A JOURNAL
OF
NATURAL PHILOSOPHY,
CHEMISTRY,
AND
THE ARTS.

VOL. IX.

Illustrated with Engravings.

BY WILLIAM NICHOLSON.

LONDON:
PRINTED BY W. STRATFORD, CROWN COURT, TEMPLE BAR; FOR
THE AUTHOR,
AND SOLD BY HIM AT NO. 10, SOHO-SQUARE;
AND BY
J. MURRAY, NO. 32, FLEET-STREET.

1804.
IV.

Description of a compound Electrical Instrument for condensing and doubling: with Experiments. By Mr. Wilson.

London, August 10, 1804.

To Mr. Nicholson,

Sir,

I take the liberty of troubling you with the following account and drawing of a compound condenser of electricity, which I think is an improvement on Cavallio's multiplier of electricity, described in his Treatise on Electricity in the third volume, of the fourth edition, and if you think it worth a place in your Philosophical Journal, you will very much oblige me by inserting it therein.

I am your obedient service,

Humble servant,

W. Wilson.

The drawing is an exact representation of the instrument. The plates A, B, C, D, and E are supported by glass sticks, covered with sealing wax at the upper part; but the plate F is supported by a wire, which has a joint at the bottom, by which it may be brought near the plate E, or thrown back away from it. 3 is a screw, which stops against the glass support of E, and regulates the distance of the two plates when one is brought near the other. The plates A, C and E are fixed to the bottom board, and B and D to the levers L, L1, which move round the pins p p, and are connected by the rod R. It will be seen by the drawing, that when the lever L is moved, the plates B and D are moved in contrary directions, that is, they both approach towards or recede from the plate C at the same time, but on opposite sides. The faces of the plates are ground flat, and they are so adjusted that if the screws 2 2 did not stop the levers when they are moved, the face of B would stop flat against the face of A, and so would the face of D against C. The screws 2 2 stop them when at a very small distance, which may be made more or less by turning the screws.

C 2

This
This instrument serves the purpose of a condenser, a single and double multiplier, and a doubler of electricity. When it is used as a single condenser, the plate B is brought as near A as the screw 2 will permit, and then the wires b and f touch one another and uninsulate B, which increases the capacity of A. As the capacity of A is increased it will receive a greater charge of electricity from any electrified body brought into contact with it. Consequently, when B is removed, the charge on A will be much more intense than it would have been if the plate B had not been opposed to it; but this intensity will not be greater than that of the electrified body, if its surface is not greater than the surface of the receiving plate A; for a condenser does not increase the quantity of electricity, it only collects it into a smaller space than it was before. So that if the electricity of a very small body is required to be ascertained, the simple condenser will not answer the purpose. Some other means must be used when this is the case, and Cavallo's multiplier is the least exceptionable of the instruments used for this purpose. The instrument represented in the drawing forms a multiplier, either single or double, for when B is near A and uninsulated, A will receive a much greater charge than it would if B had not been near. And because B is uninsulated, A will induce a contrary state on B, and of nearly equal intensity; which state is preferred: For the instant the lever is moved to carry B farther from A; the contact between the wires b and f is disconnected, and B insulated, and as it removes farther away from A, the intensity of its charge will increase the same as that of A will, and be ready to part with nearly the whole to another condenser.

Now as the plate B removes away from A, the plate D approaches C, and when at a small distance from it, the wires d and g come into contact, which operation uninsulates D, and therefore causes the two plates C and D to form a condenser; and at the same instant that d touches g, the wires b and f touch one another, so that nearly the whole of the charge of B is communicated to C, which induces a contrary state on D, as the charge of A did on B. D will therefore be in the same state as A is, which state is preferred; for the instant the plate B removes away from near C, the plate D also removes away from it, and the contact between the wires d and g is disconnected, and D insulated; and by continuing the motion the
plate B will come near A, and D will remove away from C till the wires b and f touch one another, at which instant the wire d touches the wire e. Now if the plate E and F are near one another, they will form a third condenser, and nearly the whole of the charge of D is communicated to E in the same manner the charge of B was communicated to C; at the same time B recruits its charge by coming near A, which will be communicated to C, which induces a contrary plate on D, and which D communicates to E, and this operation is repeated every time the lever is moved backwards and forwards; so that the charge on C is increasing at every motion of the lever, while the charge on A remains the same; and when C becomes so much charged as not to be capable of receiving any more from B (which will be the case in a certain number of motions) the operation will still go on between D and E, the charge on E increasing while the charge on C remains the same, so that E will acquire a charge as much greater than C as the charge on C is greater than the charge on A, which will be manifested by removing the plate F away from E. When the wire a is screwed into the plate A, and connected with E by means of the wire 4 5; the instrument then possesses all the properties of the double of electricity, for then all the charge communicated to E (which is of the same nature as that of A) will be communicated to A, which will continually increase the intensity of its charge, and that will have an increased effect on B, &c. at every motion of the lever. There is no limits to this accumulation, but that where the charge is so intense as to pass from one plate to the other in the form of a spark.

I have made many experiments with this instrument relative to its spontaneous electricity, and I find, as a single multiplier (that is when an electrometer is connected with C) it has no effect on the most delicate gold leaf electrometer I could make; but as a double multiplier (that is when an electrometer is connected with E) there is some small effect if some electricity had been communicated to it within an hour or two, although it may have been discharged by touching each of the plates with a metal point (which I find is the most effectual way of discharging small portions of electricity,) but if it has stood three or four hours after being discharged, it will not give any signs of electricity. When used as a doubler it always becomes electrified with between eight and sixteen motions of the lever, even.
On the spontaneous electricity of this instrument.

even though it has not been used for two or three months. — But if it has been used within two or three hours, the effect will take place with fewer motions of the lever, and if it has been used within a few minutes, two or three motions will be more than sufficient to ascertain the quality of the electricity. It is to be observed that the instrument was always discharged (by the metal point as before observed) between each trial.

In the course of making the experiments on the spontaneous electricity of this instrument I found that it was always positive if the instrument had not been used for two or three days, whatever electricity it was last charged with. But the time it must stand unused after it has been discharged, to produce this effect, depends a great deal on the weather; if the air is very humid, twenty-four hours is quite sufficient, but if it is very dry, it will require four or five days.

After I had observed that after the instrument was charged with positive electricity its spontaneous electricity was always positive; and that after it was charged with negative electricity, its spontaneous electricity was negative only within a certain time after it had been discharged, and then became positive; and also that it required a greater number of motions of the lever to produce a certain effect on the electrometer with negative electricity, the longer it stood after it had been charged with negative electricity, and that when it became positive, the longer it stood the less number of motions of the lever it required to effect the electrometer with positive electricity to a certain degree, and this within some certain limits. I was at a loss how to account for this change. However, after some consideration, I began to suspect that the plates (although all of the same metal, copper) had each a property peculiar to itself, of acquiring a certain small charge of one kind of electricity in preference to the other; and that if they were left to themselves they would naturally do so. I therefore began a set of experiments to ascertain the probability of this supposition. First, directly after the instrument had been used for negative electricity, I discharged it by touching each of the plates with a metal point, which I held in contact with each plate for two or three seconds. An electrometer was then connected with the plate A, and while it was in this situation, it was made to diverge with positive electricity;* it was then

* The electrometer was made to diverge by bringing an excited glass or sealing wax near it.
discharged by a slight touch with the finger, the lever was then moved backwards and forwards about fourteen times, and the electrometer diverged with negative electricity. This was repeated several times with the same effect.

The lever was then put in such a position that the plates could not be supposed to act as condensers, one pair more than another, and the whole was left untouched for twenty-four hours. It was then tried, and with twenty motions of the lever the electrometer diverged with positive electricity.

It was then left untouched for eighteen hours more, and on trial the electrometer diverged with positive electricity. The instrument was next discharged with the metal point as before, and the electrometer made to diverge with negative electricity, which was discharged by a slight touch of the finger. The lever was now worked, and with nine motions of the electrometer diverged with positive electricity. It was then discharged and left untouched for sixteen hours, after which it diverged with positive electricity after a few motions of the lever. It was then left untouched for five days, after that time it gave positive electricity when the lever was worked. These experiments I have repeated a great many times with the same effect.

As it appeared from the foregoing experiments that the residuum on the electrometer was insufficient to overcome the effect of the residuum on the plates, I was induced to charge the whole instrument with the effect of the electricity, I would with to communicate to it, and this I did by making the electrometer diverge with the desired electricity, and while it was divergent I began working the lever, to communicate the effect to all the plates. I charged the instrument with negative electricity first, and discharged it with the metal point. The lever was then worked, and in eight motions the electrometer diverged with negative electricity. It was then left untouched for five days, when eighteen motions of the lever made the electrometer diverge with positive electricity. This has been often repeated with the same effect.

The instrument was next charged with positive electricity, and discharged as before, after which, six motions of the lever made the electrometer diverge with positive electricity. It was left untouched for twenty-four hours, when the electrometer
COMPUND ELECTRICAL INSTRUMENT.

On the spontaneous electricity of this instrument, the electrometer diverged with positive electricity with twelve motions of the lever, and so it did after it had stood untouched for six days.

The probability of the foregoing supposition concerning the property of the plates acquiring a charge of one electricity in preference to the other, was more strengthened by the following experiment, which has been repeated several times. The instrument was charged with negative electricity, and then left without discharging for twenty-four hours, when sixteen motions of the lever made the electrometer diverge with positive electricity.

I make no doubt if the plates were of different metals this effect would be more striking, and that in some cases we should have the contrary electricity. I intend to construct one of these instruments in such a way that plates of any metal may be put on, and their effect tried. I think this a subject well worth pursuing as it may throw some light on some of the phenomena of electricity, which have their causes at present buried in obscurity.

V.

Note respecting the Suspension of Zinc in Hydrogen, and the consequent Ignition and Fusion of Platina Wire. By AMICUS.

To Mr. NICHOLSON.

DEAR SIR,

I EMPLOY a gasometer of a much more simple construction and much less expense than Lavoisier's, which that skilful and intelligent artist, Cuthbertson, invented at my entreaty, about ten years ago. It is described in your valuable Journal (quarto series, vol. II. p. 235.) The brass rod or the thick wire, which conveys the electric fire through the upper receiver, has about half an inch of platina wire appended, to hang just over the aperture through which the hydrogen gas rises at the bottom in the brass work. Zinc of any other sort of metal would either be melted or readily oxidised. But the other day, I was much surprized to see the platina wire, on becoming as usual red hot from the flame of the hydrogen gas, melt into globules