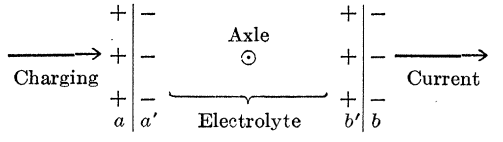
same. The electrodes must be bright, as otherwise the phenomenon becomes very complicated. Furthermore the original polarization must often surpass a certain value if the residual polarization is to be contrary in sign; and there are other differences in detail for which there is no room here. Thus the rotational effect may proceed gradually to a maximum; an electromotive force zero may imply a very large residual polarization appearing on motion. The charging of moving electrodes is an interesting case; etc.

To elucidate this phenomenon, it suffices here to assume the occurrence of paired double layers $a\ a'$ and $b'\ b$, one double layer at each electrode. One element, a', b', of each double layer is localized in the liquid and the other element a, b in the solid electrode, both of the double layers having the same direction; *i. e.*, being two condensers in series. Hence there are two interpenetrating electrostatic fields, one



$b'\ a'$ localized in the liquid and the other $a\ b$ in the electrodes. These fields are in a contrary direction and the liquid field must be very much stronger to correspond with the initial counter polarization. On rotating the electrodes, the field localized in the liquid $b'\ a'$ is set free and its ions dissipated. The field localized in the solid, $a\ b$, however, remains and this constitutes the residual polarization in the direction of the charging current. Both fields decay in the lapse of time in the usual way.

When rotation ceases a liquid field is reestablished, but usually, though not always, to a smaller degree. Eventually a probably discharges a' and b, b', one of the fields passing through zero first, so that the effect of rotation finally vanishes. I have met both with marked polarization which on rotation vanished, as well as with an apparent absence of polarization which on rotation became very marked.

To obtain moving electrodes as free from polarization disturbances at the contact with a liquid, it is therefore prudent to capture both fields; *i. e.*, to leave the electrodes entirely without interferences. This may be done by surrounding each with a porous cup, closed and completely filled with an electrolyte, the terminals passing out through an insulating tube. The electrodes should moreover be fixed rigidly to the cup. Again since zinc electrodes soon tarnish in brine but remain bright in concentrated zinc sulphate solution, the latter is a preferable electrolyte and the cups may be submerged in brine or any other solution.

I therefore constructed two cup electrodes of the kind in question and placed them in the rotational apparatus as before. The original potential difference of the zincs was about .4 millivolt. After keeping the circuit closed over night this fell off to below .05 millivolt, and could be eliminated by exchanging the cup electrodes. Rotation of the appartus, *i. e.*, an external current in the brine surrounding the cups, produced no appreciable effect. The electrodes were then charged with a current of .2 am. for 30 sec. The polarization remaining was now much less than above, throughout, beginning with about 5 millivolts which fell to .5 m.v. in 5 minutes and to .05 in a few hours. Rotation was ineffective through all stages of the decay. No doubt the simple electrode in which both the original and the residual polarizations have vanished would often suffice, but with greater uncertainty, because such electrodes can not be exchanged without danger as to modifying their value.

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