XLIX. *Observations and Experiments tending to confirm Dr.* Ingenhouſz's *Theory of the Electrophorus; and to ſhew the Impermeability of Glaſs to Electric Fluid.* *By* William Henly, *F. R. S.*

Read July 9, 1778.

DR. FRANKLIN has obſerved, "That "there is a great quantity of the elec- "trical fire in glaſs; that what it has it holds; and that "it has as much as it can hold: that what is already in "it refuſes, or ſtrongly repels any additional quantity: "that when an additional quantity is applied to one ſur- "face of a phial (for inſtance, by the atmoſphere of an "excited tube) a quantity is repelled or driven out of the "inner ſurface of that ſide into the veſſel, returning "again into its pores, when the excited tube with its at- "moſphere is withdrawn; and that the particles of that "atmoſphere do not themſelves paſs through the glaſs."

The following experiments, I think, remarkably illuſtrate this, by ſhewing that bodies are very differently

affected by a fluid acting immediately upon them *through glaſs*; or by acting upon them immediately *by the glaſs*, as above mentioned.

EXPERIMENT.

A circular box, three or four inches in diameter, and a quarter of an inch deep, is furniſhed with a thin glaſs for a top. In this box ſcatter ſome very ſmall ſteel filings, or ſift them into it through a piece of writing paper, which has a number of holes pricked through it with a pin. Then apply one of the ends of a magnetic bar to the upper ſurface of the glaſs; the filings will be inſtantly attracted to the glaſs, and remain there as long as the magnet is thus ſuſpended over them; but the moment it is removed, the filings fall to the bottom of the box, and there remain at reſt. The glaſs then being made perfectly clean and warm, let a fine piece of amber, ſealing wax, &c. be ſtrongly excited and applied to it as the magnet was in the former experiment; the filings will be inſtantly in motion, and will continue ſo for ſome ſeconds. When their motion ceaſes, withdraw the amber, &c. and the motion of the filings will be renewed, and continue as at firſt; this ſhews, I think, that in

both caſes, they really act as conductors of the electric fluid between the lower ſurface of the glaſs and the bottom of the box, in order to reſtore an equilibrium, as upon Dr. FRANKLIN's principles they ought to do; and that the electric fluid does not, like the magnetic, abſolutely permeate the glaſs.

EXPERIMENT.

Take a clean, dry, thin phial, about four inches long, and one inch in diameter. In the cork of this phial fix a ſmall loop of very fine iron wire. In the loop ſuſpend another wire, about two inches and an half in length, by a ſimilar loop; and on the lower end hang a light round ball of the pith of elder or cork, and be careful to give the wire as free a motion as poſſible. Let one of the ends of a ſmall magnetic bar be brought near the ſide of the phial, and the little ball will inſtantly come to the glaſs, and there remain as long as the magnet is held within the diſtance of its influence. Remove the magnet, and the ball inſtantly retires to, and remains in the center of the phial: then dry and warm the glaſs, and let an electric ſtrongly excited be applied to the ſide of the phial, as the magnet was in the former experiment; the

ball inſtantly comes to the ſide of the glaſs, and there remains ſome ſeconds, and then returns to the center of the phial. Withdraw now the excited electric, and the ball inſtantly returns to the glaſs upon the principle before mentioned, which is more completely ſhewn by the filings in the little box.

EXPERIMENT.

Let a piece of thin glaſs be placed as a cover to a circular box, about ſix inches in diameter, and three quarters of an inch deep: put into the box twenty or thirty light balls of cork, or of the pith of elder; then, having made the glaſs very dry and warm, expoſe the ſurface of it to the electric matter iſſuing from the prime conductor to a good electrical machine, the balls will be inſtantly in motion, and will ſo continue for ſome time, the box being moved in ſuch manner that every part of the glaſs may be affected. Then remove the box, and the balls being at reſt, turn the glaſs, placing the upper ſurface downward; the balls will then inſtantly renew their motion. When this ſecond motion ceaſes, touch the ſurface of the glaſs near the center with a finger, or, which is better, with a round, ſmooth piece

of

of wood or metal, the balls will inſtantly fly to either of theſe, and will frequently pile themſelves up between the glaſs and the bottom of the box, eight or ten in a pile, and will remove themſelves, following the wood, &c. to different parts of the glaſs, till the charge is exhauſted. Apply the glaſs again to the conductor as before, and when the motion of the balls nearly ceaſes, remove the glaſs, and place on each ſurface a circular coating of metal, reaching within an inch of the edge of the glaſs all round. Make a communication between theſe coatings, and the glaſs will then ſhew that it has been charged, and will give a very ſtrong ſhock: this proves, that the electric matter did not abſolutely paſs through the glaſs, but only acted on the electricity inherent in it in the manner explained by Dr. FRANKLIN.

The direction of the electric matter, in the diſcharge of the Leyden bottle, hath been ſhewn in a variety of methods (ſee Philoſophical Tranſactions, vol. LXIV. and LXVII.); but I ſhall here mention one which, I think, a very curious addition to the number. Mr. LULLIN, of Geneva, placed two wires, the one upon, the other under, a card, the ends of the wires, in contact with the card, being about an inch from each other. This apparatus

ratus being made a part of the circuit, a charged bottle of a proper ſize was diſcharged through it: when the charge paſſed along the ſurface of the card from the end of that wire into which it was diſcharged, till it came to the end of the other wire, and there pierced a hole through the card, paſſing by that wire to the negative ſide of the bottle; and this happened whether the bottle was charged poſitively or negatively. A learned and ingenious correſpondent of mine, the honourable FREDERIC CHRISTIAN MAHLING, counſellor of ſtate at Copenhagen, has improved this experiment, by firſt painting the card in a line about half an inch broad on each ſurface with vermillion. The charge paſſing in this line (the card being previouſly well-dried) ſhews its paſſage by a black mark on the vermillion, the mark being on one ſide of the card when the bottle is charged poſitively, and on the other ſide of it when the bottle is charged negatively. To which I would add, that a line of light is ſeen upon one ſurface of the card through the whole ſpace between the ends of the wires in one caſe, for inſtance, when the bottle is charged poſitively. But no light is ſeen in the other caſe, that is, when the bottle is charged negatively, till the electricity burſts a hole through the card to get at the wire which is in contact with

with the negative ſide of the bottle, as in this caſe the charge paſſes along the under ſurface of the card. If the card be placed vertically between two inſulated wires, as in the univerſal diſcharger, deſcribed in Mr. CAVALLO's Treatiſe on Electricity, the experiment may be made with great facility and certainty. The card may be fixed on a bit of ſealing wax, or ſet in a piece of wood, ſawn to a proper depth with a fine tenon ſaw.