

the felspar, the cavernous structure has developed. These etched out spaces were subsequently filled with the white or yellowish silica.

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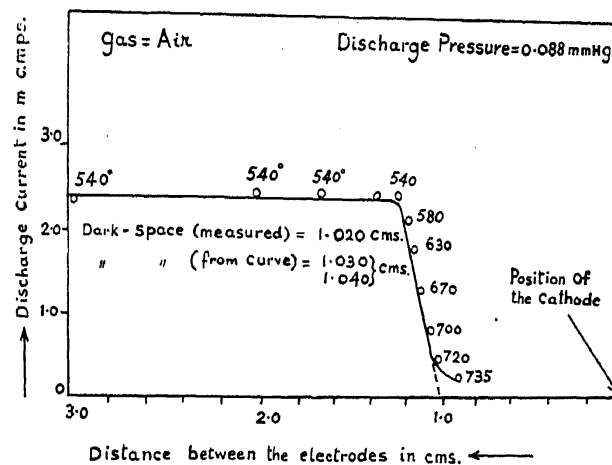
ON THE CATHODE DARK-SPACE OF A GLOW DISCHARGE IN GASES AT LOW PRESSURES

A NUMBER of experimenters^{1,2,3} have studied the characteristics of the cathode Dark-Space and they all agree that this is the most active region of a glow discharge. The views held by different investigators on the mechanism of the flow of current across the Dark-Space are, however, very divergent. Thomson⁴ believes that the ionisation in the space is caused by electrons which themselves are emitted from the cathode surface by the impact of the positive ions so produced. This theory finds a good support from the experiments of Oliphant⁵ on the secondary electron emission from metals by positive ions. The entire supply of the ions to the cathode is, according to them, from the Dark-Space itself and very few of them flow into it from the negative glow and particularly so when the discharge is normal. Moreover, they consider it probable that on account of their high density in the Dark-Space some of the ions flow back into the negative glow. Loeb⁶ takes the reverse process to be more probable. Ryde⁷ and Compton and Morse⁸ also hold that it is the negative glow which acts as a source of the positive ions. They further assume that this section of the discharge behaves like an emitter of the ions and the cathode as a collector of them, the relation connecting the cathode fall, the Dark-Space length and the discharge current being of the same form as the Langmuir's Space-Charge Law which is true for electronic emission from a hot metal in a high vacuum. There is, however, no direct experimental evidence in favour of any of the above assumptions.

We have carried out experiments with two plane parallel electrodes in a discharge tube, the anode being moveable. It is observed that as the anode is brought closer to the cathode there is no variation in the discharge current or the voltage till the former reaches a point in the negative glow a few mm. away from the boundary of the cathode Dark-Space. If the anode is pushed further towards the cathode the current regularly falls but the voltage required to maintain the current rises continuously. The fall in the current is linear with the displacement of the anode till it reaches a point near the edge of the Dark-Space. Beyond that the current diminishes much more gradually.

A large number of curves connecting the discharge current and the distance between the electrodes have been obtained. The curve

in the figure typifies the results in Air and Oxygen. The voltage required to maintain the



discharge current at varying distances between the electrodes is given along the curve at each step. If the straight falling part of the curve is produced to cut the distance axis the point of intersection of the two lies away from the cathode equal to the width of the cathode Dark-Space which was measured usually with the help of a cathetometer. This applies practically to all the curves.

The experiments have been carried out in air over a pressure range, 0.043-0.142 mm. Hg, voltage range, 350-950 volts and current range, 1.2-4.0 m.amps.; corresponding values for oxygen are 0.112-0.165 mm. Hg, 400-520 volts and 1.8-3.2 m.amps.

We have come to the following conclusion from these experiments:—

1. The positive ions reaching the cathode do not all come from the Dark-Space but a considerable number of them flows into the Dark-Space from the negative glow under all conditions of the discharge studied.
2. The discharge current is carried across the common boundary of the Dark-Space and the negative glow both by the cathode rays and the positive ions travelling in opposite directions.
3. The length of the negative glow which acts as a source of the positive ions to the Dark-Space depends upon the discharge voltage and pressure.

Details of the experiments will be published elsewhere.

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January 2, 1945.

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