$\Delta J = \pm 1$, 0 except for transitions from the ground state to the first two of the above eigenvalues where the selection rules are $\Delta J = -1,0$ and $\Delta J = -1,0$, respectively. This state of affairs seems to be more complicated than envisaged by other workers.[2]

The state $2\nu_3$ (and $2\nu_4$) has been investigated in the same manner and eigenfunctions have been obtained for H_1' which lead to the eigenvalues 0, $2J\zeta_3\hbar^2/A_0$, $(J-2)\zeta_3\hbar^2/A_0$, $-3\zeta_3\hbar^2/A_0$, $-(J+3)\zeta_3\hbar^2/A_0$ and $-2(J+1)\zeta_3\hbar^2/A_0$.

From these eigenfunctions the corrections to the rotation-vibration energy levels arising from H_2' have been evaluated for these states. A splitting up of the rotation levels was found quite generally. The term studied by Jahn is found to be important not only for ν_4, but for all overtone and combination bands of ν_4.

Complete details of these calculations and the values of the vibration-rotation energy levels and their dependence upon the potential energy constants will be published in this journal in the near future.

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Progressive Breakdown in a Conducting Liquid

The impulsive electrical discharge through liquids has been investigated quite extensively.[1] In most of this work liquids with good insulating properties were studied, which necessitated the use either of small gap spacings or of high voltage. Under these conditions the actual breakdown process takes place in a very short time interval. Consequently, apparatus of high time-resolving power must be used to follow the various stages in the discharge. It is the purpose of this note to report some observations on a comparatively slow type of liquid breakdown.

The discharge takes place between Cu electrodes under the surface of a $CuSO_4$ solution contained in a special cell fitted with a viewing window. The high voltage electrode is conical, with the end rounded (about $\frac{1}{2}$ mm radius of curvature), and is mounted coaxially at a distance of 9 mm from the flat end of a 5-mm diameter rod, which serves as the grounded electrode. The low potential resistance of the solution between electrodes is 70 ohms. Impulsive voltage is applied to the gap from a 0.5 mf condenser through a series resistance of 75 ohms. The maximum voltage across the gap is 9.1 kv.

With the electrodes separated to such a distance that complete breakdown across the gap does not occur, luminosity appears at the conical electrode regardless of polarity. This is to be expected because of the high current density and high field at the point. Fig. 1a shows an ordinary photograph of this case with the point positive. The resemblance to electrical figures observed under insulating liquids is quite marked.[2] There is no noticeable

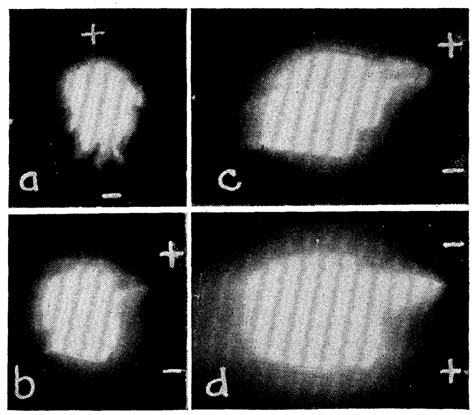

FIG. 1 (a) Stationary photograph of figure (point +); (b) rotating mirror photograph of complete discharge, point +; (c) same as (b) showing stepped progression; (d) rotating mirror photograph (point −).

difference in appearance between the positive and negative figures. It is well known that electrical figures in general have a rather definite rate of expansion under constant conditions.[3] Consequently, it would be expected that the formation of an ionized path between electrodes would be due to the extension of a figure of the type shown in Fig. 1a from the point to the plane electrode. Rotating mirror photographs show this to be the case.

Figure 1b is such a photograph with the point positive. The luminosity starts at the point and moves towards the grounded electrode at a rather constant rate (5.3×10^4 cm/sec.). After an ionized path bridges the gap, the luminosity increases suddenly. Fig. 1c shows a stepped type of extension with the same polarity (average speed 2.3×10^4 cm/sec.). This "stepping" is probably connected with the current and voltage limitation introduced by the supply circuit.

Figure 1d is a photograph with point negative. The speed of progression is 2.9×10^4 cm/sec. The average speed was found to depend upon the voltage applied to the gap for both positive and negative points.

The order of the various stages in this type of breakdown is the same as that observed in long sparks, surface discharges on liquids, and in long discharge tubes. The initial leader stroke (adapting Schonland's terminology) would normally be followed by a return stroke discharging the leader channel and this, in turn, followed by the discharge of the circuit as a whole. The return stroke is unresolved in these photographs, but the damped discharge of the circuit as a unit accounts for the great increase in luminosity after the leader has reached the grounded electrode.

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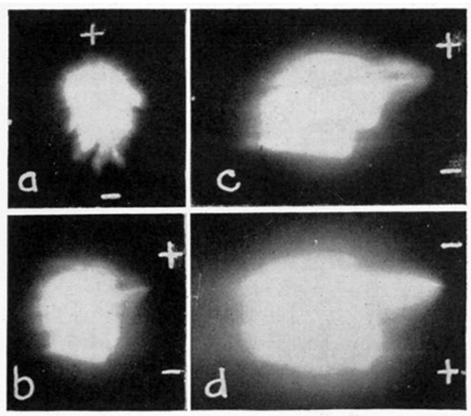

FIG. 1 (a) Stationary photograph of figure (point +); (b) rotating mirror photograph of complete discharge, point +; (c) same as (b) showing stepped progression; (d) rotating mirror photograph (point −).