

XVI. *Description of a new Electrical Instrument capable of collecting together a diffused or little condensed Quantity of Electricity.* By Mr. Tiberius Cavallo, F. R. S.

Read April 10, 1788.

ONE of the principal desiderata in practical electricity has been a method of ascertaining the presence and quality of such diffused or weak electricity as could not immediately affect an electrometer; of this nature is the electricity produced by effervescences and other processes, the electricity of the atmosphere in serene and warm weather, &c.

M. VOLTA'S condenser, which is described in Volume LXXII. of the Philosophical Transactions, was the first attempt of the kind, and, indeed, when this instrument is in good order, it answers exceedingly well; but the difficulty of constructing and of preserving it, added to the frequent uncertainty of the result (it being difficult to say, whether in certain cases the electricity obtained comes from the instrument itself, or from the substance in question) have occasioned its being little, if at all, used by those who study the subject of electricity.

Mr. BENNET'S doubler, which is described in Volume LXXVII. of the Philosophical Transactions, was also intended to manifest small, and otherwise unperceivable, quantities of electricity; but from the experiments and observations, which I had the honour of laying before the Royal Society in November last, it seems to be clearly shewn, that this doubler

bler cannot be of any use, on account of its being naturally always electrified.

In the same Paper of last November, I likewise shortly mentioned a method which I had used for collecting diffused quantities of electricity. Since that time, I have improved the method; and, after several alterations, have constructed an instrument for the purpose, which, to all my friends who are conversant in electricity, as well as to myself, seems to be free from all those faults which render M. VOLTA's and Mr. BENNET's instruments of little, if at all of any use. It seems, therefore, that the following description of this new instrument may be of use to those who are pursuing electrical experiments and investigations.

The properties of this machine, which from its office may be called *a collector of electricity*, are, first, that when connected with the atmosphere, the rain, or in short with any body which produces electricity slowly, or which contains that power in a very rarefied manner, it collects the electricity, and afterwards renders both the presence and quality of it manifest, by communicating it to an electrometer. Secondly, This collecting power, by increasing the size of the instrument, and especially by using a second or smaller instrument of the like sort to collect the electricity from the former, may be augmented to any degree. Thirdly, It is constructed, managed, and preserved with ease and certainty; and it never gives, nor can it give, an equivocal result, as I have proved experimentally, and as will appear by considering its construction.

The annexed drawing exhibits two perspective views of this collector. Fig. 1. (Tab. IV.) shews the instrument in the state of collecting the electricity; and fig. 2. shews it in the state in which the collected electricity is to be rendered manifest. An electrometer

electrometer is annexed to each. The letters of reference indicate the same parts in both figures.

ABCD is a flat tin plate, thirteen inches long and eight inches broad; to the two shorter sides of which are foldered two tin tubes AD and BC, which are open at both ends. DE and CF are two glass sticks covered with sealing wax by means of heat, and not by dissolving the sealing wax in spirits. They are cemented into the lower apertures of the tin tubes, and also in the wooden bottom of the frame or machine at E and F, so that the tin plate ABCD is supported by those glass sticks in a vertical position, and is exceedingly well insulated. GHILKM and NOPV are two frames of wood, which being fastened to the bottom boards, by means of brass hinges, may be placed so as to stand in an upright position and parallel to the tin plate, as shewn in fig. 1. or they may be opened, and laid upon the table which supports the instrument, as shewn in fig. 2. The inward surfaces of those frames from their middle upwards is covered with gilt paper XY; but it would be better to cover them with tin plates, hammered very flat. When the lateral frames stand straight up, they do not touch the tin plate; but they stand at about one-fifth part of an inch asunder. They are also a little shorter than the tin plate, in order that they might not touch the tin tubes AD, BC. In the middle of the upper part of each lateral frame is a small flat piece of wood S and T, with a brass hook; the use of which is to hold up the frames without the danger of their falling down when not required, and at the same time it prevents their coming nearer to the tin plate than the proper limit. It is evident, that when the instrument stands as shewn in fig. 1. the gilt surface of the paper XY, which covers the inside of the lateral frames, stands contiguous and parallel to the tin plate.

When

When the instrument is to be used, it must be placed upon a table, a window, or other convenient support, a bottle electrometer is placed near it, and is connected, by means of a wire, with one of the tin tubes AD, BC; and by another conducting communication the tin plate must be connected with the electrified substance, the electricity of which is required to be collected on the plate ABCD: thus, for instance, if it be required to collect the electricity of the rain, or of the air, the instrument being placed near a window, a long wire must be put with one extremity into the aperture A or B of one of the tin tubes, and with the other extremity projecting out of the window. If it be required to collect the electricity produced by evaporation, a small tin pan, having a wire or foot of about six inches in length, must be put upon one of the tin tubes, so that the wire going into the tube the pan may stand about two or three inches above the instrument. A lighted coal is then put into the pan, and a few drops of water poured upon it will produce the desired effect. Thus far may suffice with respect to the mechanical description of the instrument: the power and use of it will be made apparent by the following experiments.

EXP. 1. Communicate to the tin plate ABCD a quantity of electricity, for instance, as much as would very sensibly affect a common cork-ball electrometer; then, if the lateral frames GHM, NOP, stand upright, as in fig. 1. the electrometer W will shew no divergency; but if the frames are opened and let down, as in fig. 2. the balls of the electrometer W will immediately repel each other, and by the approach of an excited piece of sealing-wax, the quality of the electricity may be easily ascertained after the usual manner.—Put up the lateral frames again, and the electricity will apparently vanish;—let them down, and the electricity will re-appear, and so on.

If

If you touch any part of the tin plate or tin tubes with your finger, the electricity is thereby intirely removed, and that will be the case whether the lateral frames are up or down.

EXP. II. Take an extended piece of tinfoil, about four yards square, and, holding it by a silk thread, electrify it so weakly as not to be capable of affecting an electrometer; then bring it in contact with the tin plate of the collector, whilst the lateral frames are up. This done, remove the tin-foil, let down the lateral frames one after the other, and on doing this, the electrometer W will immediately manifest a considerable degree of electricity. But if the electrometer were to shew no sensible degree of electricity, a smaller collector, *viz.* one having a tin plate of about four square inches, must be brought into contact with the tin plate of the large collector, whilst the lateral frames of the latter only are down; and then the small collector being removed from the large one, its lateral frames are opened, and its tin plate is presented to an electrometer, which will thereby be electrified to a much greater degree than the electrometer W was by the large collector.

EXP. III. Let a common cork-ball electrometer be fastened to an insulated conductor, having about two or three square feet of surface, and communicate to it such a quantity of electricity as may be sufficient to let the balls of the electrometer stand at about one inch asunder. In this state bring the conductor in contact with the tin plate of the collector for a very short time, and it will be found, that the balls of its electrometer will immediately approach and touch each other, shewing that the electricity of the conductor is gone to the plate of the collector; and, in fact, if you let down the lateral frames, the balls of the electrometer W will immediately repel each other to a very great degree.

It seems, therefore, to be clearly shewn by these experiments, that the tin plate of this instrument can collect and retain a vast quantity of electricity, when the conducting surfaces of the lateral frames are contiguous to it, in comparison to that quantity which it can either collect or retain when those surfaces are removed from its vicinity.

The quantity of electricity, which the tin plate ABCD is capable of collecting, principally depends on three circumstances, *viz.* 1st, on the distance between the tin plate and the conducting lateral surfaces; the smaller that distance is, the greater being the collecting power; 2dly, on the size of the instrument; and, 3dly, on the quantity of electricity possessed by the body from which it must be collected or taken away.

I need not expatiate on the principle upon which the action of this instrument depends; this being the same as that of the electrophorus, of M. VOLTA's condenser, and of many other electrical experiments; namely, that a body has a much greater capacity for holding electricity when its surface is contiguous to a conductor which can easily acquire the contrary electricity, than when it stands not in that situation.

I shall lastly add, that having actually used this new instrument in several experiments, I have found it to answer perfectly well; one of its principal recommendations being the certainty of its operation.

