

IV. *A Letter from Mr. Stephen Gray to Dr. Mortimer, Secr. R. S. containing a farther Account of his Experiments concerning Electricity.*

*Charter-House, June 7th, 1732.*

S I R,

SINCE my last (N<sup>o</sup> 422) wherein I gave an Account of my Experiments, shewing Water will be attracted by Electric Bodies, and that it may have an Electric Vertue communicated to it, so as to attract solid ones, I have been upon another Enquiry; Whether there might not be a Way found to make this Property of Electrical Attraction more permanent in Bodies? How far I have succeeded in this Attempt, will appear by the Experiments I have made on the several Bodies mentioned in the following Catalogue; and as they were all of them prepared after the same manner, excepting Numb. 18 and 19, which shall be described afterwards, a general Description of the Method of preparing and preserving them in a State of Attraction, may suffice.

The Bodies on which the Experiments were made, were Rosin both black and white, Stone-Pitch, Shell or Gum-Lac, Bees-Wax, and Sulphur. I procured three Iron Ladles of several Sizes, in which I melted these Substances, making use of that which I thought most convenient for the Quantity I designed to melt. When any of these Bodies were melted, they were

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taken off the Fire, and set by in the Ladle to cool and harden; then it was returned to the Fire, where it remained 'till it was melted about the Bottom and Sides of the Ladle, so as to be moveable; so that by inverting the Ladle, it might be taken out; having the Form of nearly the Section of a Sphere, the Convex Surface, as also the Plain one, being naturally (if I may so say) polished, excepting the Sulphur, which cools without retaining its Polish, except when cast in Glass Vessels, as shall be shewed hereafter. I shall now proceed to the Experiments and Observations made on these Electrick Bodies.

When any of them were taken out of the Ladle, and their Convex Surface hardened, they would not at first attract, 'till the Heat was abated, or 'till they came to a certain Degree of Warmth, and then there was a small Attraction; which Warmth I estimated to be nearly that of a Hen's Egg when just laid: The Attraction encreasing so, as when cold, to attract at least ten times farther than at first.

The manner of preserving them in a State of Attraction, was by wrapping them up in any thing that would keep them from the external Air; as at first for the smaller Bodies I used white Paper, but for the larger ones white Flannel; but afterwards found that black Worsted Stockings would do as well. Being thus clothed, they were put into a large Fir Box, there to remain 'till I had Occasion to make use of them.

The Cylinder of Sulphur, Numb. 18, was made by melting the Sulphur, and pouring it into a Cylindrick Glass Vessel, which had first been heated, to prevent its cracking. When the Sulphur was hardened, it

was somewhat less than the Glass; so that by inverting the Glass, it came out easily, and had a polished Surface almost as smooth as the Glass in which it was cast. The large Cone of Sulphur, Numb. 19, was made after the same manner; *viz.* by being cast in a large Drinking-Glass.

I am now to give an Account of the Observations made on the several Bodies mentioned in the Catalogue, but must first give a Description of the Catalogue. The first Column contains the Number, which in a small Piece of Paper is fixed on each of the several Bodies; the Name of which is given in the second Column, whether they are single or compound Substances. The third Column shews of what Weight they were of when melted, in Ounces and Drachms of *Averdupois* Weight. In the fourth Column you have the Days of the Month when the Body was melted and received its Form, and consequently when it first began to attract.

I did for thirty Days continue to observe every one of these Bodies, and found that at the End of the said Time they attracted as vigorously as at the first or second Day, as they do now at the writing hereof. By the Times mentioned in the Catalogue, being subtracted from any Time after, will be shewn how long any of the Bodies have continued their Attractive Vertue; by which it will appear, that some of them have not lost their Attraction for more than four Months: So that we have some Reason to believe, that we have now discovered that there is a *perpetual attractive Power* in all Electric Bodies, without exciting by either rubbing, beating, &c. or any other Attrition. But this will further appear by the Account I am now to give of the two

last Bodies mentioned in the Catalogue. The Cone of Sulphur, Numb. 19, that was cast in a large Drinking-Glass, in about two Hours after it was taken out of the Glass, attracted, and the Glass attracted too, but at a small Distance. Next Day the Sulphur was taken out of the Glass, and then it attracted strongly, but there was now no perceivable Attraction of the Glass. Then the Cone of Sulphur was set with its Base upon the Lid of the Fir Box, wherein the other Electric Bodies lay, and the Glass whelmed over it. I examined it every Day after, and still found it to attract; but finding the Place not so convenient, having Occasion to look into the Box often, I removed it to the Table that stands between the two Windows of my Chamber, where it has continued to this Time, and whenever the Glass is taken off, attracts at near as great a Distance as the Sulphur that is clothed and shut up in the Box abovementioned. And though at first there was no Attraction, when the Glass was taken off, yet I now find, that in fair Weather the Glass also attracts, but not at so great a Distance as the Sulphur, which never fails to attract, let the Wind or Weather be never so variable, as do all the other Bodies mentioned in the Catalogue; only in wet Weather the Attractions are not made at so great a Distance as in fair Weather.

Number 20 is a Cake of Sulphur that was melted; and as the other Bodies have taken the Form of a Convex Section of a Sphere, this, when cold, was laid with its flat Side downwards, on the same Table with the Cone of Sulphur: They were both placed so near the Wall, as to prevent the Sun shining on them. This was, as the Catalogue shews, on the 18th  
of

of *April*; and though it had no manner of Clothing or Covering, has attracted ever since. And in this, as in the other Bodies, the Attraction will be according to the Weather; but when it attracts the strongest, it is not more than the tenth Part of what the Cone of Sulphur, that is covered, attracts.

The manner of observing these Attractions is best performed by holding the Attracting Body in one Hand, and a fine white Thread tied to the End of a Stick, in the other; by this means far less Degrees of Attraction will be perceived, than by making use of Leaf-Brafs. When the Thread is held at the utmost Distance, it may be attracted; the Motion of it is at first very slow, but still accelerating as it approaches nearer to the attracting Body.

I am now on the Subject of permanent Attraction in Glass, then in the other Bodies, but have not yet completed those Experiments, meeting with more Interruption by the Weather.

With a small Hand Air-Pump that was lent me by a Friend, I have made Experiments on several Bodies, and find that they will attract *in vacuo*; and that at very nearly the same Distance as *in pleno*, provided that the Experiment be made in the same Receiver filled with Air; as will appear by the following Experiments.

There was taken a hollow Glass Sphere, of somewhat more than  $2 \frac{1}{2}$  Inches Diameter, being first excited. It was suspended by a Loop of Silk that went through a small Cork, with which the Hole in the Glass Ball, by which it was blown, was stopped, and by the Loop suspended on a small Hook that was skewed on to the Brafs Wire that came through  
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the Collar of Leather in the Brass-Plate that covered the Top of the open Receiver ; as in the Experiment of letting fall the Guinea and Feather *in vacuo*. Then the Ball was drawn up to the Top of the Receiver, and the Top of the small Stand, covered with Paper, was laid on the wet Leather on the Plate of the Pump, and Leaf-Brass laid on the same. Then the Air was exhausted, when the Glass Ball was let down to about an Inch, or somewhat more, towards the Pieces of Leaf-Brass : Many of them were attracted by it. Then the Air was let into the Receiver, and the Leaf-Brass laid on the Stand, the Ball being, as before, suspended, was let down to about the same Distance from the Leaf-Brass as before, and there seemed to be very little Difference in the Attraction.

I have made the same Experiments with Sulphur, Shell-Lac, Rosin, and white Bees-Wax. These would be attracted to the Height of an Inch and a half by Estimation ; and when the Experiment was made with the Receiver full of Air, there was very little, if any Difference in the Height of the Attraction, when there was the same Time spent before the Attraction was begun *in pleno*, as there was required to exhaust the Receiver.

*A CATALOGUE of the several Electrick Bodies mentioned in the foregoing Discourse.*

N <sup>o</sup>	Names of the several Bodies.	Weight.	Month.	Days.
		3	3	
1	Fine black Rosin — —	2	0	January 31
2	Stone Pitch and black Rosin	2	2	January 31
3	Fine Rosin and Bees-Wax	2	1	February 1
4	Stone Pitch — —	1	7	February 1
5	Stone Sulphur — —	3	6	February 4
6	Shell-lac — —	10	0	February 10
7	Fine black Rosin — —	10	4	February 11
8	Bees-Wax and Rosin —	9	0	February 12
9	Rosin 4, and Gum-lac 1 part	10	0	February 12
10	Sulphur — —	18	0	February 15
11	Stone Pitch — —	10	12	February 16
12	Black Rosin — —	23	0	February 23
13	White Rosin — —	7	12	February 25
14	Gum-lac — —	11	14	February 26
15	Gum-lac and black Rosin <i>ana</i>	9	12	February 26
16	Gum-lac 4 parts, Rosin 1 pt.	17	8	February 28
17	Shell-lac, fine black Rosin <i>ana</i>	28	4	March 2
18	A Cylinder of Stone Sulphur	19	4	March 20
19	A large Cone of Stone Sulphur	30	0	March 29
20	A Cake of Sulphur — —	11	4	April 29

*S I R,*

Be pleased to communicate these to the *Royal Society*, to whom I hope they will be no less acceptable than some of my former Discoveries from me; who am,

*S I R,*

*Theirs, and your most Obedient Servant,*

**Stephen Gray.**