IV. *A Letter from* Granvile Wheler, *Esq; to Dr.* Mortimer, *Secr.* R. S. *containing some* Remarks *on the late* Stephen Gray, F. R. S. *his* Electrical Circular *Experiment.* *

SIR,

SOME odd Circumstances led me to make Mr. *Gray's* circular Experiment in the following Manner. While I excited a Cake of Rosin and Bees-wax ten Inches Diameter, by clapping with my Hand, I let my ivory Ball continue in a Basin of Water; then shaking off the Drops, placed it in the Centre, and with my right Hand held a fine Thread, about eight or nine Inches long, having one End rolled up into a little Ball, and the other, for about an Inch, reduced to its greatest Fineness, to only one Fibre, myself and Hand being supported on the Back of a Chair. The Success was, I had a great many Revolutions, to the Number of Fifty, from West to East; but at first not so regular as towards the last, at first describing only about one third Part of the Circumference at a time, and after standing still a little, describing another third Part. I might probably have had a great many more Revolutions, but being tired, I was forced to rest myself, which I did for ten Minutes, then took up the Thread again. The Thread stood repelled at some Distance, without making any Revolutions, and at last only made half an one the contrary way to what it did before; but upon wetting it, by drawing it two or three times

* See *Philosophical Transactions*, *n.* 441, *p.* 220. and *n.* 444, *p.* 400. of the Revolutions of *pendulous Bodies* by Electricity.

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over the Surface of the Water, it made again twenty more Revolutions from Weſt to Eaſt, only at a ſmaller Diſtance from the Ball, (for the Water muſt make it heavier) but full as regular as before, and rather quicker: The Virtue of the Cake muſt now have laſted about three quarters of an Hour. After reſting about ſix Minutes, I tried again with the String freſh wetted, the Ball and Cake continuing as before; and had, to my great Surprize, one hundred Revolutions in the Space of about twelve Minutes, the Revolutions being ſtill quicker, and more regular, and nearer the Ball; and at the ſixth Revolution of this laſt Hundred, the Thread was attracted to the Surface of the Ball, and, being wet, did not diſengage itſelf, till pulled away; yet after this, deſcribed the remaining Ninety-four Revolutions of the Hundred, and ſeemed inclined to deſcribe a great many more, but that I was forced to reſt my Arm again, which I did for about eight Minutes, then tried again, the Thread being freſh wetted, and had ſeventy Revolutions at nearly the ſame Diſtance from the Ball in leſs than nine Minutes, all very regular, and without any Attraction of the Thread to the Ball. I reſted again ſixteen Minutes, wet the Thread again, and held it as uſual; it was repelled at about half an Inch Diſtance from the Ball, but ſeemed to have no Tendency to a circular Motion; yet after continuing ſtationary about a Minute, I perceived a Motion about its Axis, about which it took ſeveral Turns; but ſtill had little or no progreſſive Motion, till about a Minute longer, when it began to move forward, and continued doing ſo from Weſt to Eaſt, for about thirty-three Revolutions, very regular, but ſlower than in the two laſt Caſes, the String having been held about ten Minutes,

nutes, and the Revolutions performed in about ſeven or eight of them. I obſerved each of theſe three laſt times, it was rather longer before the progreſſive Motion began than uſual; and in all the Trials of this Experiment, I frequently perceived a Motion about the Axis, which was generally from Weſt to Eaſt, though now-and-then the contrary Way. The Virtue of the Cake muſt now have laſted near two Hours; about three quarters of an Hour after, I tried again, and had ſixty Revolutions from Weſt to Eaſt, in about ten Minutes, the Diſtance from the Ball being ſtill leſs than before, hardly one quarter of an Inch, ſcarce any Revolution about the Axis appeared, and at the Beginning the Thread was twice attracted to the Ball. About an Hour and half after, the Virtue of the Ball was not quite gone, the wet Thread being repelled, and making three or four Revolutions from Weſt to Eaſt, as well as moving a little about its Axis the ſame Way. But as it was reaſonable to ſuppoſe the Ball itſelf in the Centre of the Cake was now dry, with a Feather dipp'd in Water I wet its Surface; yet found no Increaſe of Virtue, rather a Diminution of it, the pendulous Body ſeeming ſcarce at all repelled; but it is to be obſerved, that the Ball, as it was wetting, twice tumbled over, and rolled upon the Surface of the Cake; by which means the Virtue of the Cake might be much diminiſhed.

It is not improper too to take Notice here, that during the Revolutions of the wet String, I have frequently obſerved a kind of Oſcillatory Motion, as if there was an alternate Intention and Remiſſion of the repulſive Force. As alſo that I have often took Notice of little Plucks, and convulſive Motions,

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in the pendulous Body, and ſometimes thought I have felt ſomething like it in my Arm that held it, though at no other time have I ever been ſenſible of any ſuch thing.

I have ſeveral times ſince repeated this Experiment with the Thread and Ball both wet, and found it ſucceed much better than when they were both dry; and once I find by my Notes I had two hundred and twenty Revolutions before I reſted my Arm. I have tried too with the Ball dry, and the String only made wet; but the Virtue did not continue ſo long, as when both were wet.

I now flattered myſelf with Hopes of Succeſs, if the Thread was ſuſpended from an undoubted fixed Point, which therefore I proceeded again to try with the greateſt Care and Caution, but in vain; the Revolutions were uncertain.

This Difference naturally led me to reflect upon the Cauſe of it. The Tremor of the Hand would not account for it; for this being both ways backward as well as forward, muſt as often hinder as promote a continual Motion one way: And though in two oppoſite Parts of a Circle, the Motion is really in contrary Directions, and therefore the contrary Impulſes of a Tremor may promote a Revolution applied at oppoſite Places of the Orbit; yet as theſe Tremors are irregular, and ſucceed much quicker than the Revolutions are perform'd, they ſeem inſufficient to account for the Motions of the pendulous Body, performed with any Degree of Regularity.

A Stream of Air in my Room might impel along the Tangent the pendulous Body, kept at a Diſtance from the Ball by its repulſive Force; and then Gravity,

taking place, might with the firſt Motion compound a Curve; but ſtill the Reſiſtance of the Air would ſoon deſtroy the original Impulſe, could a few Revolutions be performed; and beſides, one Revolution could not be performed, becauſe the ſame Stream of Air that began the Motion, muſt be contrary to it in its Return.

A Finger held on the right Hand near the pendulous Body, when ſuſpended from a fixed Point, will make it revolve from Weſt to Eaſt; but then it muſt be applied and removed alternately: The repulſive Force therefore which the Arm may acquire, by being held in the Sphere of the *Effluvia*, is inſufficient; for, as it is in one Place, it muſt impel only one way, and conſtantly the ſame way; and therefore, like a Stream of Air in the Room, though it might create the Beginning, it muſt hinder the Completion of a Revolution.

Sometimes I have doubted, whether the Pulſe of the Arm might not be aſſiſting in giving a projectile Motion. When one Leg is laid over the Knee of the other, a Motion and Heaving of the Leg that lies over, anſwering to every Stroke of the Pulſe, is very apparent at a Diſtance: The Arm therefore in ſome Poſtures, in which its great Artery meets with a proportionable Preſſure or Reſiſtance, may have a conſtant Motion, though leſs perceivable.

What ſeemed the moſt probable Solution, was this: When the Arm is extended, the Poſture being uneaſy, there muſt be a Reaction of the Muſcles, or a continual pulling of the Arm towards the Body. When therefore the right Arm is made uſe of, the pulling will be from Right to Left; and conſequently the

the Motion produced in the Body held by it in the ſame Direction, or from Weſt to Eaſt. When the left Arm is made uſe of, the Reaction of the Muſcles will be from Left to Right, and therefore the Motion of the pendulous Body from Eaſt to Weſt. And, agreeably to this, I have obſerved, (as I formerly took Notice, though this Reaſon did not then occur to me) when I uſed my left Hand, all other Circumſtances continuing the ſame, the Motion of the pendulous Body was from Left to Right, or from Eaſt to Weſt, contrary to what was obſerved when held by the right Hand.

Yet ſtill neither of theſe Solutions would account for the Variety of Oddneſſes I have met with under various Circumſtances.

I proceeded therefore to try with Reſts for my Arm of different Heights, having an Arm of Wood, about two Feet long, fixed to a Reſt for my Teleſcopes, which I could raiſe to any Height I wanted; and I found the Experiment ſucceed only well, when the Reſt was lower than the electric *Area*, and the Arm was ſupported upon its Elbow, which was the Poſture conſtantly made uſe of, when reſted upon a Chair, the Chair being lower than the electric *Area*, that it might leſs affect the *Effluvia*, as was then thought.

I began now to think with myſelf, whether it was not poſſible, that an Inclination to a Motion one way in the Perſon that holds the Body, might not have ſuch an Influence upon the Arm, and conſequently the String and pendulous Body, as to determine them the ſame way by ſome Preſſure or Byaſs put upon it, though no Motion ſenſible even to himſelf,

ſelf, was produced in the Hand. If ſo, I might, by a contrary Inclination, produce a Motion the contrary way. Having therefore a fine Day, and my circular Cake being well excited, I tried if I could not produce a regular Motion from Eaſt to Weſt, about the Ball in the Centre, having my Hand ſupported, as uſual, upon the Back of a Chair. I found I could produce a very regular one from Eaſt to Weſt for many Revolutions, and change from one Motion to another, without being ſenſible I moved my Hand at all.

I then wet the Ball and String, as in the Experiment before-mentioned, and found I could tire myſelf with a Motion either from Eaſt to Weſt, or from Weſt to Eaſt, as I pleaſed, without giving any Motion, that I could perceive, to my Hand or Fingers. Hence many odd Experiments that pleaſe, may, when repeated, ſucceed.

Since therefore the Motion of the pendulous Body from a Point undoubtedly fixed, is irregular, as I have found by many different Experiments, repeated with the greateſt Care and Caution; and ſince I am convinced from theſe laſt-mentioned Trials, the Motion from Weſt to Eaſt, and from Eaſt to Weſt, muſt generally have been determined by myſelf; I am inclined to think, that a Deſire of producing a Motion from Weſt to Eaſt, was the ſecret Cauſe that determined the pendulous Body to that Direction, by ſome Impreſſion from Mr. *Gray*'s Hand, as well as my own, though I am perſuaded at the ſame time, he was not ſenſible of giving any Motion to his Hand himſelf: And I the rather think this was the Caſe, from the Inſtance Mr. *Gray* gives, by way of Explanation,

nation, of a Man reſting his Elbows upon his Knees, this implying that he reſted his Arm upon his Elbow, as I did myſelf.

But though upon the Whole it does at laſt appear, that this Motion from Weſt to Eaſt in a pendulous Body, applied to another in the Centre of an electric *Area*, is to be aſcribed to the Hand that holds it, and not ſolely to the Nature of the electric *Effluvia*, or the Figure of the central Body; yet ſtill, perhaps, it may not be improper for Aſtronomers to conſider, whether or no a Medium with this Property, that all Bodies immerſed in it, are repulſive of one another, ought not to be joined with Gravity to explain the heavenly *Phænomena*; eſpecially ſince the *Phænomena* of Fire, and our electric *Effluvia*, have a great Affinity to each other; and ſince many of the heavenly *Phænomena* are to be accounted for, upon this Suppoſition, with great Simplicity; and ſome of them, that have not yet perhaps been fully accounted for, ſeem neceſſarily to follow.

I am, Sir, with a very great Regard,

Otterden-Place,
Feb. 20. 1737-8.

Your much obliged,
humble Servant,

Granv. Wheler.

P S. This was intended to have been ſent eleven Days ago.
Mar. 3. 1737-8.