

when that River was frozen over for several Miles, and Booths and Streets were made on the Ice, an Ox roasted thereon, &c. For the lowest Point of Freezing in 1716, was on *January 7*, when the Spirits fell to 35 Degrees only of the Glafs I now make use: But the true Cause of the freezing of the *Thames* that Year was not barely the Excess of the Cold, but the long Continuance of it: Which was also the principal Cause of those remarkable Congelations of that River in 1683 and 1708, when I saw Coaches driven over the Ice, large Fires made on it, &c. I am, with great Respect,

Honoured S I R,

*Upminster, Feb.
13th, 1739.*

Yours,

WILLIAM DERHAM.

V. *A Letter to Cromwell Mortimer, M. D. Secr. R. S. containing several Experiments concerning Electricity; by Mr. Stephen Gray.*

S I R,

IN the Year 1729 I communicated to Dr. *Desaguliers*, and some other Gentlemen, a Discovery I had then lately made, shewing that the Electric Vertue of a Glafs Tube may be conveyed to any other Bodies, so as to give them the same Property of attract-
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ing and repelling light Bodies, as the Tube does, when excited by rubbing; that this attractive Vertue might be carried to Bodies that were many Feet distant from the Tube. On *May* the 1st Dr *Desaguliers* made a Report of the Experiments he had seen, to the *Royal Society*; I then promised to communicate a more particular Account of these Experiments to the *Society*; but as I was the next Day to go into the Country, where I knew that I should have the Opportunity of carrying on the Experiments much farther than I had yet done, for want of Room in my Chamber, which was not large enough for carrying on several other Experiments I had in View; I was willing, as I had begun the Discovery, to carry it on as much farther as I could, before I communicated it to the *Royal Society*, which I now humbly offer to their Consideration.

In *February* 1728, I repeated some of the Experiments I had formerly made, in the first Discovery of an Electrical Attraction in many Bodies, not before known to have that Property, which I communicated to the *Royal Society*. An Account of those Experiments is given in the *Philosophical Transactions*, N^o 366. I made several Attempts on the Metals, to see whether they might not be made attractive by the same Method as other Bodies were, *viz.* by heating, rubbing and hammering, but without any Success: I then resolved to procure me a large Flint-Glass Tube, to see if I could make any farther Discovery with it, having called to Mind a Suspicion which some Years ago I had, that as the Tube communicated a Light to Bodies, when it was rubbed in the Dark, whether it might not at the same Time communicate an Electricity to them, though

I never till now tried the Experiment, not imagining the Tube could have so great and wonderful an Influence, as to cause them to attract with so much Force, or that the Attraction would be carried to such prodigious Distances, as will be found in the Sequel of this Discourse.

Before I proceed to the Experiments, it may be necessary to give a Description of the Tube: Its Length is three Feet five Inches, and near one Inch two Tenths in Diameter: I give the mean Dimensions, the Tube being larger at each End than in the Middle, the Bore about one Inch. To each End I fitted a Cork, to keep the Dust out when the Tube was not in use.

The first Experiment I made, was to see if I could find any Difference in its Attraction, when the Tube was stopped at both Ends by the Corks, or when left open, but could perceive no sensible Difference; but upon holding a Down-Feather over against the upper End of the Tube, I found that it would go to the Cork, being attracted and repelled by it, as by the Tube when it had been excited by rubbing. I then held the Feather over against the flat End of the Cork, which attracted and repelled many Times together; at which I was much surprized, and concluded that there was certainly an attractive Vertue communicated to the Cork by the excited Tube.

Having by me an Ivory Ball of about one Inch three Tenths Diameter, with a Hole through it, this I fixed upon a Fir-Stick about four Inches long, thrusting the other End into the Cork, and upon rubbing the Tube, found that the Ball attracted and repelled the Feather with more Vigour than the Cork had done,
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repeating its Attractions and Repulsions for many Times together: I then fixed the Ball on longer Sticks, first upon one of eight Inches, and afterwards upon one of twenty-four Inches long, and found the Effect the same. Then I made use of first Iron, and then Brass Wire, to fix the Ball on, inserting the other End of the Wire in the Cork, as before, and found that the Attraction was the same as when the Fir-Sticks were made use of, and that when the Feather was held over against any Part of the Wire, it was attracted by it; but though it was then nearer the Tube, yet its Attraction was not so strong as that of the Ball. When the Wire of two or three Feet long was used, its Vibrations, caused by rubbing the Tube, made it somewhat troublesome to be managed: This put me upon thinking, whether if the Ball was hung by a Packthread, and suspended by a Loop on the Tube, the Electricity would not be carried down the Line to the Ball: I found it to succeed accordingly; for upon suspending the Ball on the Tube by a Packthread about three Feet long, when the Tube had been excited by rubbing, the Ivory Ball attracted and repelled the Leaf-Brass, over which it was held, as freely as it had done, when it was suspended on Sticks or Wire; as did also a Ball of Cork, and another of Lead that weighed one Pound and a quarter.

After I had found that the several Bodies above-mentioned had an Electricity communicated to them, I then went on to see upon what other Bodies the Tube would have the same Effect, beginning with the Metals, suspending them on the Tube by the Method above-mentioned; first in small Pieces, as with a Guinea, a Shilling, a Half-penny, a Piece of Block-Tin,

a Piece of Lead ; then with larger Quantities of Metal, suspending them on the Tube by Packthread. Here I made use of a Fire-Shovel, Tongs, and Iron Poker, a Copper Tea-Kettle, which succeeded the same, whether empty, or full of either cold or hot Water ; a Silver Pint Pot ; all which were strongly Electrical, attracting the Leaf-Brass to the Height of several Inches. After I had found that the Metals were thus Electrical, I went on to make Trials on other Bodies, as Flint-Stone, Sand-Stone, Load-Stone, Bricks, Tiles, Chalk ; and then on several vegetable Substances, as well green as dry, and found that they had all of them an Electric Vertue communicated to them, either by being suspended on the Tube by a Line, or fixed on the End of it by the Method above-mentioned.

I next proceeded to try at what greater Distances the Electric Vertue might be carried, and having by me Part of a hollow walking Cane, which I suppose was Part of a Fishing-Rod, two Feet seven Inches long ; I cut the great End of it, to fit it into the Bore of the Tube, into which it went about five Inches ; then when the Cane was put into the End of the Tube, and this excited, the Cane drew the Leaf-Brass to the Height of more than two Inches, as did also the Ivory Ball, when by a Cork and Stick it had been fixed to the End of the Cane. A solid Cane had the same Effect, when inserted in the Tube after the same Manner as the hollow one had been. I then took the two upper Joints of a large Fishing-Rod, the one of *Spanish* Cane, the other partly Wood and the upper End Whale-bone, which, together with the Tube, made a Length of more than fourteen Feet. Upon the lesser
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End of the Whale-bone was fixed a Ball of Cork of about an Inch and quarter Diameter; then the great End of the Rod being inserted in the Tube, the Leaf-Brafs laid on the Table, and the Tube excited, the Ball attracted the Leaf-Brafs to the Hight of about three Inches by Estimation. With several Pieces of *Spanish* Cane and Fir-Sticks I afterwards made a Rod, which, together with the Tube, was somewhat more than eighteen Feet long, which was the greatest Length I could conveniently use in my Chamber, and found the Attraction very nearly, if not altogether as strong, as when the Ball was placed on shorter Rods. Thus far I proceeded before I went into the Country, which I did the 2d of *May*, 1729, taking with me several Glass Canes, and such other Materials I thought would be necessary, and could not well be procured there. I shall now give an Account of the Experiments I then made, some of which were made at *Norton-Court* near *Feverham* in *Kent*, at my honoured Friend's *John Godfrey's*, Esq; the other at *Otterden-Place*, at my honoured Friend's *Granvil Wheler's*, Esq; a worthy Member of the *Royal Society*, with whom I have had the Honour to be lately acquainted. I shall set down each Experiment in the Order of the Time and Place they were made, as I find it in my Notes.

The first Experiment was made at *Norton-Court*, *May* 14th, 1729, between six and seven o'Clock in the Evening. Having provided a Rod of about twenty-four Feet, that consisted of a Fir-Pole, of Cane, and the Top of Reed, upon the End of which the Ball of Cork was placed, and the great End of the Rod put into the Tube about seven or eight Inches; then the
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Leaf-Bras being laid down, and the Tube rubbed, the Ball attracted and repelled the Leaf-Bras with Vigour ; so that it was not at all to be doubted, but with a longer Pole the Electricity would have been carried much farther.

May the 16th, I made a Rod thirty-two Feet long, including the Tube ; the bigger Part of it was a Fir-Staff about six Feet and a half long, the rest was of Cane, and Reed for the top Part of it. All Things being prepared, as before, the Effect was the same as in the last Experiment, only the Pole bending so much, and vibrating by rubbing the Tube, made it more troublesome to manage the Experiment. This put me upon making the following Experiments.

May the 19th, about six in the Morning, the Ivory Ball being suspended on the Tube, by a Line of Packthread twenty-six Feet long, which was the Hight, I stood at in the Balcony, from the Court where he stood, that held the Board with the Leaf-Bras on it ; then the Tube being rubbed, attracted the Leaf-Bras to the Hight of near two Inches, as he that assisted informed me. This was repeated with the Cork Ball with the same Success.

May the 31st, in the Morning, to a Pole of eighteen Feet there was tied a Line of thirty-four Feet in Length ; so that the Pole and Line together were fifty-two Feet. With the Pole and Tube I stood in the Balcony, the Assistant below in the Court, where he held the Board with the Leaf-Bras on it ; then the Tube being excited as usual, the Electrick Vertue passed from the Tube up the Pole, and down the Line to the Ivory Ball, which attracted the Leaf-Bras, and as the Ball passed

passed over it in its Vibrations, the Leaf-Brafs would follow it, till it was carried off the Board: But these Experiments are difficult to make in the open Air, the least Wind that is stirring, carrying away the Leaf-Brafs.

Some Time after I made several Attempts to carry the Electric Vertue in a Line horizontally, since I had not the Opportunity here of carrying it from greater Hights perpendicularly, but without Success, for want of then making use of proper Materials, as will appear from what follows. The first Method I made Trial of, was by making a Loop at each End of a Line, and hanging it on a Nail drove into a Beam, the other End hanging downwards, through the Loop at this End the Line with the Ivory Ball was put; the other End of this Line was by a Loop hung on the Tube; so that that Part of the Line next the Ball hung Perpendicular, the rest of the Line Horizontal: Then the Leaf-Brafs being laid under the Ball, and the Tube rubbed, yet not the least Sign of Attraction was perceived. Upon this I concluded, that when the Electric Vertue came to the Loop that was suspended on the Beam, it went up the same to the Beam; so that none, or very little of it at least, came down to the Ball, which was afterwards verified, as will appear by the Experiments that will be mentioned hereafter. Upon this I gave over making any farther Attempts of carrying the Electricity horizontally, designing at my Return to *London*, if I could get Assistance, to have tried the Experiment from the Top of the Cupola of *St. Paul's*, not doubting but the Electric Attraction

would be carried down perpendicular, from thence to the Ground.

June the 30th, 1729, I went to *Otterden-Place*, to wait on Mr. *Wheler*, carrying with me a small solid Glass Cane of about eleven Inches long, and seven eighth Parts of an Inch in Diameter, with some other requisite Materials, designing only to give Mr. *Wheler* a Specimen of my Experiments. The first was from the Window in the Long Gallery that opened into the Hall, the Hight about sixteen Feet; the next from the Battlements of the House down into the fore Court, twenty-nine Feet; then from the Clock-Turret to the Ground, which was thirty-four Feet, this being the greatest Hight we could come at; and notwithstanding the Smallness of the Cane, the Leaf-Brass was attracted and repelled beyond what I expected. As we had no greater Hights here, Mr. *Wheler* was desirous to try whether we could not carry the Electric Vertue horizontally. I then told him of the Attempt I had made with that Design, but without Success, telling him the Method and Materials made use of, as mentioned above. He then proposed a Silk Line to support the Line, by which the Electric Vertue was to pass. I told him it might do better upon the Account of its Smallness; so that there would be less Vertue carried from the Line of Communication, with which, together with the apt Method Mr. *Wheler* contrived, and with the great Pains he took himself, and the Assistance of his Servants, we succeeded far beyond our Expectation.

The first Experiment was made in the matted Gallery *July* 2, 1729, about Ten in the Morning. About four Feet

Feet from the End of the Gallery there was a cross Line that was fixed by its Ends to each Side of the Gallery by two Nails; the middle Part of the Line was Silk, the rest at each End Packthread; then the Line to which the Ivory Ball was hung, and by which the Electric Vertue was to be conveyed to it from the Tube, being eighty Feet and a half in Length, was laid on the cross Silk Line, so as that the Ball hung about nine Feet below it: Then the other End of the Line was by a Loop suspended on the Glass Cane, and the Leaf-Brafs held under the Ball on a Piece of white Paper; when the Tube being rubbed, the Ball attracted the Leaf-Brafs, and kept it suspended on it for some Time.

This Experiment succeeding so well, and the Gallery not permitting us to go any farther in one Length, Mr. *Wheler* thought of another Expedient, by which we might encrease the Length of our Line, which was by putting up another cross Line near the other End of the Gallery; and over the Silk Part of both the Lines there was laid a Line that was long enough to be returned to the other End, where the Ball hung; and though now both Ends of the Line were at the same End of the Gallery, yet Care was taken that the Tube was far enough off from having any Influence upon the Leaf-Brafs, except what passed by the Line of Communication: Then the Cane being rubbed, and the Leaf-Brafs held under the Ivory Ball, the Electric Vertue passed by the Line of Communication to the other End of the Gallery, and returned back again to the Ivory Ball, which attracted the Leaf-Brafs, and suspended it as before. The whole Length of the Line was 147 Feet.

We then thought of trying whether the Attraction would not be stronger without doubling or returning the Line, which we found Means of doing in the Barn, where we had a Line of 124 Feet long, fourteen Feet of which hung perpendicular from the Silk Line ; and now the Attraction was, as we then concluded, stronger than when the Line was returned, as in the matted Gallery.

July 3, having now brought with me the great Glass Tube, between Ten and Eleven in the Morning we went again into the Barn, carrying with us the solid Cane, and repeated the last mentioned Experiment with both the Tube and Cane ; but the Attraction was not so strong as in the preceding Evening, nor was there so great a Difference in the Attraction communicated by the solid Cane and Glass Tube, as one would have expected, considering the Difference of their Lengths and Diameters.

We then proceeded farther, by adding so much more Line as would make a Return to the other End of the Barn, the whole Length of the Line being now 293 Feet ; and though the Line was so much lengthened, we found no perceivable Difference in the Attraction, the Ball attracting as strongly as before. This encouraged us to add another Return ; but upon beginning to rub the Tube, our Silk Lines broke, being not strong enough to bear the Weight of the Line, when shaken by the Motion given it by rubbing the Tube. Upon this, having brought with me both Brass and Iron Wire, instead of the Silk we put up small Iron Wire ; but this was too weak to bear the Weight of the Line. We then took Brass Wire of a somewhat larger Size than

than that of Iron. This supported our Line of Communication; but though the Tube was well rubbed, yet there was not the least Motion or Attraction given by the Ball, neither with the great Tube, which we made use of when we found the small solid Cane to be ineffectual: By which we were now convinced, that the Success we had before, depended upon the Lines that supported the Line of Communication, being Silk, and not upon their being small, as before Trial I imagined it might be; the same Effect happening here as it did when the Line that is to convey the Electric Vertue is supported by Packthread; *viz.* that when the Effluvia come to the Wire or Packthread that supports the Line, it passes by them to the Timber, to which each End of them is fixed, and so goes no farther forward in the Line that is to carry it to the Ivory Ball.

Finding that our Silk Threads were too weak to bear many Returns of Line, Mr. *Wheler* thought of another Way of managing them, so that fewer Returns might be upon each Silk Line; which was by placing two other cross Lines some Feet below the upper ones; so that every other Turn of Line was suspended by the lower cross Line. By this Means there was but half the Weight of Line upon each Silk, of what there was when only two cross Lines were made use of as before. By this Contrivance, we could add a much greater Length of Line, without Danger of breaking our Silk. We then put up a Line that was 666 Feet in Length, by eight Returns: Then the Leaf-Brafs being held on a Piece of white Paper under the Ivory Ball, and the Tube, with the other End of the Line

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suspended on it, being rubbed for some Time, the Leaf-Brass was attracted as manifestly as it had been with much shorter Lines. We then repeated the Experiment with the little short solid Cane, and found there was somewhat of an Attraction, but not near so great as with the large Tube.

Though the going and returning of the Electrick Effluvia was very surprizing, yet we were willing to try how far the attractive Vertue might be carried in a continued right Line; the Method of doing which was thus: That End of the Line where the Attraction was to be made, was suspended on a Silk Line that was fixed cross the Garret Window on the North-side of the House, which was by Estimation about forty Feet high; at about an hundred Feet from hence two Rods or Poles of about ten Feet long, and at two Feet distance from each other, were drove into the Ground, so as that they stood nearly perpendicular. These were in the great Garden. Beyond these, in the great Field, that is separated from the Garden by a deep Foss, about the same Distance from the first, were another Pair of Poles fixed; then four others at a like Distance. Upon the Ends of these Poles were tied the cross Lines of Silk, to support the Line of Communication, which being laid on the Silk Lines, the Ivory Ball hanging in the Garret Window, and the other End of the Line being hung by a Loop on the Tube, the Leaf-Brass was held under the Ball, and after the Tube had been rubbed for some Time, they called to me to let me know that there was an Attraction of the Leaf-Brass. This was several Times repeated with Success; then Mr. *Wheler* came into the Field, and rubbed the Tube
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himself, that I might see there was an Attraction; which I saw, though I perceived it not to be so strong, as when the Attraction was carried by a longer Line, by returning it, as in the Experiments above-mentioned. The Length of the Line was 650 Feet. This was several Times repeated, but the Experiment being made in the Evening, at length the Dew began to fall. We began about Seven o'Clock, or some little Time after, but before Eight the Attraction ceased: But whether this was caused by the Dew falling, or by my being very hot, we could not positively say, but I rather impute it to the latter. This Experiment was made *July 14, 1729.*

Note, That though we call the carrying the Electric Vertue by the Lines in this Position Horizontal, you are not to understand it in a strict Sense, as may be easily perceived by the Description of the Method; and That as the Line swagged down much below the Silk Lines that supported it, in the middle Part between those Lines, it was some Feet longer than the Distance of the Poles.

Some Days after this Experiment was repeated from the Turret Closet Window, when the Line was 765 Feet, and the Attraction was no less perceivable than in the Experiment above-mentioned.

More Experiments made at Mr. Wheler's, shewing that large Surfaces may be impregnated with Electric Effluvia.

A large Map of the World, that had twenty-seven square Feet in it; a Table-Cloth containing fifty-nine square Feet; these suspended on the Tube by
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Packthreads, became Electrical. An Umbrello, suspended by a Packthread tied to the Handle of it, became strongly Electrical.

An Experiment proposed by Mr. Wheeler, to see whether the Electrical Vertue would be any Way hindered by the magnetical Effluvia of a Loadstone.

This had a small Key hung by one of its arming Irons, and the Stone, together with the Key hung to it, were suspended on the Tube by a Packthread ; then the Tube being rubbed, the Key and Stone both attracted the Leaf-Brass, the Attraction being the same as that of other Bodies.

An Experiment made to shew that the Electrical Vertue is carried several Ways at the same Time, and may be conveyed to considerable Distances.

There was made three Stands, each composed of two upright Pieces of Fir, fixed perpendicular, near the Ends of a long square Board, distant from each other near a Foot and a half. Upon the Tops of these were tied Threads of Silk to support the Lines of Communication with the Tube and the attracting Bodies. One of these Stands was placed in the great Parlour, near the farther End; another in the little Parlour, and a third in the Hall, which was between the two Parlours : As the other two were one of them to the right, the other to the left Hand, this last was placed near the Hall-Window forwards ; the two first were about fifty Feet, the other about twenty Feet from the Place where

where the Tube was held ; then there were taken three small square Pieces of Wood, that were tied to three Lines of Packthread : These were of about the Lengths above-mentioned. They were laid on the Silk Lines, and by Loops at the other Ends were suspended on the Tube ; then the Leaf-Brafs being held under the Pieces of Wood, and the Tube rubbed, they all of them attracted the Leaf-Brafs at the same Time. Some Time after, in my Absence, Mr. *Wheler* tried a red hot Poker, and found that the Attraction was the same as when cold. He also suspended a live Chick upon the Tube, by the Legs, and found that the Breast of the Chick was strongly Electrical.

At Mr. Godfrey's I made the following Experiments ; shewing that the Electrick Vertue may be carried from the Tube, without touching the Line of Communication, by only being held near it.

The first of these Experiments was made the 5th of *August*, 1729. I shall here mention some of the most considerable ones ; but as I did not always set down the Day of the Month, some of them may not be related in the Order of Time they were made ; nor did I always mention the Length of the Lines, these not being thought to be absolutely necessary.

I took a Piece of a Hair-Line, such as Linnen-Cloaths are dried on, of about eleven Feet in Length ; which, by a Loop at the upper End of it, was suspended on a Nail, that was drove into one of the Rafters in the Garret, and had at its lower End

a leaden Weight of fourteen Pounds hung to it by an Iron Ring : then the Leaf-Brafs was laid under the Weight, and the Tube rubbed, and being held near the Line without touching it, the Lead-Weight attracted and repelled the Leaf-Brafs for several times together, to the Hight of at least three, if not four Inches. If the Tube was held three or four Feet above the Weight, there would be an Attraction ; but if it were held higher up, so as to be near the Rafter where the Weight was hung by the Hair-Line, there would be no Attraction.

An Experiment, shewing that the Electrck Vertue may be carried several Ways at the same Time, by a Line of Communication, without touching the said Line.

There were taken two Hair-Lines, of between four and five Feet long ; to each of these was tied a square Piece of Cork, by Packthread ; the Lines were suspended by Loops at their upper Ends, upon two Nails ; near the lower Ends there was tied to the Hair-Lines a Piece of Packthread, by which there was a Communication between the two Hair-Lines ; then the Leaf-Brafs laid under the Corks, the Tube being rubbed, and held near one of the Lines, both the Corks attracted ; but that which was farthest, much stronger than that, near which the Tube was held. About the Middle of the Line of Communication they both drew with equal Force.

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Some Time after, at Mr. Wheler's, we made the following Experiment, in order to try whether the Electric Attraction be proportional to the Quantity of Matter in Bodies.

There were made two Cubes of Oak, of about six Inches Square, the one solid, the other hollow : These were suspended by two Hair-Lines, nearly after the same Manner as in the Experiment above-mentioned ; the Distance of the Cubes from each other, was by Estimation, about fourteen or fifteen Feet ; the Line of Communication being tied to each Hair-Line, and the Leaf-Brafs placed under the Cubes, the Tube was rubbed and held over the Middle of the Line, and as near as could be guessed, at equal Distances from the Cubes, when both of them attracted and repelled the Leaf-Brafs at the same Time, and to the same Height ; so that there seemed to be no more Attraction in the solid than in the hollow Cube ; yet I am apt to think that the Electric Effluvia pass through all the interior Parts of the solid Cube, though no Part but the Surface attracts ; for from several Experiments it appears, that if any other Body touches that which attracts, its Attraction ceases till that Body be removed, and the other be again excited by the Tube.

A Continuation of the Experiments made at Mr. Godfrey's.

I next went on with an Experiment, to see if the Electric Vertue might not be conveyed to a Rod, without inserting it into the Bore of the Tube, or without touching the Rod, which I found to succeed,

by suspending the Rod either by Lines of Silk, or by Pieces of Horse-Hair Fishing-Lines, placing a Ball of Cork on the lesser End of the Rod.

August 13, I took a large Pole that was twenty-seven Feet long, two Inches and a half Diameter at the great End, and at the lesser about half an Inch : It was that Sort of Wood they call Horse-Beech, with the Rind on. This was suspended by two Hair-Lines of about four Feet and a half in Length; the first Line was about two Feet from the great End of the Pole, the other about eight Feet from the lesser End; so that the Pole hung horizontal. At the little End of the Pole was hung a Ball of Cork about an Inch and a half Diameter by a Packthread about a Foot long, and a small leaden Ball upon the Cork to keep the Packthread extended : Then the Leaf-Brass being laid under the Cork, the Tube rubbed and held near the great End of the Pole, the Cork Ball drew the Leaf-Brass strongly to the Height of an Inch, if not more : Then the Leaf-Brass being held under several Parts of the Pole, it was attracted by it, as Mr. *Godfrey* observed, but not near so strongly as the Cork did.

About the Beginning of September I made the following Experiment, which shews that the Electric Effluvia will be carried in a Circle, and be communicated from one Circle to another.

There was taken a Hoop of about two Feet two Inches Diameter; this I suspended by a Hair-Line upon a Nail drove into a Beam; the Line was about four Feet long; then the Leaf-Brass being laid under the Hoop, the Tube was rubbed, and held
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within the Hoop, near the upper Side of it, without touching it by several Inches: Then the lower Part of the Hoop attracted and repelled the Leaf-Brass strongly; but when held near the lower Part, there was very little, if any Attraction. If the Tube was held near the outside of the Hoop, it attracted; but strongest, when at the same Time it was held near the Knot of the Hair-Line the Hoop was suspended by. To this Hoop there was tied a lesser Hoop of about a Foot and a half Diameter: It was tied to it by Packthread, so as to hang below it about two Inches; they were suspended together by the Hair-Line; then the Leaf-Brass and the Tube being prepared, as hath been mentioned before, the Tube being held near the upper Hoop, the lower Part of the lower Hoop attracted strongly, and when held near the upper Part of the lower Hoop, but very weakly; but when held near the lower Part of the lower Hoop, there was no Attraction.

On the 15th of September I made the following Experiment, which shews, that the Electric Effluvia have the same Effect in a Circle, when its Position is horizontal.

I took a large Hoop, of somewhat more than three Feet Diameter, and Breadth of about two Inches and a half; to this was tied at near equal Distances, four Lines: They were what they call Twine, which is of three Threads of Packthread twisted together, each about two Feet eight Inches long. These were tied with their Ends together to a Hair-Line of about two Feet and a half long, by which the Hoop was hung.

hung on a Nail, as in the other Experiments, so that the Hoop hung now in an horizontal Position : Then the Leaf-Brafs being laid under the Edge of the Hoop, at between two and three Inches below it, the Tube being rubbed, and held between the Cords without touching them, the Leaf-Brafs was attracted and repelled for several times together ; but when held near the outside of the Hoop, opposite to that Part where the Leaf-Brafs lay, the Attraction was much stronger.

About the latter End of Autumn, and the Beginning of the Winter in 1729, I resumed my Enquiry after other Electrick Bodies, to see what Addition I could make to the Catalogue of those mentioned above, in Page 100 and found many more that have the same Property, and may be excited to attract by the same Method. As for Instance, the dry withered Leaves of Reeds and Flags, Grass and Corn, both Leaves and Straw ; the Leaves of Trees, as those of the Laurel, the Oak, the Walnut, the Chesnut, Hazle-nut, Apple and Pear-tree Leaves ; so that we may conclude, that the Leaves of all Vegetables have this Attractive Vertue.

I shall now give an Account of the Experiments made at my Chamber in the Year 1730.

March the 23d, I dissolved Soap in the Thames-Water, then I suspended a Tobacco-Pipe by a Hair-Line, so as that it hung nearly horizontal, with the Mouth of the Bowl downwards ; then having dipped it in the Soap-Liquor, and blown a Bubble, the Leaf-Brafs laid on a Stand under it, the Tube being rubbed, the Brafs was attracted by the Bubble, when
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the Tube was held near the Hair-Line. Then I repeated the Experiment with another Bubble, holding the Tube near the little End of the Pipe, and the Attraction was now much greater, the Leaf-Brafs being attracted to the Hight of near two Inches.

March the 25th, I repeated this Experiment after a somewhat different Manner: The Pipe was now suspended by two Lines of white sewing Silk, of about five Feet and a half long; these were hung upon two Nails drove into the Beam of my Chamber, distant from each other about a Foot, by Loops at the other End of the Lines, by which the Pipe was suspended; then the Bubble being blown, by holding the Tube to the little End of the Pipe, the Bubble attracted the Leaf-Brafs to the Hight of near four Inches. This Experiment was made to see whether fluid Bodies would not have an Electricity communicated to them.

April 8, 1730, I made the following Experiment on a Boy between eight and nine Years of Age. His Weight, with his Cloaths on, was forty-seven Pounds ten Ounces. I suspended him in a horizontal Position, by two Hair-Lines, such as Cloaths are dried on: They were about thirteen Feet long, with Loops at each End. There was drove into the Beam of my Chamber, which was a Foot thick, a Pair of Hooks opposite to each other, and two Feet from these another Pair in the same manner. Upon these Hooks the Lines were hung by their Loops, so as to be in the Manner of two Swings, the lower Parts hanging within about two Feet of the Floor of the Room: Then the Boy was laid on these Lines with his Face downwards, one of the Lines being put under his Breast, the other

under his Thighs : Then the Leaf-Brafs was laid on a Stand, which was a round Board of a Foot Diameter, with white Paper pasted on it, supported on a Pedestal of a Foot in Hight, which I often made use of in other Experiments, though not till now mentioned : Upon the Tube's being rubbed, and held near his Feet, without touching them, the Leaf-Brafs was attracted by the Boy's Face with much Vigour, so as to rise to the Hight of eight, and sometimes ten Inches. I put a great many Pieces on the Board together, and almost all of them came up together at the same Time. Then the Boy was laid with his Face upwards, and the hind Part of his Head, which had short Hair on, attracted, but not at quite so great a Hight as his Face did. Then the Leaf-Brafs was placed under his Feet, his Shoes and Stockings being on, and the Tube held near his Head, his Feet attracted, but not altogether at so great a Hight as his Head : Then the Leaf-Brafs was again laid under his Head, and the Tube held over it, but there was then no Attraction, nor was there any when the Leaf-Brafs was laid under his Feet, and the Tube held over them.

April the 16th, I repeated the Experiment with the Boy, but now the Attraction was not quite so strong as at the first, the Brafs not rising higher than to about six Inches. His Hands being stretched nearly horizontal, I placed a small Stand with Leaf-Brafs under each Hand, and under his Face the great one, furnished as the others ; when the excited Tube being held near his Feet, there was an Attraction by his Hands and Face at the same Time. I then gave him the Top of a Fishing-Rod to hold in his Hand ; there was a
Ball

Ball of Cork stuck on the little End of it, under which the Leaf-Brafs being laid, and the Tube rubbed and held near his Feet, the Ball attracted the Leaf-Brafs to the Hight of two Inches, and repelled it, and attracted for several Times together with great Vigour.

April 21, I again repeated the Experiment on the Boy; and now he attracted much stronger than at the first: The Leaf-Brafs rose to his Face at the Hight of more than twelve Inches. Then I gave the Boy to hold in each Hand the Tops of two Fishing-Rods, with a Ball of Cork on each of their lesser Ends; then a small Stand being set under each Ball, with the Leaf-Brafs on it, the Tube being rubbed, and held near his Feet, both the Corks attracted and repelled together strongly. The Length of the Poles were each of them about seven Feet. Then the Boy was laid on his left Side, and a Fishing-Rod, of near twelve Feet in Length, given him to hold with both his Hands; there was a small Ball of Cork at the End of the Rod, that was an Inch and three quarters Diameter: Then all Things being prepared, the Tube held near the Boy's Feet, the Cork Ball attracted and repelled the Leaf-Brafs with Force to the Hight of at least two Inches.

Note, That when I speak of holding the Tube near the Boy's Feet, I mean over against the Soles of his Feet; and when near his Head, is to be understood the Crown of his Head; for when the Tube is held above, or over his Legs, the Attraction is not so strongly communicated to the other Parts of his Body.

By these Experiments we see that Animals receive a greater Quantity of Electrick Effluvia, and that they may be conveyed from them several Ways at the same Time to considerable Distances, wherever they meet with a Passage proper for their Conveyance, and there exert their Attracting Power.

In these Experiments, besides the large Stand above-mentioned, I made use of two small ones, which, as I found them very useful, it may not be improper to describe them. The Tops of them were three Inches Diameter; they were supported by a Column of about a Foot in Hight, their Bases of about four Inches and a half: They were turned of *Lignum vitæ*; their Tops and Bases made to skrew on for Convenience of Carriage. Upon the Tops were pasted white Paper. When the Leaf-Brafs is laid on any of these Stands, I find it is attracted to a much greater Hight than when laid on a Table, and at least three Times higher than when laid on the Floor of a Room.

June 20, I made the following Experiment, shewing that the Attraction and Repulsion is as strong, if not stronger, and that the Effluvia may be carried to great Lengths, without touching the Line by the Tube.

There was taken a Line of Packthread 231 Feet in Length; it was supported on two cros Lines of blue Silk; the Distance of these Lines was near eighteen Feet. About four Feet below one of these Lines, was put up another Silk Line of the same Colour: To this was tied one End of the Packthread; at the other End the Ivory Ball hung; the Line was returned over

the cross Lines thirteen times ; then the Leaf-Brafs being laid under the Ball, upon one of the small Stands, and the Tube excited, the Ball attracted and repelled to the Hight of one of its Diameters, which was about an Inch and a quarter.

I have, by several Trials lately made, found that rubbing the Tube, and putting it up between the Returns of the Line in several Places, before I go with the Tube to the End of the Line, much facilitates, and causes the Attraction much sooner than when one stands with the Tube and applies it to the End of the Line only.

About the middle of July I went into the Country, and August 1, at Mr. Wheler's, we made the following Experiment; being an Attempt to see how far the Electric Vertue might be carried forward in a Line, without touching the same.

This Experiment was made by carrying the Line out of the Great Parlour Window into the Garden, and down the great Field before it. The Line was supported by fifteen Pair of Poles; each Pair had a Line of blue Silk tied from one Pole to the other, the Length of about four Feet, equal to the Distance of the two Poles: About ten Feet from the Window there was a Silk Line put up cross the Room, upon which that Part of the Line hung that had the Ivory Ball upon it. Below the cross Line of the farthest Pair of Poles was placed another cross Line, four Feet from the Ground, to which was fastened the other End of the communicating Line, as mentioned in the Experiment above: Then the Leaf-Brafs and Tube being pre-

pared as usual, the Tube being held over the Line at several Distances, beginning towards that End where the Ball hung, and so proceeding towards the farther End of the Line, the Leaf-Brass was attracted at the Stations not exceeding two or three hundred Feet, pretty strongly; but still grew weaker as we came towards the farther End of the Line: Yet even at the End of the Line the Leaf-Brass would be lifted by the Ball, when the Tube touched the Line, whose Length was 886 Feet.

I should now have given some Account of the Discovery I made the last Year concerning the Attraction of coloured Bodies, shewing that they attract more or less, according to what Colours they are of, though the Substance be the same, and of equal Weight and Bigness; only I shall observe, that I find the Red, Orange or Yellow, attract at least three or four times stronger than Green, Blue or Purple: But having very lately found out a new and more accurate Method of making these Experiments, I must beg Leave to proceed farther with them, before I communicate them. I am,

S I R,

Your Humble Servant,

Charter-House,
Feb. 8, 1731.

S T E P H E N G R A Y.