"The Action of Magnetised Electrodes upon Electrical Discharge Phenomena in Rarefied Gases." By C. E. S. PHILLIPS. Communicated by Sir WILLIAM CROOKES, F.R.S. Received February 28,—Read March 14, 1901.

(Abstract.)

A preliminary account of this investigation has already been laid before the Society.* The present paper deals more particularly with the conditions necessary for the production of a luminous ring in rarefied gases and under the inflnence of electrostatic and magnetic forces.

The cause of the luminous phenomenon is traced to the action of the magnetic field upon electrified gaseous particles within the rarefied space, and experimental evidence is given to show that the rate of change of the magnetic lines is an important factor.

Numerous experiments relating to the loss of positive electrification from a charged body when placed in a rarefied space, and in the neighbourhood of a magnetic field, are also described in detail.†

An apparatus similar to that referred to in a previous communication was generally found most suitable for observing the formation and behaviour of the luminous ring. It consisted of a small spherical glass bulb 2·5 inches in diameter, and provided with short projecting necks for the purpose of carrying two oppositely placed soft iron rods. These rods were pushed one through each of the short tubes, cemented in position, and arranged to have their pointed ends within the bulb and a sixteenth of an inch apart.

The cores of two electro-magnets were then butted against the external ends of the rods, for the purpose of magnetising them when required.

When the gas within the bulb had been rarefied to a pressure of about 0·005 mm. of mercury, a discharge from an induction coil was sent through it for a few seconds, the rods (now used as electrodes) meanwhile remaining unmagnetised. But when the discharge was stopped and the magnets were excited, a luminous ring appeared within the bulb, in a plane at right angles to the magnetic axis, between the pointed ends of the electrodes, and in rotation about the lines of magnetic induction.

The luminosity of the ring was fonnd to be intermittent, its spectrum showed no peculiarity, and it was not possible to obtain satisfactory photographs of the revolving glow. In oxygen the ring appeared a little brighter, but in hydrogen or carbonic dioxide the luminosity seemed about the same as in air.

* 'Roy. Soc. Proc.,' vol. 64, p. 172.

† 'Roy. Soc. Proc.,' vol. 65, p. 320.

Two or more rings could be made to appear by placing an electrified platinum circle of wire equatorially within the bulb. When the platinum circle was negatively electrified, the luminous ring was repelled by it. In this manner the ring itself was invariably shown to be negatively electrified. Its direction of rotation was found to be that of the current induced in a loop of wire when the loop is suddenly moved up to a north magnetic pole—clockwise, looking through the loop at the pole. The outside of the glass bulb was always negatively electrified when a luminous ring appeared in the interior. This pointed to the removal of a layer of positively electrified gas from the inner surface of the bulb through the action of the magnetic field. Although such radial streams of positive ions so produced might account for the luminosity of the ring through their collisions with an accumulation of negative ions at the more central part of the bulb, they would not have produced rotation of the luminous ring in the direction already observed. The incoming radial streams of positive ions were studied in detail with an apparatus more suitable for examining the diselectrifying action of the magnetic field. Those experiments established two facts, viz., that the loss of positive electrification from charged bodies is brought about by the magnet, through the concentration of negative ions which occurs at the strongest part of the magnetic field immediately the electrodes are magnetised, and also that the luminosity of the ring itself is due largely to the collisions between the incoming streams of positive ions and this accumulation of negatively electrified gas between the pointed ends of the electrodes. A potential difference is thus set up within the bulb between the negative gas-mass at the centre and the positively electrified layer of ions residing upon the inner surface of the glass, which rapidly reaches a value sufficient to give rise to a discharge through the residual gas. It is then that the positive ions stream inwards, accompanied by a corresponding outward-moving whirl of negative ions.

Experiments upon the effect of causing the magnetic field to either slowly or rapidly reach its maximum value, as well as diminish either slowly or rapidly to zero, have shown that the rate of change of the magnetic lines plays an important part in the actions here described. A very rapidly growing field would diselectrify a positively charged body, whereas, when the magnets were slowly increased in strength there was no diselectrification in such cases. In certain experiments, the act of suddenly destroying the magnetic field produced diselectrification, while if the current were slowly diminished in the coils of the electro-magnets there was no evidence of any such effect.

Both the luminous ring and the diselectrification phenomena are attributable to the same causes. The direction of rotation of the ring, however, forms a difficulty, on the assumption that a rapidly moving ion is equivalent to a current along a flexible conductor. Incoming

streams of positive ions would give a direction opposite to that observed, and if the rotation were produced by the changing strength of the magnetic field upon the negative ions, then also would the direction of rotation be opposite to that actually obtained. The viscosity of the gas would tend to annul any sudden twist which the changing magnetic field might give to the cloud of negative ions within the bulb, although the reaction set up between the magnets and the ions under such conditions would be sufficient to cause the negative particles to be thrown forward, and to concentrate in a manner consistent with the experimental results given. It is not clear, however, why the sudden cessation of the magnetic field should also produce such a concentration of negative ions. But we have already seen that under those conditions diselectrification is easily produced; moreover, a luminous ring that has grown dim, can usually be momentarily brightened by suddenly destroying the magnetic field.

A pause was sometimes noticed between the excitation of the magnets and either the formation of the ring or the loss of charge from a positively electrified body.

This result showed that the steady magnetic field itself so modified the paths of moving negative ions within the bulb, that a concentration of them at the strongest part of the field took place for this reason also.

The direction of rotation of the luminous ring can be accounted for in the following manner:—

When the potential difference between the accumulation of negative ions at the centre of the bulb and the layer of electrified gas upon the inner surface of the glass is such that a shower of incoming positive ions occurs and the luminous ring appears, the outer portion of the ring will be more positive than the surrounding negatively electrified cloud of gaseous particles. These will therefore be attracted inwards, and in that way give a rotatory motion to the luminous gas-mass in the direction actually observed.

"The Chemistry of Nerve-degeneration." By F. W. MOTT, M.D., F.R.S., and W. D. HALLIBURTON, M.D., F.R.S. Received March 1,—Read March 14, 1901.

(Abstract.)

We have previously shown that in the disease, General Paralysis of the Insane, the marked degeneration that occurs in the brain is accompanied by the passing of the products of degeneration into the cerebro-spinal fluid. Of these, nucleo-proteid and choline are those which can be most readily detected. Choline can also be found in the blood.