the greatest electromotive force of polarisation which the electrolyte can produce, and R the resistance of the circuit, the current C will be given by the equitation—

$$C = \frac{E - e.}{R}$$

When a battery, which is not sufficiently powerful to decompose an electrolyte, is connected with platinum electrodes inserted in the liquid, a transient current passes, polarising the electrodes, and the passage of this current is associated with a tranference of the ions to the platinum plates. There is, in fact, no evidence of the passage of any quantity of electricity through an electrolyte unaccompanied by the transfer of a corresponding amount of the ions. But though the transitory current from the battery is associated with the accumulation of the ions upon the platinum electrodes, it does not follow that the battery has performed the work of tearing asunder the electrolyte into its constituents. The molecules of every liquid must be regarded as moving about among each other, the average energy of the molecules being perfectly definite and depending only on the temperature. But though the average energy is definite, the energy of individual molecules may vary without limit, and thus it may happen that two molecules moving with far more than the average energy may come into collision and the shock may split them into their individual atoms. These atoms will move on by themselves until they meet with others with which they can combine, reforming molecules of the electrolyte. The atoms thus separated are said to be "dissociated," and the percentage of dissociated atoms present increases with the temperature on account of the increase in the average energy of the moving molecules. Thus, in every electrolyte there is always a definite fraction of the whole compound in a state of dissociation, and this fraction will increase with the temperature. A battery may, therefore, be capable of separating these ions without doing the work of decomposing the compound. It has only to guide the different constituents to different destinations. If we suppose each atom of one constituent to be electrified positively, and each atom of the other to have a precisely equal, but negative charge, then the electromotive force acting between the platinum electrodes will urge the positively electrified constituent from the anode to the kathode, and the negatively electified constituent in the opposite direction. This goes on on until the accumulation of the electrified ions upon the surface of the electrodes introduces an opposing electromotive force equal to that of the battery, and stops the current. If the E.M.F. of the battery is so great as to allow of the accumulation of the ions in sufficient quantity, the nascent atoms combine into ordinary molecules of silver, chlorine, etc., but this only takes place when the E.M.F. of polarization is equal to the energy developed in the combination of one electro-chemical equivalent of each of the constituents.

When the same battery is employed to send a current through several electrolytes in succession, the E.M.F. of the battery must be equal to the sum of the E.M.F.'s necessary for the decomposition of the electrodes exceeds that necessary for the decomposition of the electrolyte the excess of the work done by the battery is employed in heating the liquid according to Joule's law.

As all the electricity which crosses and electrolyte has to be carried by the ions, and each atom carries a definite charge, we see at once a reason for Faraday's law of electro-chemical equivalents. Also it is clear that the greater the number of dissociated atoms in a liquid the greater will be the current conveyed in obedience to a given E.M.F., that is, the greater will be the conductivity of the electrolyte. But, the percentage of dissociated atoms increases with the temperature. Hence the conductivities of electrolytes may be expected to increase with the temperature, and experiment proves that they do so in a rapid ratio. In metallic conductors it is the resistance which is increased by increase of temperature.

If a plate of copper and a plate of amalgamated zinc are dipped in dilute sulphuric acid and connected by a wire, a current flows round the circuit, the zinc is dissolved and hydrogen escapes, but the hydrogen is not evolved from the surface of the zinc; it passes through the acid and appears upon the surface of the copper plate thus becomes coated with a layer of nascent hydrogen. When the accumulation of gas on the plate is considerable, bubbles of ordinary hydrogen will be formed, and escape, and the rate at which such bubbles are formed increases with the amount of the gas accumulated on the plate. Hence, if a strong current is evolving hydrogen very rapidly, the amount to be found on the copper plate will be considerable and increase somewhat with the current. The copper plate thus becomes polarised, like the platinum plates described above; it is practically converted into a hydrogen plate instead of a copper plate, and as the E.M.F. of a battery, consisting of zinc and hydrogen plates dipped in sulphuric acid, is much less than that of a zinc-copper couple, the E.M.F. of the battery is correspondingly reduced while the resistance of the battery is increased on account of the layer of badly conducting hydrogen adhering to the copper plate. Thus, the polarization of the plates of a battery reduces the E.M.F. of the battery, but increases its resistance.

Smee reduced the polarization by replacing the copper plates with silver plates coated with finely divided platinum. This battery has a slightly greater E.M.F. than the copper zinc battery, and the particles of platinum projecting from the silver act as point, and assist the liberation of the gaseous hydrogen.

The essential feature of a so-called constant battery is that the E.M.F. is the same, whatever be the magnitude of the current flowing through it, that is, whether the resistance of the external circuit be great or little. It is, in fact, a battery which does not polarise. No batteries are absolutely constant. In experimenting with a certain one fluid battery it was found that when the resistance of the circuit was 10,000 Ohms the E.M.F. was more than 1.6 Volts, but on reducing the resistance and thus increasing the current, the E.M.F. fell, and when the resistance of the circuit was about 10 Ohms the E.M.F. was reduced to 1·2 Volts. There are many batteries in which the polarization is much worse than this.

Some one-fluid batteries, have been constructed in which the hydrogen is employed at once in a secondary chemical action, and is thus prevented from accumulating on the metal plates. The bichromate battery is a