V. *A Letter from Monſ.* Du Fay, *F. R. S. and of the Royal Academy of Sciences at* Paris, *to his Grace* CHARLES *Duke of* Richmond *and* Lenox, *concerning* Electricity. *Tranſlated from the* French *by* T. S. *M D.*

Paris, December 27, 1733.

My LORD,

I Flatter my ſelf your Grace will not be diſpleaſed with an Account of ſome extraordinary Diſcoveries I have made in the *Electricity* of Bodies, nor refuſe the Favour I have to aſk, that it may be communicated to the *Royal Society*. I owe this Homage to that Illuſtrious Body, not only as a Member thereof, but in this reſpect as a Debtor to their Works; for the Writings of Mr. *Gray*, and the late Mr. *Hauksbee*, both of that *Society*, firſt put me upon the Subject, and furniſh'd me with the Hints that led me to the following Diſcoveries.

Firſt, I have found that all Bodies (metallick, ſoft or fluid ones excepted) may be made Electrick, by firſt heating them more or leſs, and then rubbing them on any ſort of Cloth. So that all kinds of Stones, as well precious as common, all ſorts of Wood, and in general every thing that I have made Trial of, became Electrick, by heating and rubbing; except ſuch Bodies as grow ſoft by Heat, as the Gums, which diſſolve in Water, Glue, and ſuch other Subſtances. 'Tis alſo to be remark'd, that the hardeſt

hardeſt Stones and Marbles require more chafing or heating than others, and that the ſame Rule obtains with regard to the Woods; ſo that Box, *Lignum Vitæ*, and ſuch others muſt be chafed almoſt to the Degree of burning, whereas *Fir*, *Lime-Tree* and *Cork*, require but a moderate Heat.

Secondly, Having read in one of Mr. *Gray*'s Letters, that Water may be made Electrical by holding the excited Glaſs Tube near it (a Diſh of Water being firſt fix'd to a Stand, and that ſet on a Plate of Glaſs, or on the Brim of a Drinking-Glaſs, previouſly chafed, or otherwiſe warmed) I have found upon Trial, that the ſame thing happen'd to all Bodies without Exception, whether ſolid or fluid; and that for that Purpoſe 'twas ſufficient to ſet them on a Glaſs-Stand ſlightly warm'd, or only dried; and then by bringing the Tube near them, they immediately became Electrical. I made this Experiment with Ice, with a lighted Wood-coal, and with every thing that came into my Mind; and I conſtantly remark'd, that ſuch Bodies as of themſelves were leaſt Electrical, had the greateſt Degree of Electricity communicated to them at the Approach of the Glaſs Tube. *Philoſ. Tranſ.* N°422.p.227.

Thirdly, Mr. *Gray* ſays, towards the End of one of his Letters, that Bodies attract more or leſs according to their Colours. This led me to make ſeveral very ſingular Experiments. I took nine ſilk Ribbons of equal Size, one white, one black, and the other ſeven of the ſeven primitive Colours, and having hung them all in Order on the ſame Line, and then bringing the Tube near them, the black one was firſt attracted, the white *Philoſ. Tranſact.* N° 417 p. 44.

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one next, and the others in Order ſucceſſively to the red one, which was attracted leaſt, and the laſt of them all. I afterwards cut out nine ſquare Pieces of Gauſe, of the ſame Colours with the Ribbons, and having put them one after another on a Hoop of Wood with Leaf-Gold under them, the Leaf-Gold was attracted thro' all the coloured Pieces of Gauſe, but not thro' the white or black. This inclined me at firſt to think, that the Colours contributed much to Electricity. But three Experiments convinced me of the contrary: The firſt, that by warming the Pieces of Gauſe, neither the black nor white Pieces obſtructed the Action of the Electrical Tube more than thoſe of the other Colours. In like manner, the Ribbons being warm'd, the black and white are not more ſtrongly attracted than the reſt. The ſecond is, the Gauſes and Ribbons being wetted, the Ribbons are all attracted equally, and all the Pieces of Gauſe equally intercept the Action of Electrick Bodies. The third is, that the Colours of a Priſm being thrown on a Piece of white Gauſe, there appear no Differences of Attraction. Whence it follows, that this Difference proceeds not from the Colour, as a Colour, but from the Subſtances that are employ'd in the dying. For when I coloured Ribbons, by rubbing them with Charcoal, Carmine, and ſuch other Subſtances, the Differences no longer proved the ſame.

Fourthly, Having communicated the Electricity of the Tube by means of a Packthread, after Mr. *Gray*'s manner, I obſerv'd, that the Experiment ſucceeded the better for wetting the Line; and that it may be ſupported on Glaſs-Tubes inſtead of Silk-Lines. And I made this Experiment at 1256 Feet Diſtance,

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in a Garden, tho' the Wind was high, and that the Line made eight Returns, and paſs'd thro' two different Walks. By means of two Silk Loops I adjuſted two Lines in ſuch a manner, that their Ends were but a Foot diſtance from one another, and I remark'd that the Electrick Virtue was ſtill communicated. I have ſince that ſeen in the *Philoſ. Tranſ.* N° 426, *p.* 431, that Mr. *Gray* had the ſame Thought, and that he had done the ſame with Rods. This Experiment put me upon placing ſeveral different Bodies between the two Lines, in order to examine which diminiſhed or intercepted the Electricity, and which gave no Obſtruction to it; I have given the *Academy* an Account of the Particulars, which I now omit for the ſake of Brevity.

Fifthly, I ſuſpended a Child on Silk Lines, and made all the ſurpriſing Experiments deſcribed by Mr. *Gray*. But having tried the Experiment upon my own Body in the ſame manner, I obſerved ſeveral things very remarkable. Firſt, when I take the Paſte-board or Stand, on which the Leaf-Gold is laid, into my Hand, neither my other Hand nor my Face has any Attraction. But if another Perſon, who is in the Chamber, come near me, he will attract it with his Face, his Hand, or even with a Stick. Secondly, while I am ſuſpended on the Lines, if the electrick Tube be put near one of my Hands, or my Legs, and then if another Perſon approach me, and paſs his Hand within an Inch or thereabouts of my Face, Legs, Hand or Cloaths, there immediately iſſues from my Body one or more pricking Shoots, with a crackling Noiſe, that cauſes to that Perſon as well as to my ſelf, a little Pain

Philoſ. Tranſ. N°417. *p.*39.

Pain reſembling that from the ſudden Prick of a Pin, or the burning from a Spark of Fire, which is as ſenſibly felt thro' ones Cloaths, as on the (bare) Hand or Face. And in the Dark theſe Snappings are, as may be eaſily imagined, ſo many Sparks of Fire. Theſe Snappings, or Sparks, are not excited, if a Bit of Wood, Cloth, or any other Subſtance than a living Body be paſſed over the Perſon ſuſpended on the Lines, unleſs it be a Piece of Metal, which produces very nearly the ſame Effect. Any other living Animal doth the ſame, if put on the Lines, and that firſt the Tube, and then the Hand be applied near it: But it is otherwiſe, if the Experiment be made with the Carkaſs of an Animal; for then one perceives only, if it be in the Dark, a ſtill uniform Light, without Snappings or Sparks. I omit many other Circumſtances of leſs Importance, though curious, to avoid running into too great a Length.

Sixthly, On making the Experiment related by *Otho de Guerik*, in his Collection of Experiments *de Spatio Vacuo*, which conſiſts in making a Ball of Sulphur render'd Electrical, to repel a Down-Feather, I perceived that the ſame Effects were produced not only by the Tube, but by all electrick Bodies whatſoever; and I diſcovered a very ſimple Principle, which accounts for a great Part of the Irregularities, and if I may uſe the Term, of the Caprices that ſeem to accompany moſt of the Experiments on Electricity. This Principle is, that Electrick Bodies attract all thoſe that are not ſo, and repel them as ſoon as they are become electrick, by the Vicinity or Contact of the electrick Body. Thus Leaf-

Leaf-Gold is firſt attracted by the Tube; and acquires an Electricity by approaching it; and of conſequence is immediately repell'd by it. Nor is it re-attracted, while it retains its electrick Quality. But if, while it is thus ſuſtain'd in the Air, it chance to light on ſome other Body, it ſtraightways loſes its Electricity; and conſequently is re-attracted by the Tube, which, after having given it a new Electricity, repels it a ſecond time; which continues as long as the Tube keeps its Electricity. Upon applying this Principle to the various Experiments of Electricity, one will be ſurprized at the Number of obſcure and puzzling Facts it clears up. For Mr. *Hauksbee*'s famous Experiment of the Glaſs Globe, in which Silk Threads are put, is a neceſſary Conſequence of it. When theſe Threads are ranged in Form of Rays by the Electricity of the Sides of the Globe, if the Finger be put near the Outſide of the Globe, the Silk Threads within fly from it, as is well known; which happens only becauſe the Finger, or any other Body applied near the Glaſs Globe, is thereby render'd electrical, and conſequently repels the Silk Threads, which are endow'd with the like Quality. With a little Reflection one may in the ſame manner account for moſt of the other *Phænomena*, and which ſeem inexplicable, without attending to this Principle.

Seventhly, Chance has thrown in my way another Principle, more univerſal and remarkable than the preceding one, and which caſts a new Light on the Subject of Electricity. This Principle is, that there are two diſtinct Electricities, very different from one another; one of which I call *vitreous*

Electricity, and the other *reſinous Electricity*. The firſt is that of Glaſs, Rock-Cryſtal, Precious Stones, Hair of Animals, Wool, and many other Bodies: The ſecond is that of Amber, Copal, Gum-Lack, Silk, Thread, Paper, and a vaſt Number of other Subſtances. The Characteriſtick of theſe two Electricities is, that a Body of the *vitreous Electricity*, for Example, repels all ſuch as are of the ſame Electricity; and on the contrary, attracts all thoſe of the *reſinous Electricity*; ſo that the Tube, made electrical, will repel Glaſs, Cryſtal, Hair of Animals, *&c.* when render'd electrick and will attract Silk, Thread, Paper, *&c.* though render'd electrical likewiſe. Amber on the contrary will attract electrick Glaſs, and other Subſtances of the ſame Claſs, and will repel Gum-Lac, Copal, Silk, Thread, *&c.* Two Silk Ribbons rendered electrical, will repel each other; two Woollen Threads will do the like; but a Woollen Thread and a Silk Thread will mutually attract one another. This Principle very naturally explains, why the Ends of Threads, of Silk, or Wool, recede from one another in Form of a Pencil or Broom, when they have acquired an electrick Quality. From this Principle one may with the ſame Eaſe deduce the Explanation of a great Number of other *Phænomena*. And 'tis probable, that this Truth will lead us to the further Diſcovery of many other things.

In order to know immediately, to which of the two Claſſes of Electricity belongs any Body whatſoever, one need only render Electrical a Silk Thread, which is known to be of the *reſinous Electricity*, and ſee whether that Body, render'd electrical, attracts

attracts or repels it. If it attracts, 'tis certainly of that kind of Electricity which I call *vitreous*; if on the contrary it repels, 'tis of the ſame kind of Electricity with the Silk, that is, of the *reſinous*. I have likewiſe obſerved that communicated Electricity retains the ſame Properties: For if a Ball of Ivory, or Wood, be ſet on a Glaſs Stand, and this Ball be render'd electrick by the Tube, it will repel all ſuch Subſtances as the Tube repels; but if it be rendered electrick by applying a Cylinder of Gum-Lac near it, it will produce quite contrary Effects, *viz.* preciſely the ſame as Gum-Lac would produce. In order to ſucceed in theſe Experiments, 'tis requiſite that the two Bodies, which are put near one another, to find out the Nature of their Electricity, be rendered as electrical as poſſible; for if one of them was not at all, or but weakly electrical, it would be attracted by the other, though it be of that Sort, that ſhould naturally be repelled by it. But the Experiment will always ſucceed perfectly well, if both the Bodies are ſufficiently electrical.

I have ſeveral other Methods to diſcover the Nature of the Electricity any Body is of; but my Letter is already long enough, and my Deſign was only to give your Grace a very ſuccinct Extract of the Experiments I have made this laſt Year. I beſeech your Grace to communicate it to the *Royal Society*, and in particular to Mr. *Gray*, who works on this Subject with ſo much Application and Succeſs, and to whom I acknowledge my ſelf indebted for the Diſcoveries I have made, as well as for thoſe I may poſſibly make hereafter; ſince 'tis from his Writings

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that I took the Reſolution of applying my ſelf to this kind of Experiments.

I have the Honour to be with the moſt ſincere, and moſt reſpectuous Attachment,

My LORD,

Your GRACE's

Moſt Humble and moſt

Obedient Servant,

DU FAY.

FINIS.