*advancing streamer from glow to arc conditions.* As the streamer advances, an increasing current must flow through the tip of the preceding dart to maintain the increasing lateral or corona current from the sides of the streamer. When this current, together with the small current involved in the vertical progression of the tip, builds up to the order of one or a few amperes, sudden transition from glow to arc will occur[5, 6, 7]. The order of magnitude at least of the current attained when the streamer reaches a length of 7–10 metres, and the average length of the darts, can be estimated from the charge neutralized in the atmosphere by the average lightning flash, namely, about 10 coulombs, of which about half is probably neutralized during the first leader stroke[1]. From the duration of the leader stroke, say $10^{-2}$ sec., and the length of the lightning channel, say 2·5 km., this neutralization requires a lateral current of the order of $4 \times 10^{-3}$ amp. per cm. length of channel, or 3-4 amp. over the length of a dart. Allowance for the branching of the first stroke would merely reduce this current by a factor of about 3, so that this current is in good agreement with that for which glow - arc transition occurs.

Further support is derived from a consideration of the transition from arc back to glow. This occurs for a current which is about 10 per cent of that required for glow - arc transition[7], so that arc conditions would not be maintained in the last tenth of the dart length, which would therefore be re-illuminated by the succeeding dart, just as has been actually observed by Schonland[4]. Again, Allibone and Meek[8] observed that currents of the same order flowed during the leader stroke of the spark discharge, and it is interesting to observe that, owing to their rapidly varying nature, the currents in the leader strokes in this case were often greater than those of the subsequent return strokes, a conclusion supported by the relative photographic intensities of the two strokes.

Such an arc channel can be regarded simply as an extension of the initiating conductor, and the voltage gradient along it is only of the order of 10 volts per cm. These considerations explain the 'self-propagating' nature of the discharge and the large charge neutralized by the corona, which is thus seen to be an important, though hitherto unrecognized, feature of the discharge.

The condition for the occurrence of a spark in a non-homogeneous field would thus appear to be that *the current in the brush discharge from an electrode should be sufficient to cause glow - arc transition to occur*, after which the leader progresses by the above mechanism.

A more detailed account of this work will be published shortly.

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[1] Bruce, C. E. R., and Golde, R. H., *J. Inst. Elect. Eng.* (in press).
[2] Wilson, C. T. R., *Phil. Trans. Roy. Soc.*, **221**, 73 (1921).
[3] Meek, J. M., *Phys. Rev.*, **55**, 972 (May 15, 1939).
[4] Schonland, B. F. J., Malan, D. J., and Collens, H., *Proc. Roy. Soc.*, A, **152**, 595 (1935).
[5] Todd, F. C., and Browne, T. E., *Phys. Rev.*, **36**, 732 (Aug. 15, 1930).
[6] Fan, H. Y., *Phys. Rev.*, **55**, 769 (April 15, 1939).
[7] Attwood, S. S., Dow, W. G., and Krausnick, W., *Trans. Amer. Inst. Elect. Eng.*, **50** (3), 854 (Sept., 1931).
[8] Allibone, T. E., and Meek, J. M., *Proc. Roy. Soc.*, A, **166**, 97 (1939).

# An Effect of Light in Gases under Electrical Discharge

THE observation reported previously[1], namely, an instantaneous diminution of the discharge current in chlorine on irradiation, has now been extended to other gases subjected to ionization by collision in electric fields due to alternating potentials in Siemens' tubes.

It is observed that the photo-variation of the discharge current varies rapidly in the order: chlorine, bromine, hydrochloric acid gas, iodine. In fact, observation of the effect in iodine is nearly impossible without a sensitive indicator and adequate irradiation. Furthermore, especially in the case of iodine, the photo-effect is easily masked by a dark, in part, 'ageing' effect, that is, a time-variation of the discharge current produced under a constant applied potential; this varies in the order: iodine, bromine, chlorine. Other conditions remaining the same, a rise in the gas pressure and temperature tends to diminish the light-effect; an increase in the applied potential, frequency of the A.C. supply and of the external radiation employed, as also its intensity, increases it.

Preliminary experiments have shown that differences in the magnitude of the light-effect in chlorine using plane polarized and equally intense ordinary light lie within the margin of probable experimental error.

The use of larger discharge tubes, radiation of much greater intensity and of shorter wave-length, and of specially sensitive current indicators has revealed the effect in oxygen, air, nitrogen and hydrogen; its magnitude is, however, very considerably smaller in these gases than in the case of the halogens.

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[1] *Current Science*, **9**, 535–537 (1940).

# Pigmentary Changes and the Background Response in Amphibia

THE results of recent experiments of mine have shown that our conception of the nature of the background response in Amphibia is inadequate and must be extended. When *Rana temporaria* is kept on an illuminated black background for several weeks, melanin granules are dispersed in the melanophores and the amount of melanin in the skin is increased. Conversely, when the animal is kept on a white background, melanin granules are aggregated in the pigment cells and the amount of melanin in the skin is decreased. In short, additive and subtractive processes are operative. Both effects have been observed by means of photometric determinations of solutions of melanin extracted from the skin, and the latter effect is apparent microscopically in the degeneration of melanophores[1].

Other experiments of mine have tended to show that the amount of melanin in the retinal pigment epithelium of *Rana temporaria* varies under certain conditions. When the eye has received the radiations from a Hanovia lamp, melanin granules may be densely aggregated at the same time in both the basal regions and the processes of the retinal pigment cells. A condition thus arises which is not