrel takes Fire, the Flame of the Powder already fired is always contiguous to ſome Part of the Powder as yet unfired; and conſequently ſome Part of this laſt muſt be continually taking Fire, ſo long as any unfired Powder remains within the Barrel; that is, the firing of the Powder cannot be over, till all the unfired Powder is driven out of the Gun: But before any Part, how ſmall ſoever, of the unfired Powder is driven out of the Gun, the Bullet which lies between the Charge and the Muzzle, muſt neceſſarily have been driven out of the Gun. Therefore the firing of the Powder is not over, or all the Powder that is fired, is not fired, till after the Bullet is driven out of the Gun. And

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conſequently the Bullet muſt be ſenſibly moved from its Place, before all the Powder that is fired, has taken Fire.

As to the Second Queſtion, *Whether the Diſtance to which the Bullet is thrown, may not become greater or leſs, by changing the Form of the Chamber, though the Charge of Powder and all other Circumſtances continue unchanged?*

The Committee are of Opinion, *That the Change of the Form in the Chamber, will produce a Change of the Diſtance to which the Bullet is thrown.* Their Opinion is grounded upon the following Experiments, in which the *longeſt Chamber* of equal Capacity drove the Ball fartheſt.

Three braſs Chambers were made, whoſe Depths were reſpectively Three Inches; one Inch and half; and Three-fourths of an Inch; ſo turned as to fit the Chamber of Mr. *Hauksbee*'s Mortar; each of theſe Chambers contained, when full, One Ounce *Troy* of Powder. The Ball was of Braſs, weighing Twenty-four Pound Six Ounces and an half *Avoirdupois*, that is, nearly Three hundred Fifty-ſix Ounces *Troy* *.

The Ball touched the Powder of the Charge in all theſe Experiments. With the Firſt Chamber of Three Inches deep, the Elevation of the Mortar being Forty-five Degrees, the Ranges at Four different Trials were found to be,

Shot.	*Chains.*	*Links.*	
I. . . .	11.	39. or nearly	752 Feet.
II. . . .	10.	38.	685.
III. . . .	11.	17.	737.
IV. . . .	11.	10.	733.

* Suppoſing 14 Ounces 11 Penny-weight and 15 Grains and an half *Troy*, equal to 1 Pound *Avoirdupois*.

In the Second of theſe Experiments, the braſs Chamber, not being ſufficiently thruſt home before the Diſcharge, was by the Violence of the Powder driven in ſo, that it could not be got out again without the Help of an iron Screw, and a vaſt Force applied to iron Wedges. This was doubtleſs the Cauſe of the great Irregularity obſerved in this Caſe. The mean Diſtance, collected from the other Three Experiments, is nearly 741 Feet.

Then Three Diſcharges were made with the Chamber Three-fourths of an Inch deep, with Ball, Powder and Elevation, as before. The Ranges were,

Shot.	*Chains.*	*Links.*	
I.	7.	6.	or 466 Feet nearly.
II.	7.	2.	463.
III.	7.	2.	463.

The mean Diſtance to which the Ball was thrown in theſe Three Experiments is 464 Feet.

The Chamber One Inch and an half deep, was alſo tried; but this not fitting the Mortar ſo well as the other Two, the Ranges were found to be very irregular, being

Shot.	*Chains.*	*Links.*	
I.	10.	40.	or nearly 686 Feet.
II.	9.	6.	598.
III.	7.	8.	467.

The laſt Shot, falling ſo much ſhort, may be aſcribed to the Damp, it being late in the Evening when it was fired.

That Moiſture greatly weakens the Effect of Powder, is commonly known; and the Committee found by an Experiment, That Powder dried by means of a Phial in *Balneo*, and put warm into the Chamber, threw

threw the Ball twice as far as the ſame Quantity of Powder taken out of the ſame Barrel, before it was dried.

IV. *An Account of a* Meteor *ſeen near* Holkam *in* Norfolk, Aug. 1741. *tranſmitted to the* ROYAL SOCIETY *by the Right Hon^ble* Thomas *Lord* Lovell, F. R. S.

Read Nov. 4. 1742.

THomas *Savory*, *John Walker*, and others of Lord *Lovell's* Ploughmen, being at Plough about the Middle of *Auguſt* 1741. on a fair Day, at Ten o'Clock in the Morning, ſaw on a Heath about a Quarter of a Mile from them, a Wind like a Whirlwind, come gradually towards them, in a ſtrait Line from Eaſt to Weſt. It paſſed through the Field where they were at Plough, tore up the Stubble in the ploughed Ground, and alſo the Graſs beſides the ſame, for Two Miles in Length, and Thirty Yards in Breadth. When it came to ſome Cloſes at the Top of a riſing Ground called *Ferrybuſh-Cloſes*, *Philip Henning*, and others, who were houghing *Turneps*, ſaw it appear like a great Flaſh or Ball of Fire. After having ſeen the Wind come into the Cloſes, *Robert May* was in a Cottage where he lives by a Road-ſide, at the Bottom of the Park, about a Furlong down-hill from the Cloſe, when one of his Children about Six Years old, who was playing at the Door, cried out, That *Ferrybuſh-Cloſes* were on Fire; on which he went out to look, but ſaw no Fire, only a terrible Smoak, and heard ſuch a Noiſe as Fire makes when a Barn is burning.