Experiments and observations made with a view to point out the errors of the present received theory of electricity and which tend in their progress to establish a new system, on principles more ...

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Chapter XIII. Miscellaneous experiments and observations [...].

CHAPTER XIII.

Miscellaneous experiments and observations, with remarks on several electric phænomena which have not yet been satisfactorily accounted for.

SECTION I.

AS there have been but few attempts (that I have seen) since Mr. Symmer's experiments with his silk stockings, to ascertain the strength of cohesion in electrified bodies, I have made several trials to find out what force is necessary to separate different electrified substances, both when insulated and otherwise, in order to fix on some general law. After many unsuccessful endeavours, I can add but little more on this subject than repeat my experiments; which may probably serve as hints to some more ingenious and indefatigable enquirer, whose patience may be better adapted to encounter the difficulties which shall arise in this pursuit than my own.

The description of the apparatus used in the following experiments.

Let *a* represent a mahogany foot, with a glass tube *b* fixed in it, about eighteen or twenty inches long, and perpendicularly to the horizon (see plate II. fig. 6.) Upon the top of the glass tube let there be fixed, either by a screw or a socket, the arm *c*, with a brass pully *d* at the end of it, to turn very freely on its axis. To one end of the fine silk *e*, which slips in the groove of the brass pulley, is fixed a glass vessel

 with

with a wide mouth, to receive any number of ſmall weights, without touching the glaſs in putting them in, while making the experiments. The veſſel is fixed with a horſe-hair cord to the ſilk. The ſilken thread *m*, is to hold up the glaſs veſſel, while the electrical effluvia are paſſing down the thread *n*, to the ſilk, paper, woollen, or whatever you intend to make trial with, which is faſtened to the end of the ſilk at *g*, and is placed upon ſome other body upon the ſtool *l*, with glaſs legs. In the middle of the ſtool *l*, is a hole to admit a ſilk, or a thread; one end of which is faſtened in the center of the lower piece lying upon the ſtool, and the other end has a nooſe to admit a ſmall bolt which ſlides croſs the hole on the under part of the ſtool. While you are making experiments with this apparatus, ſtand upon a ſtool with glaſs legs, and hold up the glaſs veſſel by the ſilken thread, that the weight of it may not hinder the two bodies from cohereing. When they are ſufficiently electrified, eaſe the glaſs veſſel gently down, and it will draw up by its weight the two pieces, whatever they be, lying upon the ſtool, 'till the thread which goes round the bolt in the lower part of the ſtool ſtops them. As the two electrified ſubſtances are by this means ſuſpended in the air, the power which ſeparates them muſt be the force with which they cohere; and by letting ſmall weights drop carefully into the glaſs veſſel, this force may be known. It will be neceſſary, while you are putting in the weights, to keep up the glaſs veſſel by the ſilken thread *m*, that the dropping in of the weights may not ſhake the pieces, and cauſe them to ſeparate with leſs force than they would otherwiſe do. It is neceſſary that the perſon who works the machine, ſhould keep turning during the time of making the experiment; for if you only touch the glaſs veſſel in dropping in the weights, the whole procefs is deftroyed, and you muft begin again. I have found this frequently happen, and I believe if there be any fharp angles to the weights, they will lead off a great deal of the electric fluid (notwithftanding you are placed upon a ftool with glafs legs) and weaken the force of the cohefion very much.

Experiment I.

The ten following trials were made with different-coloured pieces of ribbon an inch and a half fquare, and fufpended from the beam of an hydroftatic balance with a filken thread; and the pane of glafs to which they adhered was excited by rubbing it with a piece of flannel, and fometimes the bare hand.

The glafs was rubbed upon every attempt.

1. The pane of glafs being excited, and a piece of ribbon an inch and a half fquare fufpended from the hydroftatic balance, fixed upon the glafs, and gently preffed with an ivory knife, required 20 grains to feparate it from the glafs. The ribbon was of a deep red colour.

2. A piece of pink-coloured ribbon fixed as above, required 19 grains to feparate it from the glafs.

	Grains.
3. A piece of light green, &c. — —	17
4. A piece of dark green, — —	16
5. A piece of yellow, — — —	16
6. A piece of blue, — — —	14
7. A piece of black, — — —	12
8. A piece of purple, — — —	9
9. A piece of violet, — — —	8 ½
10. A piece of white, — — —	5

 I endea-

I endeavoured, in procuring the ribbons, to have them as near as poſſible of the ſame ſubſtance; but notwithſtanding this, I am apprehenſive there is more depends upon the ſubſtance than the colour of the ribbon, in the power of its coheſion; and probably the different fabric, the goodneſs or badneſs of the quality of the ſilk, may make a conſiderable alteration in the power of coheſion.

Experiment II.

The following trials on electric and non-electric ſubſtances, both inſulated and not inſulated, are made with the apparatus already deſcribed.

Fix a piece of ſilk three inches ſquare to the end of the ſilken thread *e*, and let it be placed upon the following ſubſtances not inſulated, and it will require the underwritten forces to ſeparate them.

1\. The piece of ſilk placed upon glaſs, which has a direct communication with the floor, and the ſilk being electrified by the thread *n*, having a connection with the conductor, will require 18 dwts. 6 gr. to ſeparate it from the glaſs.

	dwts.	gr.
2. The ſilk placed upon the ſulphur, ——	16	11
3. The ſilk upon ſilk of the ſame ſize, ——	21	—
4. The ſilk upon pitch, —— ——	21	—
5. The ſilk upon woollen, —— ——	11	14
6. The ſilk upon lead, —— ——	9	13
7. The ſilk upon tin, —— ——	7	12
8. The ſilk upon linen, —— ——	9	13
9. The ſilk upon mahogany, —— ——	8	—
10. The ſilk upon wainſcot, —— ——	9	13

If the electrics be insulated, the silk will not cohere with near the force.

		dwts.	gr.
1. The silk, as before, placed upon an insulated piece of glass, will be separated with	—	13	—
2. The silk upon sulphur, —	—	5	10
3. A piece of tin-foil, four inches square, placed upon glass, will be separated from it with	—	1	22
4. The tin-foil upon sulphur, —	—	4	20

If the tin-foil be placed upon metal they will not cohere.

The following experiments differ so much from the foregoing, that I am apprehensive there can be but little dependence upon electric cohesion, 'till the state of the atmosphere, and the qualities and substances of the materials, be accurately ascertained, with which the experiments are made. In repeating the foregoing trials at a different time, in order, if possible, to acquire more power, I was much disappointed in my enquiries, as the conclusions will show.

1. The silk suspended as before, and placed upon sulphur, or glass, would not bear any more than 5 dwts. 12 grs. to separate them; nor could I, by every effort or art I could try, make it bear a greater weight.

2. I next suspended a piece of broad-cloth, three inches square, to the end of the silken thread, and placed it upon another piece of the same dimensions, and they required no more than 3 dwts. 7 grs. to separate them.

3. I tried the same piece of broad-cloth with leather, and they were separated with the same weight.

I have at several other times tried a variety of experiments of this kind, both with the apparatus already described, and also with

with an hydroftatic balance, and with a variety of different fubftances; but as my experiments have feldom agreed twice, when made at different times, I cannot pretend to fay, that two pieces of filk of a given dimenfion, or one piece of filk and a piece of fulphur, or any other different kind of bodies, when placed upon each other, and electrified, will require but fuch a weight to feparate them.

SECTION II.

[1] In examining the writings of fome of our moft eminent philofophers and electricians, I find they differ materially in their conclufions

[1] Shaw's Boyle, vol. i. p. 400. on the atmofphere of confiftent bodies, fays:

I took a large piece of good amber, and having in a fummer's morning, whilft the air was yet cold, tried, that it would not, without being excited, attract a light body, I removed it into the fun-beams, till they had made it moderately hot, and then found it had acquired an attractive virtue; and that not only in one particular place, as when it is excited by rubbing, but in feveral diftant places at once; fo that even in our climate a folid body may quickly acquire an atmofphere, by the prefence of the fun, and that long before the warmeft part of the day. I alfo took a little fmall thick veffel of glafs, and held it near the fire, till it had got a convenient degree of heat, whereby it became attractive, as that of the fun's heat had rendered the amber. Hence it feems deducible, that many confiftent bodies, whether animal, vegetable, or mineral, may emit effluvia; and that even fuch as are folid may refpectively have their little atmofpheres.

Beccaria's Treatife upon Artificial Electricity, p. 8.

Speaking of the tourmalin-ftone, he fays—Thofe gems are the only kinds of bodies that may be electrified by heating, as far as experience informs us, by the fole increafe or decreafe of their heat. Therefore, though all philofophers have generally afferted, that fulphurs, refins, and mixtures made of them, may be electrified by heating, or melting them, and if carefully kept, will retain for years their electricity, yet I think I have found the untruth of fuch an opinion, and the reafon that has caufed it to be univerfally received. This is, that the fmalleft poffible friction is fufficient to excite a degree of electricity in fuch bodies as have been carefully dried; in moving the vafe in which they were melted, in taking them out of it, in unfolding the paper conclusions drawn from their experiments on electrics heated either by the fire, or with the solar rays. It appears to be allowed by all of them, that the tourmalin-stone acquires an attractive quality by being heated; and others say that amber, glass, and such kinds of bodies, gain a power of drawing light substances by being exposed to the rays of the sun, while this is as confidently denied by others.

I am inclined to think with Mr. Boyle, that every electric, as well as the tourmalin, acquires an atmosphere, in a small degree, by being heated by the fire, or exposed for two or three hours to the rays of the sun. I have often seen, in warming glass by the fire, that after it had acquired a moderate heat, the light ashes from the bars would fly to it, if the pane was brought near the fire. This, and some other reasons, induced me to make several trials with electrics, heated both by the solar rays, and the common fire; and some of them are as follows.

Experiment I.

Take a large jar of green glass, which will contain between three and four gallons, place it upon a stool with glass legs, and set it under a flint wall, where the sun's rays may fall upon it without being intercepted by any other object. After standing there about two hours (if there be any current of air) remove the

paper in which they were kept, or even in placing them upon a table, it is next to impossible to avoid a small friction, sufficient to lead into a mistake. But, if you take one end of a stick of sealing-wax, of sulphur, and so on, and heat it in any degree, and then let it cool, holding it all the while by the same end, and taking care not to handle it otherwise, or let it touch any body, you will find yourself absolutely unable to draw with it the smallest hair, or thread; but whenever the stick has been in contact with any other body, it will immediately attract them.

jar

jar into a close room, which is dry, and warm; this may be done without touching it, if you carefully lift it up by the stool; and there cannot be any the least friction, to excite the electric fluid, on the glass jar. Take a small ball made of bees-wax, and fixed to the end of a very fine silk, or a long horse-hair, and, holding the end of it between your finger and thumb, bring the ball near the upper part, or the welted edge of the jar, and it will very soon begin to move; as the vibration increases, draw your hand a little farther from the jar, that the chord of the arch, described by the ball, may be extended. The ball, in this case, will fly to the edge of the jar, and be repelled from it, and this alternate attraction and repulsion, or vibratory motion, may be continued for some time.

Experiment II.

Take a fine silken thread about six inches long, and fix a small ball of bees-wax at one end of it, and another ball of sealing-wax of the same size at the other end. I apprehend that small balls made of any other electric, or probably non-electric substance will answer the same purpose. Fix a small wire in the center of a stick of sulphur, and at one end of it. Let the sulphur be fixed upon a stand, and in such a position as to receive the sun's rays through a lens upon the end opposite to the wire. Suspend the two balls by the middle of the silken thread, from the end of the wire, and let them touch each other. After the apparatus is ready, take it out to a place where the sun may shine full upon it, and with a lens throw the rays upon the end of the sulphur opposite to the wire and the balls. As the sulphur heats, present your finger near the balls, within about half

half an inch, and they will begin to vibrate like a pendulum. If you draw back your finger, as they increaſe the chord of the arc, they will ſometimes ſwing as far as the ſilk will admit.

If either the head, or the point, of a pin, be preſented to the balls, they will be put in motion; but after ſeveral trials, I find the balls will not deſcribe ſo large a chord between the point of the pin and their perpendicular ſituation under the point of ſuſpenſion, as they do between the ſaid point and their fartheſt vibration on the oppoſite ſide of the wire.

EXPERIMENT III.

If a phial be filled full of powdered ſulphur, and a wire thruſt through the cork into the ſulphur to ſupport the balls, as in the preceding experiment, and the phial with the balls be ſuſpended, or fixed upon a ſtand, that the bottom of the phial may be heated, ſo as to melt the ſulphur; the balls will vibrate as in the laſt experiment, if any thing be brought near them. I have ſometimes, when the balls have been in motion, held my finger in another direction, and after a few oſcillations the balls have been drawn a little out of their track, and deſcribed an ellipſis.

EXPERIMENT IV.

If you place a ſulphur electrophorus, with the cover upon it, in the ſun, and after letting it ſtand ſome time, if you put two or three ſmall bits of paper upon the edge of the cover, after touching the cover, and taking it off, the bits of paper will be repelled.

In this experiment I ſuppoſe it will be ſaid, the electricity is

 excited

excited in the ſulphur by the friction of the cover on the top of the electrophorus; but, if this be the caſe, I could not always ſucceed.

Soon after the ſun's rays fall upon the ſulphur-cake, you may hear a little ſnapping noiſe, and if the ſun ſhines long upon it, under a warm wall, the ſulphur will crack in ſeveral places.

The experiment with the ball, and the large jar of green glaſs, led me on to another attempt of a different kind, and which ſoon gave me reaſon to conclude, that there was another cauſe operating with the glaſs jar, and which aſſiſted, if it was not the firſt mover of the waxen-balls.

Experiment V.

If you take the ſilken thread with the two balls by the middle, between your finger and thumb, and let them hang down clear of your body, two or three minutes, they will acquire a ſmall motion; if you preſent your finger near the balls, the motion will be increaſed, and if every thing be favourable, the balls will deſcribe a conſiderable arc in this inſtance.

In this experiment, either the heat communicated to the ſilk by the finger and the thumb, like the heat tranſmitted to the ſulphur through the lens by the ſolar rays, muſt occaſion this vibratory motion in the ſilk, or elſe the pulſation of the artery in the finger and thumb communicates its motion to the balls, and cauſes them firſt to move.

I have tried balls of different ſubſtances and dimenſions, ſuſpended with ſilk and thread from different ſtands; but I never could find they would acquire any motion, unleſs they were either heated by the light of a candle, or the ſolar rays, or held between

between the finger and the thumb. If the balls are held by the middle of the ſilk as before, and you juſt touch them with the knuckle of your left hand, but not to preſs againſt them, they will be repeatedly attracted and repelled, or, if it be not an attraction and repulſion, it muſt be a motion proceeding from the power they acquire from the finger of the right-hand; and if I were to offer an opinion, I ſhould think it proceeds from the pulſation of the artery. Since the trying theſe experiments in July 1777, I have read in the Philoſophical Tranſactions [*], an account of a ſimilar experiment related by Mr. Grey to D. Mortimer, as he lay on his death-bed.

I do not lay any ſtreſs upon theſe experiments, but mention them to ſhow how liable we are to be deceived, when we depend upon the attraction of pendulous bodies in a doubtful caſe, ſuſpended by a ſilken thread, and ſupported by the hand.

SECTION III.

Though friction be the common method uſed of exciting electrics, it is proved by experiment, that the melting an electric, and the pouring it into a veſſel made either of wood,

[*] Philoſ. Tranſ. abridged, vol. viii. p. 404 and 405.

Place a ſmall bullet, of an inch, or an inch and a half in diameter, on the middle of a circular cake of roſin, ſeven or eight inches in diameter, gently excited; and then a light body ſuſpended by a very fine thread, five or ſix inches long, held in the hand over the center of the table, will, of itſelf, begin to move in a circle round the iron globe, and conſtantly from eaſt to weſt. If the globe be placed at any diſtance from the center of the circular cake, it will deſcribe an ellipſis, which will have the ſame eccentricity, as the diſtance of the globe from the center of the cake.

He acknowledged he had not found the experiment ſucceed, if the thread was ſupported by any thing but a human hand; though he fancied it would have ſucceeded, if it had been ſupported by any animal ſubſtance, living or dead.

 metal,

metal, or glaſs, will cauſe them both to ſhow an electrical appearance, by attracting any light ſubſtance brought near them [3].

I am rather apprehenſive that the pouring a melted electric from one veſſel to another, is a kind of friction of the particles againſt each other, as well as the friction of the particles againſt the ſides of the veſſel into which they are poured, and from which they run. I believe by this method of heating or melting ſubſtances, and pouring them into an electric, moſt of the ſolid bodies in nature, powdered, heated, and poured into a glaſs veſſel, will attract, and that powerfully, a pith-ball ſuſpended by a flaxen or a ſilken thread.

[3] Cavallo's Treatiſe, &c. p. 21 and 22. and Phil. Tranſ. 1778.

If ſulphur be melted in an earthen veſſel, and left to cool upon conductors; if taken out of the veſſel when cold, it will be found ſtrongly electrical; but not at all ſo, if left to cool upon electrics.

If ſulphur be melted in glaſs veſſels, and afterwards left to cool, they will both acquire a ſtrong electricity, whether they be left to cool upon electrics, or conductors. It is remarkable, that the ſulphur acquires no electricity 'till it begins to cool; its power increaſes in proportion as it contracts, and is the ſtrongeſt when in the ſtate of the greateſt contraction, but then the electricity of the glaſs veſſel is at the ſame time the weakeſt.

Melted ſulphur poured into a metal cup, and there left to cool, ſhews no ſigns of electricity whilſt in the cup; but if they are ſeparated they will then appear ſtrongly electrified, the ſulphur plus, and the cup minus. If the ſulphur is again replaced in the cup, every ſign of electricity will vaniſh; but if, whilſt they are ſeparate, the electricity of either of them is taken off, they will both, upon being replaced, appear poſſeſſed of that electricity which has not been taken off.

Chocolate, freſh from the mill, as it cools in tin pans, becomes ſtrongly electrical; when turned out of the pans, it for ſome time retains this property, but ſoon loſes it by handling. By melting again it may be renewed, &c. &c.

EXPERIMENT

EXPERIMENT *with ſea ſand.*

Take a pint, or more, of ſea ſand, and ſpread it upon an iron plate, or in an iron ſhovel, and put it over the fire, and there let it remain 'till the moiſture is all evaporated, and the ſand very hot. Pour it as gently as poſſibly you can from one corner of the ſhovel into a glaſs tumbler, or jar, and both the ſand and the tumbler will be ſtrongly electrified; and will attract any light ſubſtance brought near them. Small beach ſtones, known on the ſea-coaſt by the name of ſhingle, if dried and heated in the ſame manner as the ſand, and poured into a glaſs veſſel, will be ſtrongly electrified.

After ſucceeding with the two foregoing experiments, I have thought it needleſs to try any other ſolid ſubſtance; for if ſea ſand can be made electrical, there cannot be a doubt but that marble, flints, bricks, and even foſſils and earths, will, when heated, and poured into glaſs, produce a ſimilar appearance. I have not paid the leaſt attention to the different kinds of electricity which is ſuppoſed to exiſt in the veſſel and the melted ſubſtance; for I imagine that every appearance of this ſort is reducible to the rules or laws laid down for explaining the principles of action of the electrophorus, and to which I muſt refer the reader.

Sand, when heated, as in the preceding experiment, and poured into a glaſs tumbler, will retain its electricity many days in a dry room. If the end of a feather be only put into the ſand, and taken out again as ſoon as you can, it will be ſtrongly electrified, and will attract a pith-ball. If the feather be put into the ſand, it will retain its electricity a great while.

There

There are but few (if any) ſubſtances in nature more eaſily excited than dry and warm feathers and hair. This is proved by only putting the end of the feather in the electrified ſand, and notwithſtanding the friction is hardly worth mentioning, the feather will be excited, and attract a pith-ball.

This will lead me to account for a ſingular phænomenon mentioned by the honourable Robert Boyle *, and another of a ſimilar nature mentioned by Dr. Prieſtley, which are left unexplained.

* Boyle's Works, vol. i. p. 511.

That falſe locks of hair, brought to a certain degree of dryneſs, will be attracted by the fleſh of ſome perſons, I had proof in two beautiful ladies who wore them; for, at ſome time, I obſerved that they could not keep them from flying to their cheeks, and from ſticking there, though neither of them had occaſion for, or did uſe paint. When one of theſe beauties firſt ſhewed me this experiment, I turned it to a compliment, ſuſpecting there might be ſome trick in it; though I afterwards ſaw the ſame thing happen in the locks of the other too; who gave me leave to ſatisfy myſelf farther: and, deſiring her to hold her warm hand at a convenient diſtance from one of thoſe locks taken off, and placed in the free air, as ſoon as ſhe did this, the lower end of the lock, which was free, applied itſelf preſently to the hand. This ſeemed the more ſtrange, becauſe ſo great a multitude of hairs would not have been ſo eaſily attracted by an ordinary electric body, which had not been conſiderably large, or extraordinary vigorous. Afterwards I enquired of ſome other young ladies, whether they had obſerved any ſuch thing; and one of them told me, ſhe had ſometimes met with theſe troubleſome locks; but all that ſhe could ſay farther was, that they ſeemed to fly moſt to her cheeks when they had been put into a ſtiff curl, and when the weather was froſty.

Experiments and Obſervations on different Kinds of Air, by Dr. Prieſtley, vol. i. p. 275.

The remarkable electricity of the feathers of a paroquet, obſerved by Mr. Hartman, an account of which may be ſeen in Mr. Rozier's Journal for Sept. 1771. p. 61. This bird never drinks, but often waſhes itſelf; but the perſon who attended it neglected to ſupply it with water for this purpoſe; its feathers appeared to be endued with a proper electrical virtue, repelling one another, and retaining their electricity a long time after they were plucked from the body of the bird, juſt as they would have done if they had received electricity from an excited glaſs tube.

2 It

It is now well known, that human and other hair, when dry, will be ſtrongly electrified with a ſlight friction, as may be ſhown by rubbing a cat's back. In the caſe mentioned by Mr. Boyle, the very combing of the locks, and the putting them up in a curl, were ſufficient to give them an attractive power, and this would cauſe them to fly to the firſt body near them; and as the curls were at the ſide of the lady's face, they would naturally tend to the cheek.

The feathers of the paroquet, or of any other bird, when dry and warm, will become electrical with the fluttering of the wings. The paroquet being uneaſy and reſtleſs, for want of water to waſh itſelf, probably not only fluttered and extended its feathers, but frequently rubbed them againſt the cage, which could not fail of giving them an electric power ſufficient to attract a pith-ball.

When a feather is once electrified by friction, and kept dry, it will retain its electricity a conſiderable time. I have known them to retain their electricity ſeveral days.

SECTION IV.

In my repeated attempts on charging and diſcharging the Leyden phial, I made many trials in order to eſtabliſh different theories, before I could fix on one, which appeared to me to have truth on its ſide, and which could fairly be proved by experiments. As ſome of theſe experiments may have novelty to recommend them, I ſhall recite a few for the entertainment of the practical electrician, without taking any notice of the deſign for which they were made.

EXPERIMENT

Experiment I.

Fill a coated jar with boiling water as high as the top of the inſide coating, and place it in a glaſs veſſel, and then fill the veſſel with boiling water, till it riſes to a level with the water in the coated jar. Fill another jar of glaſs, to the ſame height, with cold water, and let them be placed upon a ſtool with glaſs legs, near the conductor of the electrical machine, and as far apart as the ſtool will admit. Let a chain, or rod, be fixed to the conductor, and put into the jar which contains the cold water; and then turn the cylinder to electrify the cold water. If a perſon preſents any conducting ſubſtance to the knob of the coated jar, ſtanding in the veſſel filled with hot water, it will give a ſpark; and if a communication be formed between the knob of the coated phial, and the cold water in the other veſſel, there will be a diſcharge, a ſpark, and a ſhock. In this experiment the electric fluid muſt paſs from the denſer to the rarer medium, *i. e.* from the veſſel with cold water to the jar with hot water, and if it does not paſs through the pores, or over the ſurface of the glaſs, I muſt leave it to the friends of the Franklinian theory to ſhow how the knob of the coated phial can acquire a ſufficient quantity of the electric fluid to give a ſpark.

Experiment II.

Take a broad earthen pan, four or five inches deep, and fill it almoſt full with cold water, and ſet it upon a ſtool with glaſs legs. Take the two glaſs veſſels, as in the laſt experiment, the one filled with hot water and the coated jar, and the other with cold water, and place them in the earthen pan, and as far apart as the bottom of the pan will admit. Let the chain, or a metal rod as before, reach from the conductor to the furface of the water in the pan. Turn the cylinder of the machine, and electrify the water, and either of the internal furfaces of the glafs veffels, containing the hot or the cold water, will give a fpark. A communication formed either between the knob of the coated jar, containing the hot water, and ftanding in the hot water, and the furface of the cold water in the glafs veffel, or in the earthen pan, will convey the fhock. If you touch the furface of the water in the earthen pan with your finger, and the knob of the coated jar ftanding in the hot water with your thumb, you will feel the fhock in this little circuit, and, if I am not much deceived, you will alfo feel it in your arm, as the electric fluid paffes away to the earth.

EXPERIMENT III.

Take either an uncoated jar, or a pane of glafs fixteen or eighteen inches fquare, and if you ufe the pane, bring it to the end of the conductor, but if the jar, let there be a chain reaching from the conductor to the infide of the jar, and at the fame time let the other furface of the glafs or jar reft upon the palm of your hand. Turn the cylinder of the machine, and electrify the glafs, without removing the glafs from the conductor, touch the conductor with your other hand, and you will receive a fhock in both your arms. The glafs is ftill electrified, notwithftanding you have received the fhock, and will attract a pith-ball fufpended by a flaxen thread. The infide of the jar, or that furface next to the conductor, will, after the difcharge, attract a pith-ball much farther than the outfide furface, owing to the perfon

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who holds the glaſs, being a conductor, and leading off the electrical fluid as it paſſes in the circuit, and gives the ſhock. The electrical fluid, which appears ſtrongeſt upon the upper ſurface, may be what has been called the reſiduum, or the effluvia rather, which returns to the glaſs from the conductor after the diſcharge is made.

I could add a variety of experiments; but, as my intention is more to inſtruct than to amuſe the mind, let the foregoing experiments ſuffice to cloſe this chapter.

CHAP-