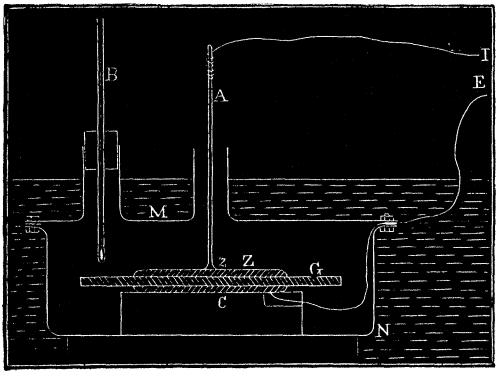
V. "Electrolytic Conduction in Solids.—First Example. Hot Glass." By Prof. Sir William Thomson, F.R.S. Received June 10, 1875.

Many years ago I projected an experiment to test the voltaic relations between different metals with glass substituted for the electrolytic liquid of an ordinary simple voltaic cell, and with so high a temperature that the glass would have conducting-power sufficient to allow induction through it to rule the difference of potentials between the two metals. Imperfect instrumental arrangements, and want of knowledge of the temperature at which glass would have sufficient conductivity to give satisfactory results, have hitherto prevented me from carrying out the proposed investigation. The quadrant electrometer has supplied the first of these deficiencies, and Mr. Perry's recent experiments* on the conductivity of glass at different temperatures the second. The investigation has now been resumed; and in a preliminary experiment I have already obtained a very decided result.

The drawing shows the arrangement adopted. M N is a brass case immersed in an oil-bath. A copper plate, C, of 5 centims. diameter, lies in the case on a block of wood; it is kept metallically connected with the outside case, E, of the electrometer. A flint-glass plate, G, which is



found to insulate very well at ordinary temperatures, is laid upon C. A zinc plate, Z, lies on the glass, and is connected with the insulated electrode, I, of the electrometer, by means of a wire attached to the end of a stout metallic stem, A Z, passing through the centre of an open vertical tube reaching above the level of the oil. The glass was heated gradually, and was usually kept between 100° and 120° C., the temperature being measured by a thermometer, B.

Even below 50° C. there is a decided result, but shown less rapidly

* See *infrà*, p. 468.

than at higher temperatures. If the glass is kept at 50° C. for some time, and I, after having been metallically connected with P, is left insulated, it soon becomes sensibly charged; and the charge increases till it is approximately equal to that acquired when zinc and copper plates in a liquid electrolyte are metallically connected with I and E respectively. With the hot glass, as with the liquid electrolyte, the charge given by the zinc to the insulated electrode of the electrometer is negative. The charge ultimately reached when the temperature is 50° is not exceeded at higher temperatures; but, as said above, when the zinc is connected with the copper and then insulated, the charge increases towards its ultimate value much more rapidly at higher temperatures than at lower.

At temperatures between 100° and 120° C. there is a sensible diminution of the ultimate charge after the zinc has been kept for a short time connected with the copper and then insulated. There is also a slow diminution of the ultimate, or, as we may now call it, the temporarily static, charge when the zinc plate is left insulated for several hours in connexion with I.

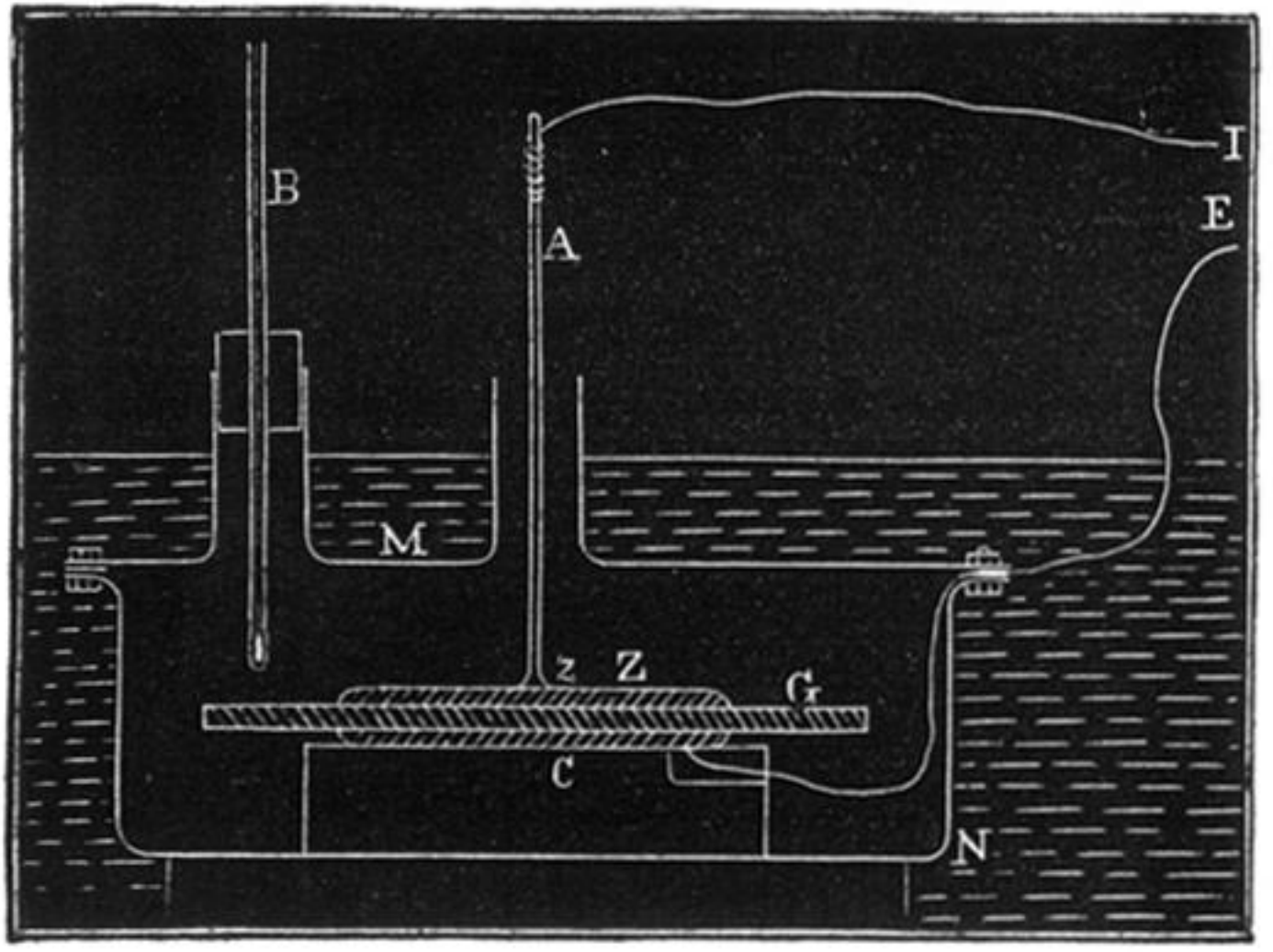
If a small quantity of either negative or positive electricity be given to I (always in metallic connexion with the zinc), the temporarily static state is reached at about the same rate as the zero would be reached by conduction through the hot glass (according to Mr. Perry's experiments, communicated to the present Meeting) were the plates both of copper or both of zinc.

After the experiment the surfaces of the copper and zinc plates in contact with the glass were found to be thickly oxidized. The glass plate was quite cloudy after the experiment, and a repetition of the experiment increased its cloudiness. This plate is the flattened bottom of a flint-glass electrometer-jar.

Three smoother glass plates, tried since, show as yet no signs of decomposition. At first they only became "exhausted" (in their power to produce the normal charge in zinc and copper) after the plates had been connected for nearly a day, the glass being at from 100° to 120° C.; but after a time, although they still gave the normal charge at the beginning of the morning's experiments, the charge fell to zero quite rapidly (that is, in about an hour), even when the zinc was kept insulated.

Keeping for a length of time the zinc charged negatively (so as to give to I a greater negative charge than that which it would have in the "temporarily static" condition of the copper, hot glass, and zinc) seemed to have no effect in restoring the normal electrolytic condition; but I propose to pursue this trial further, especially with longer time for the restorative electrification.

I propose also to return to similar experiments which I made many years ago on the electric relations of copper, ice, and zinc.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